Completed ICFRE Funded Project 2009-10 –TFRI

Project S. No.	Name of Project	PI	Thrust Area	Research Findings
1	Application of growth promoting microbes and soil amendments to produce improved seedlings of forest trees. **(April 2007, 2007-2010)**	Dr. R.K. Verma	Forest Protection (Mycorrhizae, rhizobia and other useful microbes)	Germaplasm of growth promoting organisms were collected from 11 different localities of Madhya Pradesh. Experiment on *Gmelina arborea, Dalbergia sissoo and Jatropha curcas* were conducted in root trainers and growth promoting organisms were selected for these species. Twenty different fungi isolated from rhizosphere soil were screened for plant growth promoting properties (germination % and height). Out of them *Aspergillus* sp. and four *Trichoderma* spp. were found growth promoting and selected for use in nursery. Application of plant growth promoting microbes (AM fungi, *Aspergillus* sp. *Azospirillim* sp. and soil amendments (mix of *Lucaena,* teak leaves and FYM in equal ratio v/v) increased 10-20% survival of sandal seedlings when planted out in the field, it also increase plant height up to 43%. Two field experiments were conducted one on sandal and another on *Jatropha curcas* to demonstrate the technique to users. Demonstration on application of growth promoting organisms (AM fungi and *Azospirillum*) on *Gmelina arborea* was also done at demonstration village, Moiyanala.
2	Chemical control of insect pests and diseases of *Buchanania lanzan*. **(April 2007, 2007-2010)**	Dr. P. B. Meshram,	Forest Protection: Insect pests, diseases and control.	Due to indiscriminate harvesting, cutting branches and the lopped trees attract the infestation of fungal pathogens followed by insect pests. This economically important local forest tree species was severely attacked by twelve insect pests/ diseases which adversely affect the growth and productivity. Stem borer *Plocaederus obesus* (Gahn) and canker *Hendersonula toruloidea* (Nattrass) in natural stand of *B. lanzan;* defoliator *Lamida carbonifera* (Meyrick) in plantations areas; wilt *Fusarium* oxysporum (Schltdl.) / blight *Colleototrichum gloeosporioides* (Penz.) in nurseries and mycoflora *Aspergillus* spp, *Rhizopus nigricans* (Ehn.) in storage seeds were evaluated for monitoring the status of insect pests and diseases. Incidence of major insect pests/diseases in Madhya Pradesh, Chhattisgarh and Maharashtra were recorded in nurseries, plantations and natural stand of *B. lanzan*. The seasonal incidence of five major insect pests/diseases were recorded and correlated with temperature, relative humidity and rainfall. The overall observations revealed that an increasing the incidence with rise in temperature, relative humidity and rainfall during the period. Experiments on treatment with chemical pesticides for control of insect pests/ diseases were evaluated in nurseries and plantations, natural stand and seeds storage conditions. The results revealed that soil drenching with fungicide redomil 0.2% at monthly interval was found to most effective against vascular wilt disease *F. oxysporum* in nursery stage.Foliar spray of insecticides endosulfan and monocrotophos 0.05% was found to be most effective against defoliator *L. carbonifera*. Injecting 10 ml solution of dichlorvos (nuvan) 0.5% was found to be most effective against the stem borer, *P. obesus* in natural stand of *B. lanzan.* The studies also revealed that spraying of combination of chemicals- endosulfan 0.07% + bavistin 0.2% + alpha NAA 40 ppm were found to be most effective for the production and protection of inflorescence / fruits against sap suckers/ thrips and diseases of *B. lanzan*. The protein,

				carbohydrate and oil percentage were comparatively less in infected seeds as compared with the healthy seeds. All the fungicides treated seeds exhibited positive response as compared to untreated seeds. One training programme (Fig.13) on "Insect pests/ diseases of *Buchanania lanzan* and their control measures" was organized to the SFD/Farmers at Batkakhapa, East Forest Division, Chhindwara, Madhya Pradesh on 8th January, 2010. 51 trainees were participated in training programme. Literature in Hindi was circulated. Field visit to experimental area was also conducted.
3	Evaluation of medicinal plants based agroforestry system (Silvi - medicinal) under existing teak plantation. **(April 2007, 2007-2010)**	Dr. Nanita Berry	Forest Productivity (Social Forestry, Agro forestry/ Farm Forestry)	PCR awaited
4	Screening of tropical forest tree species for their potential as carbon sink in Madhya Pradesh & Chhattisgarh. **(June 2007, 2007-2010)**	Dr. Avinash Jain	Ecosystem conservation and management (Climate change)	15 years old teak and Shisham trees planted at 2 m x 2 m spacing sequestered 14.65 and 14.75 t carbon/ha/year respectively. Agricultural crops *viz*. wheat, gram, ashwagandha, wild oat and barley, when cultivated between trees increased carbon sequestration potential of trees due to addition of crop litter to the soil, regular watering and soil working. Simultaneously, the production of agricultural crop reduced significantly because of competition for nutrients, shade effect and expansion of roots. Carbon stock in the form of litter contributed more in agroforestry systems than agricultural crops. 9 months old seedlings of *Eucalyptus eurograndis* planted at 3 m x 1 m spacing (twin row) (5000 trees/ha) were found to sequester 3.40 t C per ha, 14 months old 4.55 t/ha, 2 years old 26.75 t/ha and 21/2 years old trees were found to contain 48.65 t Carbon per hectare. When wheat was cultivated with different aged *Eucalyptus* trees, the production of wheat was reduced to 11.68% with 9 months old trees, 24.22% with 24 months old trees and 33.55% with 30 months old *Eucalyptus* trees, which could be due to shade effect, competition for nutrients and space between roots of trees and crop and allelopathic effect. The *Eucalyptus* trees planted in 1 hectare land with 3 m x 1 m spacing (twin row) (5000 trees/ha) sequestered 26.75 t/ha carbon, which should be numerically double with 1 m x 1 m spacing due to twice number of trees (10000 trees/ha). But the increase was restricted to 40.66 t/ha (52%) because of competition between crowns and roots of trees. The carbon sequestration rate of 22 years old plantation of *Shorea robusta* was found to 18.95 t/ha/year, while 41 years old plantation of *Tectona grandis* was found to sequester 22.66 t C/ha/year.

5	Seed physiology of the tropical forest species with special reference to their maturity and storage. **(June 2005, 2005-2010)**	Maitreyee Kundu	Forest Productivity (Silviculture)	Germination percentage was improved by pretreatments on *Schleichera trijuga, Terminalia arjuna, Sapindus laurifolia, Terminalia chebula, Ablomoscus moscatus, Rauvolfia serpentina, Emblica officinalis* and *Mimusops elengi,* out of 12 target species. Other species does not need any seed pretreatment. Studies on desiccation tolerance and seed storage behavior had been done on *Schleichera trijuga, Terminalia arjuna, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Terminalia chebula Ablomoscus moscatus, Rauvolfia serpentina, Emblica officinalis, Bassia latifolia* and *Mimusops elengi. Mimusops elengi* was found as intermediate and *Bassia latifolia* as recalcitrant. Other species were observed orthodox type and can be programmed for long term storage. Seeds of *Terminalia arjuna, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Terminalia chebula, Rauvolfia serpentina, Emblica officinalis, Bassia latifolia* and *Mimusops elengi.* were adjusted to three to five moisture contents and stored at four different temperatures for evaluation of storage potential for estimation of viability at regular intervals.. Viability constants were estimated for four orthodox species: *Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia,* and *Sapindus laurifolia.* Best storage conditions were determined for other species. Studies on seed maturation for determination of seed collection time had been done and maturity indicators were determined on *Schleichera trijuga, Hardwickia binnata, Moringa oleifera, Holoptelea integrifolia, Sapindus laurifolia, Ablomoscus moscatus, Bassia latifolia* and *Mimusops elengi.* Seeds of *Rauvolfia serpentine* and *Emblica officinalis* should be collected after full maturity and seeds of these species need after-ripening for better germination. Biochemical characterisation of three categories of seed Species selected :*Schleichera trijuga*- orthodox *Bassia latifolia*- recalcitrant, *Mimusops elengi*- Intermediate, *Holoptelea integrifolia*- orthodox, *Hardwickia binata*- orthodox, Total fatty oil and carbohydrate composition was compared between different category of seeds. It was concluded that there was no significant difference among the three category of seeds. As all these three species are oil-rich seed (fatty oil composition: *Schleichera trijuga*- 45%, *Bassia latifolia*- 51%, *Mimusops elengi*- 31%.) As only one out of 12 species was identified as recalcitrant and another as intermediate, no conclusion can be made in this aspect.
6	Standardization of nursery and plantation technology for *Pterocarpus marsupium* an endangered leguminous tree. **CFRHRD (July 2006, 2006-2010)**	Shri Ved Pal Singh	Forest productivity (Silviculture)	PCR awaited
7	Studies on efficacy of toxins of soil actinomycetes against major forest insects pests. **(June**	Dr. N. Roychoudhury	Forest Protection (Insect pests, diseases and control)	Out of 340 soil samples collected from forests Madhya Pradesh, Maharashtra and Chhattisgarh, isolated 9 actinomycetes/ bacteria on potato dextrose agar plates following serial dilution technique and pour plate method. Among the 3 actinomycetes isolated, one

	2006, 2006-2010)			of which was identified as *Streptomyces* sp. and confirmed from Institute of Microbial Technology, Chandigarh. Developed culture technique of soil actinomycetes for production of toxins, protocol for extraction antibiotics and its fractions for chemical characterization of toxins of isolated actinomycete, *Streptomyces* sp. Conducted toxicity tests of culture filtrate of *Streptomyces* sp., its isolated antibiotics and different fractions against major insect pests of teak, siris and mahaneem. The chemical analysis of the fractions revealed the presence of hydroxyl group. Evaluated commercially available bioproducts (ivermectin and spinosad) of soil actinomycetes against major insect pests of teak, siris, bamboo and mahaneem and worked out their relative efficacy and toxicity (LC50) through Probit analysis. The toxicity of ivermectin and spinosad against the larvae of major insect pest of teak, siris and bamboo was carried out at insectary of this institute and studied comparative efficacy based on the nature of treatment and relative toxicity (LC50) through Probit analysis. The tested products, ivermectin and spinosad, proved to be highly effective biopesticides and worked out their recommended concentrations for management. The recommended dose of ivermectin for management of teak defoliator in concentration of 0.005% (0.4 ml/liter water), teak leaf skeletonizer in concentration of 0.03% (2.5 ml/liter water), *Albizia* foliage feeder in concentration of 0.02%,(1.7 ml/liter water) bamboo leaf roller in concentration of 0.1% (8.3 ml/liter water) and *Ailanthus* web worm in concentration of 0.05% (4.2 ml/liter water) may be tested under nursery stage during outbreak period of the target insect pests. Similarly, the recommended dose of spinosad for management of teak defoliator in concentration of 0.0001% (0.002 ml/liter water), teak leaf skeletonizer in concentration of 0.0001% (0.002 ml/liter water) , *Albizia* foliage feeder in concentration of 0.0005% (0.01 ml/liter water), bamboo leaf roller in concentration of 0.0007% (0.02 ml/liter water) and *Ailanthus* web worm in concentration of 0.001% (0.02 ml/liter water) may be tested under nursery stage during outbreak period of the target insect pests.
8	Studies on the seasonal variation in active chemical constituents of Hadjora, *Cissus quadrangular* Linn. Growing on *Terminalia arjuna* (Roxb.) **CFRHRD (July 2006, 2006-2010)**	Dr. Vishakha Kumbhare	Non wood Forest products (Chemistry of NWFPs, Value Addition and Utilization)	*Cissus quadrangularis* Linn. (Hadjor) is known as asthisamharaka in Sanskrit. The Sanskrit word asthisamharaka literally means that which saves the bones from their destruction. Cissus *quadrangularis* (Hadjor) plant samples were collected from Chhindwara, Bhopal, TFRI, Jabalpur (Madhya Pradesh), Nagarjuna Botanical Garden, Akola, Nagpur (Maharashtra), Janjgir, Raigarh (Chhattisgarh) and NRCAF, Jhansi and established in nursery beds of the centre. Harvesting time is one of the most important in all medicinal plants since the quality of the herb depends on the maximum content of the active constituents at the particular time. *Cissats quadrangularis* fresh stem samples were collected on monthly basis from medicinal and aromatic plants (MAPs) nursery of the centre and analysed for total phytosterols, ascorbic acid, macroelements and trace elements content. Method was standardized for estimation of total phytosterol & ascorbic acid. Macroelements viz. calcium, magnesium, potassium were analyzed & trace elements viz. zinc, copper,

				manganese, iron and selenium content were estimated on Atomic Absorption Spectrophotometer (AAS). All the parameters have a synergistic effect on bone fracture healing, bone related problems and general weakness. Analysis of active constituents viz. total phytosterols and ascorbic acid in *Cissus quadrarzgavlaris* fresh stem samples collected from various places were also analysed simultaneously. The sample collected from Chhindwara was found to be the best in total phytosterols content followed by Akola. The sample collected from Piparia was best followed by Raigarh in terms of its ascorbic acid content. The best harvesting time based on its active chemical constituents was found to be December to March. Survey was conducted in some places of Chhattisgarh and Madhya Pradesh viz. Rajnandgaon, Khairagarh, Kapsi, Tamia and Betul district for collecting information from the tribals & traditional herbal healers regarding their knowledge on best harvesting time of C. *quadrangzclaris.* Dehydration study is useful and applicable in post-harvest processing of the valuable herb on a large scale. Dehydration studies of stem were carried out from Department of Food Technology, Nagpur University, Nagpur which included solar drying, shade drying, oven drying and radio frequency drying treatments. Radio frequency drying method was found to be the best followed by shade drying in retaining maximum amount of active constituents. From economic point of view, shade drying could be recommended for large scale drying of the herb. This information will be of immense help to forest officials, farmers, researchers and common people interested in cultivation and other aspects of this species. *Cissus quadrangularis* stem (peel & pulp) were analyzed separately for their active constituents viz. moisture, yield, ash, phytosterols, ascorbic acid and phenols. It was found that the peel samples contained yield (61%) and pulp (39%). Maximum amount of active constituents was found in peel as compared to pulp. Thus, both the peel and pulp could be beneficial especially in food and pharmaceutical industry. Technology was developed for formulation of nutraceutical food products. Six nutraceutical food products viz. biscuits, cookies, jelly, squash, chutney and pickle were developed as per Food Products Order (FPO) & Prevention of Food Adulteration Act (PFA) specifications in collaboration with Department of Food Technology, Nagpur. All the products were tested for consumer acceptance level by conducting the chemical and sensory evaluation of the finished products. All the products developed were accepted by the consumers. The research results were disseminated to the user target groups through training programmes. Four training programmes were conducted. The user target groups were State Forest Department women officials (SFDs), women Self Help Group (SHGs) and farmers. Brochures

				were published in English and Hindi. Six research papers related to the project work were presented in National seminars, workshops and conferences.
9	Study on plant diversity in Sal-Teak Ecotone Zones as influenced by ecological and climatic change. **(July 2005, 2005-2010)**	Dr. A. K. Bhowmik	Ecosystem conservation and Management (Biodiversity)	Teak- sal are important timber tree species of tropical monsoon forest and are of different nature as far as their requirement of soil, climate etc. are concerned. The places where there two species are occurring are intact merger of two different ecosystem and are sensitive zone with the climate and ecological point of view**.** So, the changing pattern of vegetation and ecological and climatic parameters are very important for study of the ecotone and pure forest of both the species. Hence, for the study on plant diversity in sal- teak ecotone zone as influenced by ecological and climatic change two ecotone zone viz. Jagdalpur (site I) and Umaria (site II) and another two sites dominated by sal and teak trees near ecotone zone have also been selected for comparison. Study reveals that there is variation of temperature, humidity and solar radiation in ecotone forest. The environmental change are due to change of microclimate of the ecotone forest and by also the timing of flowering and fruiting and other phenological parameters of some tree species in ceotone zone. The phenological changes take place one or two months earlier in ecotone area as compare to normal forest sites. This microclimatic changes may have the serious implications on decreasing the moist tropical trees (sal) and further reproductive success of dry tropical trees(teak). The occurrence of changes in behaviour, distribution, phenology etc. of associate species and the presence of new species in ecotone area of Jagdalpur (site I) and Umaria (site II) are viz. *Litsea* sp. (Maida), *D.latifolia* (Shisam), *Terminalia chebula*(Harra), *Holarrhena antidysentrica*(Kirich) and *Sterculia urens* (Kulu) are interesting features which have recorded during the study. These species are identified as indicator species of this site because these species are uncommon for teak and sal forest and found in only ecotone areas of two sites. The presence of new species also reflects some microclimatic changes occurring in the ecotone zone. It is suggested for some beneficial silvicultural operations are to be required to check th teak regeneration and better managementof the forests. If, otherwise in due cource of time the existing sal forests may lacking tol be converted into dty teak forests and physico chemical properties of the soil will also be changed.
10	Sustainable management of medicinal plants in JFM areas in different agro-climate zones of Madhya Pradesh. **(July 2005, 2005-2010)**	Dr. S.D. Sonkar	Non-wood Forest Products (Sustainable Harvesting and Management)	PCR awaited