TROPICAL FOREST RESEARCH INSTITUTE JABALPUR

Tropical Forest Research Institute (TFRI), Jabalpur is an Institution of Indian Council of Forestry Research and Education (ICFRE) and caters to the forestry research needs of four States of 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 and demonstration in agroforestry models, planting stock improvement, sustainable forest managements, 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 scientific seminars and symposia both at state and national levels and were also actively involved in extension activities. This has helped the Institute in imbibing in its research programme ideas and concepts from various user groups.

An abstract of projects run by the Institute is as follows:

		No. of projects completed in 2007-08	No. of ongoing projects in 2007-08	No. of projects initiated in 2007-08
TFRI, Jabalpur	Plan Projects	7	13	5
	Externally Aided Projects	1	17	8
CFRHRD, Chhindwara	Plan Projects	—	2	2
	Externally Aided Projects	—	1	—
	Total	**8**	**33**	**15**

PROJECTS COMPLETED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Eco-Rehabilitation of limestone mine of overburden in Madhya Pradesh [065/TFRI/2004/Ecol-1(6)]

Findings: *Acacia nilotica, Dalbergia sissoo, Leuciana leucocephala* and *Acacia catechu* among Nitrogen Fixing Tree species (NFTs) and *Jatropha curcus, Gmelina arborea, Eucalyptus* hybrid, *Simaruba glauca, Holoptellia integrifolia* and *A. indica* among non-NFT's were found best suited in overburden

dumps of limestone mine areas. Application of a combination of *Rhizobium*, VAM and phosphorous solublizing bacteria helped attaining maximum height and collar diameter in *Albizia procera*. Shoot height and root weight of *A. procera* were found significant at 5% level. Among nitrogeneous fertilizers, ammonium nitrate increased maximum height of *A. procera.* Mulching was found to have significant positive response in height increment of *Albizia procera*. Leaf litter followed by husk and grass mulches helped good shoot growth.

Project 2: Effect of microbial inoculants on growth and productivity of safed musli (*Chlorophytum borivillianum*) [082/TFRI-2005/Patho – 1(11)]

Findings: *Clorophytum borivillianum* (Safed Musli), an important medicinal plant, is being widely cultivated by farmers as it requires marginal soil for growth and development and has good market for its produce. In the present study effect of VA mycorrhizae, *Azospirillum*, PSB in the establishment of Safed Musli was undertaken. On the basis of experimental results, it has been found that the growth and saponin contents were enhanced by application of VAM, Azospirillum and PSB treatment. This combined treatment of biofertilizers was found superior.

Project 3: Studies on the role of Actinomycetes in controlling root diseases of *Tectona grandis*, *Albizia procera, Dalbergia sissoo* and *Acacia nilotica* in nurseries [072/TFRI-2004/Patho–2(9)]

Findings: One actinomycete (*Streptomyces* sp.) and three bacteria were isolated from soil and was screened in the laboratory for antagonistic activity against pathogens of forest tree species viz. *Alternaria alternata, Curvularia lunata, Sarocladium oryzae, Fusarium oxysporum, Ganoderma lucidum* and *Macrophomina phaseolina.* The culture filterate of these antagonistic organisms were also tried to control the seed microflora of *Albizia procera, Dalbergia sissoo* and *Acacia nilotica.* A formulation contains farmyard manure and chicken manure was selected after growing *Streptomyces* sp. in seventeen different substrates. *Streptomyces* sp. was also multiplied in bulk by using lab fermentor in liquid PDA medium. The inoculum was prepared in bulk by using farm yard manure as the carrier for field application. The bulk culture of bacteria was prepared in PDA broth as well as in lignite. Post-emergence damping-off disease of *A. procera, A. lebbek, D. sissoo* and *Acacia nilotica* were also controlled by using above formulation. The use of this bio-agent also safe guards the soil from pesticidal residue in nursery and plantations. It is self-multiplying in soil and appears a new species of *Streptomyces.* It is concluded that this *Streptomyces* sp. and antagonistic bacteria (T_1, T_2, T_3) can be used to control the different pathogens which are responsible for seed deterioration, causing seed borne infections, root rot and damping off diseases of above selected species in nursery.

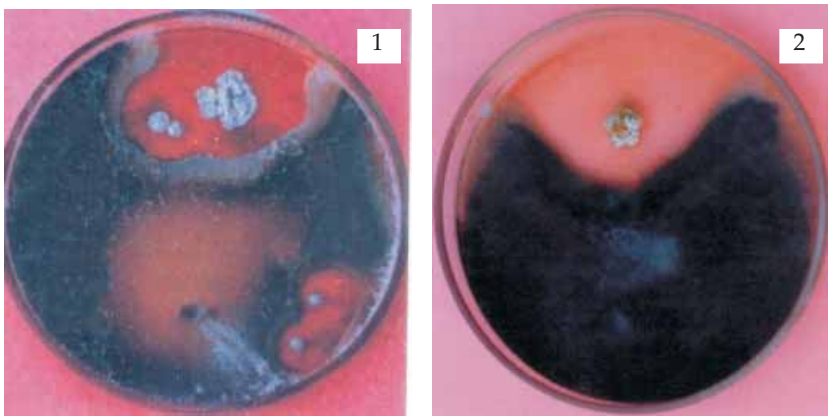
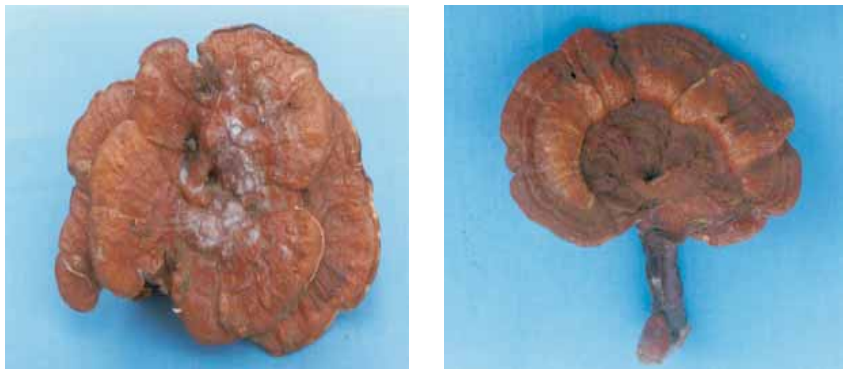


Fig. 1-2 Antagonistic effect of streptomyces
1. Phytophthora, 2. *Alternaria alternata*

Project 4: Standardization of the cultivation technique and utilization of laccate, stipitate species of Ganodermataceae (*G. lucidum*) [056/CFRHRD-2003/2(6)]

Findings: Field surveys were conducted in different agro-ecological zones of M.P., C.G. and M.S. Total 89 samples of *Ganoderma* were collected. Screening of *Ganoderma* strains were conducted by adopting cellulose degrading capability. Estimation and production of glucanase by four selected strains of *Ganoderma lucidum* was also carried out. Cellulolytic adequacy index capacity has been tested for 19 isolates of *G. lucidum* and two strains have been selected.



Medicinal mushroom of Central India

Project 5: Studies on inheritance pattern of selected wood traits in teak (*Tectona grandis* L.) [068/TFRI/2004/Gen-3 (9)]

Findings: Analysis of variance of growth and wood traits of the progenies of different parents in the trials at Lohara (Chandrapur) and Mohogata (Nagpur) showed significant variation at family level for all the traits except bark thickness. The important wood traits viz., specific gravity, heartwood percentage, sapwood percentage, fibre length, fibre diameter, fibre lumen diameter, vessel length and vessel diameter showed highly significant variation at family level.

The study also revealed moderate estimates of genetic gain for growth and wood traits from both the trials, which indicated that significant genetic gains can be realized through a moderately intensive selection programme. Some of the families showed good GCA for important growth and wood traits. The good general combiners identified in the present study can be used for establishment of advanced generation seed orchards and breeding arboreta for improvement of teak for specific or combination of above traits.

Project 6: Chemical investigations on biologically active chemicals of forest species and their utility for pest control [069/TFRI-2004/NWFP-1(9)]

Findings: *Jatropha curcas* seed oil was modified and different physico-chemical properties were assessed. *J. curcas* seeds were collected from different regions of India and estimated oil percentage and antinutritional constituents, saponins and phytates. Maximum oil percentage (kernel basis) 59.78 % was recorded in the seeds collected from Alirajpur, Jhabua (Madhya Pradesh) while oil percentage in different seed sources ranged from 37.88 to 59.78%. Toxic content phytates and saponin ranged from 4.35 to 9.10% and 0.52 to 2.52% respectively. There was no correlation between oil concentration and toxic content.

Biological activities of different oil component were assessed against Termite (*Odontotermes* spp.), Fungi (*Fusarium oxysporum* and *Alternaria alternata*), Bacteria (*Pseudomonas tectonae*) and Weed (*Parthenium hysterophorus*). 4.7% weight loss of wooden block was recorded in control while minimum weight loss (1.4%) was observed in 10% formulation of sulphated oil when tested against termites. Maximum fungal inhibition (75%) was recorded in diterpenoid fractions. Diterpenoid fraction showed potential efficacy against *A. alternata* and *P. tectonae*.

Herbicidal activity of *Jatropha* oil component was also assessed against a weed *Parthenium hysterophrus.* There was 100% root inhibition over the control.

Project 7: Evaluation of wild edible plants of central region for polysaccharides and other food [070/TFRI-2004/NWFP-2(10)]

Findings: Sal dominated forest areas of Mandla (Kalpi, Narayanganj, Bichiya, Anjanai and Mangli) of Madhya Pradesh were surveyed and wild edible fruits of Manhar (*Randia dumatorum*) and fruit bodies of edible fungi, Putpura (*Asterus hygromatricus*) were collected. Polysaccharide content (starch/carbohydrate) and other nutrient composition of fruit bodies of *A. hygromatricus* and *R. dumetorum* were estimated. Fruit bodies contain high carbohydrate (29.48% and 35.41%) in outer and inner part respectively and fruits of *R. dumetorum* contain high carbohydrate (18.93%). *A. hygromatricus* is the good source of protein. Water soluble vitamins (ascorbic acid and thiamine) were also present in both *R. dumetorum* and *A. hygromatricus.* Minerals viz., calcium, phosphorus and magnesium were also found in appreciable amount.

The rhizomes of *C. angustifolia*, *C. pseudomontana*, *C. speciosus*, *E. nuda* and *P. tuberosa* rhizomes /tubers are eaten raw or as vegetable in different parts of central region. Polysaccharide (starch) contents in tubers varied from 25.82-38.30%. Maximum content was estimated in the tubers of *P. tuberose* followed by *C. angustifolia,* only 25.82% starch recorded in *E. nuda.* Physico-chemical properties of starch were also determined. Lipid/oil content was also estimated in species,

which contribute high energy value of tubers. 6.16% oil was found in *P. tuberosa* followed by *C. pseudomontana* (4.79%). Results showed that species are rich in mineral content. The percentage of potassium, magnesium, sodium ranged from 1.26 to 2.11%, 0.12 to 0.22% and 0.12 to 0.28% respectively. The amount of sodium and magnesium was comparatively low. Phenolic acids were also identified and quantified in species with the help of HPLC.

Diosgenin contents was estimated in *Costus speciosus* collected from different localities of central region. Maximum diosgenin content was found in the rhizomes collected from Kanker followed by Mandla samples. Durg (CG) contained 2.11% diosgenin, while Dhamtari samples possessed 1.37% diosgenin respectively. Anti nutritional contents, phenol was ranged from 0.24-1.09%. Maximum phenols was found in *P. tuberosa.* The tannin content of tubers varied from 0.03-0.34%. Level of oxalate in different tubers ranged from 0.02-0.09% which was considerably lower than those found in most other starchy staples. All the plant species contain high food value. Food energy provided by the edible parts of the species varied from 126 g calories to 336 g calories which is comparable with other commonly used edible species.

EXTERNALLY AIDED PROJECT

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

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

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

PROJECTS ONGOING DURING THE YEAR 2007-2008

PLAN PROJECTS

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

Status: The project was initiated during 2006-07 with the aim of establishing medicinal plant based agroforestry system and to evaluate the performance of three medicinal plants, *Curcuma longa* L., *Costus speciosus* Koenig SM and *Gloriosa superba* L. under existing teak plantations. The medicinal crop was harvested and compilation of collected data is under progress. Results indicated that the growth performance of teak was better with various interculture operations. The system was demonstrated to the farmers of IFFDC (Indian Farm and Forestry Development Corporation), Sagar on 8th March 2008.

Project 2: Study on plant diversity in Sal – Teak ecotone zone as influenced by ecological and climatic changes [085/TFRI/2005/Biod-2(5)/2005–09]

Status: Two sites viz. Umariya (MP) and Jagadalpur (CG) have been selected for the study where sal and teak are growing together naturally. Quadrates have been laid out at both the ecotone area for floristic study.

Phenological observations of tree species were recorded from both the ecotone zone. Surface soil samples collected from the ecotone areas of Jagadalpur (24 samples) and Umariya (24 samples) were analyzed for soil micro-flora and chemical properties.

Project 3: Documentation of traditional knowledge on ethno-medicinal information from traditional herbal healers (vaidyas, ojhas, guniyas) in central Madhya Pradesh [TFRI–084/ TFRI/2005/Biod-1(4)]

Status: The tribal rich pockets have been identified for survey work in Jabalpur, Sehor, Hoshangabad, Seoni, Chhindwara and Bhopal districts of Madhya Pradesh. The traditional knowledge on cure of various diseases is documented from traditional herbal healers of different tribal localities. The local names, scientific name, plant parts used, formulation, mode of preparation of drug and doses have been recorded along with number of traditional herbal healers contacted. Importance of sustainable use of herbal medicinal plants and their conservation have been brought to the knowledge of tribal communities and herbal healers during the field visits and at Van Mela at Jabalpur and Bhopal. Slogans showing importance of medicinal plants and their sustainable use and conservation were prepared for distribution in the above tribal pockets in the form of banner/pamphlets for creating awareness.

Van Singhara (*Eulophia nuda*)

Patal Kumda (*Pueraria tuberosa*)

Tribal herbal healer collecting medicinal plants from near by forest for preparation of herbal medicine

Project 4: 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); 2005-08]

Status: Survey of important localities of districts Umaria, Sidhi, Khandwa, Khargon, Ujjain, Ratlam, Jhabua, Dhar, Datia, Gwalior, Bhind, Morena, Raisen, Vidisha, Dewas, Shajapur and Rajgarh of Madhya Pradesh was carried out for the collection of braconids. Over all 181 samples of insects were collected by sweeping method; out of which 761 Braconids were isolated and preserved. Two hundred ten samples of leaf miners and defoliators of forest tree species (*Ailanthus excelsa*, *Butea monosperma*, *Pongamia pinnata*, *Dalbergia sissoo, Syzygium cumuni, Lagerstroemia parviflora* and *Ziziphus jujube),* teak leaf defoliator / skeletonizer and bamboo leaf roller were collected from surveyed localities of Madhya Pradesh. *Apanteles bambusae* was emerged from the larvae of Bamboo leaf roller: *Crypsiptya coclesalis*; *Parahormius absonus* was reared from the larvae of *Albizia defoliator*: *Rhesala imparata*; *Chelonus deogiri* and *Hormius lamidae* were emerged from the leaf miner of *Pongamia pinnata* and *Parahormius deiphobus* was reared from Palas leaf blotch-miner. Twenty four species viz., *Apanteles hyblaeae*, *Apanteles agilis*, *Apanteles bambusae*, *Parahormius* nr. *jason*, *Parahormius absonus*, *Parahormius zonus, Parahormius rameshi*, *Hormius vitabilis*, *Hormius lamidae*, *Adialytus arvicola*, *Chelonus scutellatus*, *Chelonus gastrus, Chelonus chailini*, *Chelonus shyamus, Trioxys indicus*, *Trioxys soporensis*, *Apanteles attevae* sp.n., *Adialytus magnipalpus* sp.n., *Chelonus parascutellatus* sp.n., *Chelonus paragastrus* sp.n., *Hormius lorhaensis* sp.n., *Meteorus longiflagellata* sp.n., *Trioxys magnicorpa* sp. n. and *Agathirsia paratestacea* sp.n., were identified up to the species level.

Project 5: Studies on the efficacy of toxins of soil actinomycetes against major forest insect pests [103/TFRI/2006/Ento-2(13); 2006-09]

Status: One hundred fifty soil samples were collected from 20 forest localities of Madhya Pradesh and 10 and 5 localities of Maharashtra and Chhattisgarh respectively. Two actinomycetes were isolated on potato-dextrose agar plates following serial dilution technique and pour plate method. Extraction of toxins (antibiotics) of actinomycete, *Streptomyces* sp. were carried out. Nurseries, plantations and natural forests were surveyed for collection of insects damaging teak and *Albizia* sp. and their rearing were carried out in laboratory for experimental work. Toxicity tests of isolated antibiotics and bioproduct of a soil actinomycete were conducted against major insect pests of teak and *Albizia* spp. through larval and food treatment.

Project 6: Evaluation of biopesticidal products for the management of teak defoliator and skeletonizer in forest nursery [104/TFRI/2006/Ento-3(14)]

Status: Incidence of teak defoliator and skeletonizer was periodically monitored in teak nurseries and plantations. Periodical collection of teak defoliator and skeletonizer was made from plantation areas of Udaipur, Kalpi, Tikariya under Mandla Forest Division, Mandla (M.P.) and culture was maintained in laboratory. Sampling, isolation and identification of entomopathogenic fungi from insects collected from localities, such as, Belkund, Kundam, Seoni and Mandla in M.P. and Pauni,

Surewani, Deolapar in M.S. were carried out and culture maintained. Laboratory culture of the isolated microbes maintained and pathogenicity tested against the larvae. Laboratory culture of wax moth, *Galleria melonella*, was maintained round the year as host for Entomo-Pathogenic Nematode (EPN). Pathogenicity of the EPN was pioneered against the teak defoliator and skeletonizer. Compatibility of the EPN with that of chemical and biological insecticides evaluated. Eight concentrations each of 8 commercially available biopesticides were evaluated against the larvae of teak defoliator and skeletonizer. Anti-ovipositional effect due to prophylactic treatment of 2 botanical formulations was experimented against teak defoliator in nursery.

Project 7: Studies on bacterial and viral diseases of Teak, *Gmelina* and *Albizia* and their management [066/TFRI/2004/Patho-1(8)]


Leaf curl and stunting in teak

Status: Overall 250 bacterial/viral disease samples were collected from 27 forest nurseries of M.P., C.G. and M.S. Out of them 245 samples of teak and khamer were found to be infected with bacterial wilt and collar rot and 5 (*A. lebbek, A. procera, T. grandis* and *G. arborea*) with virus infection. 2-5% economic losses were recorded in different nurseries caused by bacteria and viruses. Total 9 bacterial isolates were purified and sensitivity test carried out to assess suitability of antibiotics for their application in nursery. An experiment has been laid out 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 noticed. Disease was successfully controlled with the application of streptocyclin 0.1% in combination with monocrotophas 0.036%.

Project 8: Evaluation, modification and value addition of starches of forest Origin [083/TFRI/2005/NWFP-2(13)]

Status: Fruit of *Carea arborea* from four localities of MP were surveyed and collected. Recorded morphological description of fruit and seeds. Analyzed chemical composition of seed. Extracted starch from seed and prepared syrup of 17 DE by acid hydrolysis of *C. arborea* starch. Surveyed potential area of *Curcuma aromatica* in Maharashtra, Madhaya Pradesh, Orissa and Chhattisgarh. Collected rhizome from Baripada Forest Division (Orissa) and Palampur (HP). Extracted starch and analyzed chemical composition and physio- chemical properties including essential oil 0.6%, fibre 8.2%, protein 4.5%, phosphorus 0.37% and starch 25.3%.

Project 9: Evaluation of management systems and level of community participation under Joint Forest Management (JFM) [071/TFRI-2004/Silvi-1(6)]

Status: Vegetation survey for phyto-sociological studies was conducted by laying out sample plots in earlier selected sites at Udaipur Forests, Comptt. No. 561, 562, 563 in Maihar Forest Range, Satna Forest Division (Madhya Pradesh), Narwar (Comptt. No. RF-18), Nipnia (Comptt. No. RF-19), Aintajhar (Comptt. No. RF-12), Singpur Forests, (Comptt. No. RF-11), Sahdol Forest Range, South Sahdol Forest Division (Madhya Pradesh), Medha Lekha Forests (Comptt. No. RF-511),

Dhanwa Forest Range and Gadchiroli Forest Division (Maharashtra), Aoti Forests (Comptt. No.185) Satna Forest Range, East Nasik Forest Division (Maharashtra) for studying effect of Joint Forest Management programme on people and forests.

Regeneration, plant density, diversity index and species richness were better in forests having Joint Forest Management (JFM) programme as compared to non-protected forests having no JFM programme. The conditions of the forest got improved under JFM programme due to controlling of illicit felling / grazing, fire protection, settlement of encroachment etc. JFM programme has developed confidence of people on forests, forestry and forest departments. It has been observed that villagers of Medha Lekha Village are protecting Govt. forests on rotational basis without getting any help / remuneration from the Govt. by considering Govt. forests as their forests.

Implementation of JFM programme has positive effect on people due to introduction of income generating scheme like fishery, plantation of grafted mango seedlings, honey collection etc., ban on use of country liquor (Mahua Daru) by active involvement of women, increase in level of ground water. This has facilitated farming of horticulture / forestry / agriculture in the area.

Project 10: Sustainable management of medicinal plants in JFM areas in different agroclimatic zones of Madhya Pradesh [079/S.P.Tripathi/ Silviculture]

Status: For sustainable harvesting of Kalmegh in Satnur Forests area, Sawari Range, West Chhindwara Forest Division, sample plots were laid out in 2005 and harvesting was done at different intensity in 2005, 2006 and 2007. Sustainability with maximum productivity was found at 60% harvesting level. Additional sample plots have been laid out near Delakhadi Forest Rest House, Delakhadi Forest Range, West Chhindwara Forest Division and at Naunichhapar Village (Comptt. No. P-1286), Chhindwara Range in East Chhindwara Forest Division in 2006 and 2007 respectively for study of sustainable harvesting of Kalmegh.

Problem of natural regeneration and sustainable harvesting of Chironjee was reflected by West Chhindwara Forest Division and for this sample plots were laid out at Sitadongri Village (Comptt. No. P-155), Delakhadi Forest Range, West Chhindwara Forest Division and Khumbhadeo Forests (Comptt. No. P-1080), East Harrai Range, East Chhindwara Forest Division. Harvesting of mature fruits / seeds were done by having treatments namely T1 (90% No. of fruits), T2 (80% No. of fruits), T3 (70% No. of fruits) and T4 (60% No. of fruits). It has been observed that harvesting of only mature fruits / seeds and leaving 10% seeds bring regeneration of Chironjee which can be managed and protected by applying silvicultural practices. Sustainable harvesting exists at 90% of harvesting level. Site having rich population of Chironjee has also been selected at Ojhaldhana Village (Comptt. No. P-955). East Batkakhapa Range, East Chhindwara Forest Division for study of regeneration, following harvesting at different intensities and protection.

Sample plots have been laid out at compartment No. 321 and 292 in Katni Forest Division, and Dhawantri Park Takshkeswara, Bhanupura Range, Mandsaur Forest Division for studying of sustainable harvesting of Satawar.

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

Status: Studies on germination of seeds have been carried out on *Schleichera trijuga, Terminalia arjuna* and *Hardwickia binnata*. Studies on desiccation tolerance and seed storage behavior have been conducted on *Schleichera trijuga, Terminalia arjuna, Sapindus laurifolia, Ablomoscus moscatus* and *Hardwickia binnata*. Seeds of *Schleichera trijuga, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia* and *Terminalia chebula* were adjusted to three to five moisture contents and stored at four different temperatures i.e. -10°C, 5°C, 10°C and 45°C for evaluation of storage potential. Seeds of stored species were sampled for viability assessment. Seed maturation studies for determination of seed collection time have been continued on *Schleichera trijuga, Terminalia arjuna, Hardwickia binnata*, *Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Terminalia chebula* and *Ablomoscus moscatus.*

Project 12: Standardization of nursery techniques of *Strchnos nux-vomica* and *Strychnos potatorum* [080/TFRI/2005/Silvi-2(9)]

Status: Seed, roots and branches of *S. nux-vomica* were collected from Sahni Khar, Dhamtari Forest Division and seed, roots and branches of *S. potatorum* were collected from Khutama, South Chhindwara Forest Division for conducting seed germination and vegetation propagation experiments. Seeds of *S. nux–vomica* soaked in cow dung slurry for 72 hours before sowing gives 66% germination followed by seed soaked in poultry manure for 72 hours before sowing gives 54% germination and untreated seed gives only 3% germination. Seed of *S. potatorum* soaked in cow dung slurry for 72 hours before sowing gives 51% germination followed by seed soaked in poultry manure for 72 hours before sowing, gives 36% germination as compared to untreated seeds giving only 6% germination.

The maximum 66% germination in *S. nux–vomica* and 54% germination in *S. potatorum* was observed under 100 ppm IBM hormone followed by the maximum 42% germination in *S. nux–vomica* and 39% germination in *S. potatorum* was noted under 50 ppm IAA hormone. Under hormonal treatment no rooting in root and branch cuttings of *S. nux-vomica* and *S. potatorum* was observed.

Project 13: Development of nursery technique for *Terminalia chebula* Rext. (Harad) [107/TFRI/2006/Silvi-1(12]

Status: Seed and branches of *Terminalia chebula* were collected from Chandrapur (Maharastra), Bilaigarh (Chhattisgarh), Tamia (Madhya Pradesh) and Sambalpur (Orissa) for conducting seed germination and vegetation propagation experiments. The seeds and branch cuttings were given different physical, chemical and hormonal treatments and laid out an experiment in silviculture nursery as per Randomized Block Design. Branch cuttings treated with different hormones with different concentrations of IAA, IBA and NAA. Maximum 90% sprouting was noted in the treatment of IBA -4000 ppm followed by IAA- 4000 ppm (70%). Best performance in inducing sprouting was observed in cuttings having diameter of 2-2.5 cms in comparison to other two groups (1-1.5 cms and 3-4 cms).

Under physical treatment for enhancing germination of seeds, 2 days drying after 7 days soaking in normal water showed best results.

EXTERNALLY AIDED PROJECTS

Project 1: Identification of species and ethnobotanical survey [088/TFRI/ 2005/ Biod–3 (CG, MFD) (6)/2005-08]

Status: Survey in 9 People Protect Areas (PPAs) of Chhattisgarh at Karpavan, Machkot, Guriya (Jagdalpur, Baster); Jabarra, Shankra (Dhamtari); Lamni, Marwahi (Bilaspur); Makadi (Kondagaon) and Antahgarh (Bhanupratappur) was conducted for vegetation study. Quadrat study has been conducted in 9 PPA sites for documenting floral wealth and increasing or decreasing trend of important forestry species in the area. Vegetation data of PPA (established during 2002-03, 2003-04, 2004-05, 2005-06 and 2006-07) for tree species with girth class, regeneration status of major tree species and medicinal plants available in the area were recorded during the study. The previous vegetation data available with forest department has also been recorded. The same has been tabulated for calculation and comparison of vegetation status. Plants observed in Karpavan, Machkot, Guriya, Jabarra, Shankra, Lamni, Marwahi, Makadi and Antahgarh PPA areas are identified with their local name, morphological character and available literature. The brief morphological description of the plants are being prepared. Some plant specimens have been collected to confirm the identity and their threatened status. The ethno-botanical uses of medicinal plants observed from above PPA sites are being documented. Common and medicinal uses of plants species found in the PPA site are recorded alongwith brief morphological description.

Project 2: To study utilization pattern of plants in ethno-medicinal uses prevalent in tribal pockets of Satpura plateau in Madhya Pradesh [101/TFRI/JBP/2006/Biod-1 (MPSBDB) (07) (2006–10]

Status: Field survey was conducted to identify rich tribal pockets in Mandla, Jabalpur, Katni and Chhindwara districts of MP for documentation of traditional knowledge from traditional herbal healers. Existing utilization pattern of medicinal plant being utilized by traditional herbal healers against various common diseases of tribal pockets from Jabalpur, Mandla and Chhindwara districts of MP have been documented. Survey of Mandla, Jabalpur, Katni, Satna, Chhindwara, Bhopal and Sagar districts of MP have been carried out to document the channels involved in marketing of herbal plants. Market day of tribal villages of Mandla and Chhindwara districts have been recorded and visited where trading of raw and finished products takes place.

Awareness has been created through local contacts to the tribal/ rural people of above surveyed districts regarding sustainable uses of medicinal plants. Morphological description of medicinal plants recorded from above localities alongwith medicinal uses are being prepared. Some slogans have been prepared on uses and importance of medicinal plants for creating awareness among tribal communities.

Project 3: Identification of suitable tree species and other vegetation for biodrainage in Bargi Command Area (Jabalpur, M.P.) [087/TFRI/2005/Ecol-1 (MOWR)(7)]

Status: A plantation of about 10 ha area was raised along Left Bank Canal (LBC) of Bargi Command Area, Jabalpur. *Jatropha curcas* and *Agave americana* were planted surrounding the plantation sites for biofencing. Cattle Protection Trench (CPT) of standard size was also dug to protect the plantation sites from cattle. The species planted included *Pongamia pinnata, Acacia nilotica, Albizia lebbek, Albizia procera, Ailanthus excelsa, Eucalyptus* hybrid (Jabalpur), *Eucalyptus* hybrid (FRI-4 and FRI-5), *Terminalia arjuna* and *Dalbergia sissoo*. *Eucalyptus* hybrid and *Terminalia arjuna* were planted at Dabhola site; *Pongamia pinnata* and *Acacia nilotica* were planted at Jamuniya and *Albizia lebbek, Albizia procera, Ailanthus excelsa, Eucalyptus* hybrid (Jabalpur), *Eucalyptus* hybrid (FRI-4 and FRI-5), *Terminalia arjuna* and *Dalbergia sissoo* were planted at Somti site. *Ailanthus excelsa* did not perform well, hence partly replaced by *Albizia procera.* All species, except *Eucalyptus* hybrid (FRI-4 and FRI-5), were planted at 2 m x 2 m spacing. *Eucalyptus* hybrid (FRI-4 and FRI-5) were planted at both 2 m x 2 m and 1 m x 1 m spacing. Growth data of the planted seedlings was measured regularly at an interval of 3 months.

Observation wells were constructed as per standard design and installed at plantation sites and control site (where no plantation was there). The observation wells were installed in the manner so that the effect of plantation of each species could be observed separately. The depth of wells was set to be 10 feet. The evaporation rate was regularly measured on daily basis by open pan evaporimeter. Soil infiltration rate was measured at different grids along LBC of Bargi Command Area in different months. Under ground water table was regularly measured with the help of observation wells in different plantations.

Project 4: Lead Institution for Achanakmar-Amarkantak Biosphere Reserve, Chhattisgarh [102/TFRI/2006/Ento-1/MoEF (12)]

Status: Six visits to Achanakmar- Amarkantak, Biosphere Reserve (BR), Bilaspur were made to get information on area of buffer and transition zones, and listing of vegetations available in each zone of BR documented. Inventory list of crustaceans, insects, fishes, amphibians, reptiles, birds and mammals existing in BR updated. Two field surveys were conducted and work on documentation of different tribes, village wise population and economic status initiated. The work is in progress. One field visit was conducted in January 2008. The information on market survey of different NTFPs sold being documented. A workshop on research needs for Achanakmar-Amarkantak BR was organized on 30th April 2007. During discussion 8 gap areas in research in Achanakmar –Amarkantak BR identified. One meeting with Principal Chief Conservator of Forest level and two with Conservator of Forest and two at Dy. Conservator of Forest level, one with Superintendent of BR were made during the year 2007-08. The updated research based information presented in the workshop on Research needs for Achanakmar- Amarkantak Biosphere Reserve, held at Tropical Forest Research Institute, Jabalpur on 30th April 2007 published and widely circulated to BR managers, academicians and scientists. Biosphere Reserve Information Series (BRIS) volume 1, part 1 published and circulated to BR managers, Directors of Parks, Sanctuaries, academicians, scientists working on Achanakmar- Amarkantak BR.

Project 5: Screening of indigenous species of *Trichogramma* Westwood and *Trichogrammatoidea* Girault (Hymenoptera: Trichogrammatidae) from Central India and their utilization against important forest insect pests [077/TFRI/2005/Ento-(1) 9; 2005-08]

Status: Survey of important localities of selected districts of Maharashtra: (Amravati, Akola, Jalgaon, Dhule, Malegaon, Nashik, Thane, Pune, Raigad, Ahmad Nagar, Aurangabad, Jalna, Washim, Wardha, Yavatmal, Bhandara, Chandrapur, Solapur, Satara and Ratnagiri) and the districts of Orissa (Sundargarh, Koenjhar, Balasore, Bhadrak, Cuttack, Jagat Singhpur, Puri, Bhubaneshwar, Balangir, Sonepur, Sambalpur, Jharsuguda, Dhenkanal, Kalahandi, Nowrangpur, Koraput, Malkangiri and adjoining areas) was carried out for the collection of *Trichogramma* and *Trichogrammatoidea* species. Over all 1337 specimens belonging to the genera *Trichogramma* and *Trichogrammatoidea* were collected. Twenty three species of *Trichogramma* (*T. breviciliata, T. flandersi, T. fasciatum, T. higai, T. thalense, 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* and *T. stampai)* and one species of *Trichogrammatoide (T. fumata)* have been recorded as indigenous species, existing in Madhya Pradesh, Chhattisgarh and Maharashtra. Live culture of 5 indigenous species viz., *Trichogramma raoi, T. plasseyensis, T. latipennis, T. breviciliata* and *T. breviflagellata* are being maintained. Culture of *Corcyra cephalonica* is being maintained for the use of their eggs as laboratory host for *Trichogramma* and *Trichogrammatoidea* species.

Project 6: 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 Sonaghati, Neempani, Wamandehi, Balaghat and Hardi (Research Extension Circle, Betul, Seoni and Rewa), compartments at Balwara and Katkut ranges (Forest Division, Badwaha), Ghisi (Forest Protection Division, Barghat/Seoni), Kanchangaon and Belkund (Forest Project Divisions Mohagaon/Mandla and Jabalpur), Deogarh and Borgaon (South Forest Division, Chhindwara), Tendukheda (Forest Division, Damoh) and Mukki (Kanha), Sakriya and Raipur (N. Forest Division, Panna) for monitoring the insect pests and diseases of target species. Incidence of white grubs *Holotrichia* species, teak defoliator *Hyblaea puera,* skeletonizer *Eutectona machaeralis*, aonla shoot gall forming insect *Betousa stylophora*, leaf roller *Garcillaria acidula*, fruit sucker *Scutellera nobilis*, case worm *Acanthopsyche* species, heart wood borer *Hoplocerambyx spinicornis* and wilt/root rot/foliar diseases *Fusarium solani, Pseudomonos tectonae, Polyporus zonalis, Rigidoporous lineatus, Peniophora* species and *Olivea tectonae* were recorded. Experiments laid out on IPM of white grubs in teak nurseries at Kanchangaon and Belkund, teak defoliator *H. puera* and skeletonizer *E. machaeralis* in teak plantations at Kanchangaon and Ghisi. Biopesticides, insecticides/fungicides and bioagent were used against insect pests/diseases. Preliminary screening of seven varieties of *E. officinalis* (Chakaiya, Kanchan, Francis, NA6, NA7, NA10 and BSR1) against insect pests/diseases done.

Project 7: Varietal improvement of *Rauvolfia serpentina* and *Tinospora cordifolia* through germplasm selection, evaluation and breeding [100/TFRI/2006/ Gen-1 (MoHFW) (10)]

Status: Three States namely Chhattisgarh, Uttarakhand and J & K were visited and germplasm of both the species were collected. The collected materials were used for raising plantlets of both the species. The *in vitro* shoot multiplication rate and rooting was optimized in both the species.

In *R. serpentina ex vitro* rooting (100%) was also achieved. Two methods namely BP (British Pharmacopoea, 2000) and spectrophotometer (Singh *et al*., 2004) were tested for estimation of total alkaloids in *R. serpentina*. In *R. serpentina* the anthesis period (4.00 am - 9.30 am) and peak time of anthesis (7.00 am - 8.00 am) were determined in May-June. Floral longitivity (20 - 28 hours) was also standardized. Microscopic floral structure of *R. serpentina* and *T. cordifolia* was studied. The process of raising planting stock of both the species of at least 10-15 accessions is in progress for establishment on demonstration of multi location field trial of both the species.

Project 8: Studies on *in vitro* regeneration of plantlets and their genetic (molecular) fidelity in *Saraca indica* Linn., a vulnerable medicinal tree [111/TFRI-2006/Gen-2 (CSIR)(12)]

Status: Seedlings of about two to three years old were collected from J.N. Agricultural University, Jabalpur, Madhya Pradesh and Nagpur, Maharashtra. Nodal explants from these seedlings were subjected to five sources of cytokinin, viz., BA, kinetin, adenine hemisulphate, zeatin and 2-isopentyl at 20 µM for *in vitro* culture initiation and bud break. BA and zeatin resulted in 60% sprouting of buds. Subsequently, six concentrations of BA (0, 0.01, 0.1, 1.0, 10.0 and 100 µM) and 3 concentrations of NAA (0, 0.1 and 1 µM) alone and in all possible combinations were tested for bud break in nodal segments of seedlings. The different concentrations of BA individually and its interactions with NAA had a significant effect on bud break (%). Maximum bud break was obtained with 100 µM BA, which was statistically on par with 10 µM BA supplemented medium. In another investigation, seeds were germinated under *in vitro* conditions on MS basal semisolid medium for harvesting of aseptic shoot explants. Four nutrient media (MS, B5, WPM and Nitsch and Nitsch) along with five doses of BA (0, 2.2, 4.4, 8.8 and 17.8 µM) alone and in all possible combinations were tried for bud sprouting and elongation of nodal segments. Nutrient medium B_5 supplemented with 2.2 µM BA has been selected for sprouting and shoot elongation.

Five sources of cytokinin, viz., BA, kinetin, adenine hemisulphate, zeatin and 2-isopentyl at 20 µM, along with different doses of 2, 4-D (0, 5 and 10 µM) were screened for induction of callus on cotyledons. The effect of cytokinins individually and their interactions with 2, 4-D were found to be significant for callus induction. Maximum callus formation (100 %) was obtained on 20 µM zeatin and 10 µM 2, 4-D.

Project 9: Processing techniques of NWFP's of Chhattisgarh– *Madhuca latifolia, Shorea robusta, Schleichera oleosa, Pongamia pinnata* and *Buchanania lanzan* Chironjee) [91/TFRI/2005/NWFP-3 (CGMFD)(14)]

Status: Seeds/fruits of different TBOs i.e. Sal (*Shorea robusta*), Chironjee (*Buchanania lanzan), Pongamia pinnata* (Karanj), *Madhuca latifolia* (Mahua) and Kusum (*Scheichera oleosa*) from Bichiya (Mandla), Kota (Bilaspur) and Kundam, Barha, Tikariya (Jabalpur) during season. Seeds were decorticated manually and dried by different methods i.e. sun-drying, shade drying, hot air drying at 40° C, 60° C and 80° C, and stored in different containers i.e. jute bag, tin containers, plastic bag and air tight plastic containers. Chironjee seeds dried at 40, 60° C in oven and stored in plastic bag, glass bottles and plastic air tight containers, room temperature and freezer.

Fungal flora in different treatments in seeds of collected species were recorded in different intervals. Total 13 fungus belonging to 9 genera were recorded in different seeds - *Aspergillus flavus, A. fumigatus, A. niger, A. nidulans, A. teneus, Chaetomoum globosum, Cladosporium herbarum, Collectotrichum gloeosporioides, Dothiorella indica, Fusarium oxysporum, Penicillium* sp. and *Rhizopus nigricans.* Fresh seeds showed 2-9% fungal infestation in different species. Fungal infestation increased with time but intensity varied in different containers i.e.13 to 81% (Jute bags), 4 to 14% (plastic jars), 4 to 15% (poly bags), 8 to 38% (tin containers). Maximum deterioration was recorded in Jute bags.

Moisture percentage in different containers under different drying treatments increased with time. Oil concentration in different seeds decreased with time. Free fatty acid concentration and saponification value of seed oil of different species increased during storage due to the degradation of oil.

Project 10: Quality assessment of NWFP's from different regions of Chhattisgarh. Species- *Asparagus racemosus, Buchanania lanzen, Emblica officinalis, Embelia ribes* and *Andrographis paniculatus* [092/TFRI/2005/ NWFP-4 (CGMFD)(15)]

Status: Different regions of Chhattisgarh (Kawardha, Pendra Road, Durg, Bilaspur, Raipur, Raigarh, Mahasamund, Ambikapur, Dhrumjaigarh, Jashpur and Kanker) were surveyed and Satawar roots, Kalmegh (whole plant), Aonla (fruits), Vaibidang (fruits) and Chironjee (fruits) samples were collected during their respective seasons of collection. Physico-chemical properties to accertain qualitative variations in samples from different regions were also assessed.

Ascorbic acid contents estimated in Aonla collected from different region of Chhattisgarh ranged from 64 – 257 mg/100 gm, minimum in Dondi, Durg (Mahamaya PPA) and maximum in Katghora (Bilaspur). Oil per cent ranged from 42.3- 63 in different localities. Maximum oil per cent was recorded in samples collected from Pandariya (Kawardha). Saponin glycosides and minerals (P, Na, K, Mg and Ca) were estimated in Satawar samples and ranged 0.4-9.9, 0.2-3.5, 2.3-12.5, mg/100 g, 0.048-0.096% and 0.08-0.4% respectively. Total saponin per cent ranged from 0.72% to 2.5%. Maximum saponin percent was found in Dondi (Durg). Andrographolide contents of in *Andrographis paniculata* estimated in different sample ranged from 0.27 to 0.38% with the help of HPLC. Maximum percentage was recorded in Kanker samples.

Project 11: Non-destructive harvesting practices for selective MFPs- *Buchanania lanzan* (Chironjee) [093/TFRI/2005/NWFP-5 (CGMFD)(16)]

Status: Different regions of Chhattisgarh (Bilaspur, Raipur, Raigarh, Mahasamund, Ambikapur, Kanker and Dhrumjaigarh) were surveyed for selection of sites. The fruits of Chironjee were collected in 3rd and 4th week of April and 1st and 2nd week of May from TFRI Campus, Jabalpur, Barha Experimental Field, Jabalpur, Bhilmadhi, Korba. Chironjee fruits were depulped and primarily quality of Chironjee was assessed on the basis of floatation test by counting the float and sunk seeds. Other physical properties of fruits/seeds - moisture%, colour of fruits, fruit weight, seed weight, kernel size, kernel fresh and dry weight were also recorded.

Bio-chemicals (oil per cent, carbohydrates, protein, free fatty acids, free amino-acids fibre, minerals, vitamins and phenolic acids) in fruits/seeds of Chironjee collected were estimated. Oil per cent in seeds increased with time (4.09-43-38%). Free Fatty Acid concentration was also increased in the seeds when collected in second week of May. Concentration of free amino-acids (FAA) decreased with time. However, protein concentration increased with time (7.4-19.30%). Similarly, fibre and mineral concentration were also increased with time. Quarterly observations on regeneration of Chironjee plants was undertaken.

Project 12: Standardization of non-destructive harvesting practices of Arjuna (*Terminalia arjuna*), Maida (*Litsea chinensis*) Bark and Salai (*Boswellia serrata*) oleoresin [96/TFRI/2005/NWFP-8(CGMFD)(19)]

Status : In Arjuna, the stage of bark recovery (re-growth) varied from tree to tree. After one year, the stripped trees exhibited an average of 42% recovery based on surface area covered with fresh bark. The trees in which the bark was harvested on December 2005 by putting blaze size (30 × 30 cm) showed almost complete bark recovery nearly after two years. However, few trees showed partial recovery of bark. The availability of Maida trees in the forest areas is very less. Thumb size collar diameter Maida trees were found harvested for bark. Minimum and maximum girth of Maida trees selected for study was 12 cm and 178 cm respectively. Mean thickness of bark varied from trees to trees. It is irrespective from the age/girth of tree. The tannin content ranged from 3.55 to 5.73 gm per 100 gms. In Maida trees the recovery of bark was faster. The regeneration of bark in young trees was fast in comparison to older trees and completed regeneration within one year. Various girth size *Boswellia serrata* (Salai) (age group) trees were selected for study. Different type of blazes having varied length, width and deep were laid out in December and March 2007 to optimize best blaze to harvest oleoresin from tree. In some trees the oleoresin oozes out but the yield was very less.

Project 13: Standardization of non-destructive harvesting practices of Baividang (*Embelia ribes*), Baheda (*Terminalia belerica*) and Aonla (*Emblica officinalis*) fruits [97/TFRI/2005/NWFP-8(CGMFD)(20)]

Status : The study revealed that the availability of Aonla fruits was affected by the existing destructive harvesting practices. Aonla fruits should be harvested in the proper season, at the proper maturity stage, in a non-destructive and sustainable manner. In protected areas where more than 5 fruited Aonla trees were available in (50 × 50 m), 90% harvest of Aonla fruits was found sufficient for regeneration. However, in unprotected areas less regeneration was observed even if 20% fruits were left for regeneration. For proper regeneration fruits should be harvested in December- January only after maturity.

Baividang fruits should be collected / harvested after maturity when they change their colour from green to pink or red. Fruits should be plucked by hand instead of cutting the branches. The amount of fruits to be harvested depends upon the population of Baividang. If the population of Baividang is more (20 fruited plants per 10x10m) then 5-10 % fruits are enough to maintain sustainability whereas in the areas where population is less (10 fruited plants per 10 × 10 m) more fruits (10-20%) should be left to maintain sustainability. If the population is very less

(5 plants per 10 x 10 m) more fruits 30-40% fruits should be left for regeneration in initial years. Embelin content varied from 2.21 to 4.77%. The immature fruits contain 2.25 % embelin whereas mature fruits contain 4.77% embelin. In Baheda 90% harvest was found suitable for its regeneration in protected areas. Variations were found in fruit size, fruit weight, tannin and gallic acid content in the fruit samples of Baheda collected from various locations. Fruits collected during mid December contained around 13% tannin and 15 mg/100 g of gallic acid. However, the fruits harvested in mid October had 8-9 % tannin and 18-20 mg/100 g gallic acid. It is therefore evident from the data that the Baheda fruits harvested during December are of superior quality in respect of tannin and gallic acid content.

Project 14: National network on integrated development of Jatropha and Karanj [73/TFRI-2004/NWFP-3(NOVOD)(11)]

Status : Jatropha: All experimental trials e.g. national, zonal, progeny and package of practices trials are being maintained at the Institute campus. Experimental area at Barah, Jabalpur and its centre at Chhindwara are performing well. In national trial accessions TFRI-2 and IGAU-3 performed best among all other accessions, whereas in regional trial TFRI-I and MPKV-I performed well among all other accessions received from different member institutions with respect to growth attributes as no sufficient fruiting was observed. Jogimuar, Chhindwara genotype performed best among all progenies with respect to growth characteristics. Pruning operations in Jatropha induced more number of branches which lead to more production/fruits.

Karanja: National, zonal and progeny trials established at the institute campus, Barah experimental area and Bhandamuri, Balaghat are being maintained. In national trial accession number TNMP-4 received from TNAU, Mettupalayam, Tamil Nadu performed best among all other provenances, whereas in regional trial TFRI-2 collected from Madhya Pradesh performed best among all other provenances with respect to growth attributes. Progenies collected from Jabalpur and Lalpur, Satna-1 performed well among all other progenies in respect of growth attributes. Significant reduction in oil yield was obtained in the seeds stored for more than a year.

Project 15: Standardization of sustainable harvesting practices of *Terminalia arjuna* (Arjun) bark [78/TFRI/2005/NWFP-1(MPFED)(12)]

Status : Non-destructive harvesting technique to harvest Arjuna bark has been standardized. Only ¼ of the mature bark on total girth of the tree should be harvested. However, the length of the blaze can be varied (30, 45, 60, 75, and 90 cm) according to its GBH. Sustainable bark harvesting can be done after two years by removing opposing quarters of trunk bark rather than girdling the trees. The study shows that the technique of making of blaze on the tree also plays an important role in the recovery of bark. If the blaze is sharp the recovery is faster whereas if the blaze (cut) is not sharp the recovery is slow. The quality of the bark is directly dependent on harvesting technique and time. December to March was found best time to harvest Arjuna bark as it yielded quality bark in terms of major active ingredients.

Harvesting of bark by putting a blaze on the trunk

Terminalia arjuna tree showing regeneration of bark

Project 16: 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)]

Status: The sustainable harvesting and regeneration studies of *Andrographis paniculata* (Kalmegh), *Asparagus racemosus* (Satawar), *Celastrus paniculata* (Malkagani) and *Aegle marmelos* (Bael) were carried out in PPA of 3 different agro-climatic zones ie. Bilaspur, Raipur and Bastar of Chhattisgarh. The sample plots of standard size were laid out in randomized block design with 4 replication as per experimental design. There were four treatments i.e. T1=20%, T2=40%, T3= 60% and T4= 80% harvesting level for *Andrographis paniculata, Celastrus paniculata* and *Aegle marmelos,* however, there were 5 treatments i.e. T1=100% harvesting of roots without disturbance of parent disc, T2=20%, T3= 40%, T4=60% and T5= 80% harvesting of roots for *Asparagus racemosus.* The sample plots were laid out in Vasim, Belarbehra, Arjuni forest area in Sankara Forest Range, Dhamtari Forest Division, Tiriya, Machkote, Mohlai forest area in Bastar Forest Division and Bharosanga, Keochi forest area in Marwahi Forest Division for sustainable harvesting and regeneration studies of *Andrographis paniculata, Celastrus paniculata* and *Asparagus racemosus,* however, there were two sites ie. Mohgoan forest area, Khairagarh Forest Division and Lellunga forst area, Dharmjaigarh Forest Division where sample plots were laid out for sustainable harvesting and regeneration studies of *Aegle marmelos.*

Sustainability for *Andrographis paniculata* and *Celastrus paniculata* with maximum productivity was found to be at 80% harvesting level and sustainability for *Asparagus racemosus* with maximum productivity was found to be at 60% harvesting level.

Project 17: Nursery technologies of mass multiplication of superior seedlings –Baividang, Sarpgandha, Chironjee, Arjun, Aonla and Bael in Chhattisgarh [099/TFRI/2005/Silvi-4 (CGMFD -11)]

Status: Literature for nursery technology of Sarpgandha, Chironjee, Arjuna, Aonla and Bael were collected from different sources. Seeds of these species collected from M.P. and Chhattisgarh were sown in the nursery of Silviculture Division, Tropical Forest Research Institute, Jabalpur. Germination of seeds was as per literature. The information of nursery technology of the species was documented and was submitted to M/s Federation of Minor Forest Produce, Chhattisgarh.

NEW PROJECTS INITIATED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Impact of pollutants on the growth of plants [115/TFRI–2007/Ecol–1 (8)/ 2007-09]

Status: The sites selected for the study are industrial areas of Raigarh, Chhattisgarh and Bhopal, Madhya Pradesh. More than 70 Sponge Iron Factories have been installed at Raigarh in last 20 years which do emit a lot of pollutants mainly in the forms of SO_2, NO, NO_2, N_2O_5 and Suspended Particulate Matters (SPM). SPM causes a huge loss to the vegetations. The factories are by default equipped with Electro-Static Precipitator (ESP) to precipitate the SPM, but found to be reluctant to use the ESP as they consume a lot of electricity. As a matter of fact, the factories do make their emission by late night to minimize the vigilance effect. Oxides of sulfur and nitrogen do form Acid Rain in atmosphere in reaction with water molecules. The average temperature got elevated in last 20 years; the average growth of the trees found to be stunted and deformed and the loss is higher after 0.5 to 1.0 km of the industry especially if there is barrier of hill and the plantation is on the foothill due to deposition effect in atmosphere.

Bhopal Industrial area at Mandideep includes the Lupin Pharmaceutical Factory and HEG Graphite Factory. A study in this area has just been started in the last quarter as a standard comparison scale to the results of Raigarh. The area is highly polluted too with an additional contribution of automobile exhausts. More than 12 species of tree are under study like *Tectona grandis, Gmelina arborea, Dendrocalamus strictus, Eucalyptus tereticornis, Dalbergia sissoo, Pongamia pinnata, Cassia siamea, Azadiracta indica, Emblica officinalis, Peltaforum ferrugina* and *Alstonia scholaris* etc. on a critical comparison with control data collected from least polluted areas. Physicochemical estimations in terms of pH, EC, organic matter, Available N, P, K, exchangeable cations (Na, K, Ca and Mg), CEC and biochemical estimations (Chlorophyll, Sugar, Ascorbic Acid and Phenol) of leaf and soil samples are on process.

Experiments have been made with the control set at the nursery of TFRI; seedlings of the tree species have been regularly subjected to Simulated Acid Rain (SAR) at pH 4.0 and 5.0. The soil has been treated with the SPM Slug collected from the industries. This is a model experiment which shall mimic the polluted condition and analyses of which along with growth data should tell us the magnitude of the loss or how much the plant is immune to pollution effects. The trend of laboratory analyses indicates that some tree species are moderately resistant to pollution when the others are vulnerable and sensitive.

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

Status: Survey was conducted at Batkakhapa (East Forest Division, Chhindwara), Padar (North Forest Division, Betul) M.P., Laripara (Forest Division, Bilaspur), Chichola (Forest Division, Rajnandgaon), C.G. and Mohghata (Forest Division, Bhandara), Dhadgaon (North Forest Division, Dhulia), M.S. for monitoring the insect pests and diseases. Incidence of stem borer, leaf gall forming

insect, defoliator, inflorescences sap sucker thrips and wilt and leaf blight diseases were recorded. Seven chemicals were tested against stem borer *Betousa stylophora* in natural stand of *B. lanzan.* Two fungicides were tested against wilt disease in nursery stage. Observations on mycoflora of storage seed were recorded.

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

Status: Surveyed and selected agroforestry systems in M.P. and Chhattisgarh with *Tectona grandis* and *Eucalyptus* hybrid as tree species and Wheat, Gram and Ashwagandha as agricultural crops. Regularly collected growth data of the selected species. Collected and analysed soil samples for organic carbon content. Developed agroforestry systems in TFRI campus with *Tectona grandis* as tree species and Wheat, Gram and Ashwagandha as agricultural crops.

Project 4: 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 organisms were collected from Seoni, Bamandehi, Balaghat, Chhindwara and Tamia (M.P.). Different organic matter (leaves of sissoo, *Leucaena*, teak, grasses etc. were collected for conducting experiments. Sandal seeds of T-10 clone, FRC, Hyderabad obtained from IWST, Bangalore was sown in nursery beds for experiment. Seeds of *D. sissoo* were also collected locally for experiment. Fifteen growth promoting microbes were isolated from collected samples. Experiment on screening of growth promoting organisms for *D. sissoo* is in progress. Cultures of growth promoting organisms maintained in laboratory for further experimentation.

Project 5: Genetic variation for *in vitro* morphogenetic potential of *Dalbergia sissoo* Roxb. clones and evaluation of their field performance [117/TFRI-2007/Gen-1 9(13)]

Status: Four field visits were conducted for selection of promising individual and collection of planting materials was done from different progeny trials and mortality affected areas. The collected materials were treated with 100 ppm IAA overnight and planted in polythene bags for raising vegetative propagules. The vegetative propagules are being maintained in shadehouse/mist chamber. These propagules will be used for stock build up of clonal materials for *in vitro* propagation. The nodal segments of two clones were collected from newly coming branches of the propagules and sterilized with $HgCl_2$ for 304 minutes and inoculated on MS semi solid medium supplemented with 1µM BA. The newly coming microshoots were detached and transferred to MS semi solid medium and are being maintained as stock build for further experimentation.

EXTERNALLY AIDED PROJECTS

Project 1: Development of model for the management of white grubs in teak nursery, under the concept of Integrated Pest Management [113-2007/Ento–1(FDCM, MS)(16)]

Status: Monitoring of beetle emergence was made from the selected traps during the emergence period. Observations on field experiments were recorded. Beetles and their grubs were reared in

the laboratory in soil. Laboratory experiments were performed on effect of EPNs against white grubs. Observations were also recorded on the field experiment for evaluating EPNs against the grubs. Field-cum-lab experiments were laid out to evaluate six insecticides in range of concentrations against the beetles and their persistence in the field was evaluated. All the experiments were repeated minimum thrice to confirm the results. Rearing and feeding potential of a predator of white grubs was carried out in laboratory round the year. Maintenance of EPN culture was continued. Further work is in progress on development of model for the management of white grubs under the concept of IPM.

Project 2: 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.) [122/2007/Ento-3(CSIR) (18)]

Status: Collection of plant material from the custard apple areas of Seoni, Chhapara and Behrai was done and prepared for initiating extraction process. The material was extracted in 5 organic solvents and water. Larvae of teak defoliator and teak skeletonizer were collected from teak plantation areas of Udaipur, Kalpi, Tikariya under Mandla Forest Division, Mandla for laboratory experiments and continuation of the laboratory rearing. The extracts in 5 organic solvents and water were subjected to bioassays for evaluating its biological activity for feeding inhibition and growth inhibitory activity against the larvae by leaf disc bioassay in laboratory. Bioassay directed separation of the fractions is in progress. For chemical analysis, the extracts were subjected to Thin Layer Chromatography, UV-Visual Spectroscopy, Infra Red Spectroscopy and Column Chromatography. Chemical analysis of compounds like PFT analysis was carried out by using analytical facilities available in other organizations in New Delhi. Further work in bioassay-directed separation is in progress.

Project 3: Studies on taxonomy of Braconid parasitoids (Hymenoptera: Braconidae) from central India [123/TFRI/2007/Ento-4 (CSIR)(19); 2007-10]

Status: Taxonomic survey of important forestry and adjoining agroforestry areas of Chhattisgarh, covering localities of districts Kawardha, Durg, Dhamtari, Kanker, Bastar, Dantewara, Raipur, Rajnand gaon, Koriya, Sarguja, Raigarh, Jashpur Nagar, Korba, Janjgeer Chanpa and Bilaspur were carried out for braconid collection. Over all 161 samples of insect fauna were collected by sweeping; out of which 576 braconids were sorted out and preserved. 110 samples of : leaf miners, defoliators, gall forming insects and larvae / pupae of insects were collected from *Pongamia pinnata, Dalbergia sissoo, Lagerstroemia parviflora, Butea monosperma, Syzygium cumuni, Ziziphus jujuba, Tectona grandis, Shorea robusta* and *Bambusa* sp. from different surveyed areas. By laboratory rearing of hosts/ insect pests, 3 species of *Apanteles* viz., *Apanteles tiracholae* emerged from the larvae of defoliator of *Lagerstroemia parviflora*; *Apanteles agilis* from leaf feeder of *Cassia* sp. and *Apanteles hyblaeae* emerged from blotch of *Pongamia pinnata* were recorded. As a whole twenty two species of braconids: *Alabagus stigma, Apanteles tiracholae, Apanteles agilis, Apanteles hyblaeae, Apanteles cajani, Chelonus deogiri, Chelonus gastrus, Cremnops desertor, Doryctobracon areolatus, Fopius arisanus, Helcon tardator, Hormius lamidae, Hormius orientalis, Meteorus dichomeridis, Parahormius absonus, Parahormius deiphobus, Parahormius jason, Parahormius stom, Parahormius*

zonus, Phasmidiasta lia, Trioxys acalephae and *Trioxys soporensis* were identified up to species level. *Parahormius longicorpus* sp.n. is being recorded as the species new to science.

Project 4: 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: The project was initiated during January 2008. Nurseries were surveyed for teak leaf skeletonizer and diapausing larvae were collected. An unidentified ichneumonid parasite was obtained and preserved.

Project 5: Evaluation and prediction of oil bearing capacity of Sandal (*Santalum album* L.) germplasm using physio-morpho-molecular markers [120/TFRI/2007/ Gen-3/DSAE (15)]

Status: Two groups each of 30 trees of Sandal (*Santalum album*) were identified at TFRI campus and marked for conducting molecular and biochemical studies. Seven methods of DNA extraction were compared and that based on CTAB (Hexadecyl trimethyl ammonium bromide) was selected for extraction of DNA from leaves of sandal tree. Genomic DNA from leaves of Sandal trees was extracted. Twenty six Inter Simple Sequence Repeat (ISSR) primers were screened from 100 primers for amplification of genomic DNA of Sandal. Nitrate reductase and peroxidase activities in leaves of both groups of sandal trees in five replicates were measured and the data recorded.

Project 6: Development and use of Inter Simple Sequence Repeat (ISSR) markers for assessment of genetic diversity and DNA fingerprinting in *Gmelina arborea* Roxb. [121/ TFRI-2007/Gen-2(CSIR)(14)]

Status: Ten natural populations of *Gmelina arborea* were collected from Andhra Pradesh, Assam, Karnataka and Kerala. Seedlings of the populations were raised and their individual identity maintained in the nursery. Four methods of DNA extraction were compared with the selection of Hexadecyl Trimethyl Ammonium Bromide (CTAB) protocol for extraction of genomic DNA free from impurities. Eighteen Inter Simple Sequence Repeat (ISSR) primers were screened from 100 primers for amplification of genomic DNA.

Project 7: Molecular characterization of *ex situ* conserved germplasm and identification of molecular markers associated with wood quality traits in *Tectona grandis* L.f. [125/ TFRI/2007/Gen-4(DBT)(16)]

Status: Cuttings of >50 teak (*Tectona grandis*) plus trees and their ramets were collected from National Teak Germplasm Bank located at Chandrapur, Maharashtra. The cuttings were tagged for maintenance of their individual identities and planted in the polybags at the experimental area of Genetics and Plant Propagation Division for production of sprouts for DNA extraction and molecular marker studies. The data pertaining to sprouting pattern of teak plus trees were weekly recorded.

Project 8: Integrated development of bamboo for economic upliftment in central India [126/TFRI/2007/ (NBM)]

Sub-project (i) : Sustainable development of new Bamboo agroforestry techniques for increased income generation in the Central Indian States

Status: The project has been initiated.

Sub-project (ii): Bamboo species suitability for different degraded non-forest areas in Madhya Pradesh

Status: Geo-environmental survey and study of degraded lands were done at Dhuma, Damoh, Hoshangabad (Bagra), Bhopal (Ratapani), Katni (Kymore, SVIL Mines, Khitola) and Rewa (Sirmore). Data and samples were collected for nutrient study in the lab. 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 for growth data and other details. To evaluate the nutrient status of the concerned soils, the samples are analysed in the lab.

Sub-project (iii): Insect and diseases of bamboo occurring in central India and their management

Status: Six localities of agro-climatic zones of M.P. and Chhattisgarh were visited and 22 samples of bamboos were collected. In all, two insect pests viz. sap sucker, *Ochrophara montana* and leaf feeder- *Cryptisia coclesalis* and 9 pathogenic fungi viz. *Desturella divina, Fusarium semitectum, Curvularia pallescens, Scytalidium vaccinii,Trichoderma viride, Paceilomyces varioti, Hymenochete patelliformis, Trichoderma atroviride* and *Trichoderma koningi,* identified. For the biological control of defoliator, multiplication of egg parasitoid, *Trichogramma raoi* was initiated in the laboratory. A field experiment was laid out at Korba in Chhattisgarh to prevent the attack of bamboo rhizome rot and fungal culm disease in *Dendrocalamus strictus*.

Sub-project (iv): Nutritive values and value addition of some bamboo species of central India

Status: Surveys were conducted to Madhya Pradesh and Chhattisgarh to select bamboo growing areas in the central India. The tribal communities of the region use young succulent shoots of various bamboo species as vegetable, pickles, salad, etc., from June to September every year. Collected bamboo shoots were analyzed for their nutritional and anti-nutritional parameters. Considering the market potentiality and suitability of young shoots, five species i.e., *Dendrocalamus strictus, Bamboosa bambos, Bamboosa nutans, Bamboosa tulda* and *Dendrocalamus asper* have been found as potential species.

TECHNOLOGY ASSESSED AND TRANSFERRED

1. Dust free collection and storage of mahua flowers were assessed and transferred to the user groups of Mandla, Dindori and Sidhi districts of Madhya Pradesh through trainings conducted at SFRI, Jabalpur and IIFM, Bhopal.

2. *B. nutans* and *B. tulda* micro-propagation technology ready to be transferred.

3. Sustainable harvesting limit of medicinal plants namely, Satawar, Kalmegh, Bael and Chironjee has been transferred to SFDs for onward application in the field.

EDUCATION AND TRAINING

1. Four training programmes on Nursery, plantation techniques, utilization and marketing of bamboos under Bamboo Technical Support Group of National Bamboo Mission for the farmers and field functionaries of SFDs of Gujrat, M.P. and Chhattisgarh State from November 2007 to February 2008.

2. One training on Management of production populations for the officials of M.P. Forest Department on 18th and 19th December 2007.

3. One training on Improving forest productivity through technological interventions for the field executives of Maharashtra Forest Department from 3rd to 7th March 2008.

4. The following officers imparted training: Drs. A.K. Mandal, A.K. Pandey, N. Berry, S. Agarawal, S.P. Tripathi, R.S. Pal, M. Kundu, K.K. Soni, R.K. Verma and K.C. Joshi.

LINKAGES AND COLLABORATION

National

- Developed linkages and collaboration with state forest departments, forest development corporations, universities, research institutes, NGOs in the region and Department of Science and Technology (DST), Department of Bio-technology (DBT), Council of Scientific and Industrial Research (CSIR), The Energy and Research Institute (TERI), New Delhi for implementation of research projects, field experimentation etc.

PUBLICATIONS

Brochures on medicinal plants including, Sarpgandha (*Rauvolfia serpentina*); Kalihari (*Gloriosa superba*); Kalmegh (*Andrographis paniculata*); Gudmar (*Gynnema sylvestre*); Safed Siris (*Albizia procera*); Gamhar (*Gmelina arboria*) and Teak (*Tectona grandis*) and on agroforestry models on Paddy –babul; Bach- paddy and Agri-lac were published.

CONSULTANCIES

1. Evaluation of preservation plots for Maharashtra Forest Department, Nagpur during 2007-08 at a cost of Rs. 1.20 lakh.

2. Evaluation of Forest Department Agency (FDA) plantation of Madhya Pradesh during 2007-08 at a cost of Rs. 2.25 lakh.

PATENT

A patent has been granted entitled "A Protocol for Micropropagation of Bamboo from Explants" (Patent No. : 207870, date of Grant 29th June 2007).

CONFERENCE/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

1. A National Symposium on Emerging Trends of Bio-inoculants in Forestry was organized jointly by Entomology and Pathology Division, TFRI on 26th and 27th April 2007.
2. National Workshop on Research Needs for Achanakmar-Amarkantak Biosphere Reserve organized by Entomology Division, TFRI on 30th April 2007.
3. A Workshop on Prioritisation of Research Areas for TFRI was organised 29th May 2007.
4. A regional Workshop on Forestry Statistics was organised on 17th October 2007.
5. A two days National Workshop on Sustainable Management of NTFPs was organized in collaboration with Regional Centre for Development Cooperation (RCDC) Bhubneswar on 18th and 19th January 2008 at Tropical Forest Research Institute, Jabalpur.
6. A National Conference on Bamboos : Management, Conservation, Value addition and Promotion was organized w.e.f. 12th to 14th March 2008.

AWARD

Dr. Nanita Berry was adjudged as the "Best Innovator" on the theme "grassroots initiatives for management and protection of natural resources" in India Development Market place 2007 competition organized by the World Bank held at New Delhi on 27th to 29th May 2007.

DISTINGUISHED VISITORS

1. Shri Brij Mohan Agrawal, Hon'ble Minister, Ministry of Forest and Environment Chhattisgarh State visited the institute on 9th October 2007 and interacted with the researchers.

Shri Brij Mohan Agrawal, Hon'ble Minister, Ministry of Forest and Environment Chhattisgarh State interacted with the researchers

2. Dr. D.N. Tiwari, Vice Chairman, State Planning Board Chhattisgarh visited this Institute on 13th March 2008 and interacted with the scientists and officers on various issues of National Bamboo Mission.

CENTRE FOR FORESTRY RESEARCH AND HUMAN RESOURCE DEVELOPMENT, CHHINDWARA

Centre for Forestry Research and Human Resource Development (CFRHRD), Chhindwara came into existence in March 1995. In January 1996 it was declared as Satellite Centre of Tropical Forest Research Institute (TFRI), Jabalpur under the Indian Council of Forestry Research and Education, Dehradun. The mandate of the Centre is to take up forestry research in the areas like Non-Wood Forest Produce, medicinal plants cultivation, nursery techniques. The centre has also been assigned mandate to develop human resource in forestry sector by imparting vocational training leading to poverty alleviation through self employment.

PROJECTS CONTINUED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Standardization of nursery technology and evaluation of various planting stocks of *Pterocarpus marsupium* [109/CFRHRD/2006-2(9)]

Status: Seeds of *Pterocarpus marsupium* collected and sown in polybags and root trainers of different sizes viz. 90, 150 and 250cc. with different proportions of soil : manure : sand (1:1:1, 1:0:1, 0:3:0:, 1:2:0, 0:2:1 and 1:4:0) for assessing the germination. Experiments on effect of different dosages of chemical fertilizers were laid out in the nursery. The already laid out experiments on root trainer were maintained and data was recorded. Renovated older germination beds and seeds sown to study the germination variation and growth of *Pterocarpus marsupium* in different months of the year. Data on germination were collected and tabulated.

Experiments on effect of different doses i.e. 2,4 and 6gm of inorganic fertilizers on growth and development of 4 months old seedlings conducted. Urea, diammonium phosphate and murate of potash per plant was applied. Initially no effect of inorganic fertilizers on growth and development of seedlings was observed. Collected branch cuttings from mature tree in the month of February and March and experiment was laid out in mist chamber by treating the cuttings with different concentration of IBA 500, 1000, 1500 and 2000 ppm for 24 hours. Shoot formation was recorded but no root formation was observed. The experiment on root-shoot cuttings of *Pterocarpus marsupium* (bijasal) were laid out in mist chamber by treating with different concentration of IBA 100, 200, 300 and 400 ppm for 24 hours and 62, 76, 84 and 96% healthy plants were recorded.

Project 2: Studies on the seasonal variation in active chemical constituents of Hadjor, *Cissus quadrangularis* Linn. [108/CFRHRD/2006-1(8)]

Status: Fresh stem samples of *Cissus quadrangularis* Linn. were collected from the CFRHRD nursery, Chhindwara to study monthly variation in their active chemical constituents viz. total phytosterols and ascorbic acid content. Samples were also estimated for macro-elements (calcium, magnesium and potassium) and trace elements viz. copper, zinc, managenese and iron content. Soil samples collected from Bhopal, Jabalpur, Chhindwara (M.P.) and Akola (M.S.), where hadjor

growing, were analysed for pH, organic matter, organic carbon, nitrogen, phosphorus, available potassium and exchangeable calcium, magnesium, sodium and potassium. Active constituents viz. total phytosterols and ascorbic acid in *Cissus quadrangularis* fresh stem samples collected from Bhopal, Jabalpur, Piparia Chhindwara district (M.P.), Dabra (Janjgir Dist.), Raigarh (Chhattisgarh) and Akola and Nagpur (M.S.) were also analysed. Collection of *Cissus quadrangularis* were maintained. Further analysis work is under progress for confirmation of the results obtained.

EXTERNALLY AIDED PROJECT

Project 1: Field trial on agroforestry model in farmers field with medicinal trees and herbs in satpura plateau of Madhya Pradesh [110/CFRHRD/ 2006-3(NMPB)(10)]

Status: Seeds of *Moringa oleifera* (Munga) and *Emblica officinalis* (Aonla) were sown in polybags and of *Asparagus racemosus* (Satavar), *Andrographis paniculata* (Kalmegh), *Withania somnifera* (Ashwagandha) and *Rauvolfia serpentina* (Sarpagandha) in nursery beds. Maintained nursery of the above medicinal plants. Farmers from Kundalikala, Kundalikhurd, Sonagat and Umaria were contacted for establishing the agroforestry plantation of medicinal plants. Grafted plants of *Emblica officinalis* (Aonla) procured from Mansar nursery (M.S.) and distributed to the farmers including seedlings of *A. racemosus, R. serpentina* and *W. somnifera.* To make awareness among the people about the importance of medicinal plants and the cultivation of medicinal plants in their field and to get additional benefit both from top storey of medicinal plants and other agricultural crops one hundred people trained.

NEW PROJECTS INITIATED DURING THE YEAR 2007-2008

PLAN PROJECTS

Project 1: Standardization of cultivation Protocol for *Asparagus racemosus* (Satawar) [119/ CFRHRD/2007-2 (12)]

Status: Detailed literature survey on *Asparagus racemosus* (Satavar) were conducted. Site of open land was selected at TFRI, Jabalpur campus and near CFRHRD, Poama. Satavar tubers were collected from nearby places of Chhindwara including Tamia, Delakhari, Bichua and Betul.

Seeds were sown in nursery beds at 1.5 × 1.5 cm spacing. Farmyard manure and compost was applied. 70% germination was observed when the seeds were sown at the depth of 2 cm. Experiment was laid out to study the effect of different spacing viz. 45 × 45, 60 × 45, 60 × 60 and 45 × 30 cm and harvesting age of *Asparagus racemosus* on farmers field at Chhindwara and at Silviculture Nursery, TFRI, Jabalpur. Experiment was also laid out to study the effect of irrigation on growth of plants. The tubers from stress sites was found larger in size.

Soil testing of CFRHRD nursery, Chhindwara and farmers field was done. Maintained experimental plots. Data recorded on roots and growth of plants and samples of tubers collected for analysis.

Project 2: Genetic improvement of *Buchnania lanzan* [116/CFRHRD/2007- 1(11)]

Status: Survey carried out in Delakhari and Amarwada block of Chhindwara district, Madhya Pradesh. Selected 12 phenotypically superior candidate plus trees of *B. lanzan*. Out of 12 trees, seven were selected from Amarwada and five from Delakhari. Also preliminary survey has been conducted in Gondia and Shahada forest division of Maharashtra, and Kanker and Rajnandgaon forest division of Chhattisgarh for selection of phenotypically superior candidate plus trees of *B. lanzan*.

EDUCATION AND TRAINING

1. One day training programme on "Biofertilizer, Biopesticides and Agroforestry" was conducted at CFRHRD, Chhindwara on 2nd February 2008 for the farmers.

2. Centre conducted 10 training programmes. A total of 700 trainees participated in various training programmes. The target groups were SFD's, villagers, farmers, NGO's and herbal healers.

LINKAGES AND COLLABORATION

Linkages at national level were developed with State Forest Departments, Forest Development Corporation, Agriculture Research Station, Chhindwara for conducting research/ training and Forest Survey of India, Nagpur for analysis of forest floor and soil samples.

AWARD

Shri H.S. Awasthi, Forester, CFRHRD, Chhindwara received award for his service on medicinal plants identification from World Wide Fund for Nature in October 2007.