

CHAPTER-VII

TROPICAL FOREST RESEARCH INSTITUTE JABALPUR

Tropical Forest Research Institute (TFRI) is one of the eight institutes under the Indian Council of Forestry Research and Education (ICFRE). It came into existence in April 1988, although its origin goes back to 1973 as regional centre of FRI, Dehra Dun. Major thrust areas of research at TFRI are- research on Non wood forest products, rehabilitation of mined areas and other stress sites, research and demonstration in agroforestry models, planting stock improvement, research on biofertilizers and forest protection etc, with the objectives of maintenance of environmental stability and restoration of ecological balance, checking soil erosion and degradation of natural resources, increasing the productivity of forests, meeting the requirements of fuel, fodder, NWFPs and small timber and maximising the substitution of wood. The institute is responsible for addressing research issues related to forests of M.P., Maharashtra, and Orissa.

PROJECT COMPLETED DURING 1999-2000

Sl.No. : 1

Project identification No. : TFRI-97/AF-1

Name of the principal investigator: Dr. G.R.S. Reddy

Title of the project: Studies on productivity and decomposition patterns of litter of 4 tree species in alley cropping under tropical conditions of central India.

Year of start of the project : June, 1997

Cost of the project : Rs. 2.00 lakhs

Objectives: (a) To study the effect of the 4 different hedge row species viz. *Albizia procera*, *Cassia glauca*, *Senna siamea* and *Leucaena leucocephala* on associated alley crop yields. (b) To study the effect of alley width on crop yields (c) To determine rates of decomposition of litter, N - mineralization and mulch quality. (d) To assess suitability of legume and non-legume species as alley crop in central India.

Scientific importance of investigations: Alley cropping research conducted in various agro-climatic zones throughout the world has shown that proper selection of tree species, timely pruning and scientific management of hedge rows are the salient points which determine the success of alley cropping. The results of this experiment would enable the farmers to adopt most suitable model of alley cropping with sustainable production.

Results/Achievements: The annual biomass obtained from pruning was found to be highest in *S. siamea* followed by *L. leucocephala* in the first cropping season. The rate of biomass decomposition was highest for *Leucaena* among the 4 hedge row species. *S. siamea* and *Leucaena* holds promise in view of highest biomass turn over and survival per cent of the crop. The yield of rice was found to be maximum in *A. procera* hedgerows as compared to other species. However, *Leucaena* followed by *Cassia* remained the highest biomass producers in the second (1999) cropping year. Keeping in view the decomposition rates of litter and quality of litter produced in terms of nutrient addition besides other parameters like moisture status in the system, it was found that *Senna* followed by *Leucaena* and *Albizia* are suitable for sub-humid central India.

Sl. No. : 2

Project identification No. : TFRI-97/Gen-2

Name of the principal investigator: Dr. A.K. Mandal

Title of the project: Genetics and Breeding of forest tree – Genetic analysis and quantitative characters in teak and *Albizia procera*.

Year of start of the project : April, 1997

Cost of the project : Rs. 1.50 lakhs

Objectives: (a) To find out inheritance pattern of quantitative traits, (b) To identify parents with better combining ability. (c) To estimate genetic parameters. (d) To select phenotypically superior trees. (e) Genetic analysis of seed and seedling characters. (f) To establish open pollinated progeny trial for genetic analysis.

Scientific importance of investigations: Breeding strategies, therefore, need to be evolved to achieve the objective of higher genetic gain realized in terms of higher productivity. Under the project it would be possible to develop future breeding population with selected segregants.

Results/Achievements: The analysis of variance indicated presence of significant genetic variation among different families for height, diameter and basal area, which suggests scope for selection. Since open pollinated seeds of selected clones have been used in the present study, removal of inferior families will help converting the present test material into a productive seedling orchard for immediate genetic gain.

Moderate to high heritability values for height, diameter and basal area indicated the presence of additive genetic variance which is further supported by high genetic gain for all the characters. Low but positive genetic correlation found between height, diameter and basal area indicated that mutual relationship among these characters at the genetic level is not very strong in the present material.

Three parents namely, ORPUB-1, ORPUB-4 and ORPUB-5 were found to have general combining ability values for all the characters and were considered to be best general combiners for use in controlled breeding programme.

Sl. No. : 3

Project identification No. : TFRI-97 Gen-3

Name of the principal investigator: Dr. S.A. Ansari

Title of the project: Vegetative propagation of forestry species - Evolving vegetative propagation technology for teak (*Tectona grandis*) and *Albizia procera*.

Year of start of the project : 1997

Cost of the project : Rs. 2.05 lakhs

Objectives: (a) To standardize vegetative propagation technique through shoot cuttings by application of phytohormones. (b) Mass multiplication of superior planting stock. (c) To study the biochemical markers during the adventitious rhizogenesis. (d) Identification of plus trees for mass multiplication. (f) To study the biochemical changes during rhizogenesis for identifying the biochemical markers for rooting.



Raising of Stem Cutting in Poly House under Intermittent Misting



Aseptically Raised Multiple Shoot Culture of Neem



Fruit Size Variation Studies in Aegle marmelos



Storage Trail of Vateria indica Fruits under High Moisture Content Condition

Scientific importance of investigations: *Albizia procera* is a very difficult species to root among forest tree species. Investigations will lead towards the evolution of suitable vegetative propagation protocol for this species and understanding of biochemical changes during rooting process.

Results/Achievements: 4, 8 and 12 mm each of auxins (IAA, IBA and NAA), B-vitamins (thiamine and pyridoxine), C-vitamin (ascorbic acid) and inorganic salt (boric acid) were tested to induce adventitious rhizogenesis in juvenile cuttings obtained from one year old seedlings of half sib families. The experiment was conducted under controlled conditions of misting. Data on sprouting of cuttings have been recorded fortnightly and found to differ significantly from treatment to treatment.

Significant adventitious rooting has been achieved in softwood juvenile cuttings taken from seedlings. Low concentration (100 ppm) of IBA was found to enhance induction and growth of adventitious roots. The technology would help in clonal propagation of *Albizia procera* especially in case of half-sib progenies of selected superior genotypes and hybrids of known parentage.

Sl. No. : 4

Project identification No : TFRI-97/Gen-4

Name of the principal investigator: Y. Mishra

Title of the project: Developing tissue culture protocol for forestry species – Micropropagation of *Dendrocalamus strictus*, *B. vulgaris* and *Kaempferia galanga*.

Year of start of the project : 1997

Cost of the project : Rs. 1.75 lakhs

Objectives: (a) To standardize protocol for shoot multiplication, rooting and hardening. (b) Mass scale production of plantlets of the species. (c) To establish field trials to compare *in vitro* and *in vivo* plantlets.

Scientific importance of investigations: *Dendrocalamus strictus* is a very difficult species for rooting by conventional method of vegetative propagation. Therefore attempts were made for *in vitro* plantlet formation through tissue culture techniques. Consequently, a low cost tissue culture protocol utilizing cheap chemicals has been developed. This protocol provides steps for increased rooting percentage and also for production of large number of plantlets, which can be successfully transferred to field for planting.

Results/Achievements: Enhanced shoot multiplication was achieved in MS medium supplemented with BA and triacontanol. Rooting percentage was increased to 50 – 60 % by pulse treatments with some cheap chemicals and crop by-products. Hardening of *in vitro* plantlets has been successful and plantlets have been transferred to polybags in shade house. Data of three experiments have been statistically analyzed. Results indicate significant difference between various treatments.

A very high rate of shoot multiplication (7.00 fold) was achieved in *B. vulgaris* in MS medium supplemented with two cytokinins – BA and kinetin at 10 μM each. Around 90 % rooting was also achieved with 25 μM NAA supplemented MS medium.

Sixteen fold plantlet production has been achieved in case of *Kaempferia galanga* in 0.75 MS medium supplemented with 12 μM BA and 3 μM and 3 μM NAA. A large No. of plants have been produced and successfully transferred to polybags in shade house and also planted in field conditions.

The analysis of variance indicated presence of significant variation among different treatments for rate of shoot multiplication, root No., rooting percentage, root length, shoot length etc. for both the species.

Sl. No. : 5

Project identification No. : TFRI-93/Eco-9

Name of the principal investigator: S.D. Sonkar

Title of the project: Post afforestation influence on soil properties and moisture regime under some selected species in M.P.

Year of start of the project : 1993

Cost of the project : Rs. 0.60 lakhs

Objectives: (a) To ascertain the impact of different vegetation on soil attributes with special reference to its physico-chemical properties. (b) To assess the rate of litter production and decomposition due to vegetation of varying ages. (c) To study the spatial variability of soil's physico-chemical attributes under some selected species.

Scientific importance of investigations: For better management of plantation and suggesting ways and means to enhance productivity of the land.

Results/Achievements: Study of growth performance showed that N₂ enrichment was maximum by *Albizia procera*. *A. Procera* showed max. available N,P,K in 8 years old plantation. In mined overberden, *Eucalyptus tereticornis* showed best growth. Increase in organic matter and nitrogen max. under *Cassia siamiae* and *D. sissoo* in plantation on coal mine spoils. *D. sissoo* was found as most suitable spp. for loamy skeletal and murrum soil. Teak showed max. moisture conservation in surface soil of degraded sites as compared to 11 other species.

Results have been published in Indian Agriculture, 1998.

Sl. No. : 6

Project identification No. : TFRI-93/Eco-10

Name of the principal investigator: Dr. S.K. Banerjee

Title of the project: Studies on pollution absorbing efficiency of different tree species in industrial areas.

Year of start of the project : 1993

Cost of the project : Rs. 3.00 lakhs

Objectives: (a) To assess pollution load in industrial areas, and enumerate native species occurrence at different grid points from the pollution sources. (b) To study the chemical and biochemical changes in plant species present at different grid points. (c) To screen the plant species according to pollution tolerance. (d) To develop models for planting and expanding sink areas.

Scientific importance of investigations: Survival and growth of trees/shrubs/herbs etc. in industrially polluted areas depends on the tolerance of pollution by the species. The information available on this aspect is negligible. For developing effective sink area of pollution and green belt in industrially polluted areas screening and indexing of species is essential to plant the tolerant species.

Results/Achievements: Most tolerant spp. found in lime kiln pollution are :

Trees: *Ailanthus excelsa*, *Butea monosperma*, *Callistemon citrinus* and *Trema orientalis*.

Shrubs: *Xanthium strumarium*, *Lantana camara*, *Calotropis procera*, *Cassia tora*, *Gymnema sylvestre*, *Desomodium triflorum*, *Calastrus paniculata* and *Cocculus hirsutus*.

Hurbs: *Hyptis suaveolens*, *Chloris virgata*, *Tridax procumbens*, *Phyllanthus urinaria*, *Phyllanthus treturnus*, *Achyranthus aspera*, *Eulaliopsis binata*, *Eleusine indica* and *Evolvulus nummularis*.

Details have been published in the paper Phytosociological study in lime processing area of Madhya Pradesh, India. *J. Environ. Biol.* **18**(4): 401-407 (1997).

Sl. No. : 7

Project identification No. : TFRI-94/Chem-5

Name of the principal investigator: Dr. Alka Bhargava

Title of the project: Study of the nutritional value of some forest species.

Year of start of the project : 1994

Cost of the project : Rs. 2.98 lakhs

Objectives: To assess the cooking effect on nutritive value of product of forest species.

Scientific importance of investigations: The results of the project would have a bearing on the selection of nutritionally important species for planting in home gardens, agroforestry models and social forestry plantations.

Results/Achievements: Effect of cooking on the nutritional value of Khair seeds showed nitrogen and crude protein remained unchanged, but ascorbic acid, tannins and phenol content reduced. Similar studies on fruits, seeds and flower buds of Bamboos, *Sterculia urens*, *S. foetida*, *Cassia* spp. and *Acacia* spp. showed variable results which have been published in (a) *Journal of Food Science Technology*, 1996 Vol.33 (2) "Bamboo parts and seed for additional source of nutrition" (b) *Journal of Food Science Technology*, 1996 Vol.36 (6) "Studies on the nutritional composition of *Sterculia* spp."

Sl. No. : 8

Project identification No. : TFRI-96/Chem-6

Name of the principal investigator: Dr. Avanish Jain

Title of the project: Chemical screening of different clones and provenances of *Tectona grandis*, *Albizia procera* and bamboo in relation to resistance against their key defoliators.

Year of start of the project : 1996

Cost of the project : Rs. 2.00 lakhs

Objectives: (a) To identify chemical factors responsible for imparting resistance against key defoliators in the selected species. (b) Selection of resistant clones and provenances.

Scientific importance of investigations: Resistant clones/provenances against their key insect pests can be selected on the basis of phytochemical analysis of their leaves, damage intensity and feeding trials through field and laboratory observations. The selected resistant clones/provenances can be promoted for propagation.

Results/Achievements: Foliar chemicals, namely moisture, protein, nitrogen, phosphorus, potassium, calcium, magnesium, sodium, phenol and polyphenol were measured in teak of selected resistant and susceptible clones, and found to be responsible for clonal resistance in teak against teak defoliator and teak leaf skeletonizer. The ratio of protein to polyphenol played a decisive role in determining the degree of resistance.

Role of peroxidase activity was determined in clonal resistance of teak to major insect pests.

Leaf chemical, such as moisture, protein, nitrogen, potassium and polyphenol were estimated among the different species of bamboo, varieties of *Bambusa vulgaris* and provenances of *Dendrocalamus strictus* and *Albizia procera* and the results were correlated with the resistance or susceptibility of key insect pests.

Publication related to the project :

- "Nutrient assessment in teak leaves of different maturity". *Ind. J. For.* **23**(2): 155-156.
- Role of foliar protein and polyphenol and their relationship to clonal resistance in teak against the leaf skeletonizer, *J. Trop. For. Sci.* **12**(2): 221-226.

Sl. No. : 9

Project identification No.: TFRI-96/Biod-7

Name of the principal investigator: Dr. D.K. Sandangi

Title of the project: Catalytic effect of tree planting on rehabilitation of native forest biodiversity on degraded tropical land.

Year of start of the project : 1996

Cost of the project : Rs. 2.00 lakhs

Objectives: (a) To find out the variation in ground flora diversity between plantation of different tree species in bhata land and adjoining open area. (b) To estimate the variation in soil properties, microflora and fauna between plantations and adjoining areas.

Scientific importance of investigations: Under appropriate conditions, plantation of degraded sites seem to catalyze natural forest succession by modifying understorey, micro-climate conditions and soil, thereby creating a more favourable environment for the establishment of native forest flora and fauna. The results will be useful in selecting suitable species for degraded areas.

Results/Achievements: Investigation was taken up to estimate and compare diversity of ground flora species under various plantations raised on degraded land near Raipur in Madhya Pradesh.

The index of dissimilarity between plantations and open bhata land is high (0.69 to 0.79) indicating remarkable degree of dissimilarity of ground flora species. Populations of VAM fungi spores, nematodes and microarthropods in soil were significantly more under plantations. Soils under plantations was better in fertility status.

Sl. No. : 10

Project identification No.: TFRI-96/Biod-8

Name of the principal investigator: Dr. S.K. Sandangi

Title of the project: Biodiversity studies in Joint Forest Management areas.

Year of start of the project : 1996

Cost of the project : Rs. 2.00 lakhs

Objectives: (a) To study the population structure and growth of major tree species in protected and neighbouring unprotected areas. (b) To study the status of ground flora in these areas and regeneration status of the major tree species. (c) To study the physico-chemical properties of soil.

Scientific importance of investigations: Studies of vegetation conditions and patterns of ecological change in natural forests are essential for management decision.

Knowledge of the vegetative characteristics of forest, ecosystems can be effectively combined with economic and institutional information to develop participatory and locally adapted management systems.

Results/Achievements: Vegetation assessment of community managed forests has been carried out in four villages of Sambalpur and one village in Puri, Orissa under different non-protected forest areas to know the effect of community protection. It was found in Sambalpur that the No. of species and diversity index of tree, shrub and herb communities are increasing with increasing protection years. The main species of protected area in top story are *Shorea robusta*, *Buchanania lanzan*, *Acacia catechu*, *Madhuca indica*, *Terminalia bellerica* etc., in scrub *Hollarrhena antidysenterica*, *Gardenia latifolia*, *Phoenix acaulis* etc. and ground flora: *Amaranthus caudatus*, *Hedyotis* sp., *Ixora parviflora* and *Aristida* sp. etc. The forest area comprised of coppice sal forest which had been under degradation prior to protection. So, the trees of *Shorea robusta* are in pole stage at present.

Plant species diversity was higher in protected area than in neighbouring unprotected area. Regeneration of major tree species is very low because, trees are very young.

Soil pH in protected and unprotected area varies from 6.1 to 6.7. Both protected and unprotected plots are rich in available potassium.

Study was also conducted in JFM area of coastal belt of Orissa, Balukhand (Puri) village "Samagra". Villagers are protecting *Casuarina equisetifolia* forests since last 5 years. These trees of *Casurina* serve as a shelterbelt. Ground flora is sparse but trees are growing well. There are *Anacardium occidentale* (Kaju), *Acacia auriculiformis*, *Eucalyptus* etc., also in the gaps of *Casurina* plantation. The main ground flora diversity include *Hedyotis* sp., *Tylofora asthematica*, *Melacarpus verticillatus*, *Spermocosa physpida*, *Phyllanthus virgatus*, *Perotis indica*, *Bulbostylis* sp. and *Vernonia* sp., etc.

All these observations show that the JFM practices are very useful in forest management and protection.

OLD PROJECTS CONTINUED DURING 1999-2000

Sl.No.: 1

Project identification No. : TFR1-95/Silvi-1

Name of the principal investigator: Dr. H.S.Ginwal

Title of the project: Establishment and management of clonal seed orchards, seedling seed production areas and multiplication garden of teak.

Year of start of the project : 1995

Target year of completion: 2002

Cost of the project : Rs. 6.00 lakhs

Objectives: To establish clonal seed orchards, seedling seed production areas and multiplication garden of teak for the production of abundant and easily available quality planting material.

Scientific importance of investigations: Improved genetic materials for plantation purpose will increase productivity.

Results/Achievements: A total 20 ha. area of clonal seed orchard of teak with more than 52 ramets has been established. 43 ha. of seedling seed production area of teak containing 15112 plants of selected source has been established. 4 ha of vegetative propagation garden of teak with 17192 plants of best known source and clones has been established.

SL No.: 2

Project identification No.: TFRI-94/Silvi-2

Name of the principal investigator: Dr. H.S. Ginwal

Title of the project: Development of model research nursery and studies on standardization of improved nursery technology and vegetative propagation of MPT spp.

Year of start of the project : 1994

Target year of completion: 2002

Cost of the project : Rs. 3.00 lakhs

Objectives: (a) To develop Model Research Nursery with latest facilities for carrying out nursery research and production of quality planting stock. (b) To standardize the nursery technology and vegetative propagation of important MPT spp. under semi-arid conditions of Central India. (c) To introduce and standardize Root - Trainer Seedling Production System in *Albizia procera*, *Acacia nilotica* and *Dalbergia sissoo*.

Scientific importance of investigations: There is a need to update the species specific nursery technology and to modernize the basic operations in a cost effective manner so as to enhance the productivity of plantations. Technology for morphologically sound seedlings with well developed tertiary roots and root hairs resulting in the development of vigorous fibrous root system will be available.

Results/Achievements: The results of the experiments conducted in two consecutive year on *Albizia procera*, *Acacia nilotica* and *Dalbergia sissoo* were analysed. Various experiments carried out last year were repeated this year for confirmation and consistency of the results.

The black colour hyko pots with 300 cc capacity per cell were appropriate for quality seedling production as compared to other colour types and capacity of the root trainer tried in the study for *A. nilotica*, *A. procera* and *D. sissoo*. The potting mix comprising compost and sand in the ratio of 80 : 20 was found to be the best among the various combinations. The mesh wire having 49 holes / inch² used for sieving potting mix. for *A. nilotica* produced better quality seedlings in root trainer. The optimum time of sowing under Jabalpur condition is the last week of February. The individual effect of VAM + *Rhizobium* enhanced the seedling height and collar diameter in *D. sissoo* and *A. procera*. Black colour root trainer of 300 cc volume produced best quality seedling in all three species.

Sl. No : 3

Project identification No.: TFRI-98/Silvi-3

Name of the principal investigator: Dr. Smita Bist

Title of the project: Development of seed technology for *Albizia procera* and *Gmelina arborea*

Year of start of the project : 1998

Target year of completion: 2002

Cost of the project : Rs. 2.00 lakhs

Objectives: (a) To study the effect of time of harvest and different methods of seed extraction, cleaning and grading on seed quality and germination characteristics. (b) To standardize the seed storage conditions for *A. procera* and *G. arborea* with particular references to seed moisture content, storage temperature and storage containers. (c) To find out the effect of different methods of pretreatment, temperature, media and light on the vigour, viability and germination of the seeds.

Scientific importance of Investigations: The study will be able to provide a complete package of seed handling and storage right from the start of collection upto storage and pretreatment before sowing. This will result in reduction in seed requirement and the expenditure on seed procurement.

Results/Achievements: Standardization of viability testing for *Gmelina arborea* by Triphenyl Tetrazolium Chloride (TTC) staining was done. 1.0% of TTC at 45°C gave best results. Standardization of presowing treatment of *Gmelina arborea* and *Albizia procera* was done. Soaking in cold water for 24 hours was found to be the most suitable and economical method for pretreatment for both the species. The best container and temperature were plastic container at 5°C.

Sl. No.: 4

Project identification No. : TFRI-92/ Agro-4

Name of the principal investigator: Dr. G.R.S. Reddy

Title of the project: Research on tree farming models in association with instant income yielding crops such as perennial pigeon-pea, soy-bean, wheat, vegetables, fodder crops, and medicinal plants in order to motivate farmers to resort to tree farming.

Year of start of the project : 1992

Target year of completion : 2002

Cost of the project : Rs. 0.25 lakhs

Objectives: (a) To develop agroforestry models by finding out the best combination of tree and crops such as cereals, oil seed, pulses, vegetables medicinal and aromatic plants and fodder crops to suit different soils (topography, stress sites), farm sizes, irrigation, capital and labour intensities. (b) To demonstrate the proven models to user groups.

Scientific importance of investigations: This project is designed to answer a wide array of farmers' questions with the support of on-station trials based on people's preferences and needs evaluated from time to time based on PRA and RRA techniques.

Results/Achievements: Twenty varieties of Soy-bean and six varieties of pigeon-pea were screened for shade tolerance under 5 MPT's. Two varieties are identified as better for shade tolerance than others in case of Soy-bean crop.

Sl. No. : 5

Project identification No. : TFR1-94/Agro-5

Name of the principal investigator: Dr. G.R.S. Reddy

Title of the project: Multipurpose trees for Agroforestry.

Agroforestry 2.1 (Sub-project I): Trials of MPTs in Agroforestry Systems in Chhattisgarh area of M.P.

Agroforestry 2.2 (Sub-project II): Study of allelopathic effects of tree growths on agricultural crops, if any, root growth pattern under different plantation geometry and development of suitable agroforestry models.

Year of start of the project : 1994

Cost of the project : Rs. 0.50 lakhs

Objectives:

Objectives of Sub -project I: (a) To study some traditional agroforestry models in Chhattisgarh. (b) To establish on -farm trials of babul model in selected farmers fields in Chhattisgarh. (c) To establish trials of some promising models in experimental area of TFR1.

Objectives of Sub -project II. (a) Bioassay studies on germination of agricultural crops with leaf, root and shoot extracts of associated tree components of the systems. (b) Identification of allelochemicals (phenolics) from leaf and root parts of trees to establish the correlation in so far as its effects on agricultural crop is concerned. (c) To study the effect of paddy, soybean, radish and carrot with 3 treatments based on soil phytotoxins and litter decomposition using composite samples from respective combination.

Scientific importance of investigations: The results of the research on tree-crop interactions in rice-babul agroforestry system would provide scientific improvement of the system for gainful employment with increased returns. This will act as an insurance against vagaries of weather and minimise moisture stress.

Results/Achievements: A preliminary financial analysis of even aged Telia Babul-rice, Ramkanta babul-rice and sole rice cropping system was calculated on the basis of IRR, NPV and B/C ratios. The ratios are highly in favour of babul-rice system under rainfed system. A package of practices on this system has been brought out in the form of a Bulletin.

The allelopathically evaluated suitability of trees for a No. of agricultural crops like Rice (*Oryza sativa*), Soybean (*Glycine max*), Wheat (*Triticum aestivum*), Carrot (*Daucus carota*), Radish (*Raphanus sativus*), Tomato (*Lycopersicon esculentum*) and Brinjal (*Solanum melongena*) besides other agricultural crops was found to be in order of *A. procera* > *A. nilotica* > *D. sissoo* > *G. arborea* > *T. grandis*. The trend in biomass production of 5 MPT's was observed to be *D. sissoo* > *A. nilotica* > *T. grandis* > *A. procera* > *G. arborea* for above ground biomass and *D. sissoo* > *A. nilotica* > *T. grandis* > *G. arborea* > *A. procera* for below ground biomass. The allelo chemicals evaluated were phenolics, tannins, pH, N,P,K nutrients. A draft report on 7 trees and 9 agricultural crops has been brought out on the project.

Sl. No.: 6

Project identification No. : TFRI-98/Agro-6

Name of the principal investigator: Pushkar Srivastava

Title of the project: Optimum land use through mixed cropping of Bach (*Acorus calamus* Linn..) with Paddy.

Year of start of the project: 1998

Target year of completion : 2002

Cost of the project : Rs. 1.50 lakhs

Objectives:

Short term : (a) Standardisation of cultivation of bach (*Acorus calamus*) with paddy. (b) Transferring technology to user agencies

Long term: (a) Saving an important vulnerable medicinal plant from possible extinction (b) Increase in raw material supply of Bach to user industries. (c) Study of effect of inter cropping of paddy and Bach on soil conditions with particular emphasis on pH status. (d) Quantitative and qualitative studies of calamus oil of cultivated origin.

Scientific importance of investigations: Bach is used as a medicine for mental disorder such as loss of memory, hysteria, epilepsy etc. Its essential oil possesses anti ageing properties. Its roots contain insecticidal properties. Recent investigations reveal that the most important active principle, namely, Asarone has strong nematocidal properties. Investigations would help in development of biodegradable nematicide. The germplasm is scantily available in its natural habitat, owing to its injudicious exploitation. The project will help to conserve the germplasm, and multiply it along with agricultural crops like paddy. Besides, it is a potential export commodity.

Results/Achievements

Results: Comparison of essential oil of local (Mandla, M.P.) and Dudhwa (U.P.) varieties of Bach have indicated wide variation in total No. of compounds with particular reference to Asarone content.

Achievements: A bulletin has been brought out on Bach cultivation. Five chemotypes in Bach brought from different parts of country have been established with different market potential. Chemical analysis of 5 chemotypes of bach for alpha and beta Asarone contents has been partially done.

Sl. No.: 7

Project identification No. : TFRI-94/NWFP-19

Name of the principal investigator: Dr. S.S. Bisen

Title of the project: Cultivation of Non Wood Forest Products.

Sub-project (1): Germplasm collection of different spp. of bamboo, *Diospyros melanoxylon* and grasses for introduction to central India, location of high yielding species and varieties and their distribution for further multiplication.

Sub-project (2): Selection of fruit yielding trees of forest origin and edible bamboo, development of multiplication techniques, demonstration plots, and seed orchard.

Year of start of the project: 1994

Target year of completion: 2001

Cost of the project : Rs.47.00 lakhs

Objectives: (a) Survey and collection of Germplasm of different species (b) To establish and evaluate the performance trial for selection of best germplasm. (c) Multiplication of selected germplasm. (d) To conduct biochemical investigations. (e) To establish demonstration plot and seed orchards.

Scientific importance of investigations: Selection and screening of best germplasm for promotion of plantation on State Forest Department (SFD) land as well as in the farmers field will increase the productivity and provide elite planting stock.

Results/Achievements

Bamboo

Germplasm of *Bambusa bambos*, *B. nutans*, *B. polymorpha*, *B. vulgaris* (green), *Dendrocalamus membranaceus* and *D. giganteus* collected earlier are being multiplied and maintained.

Tendu (*Diospyros melanoxylon*)

370 stem cuttings of tendu were collected from naturally growing tendu bushes for vegetative propagation trials in mist chamber. The cuttings were treated with IAA, IBA & NAA and Thiamine with concentration of 100, 200 & 500 ppm. However no rooting response was observed.

Rosa grass (*Cymbopogon martinii*)

Inter cropping trials were laid out under *Dalbergia sissoo* and *Bursera penicillata* plantation. The survival percentage of the transplanted slips was very low.

Seeds of best accessions (Bastar and Jhabua) were collected. Slips were transplanted in poly bags in NWFP Garden for intercropping trial during coming season.

Demonstration plots of *Aegle marmelos* (Bel), *Phyllanthus emblica* (Aonla), and mahua (*Madhuca longifolia* var. *latifolia*) raised earlier were maintained at Barha experimental field. Growth data of plants were recorded.

For grafting of mahua, seedlings of Khirmi – *Mimosops hexandra* collected from Horticulture Nursery, Ramtek (Maharashtra) are being maintained for attaining suitable thickness of the stock. Transplanted some of these seedlings in field for grafting experiments during April-May 2000.

Edible bamboo (*Dendrocalamus asper*)

Demonstration plot of *D. asper* plants raised through tissue culture is being maintained. Fresh rhizomes were collected for chemical analysis to assess nutritive value.

Sl. No. : 8

Project identification No.: TFR-98/NWFP-20

Name of the principal investigator: Dr. S.S. Bisen

Title of the project: Agro-techniques and cultivation of medicinal plants.

Year of start of the project : 1998

Target year of completion: 2001

Cost of the project: Rs.15.42 lakhs

Objectives: (a) To collect germplasm of *Alstonia scholaris*, *Crateva magna*, *Gmelina arborea* and *Strychnos potatorum*. (b) To standardise methods for vegetative multiplication. (c) To establish demonstration plots. (d) To evaluate active constituents of wild and cultivated varieties.

Scientific importance of investigations: Standardisation of agro-technology for cultivation and conservation of rare, endangered and threatened species will be achieved.

Results/Achievements

(a) *Alstonia scholaris*

Collected seeds of *A. scholaris* from Bhopal and conducted germination trial. Germination percentage was 80. Seedlings were raised and transplanted in block design with 5x5 m spacing in 1ha.

(b) *Crateva magna*

Collected branch cuttings of *C. magna* for vegetative propagation from FRI, Dehra Dun. Surveyed different temple premises in MP and collected root shoots from Khajuraho temple premise. 100 root shoots were planted in block design with 5x5 m spacing at Barha.

(c) *Gmelina arborea*

Seeds were collected from 4 seed sources and tested for their viability and germination percentage. Seed germination studies revealed 90% germination. Seedlings were raised in polybags for planting in coming season.

(d) *Strychnos potatorum*

Collected seeds of *S. potatorum* from Barhi (Katni) and seedlings from Tikariya village, Banda, UP. Seedlings were planted in polybags and seed germination studies are in progress.

Sl. No. : 9

Project identification No. : TFRI-93/Eco-14

Name of the principal investigator: Dr. S.K. Banerjee and Dr.A.K. Singh

Title of the project: Development of afforestation methodology for different types of mined-over areas in Central India.

Year of start of the project : 1993

Target year of completion: 2000

Cost of the project : Rs. 12.45 lakhs

Major portion of the project is funded by other organisations like SECL, SAIL, etc.

Objectives: (a) To find out the nature and characteristics of spoils, and occurrences of native species. (b) To test different species for their suitability. (c) To select soil and water conservation methods for checking erosion and increasing moisture regime. (d) To test different boosters and fertilizers for initial nutrient support. (e) To initiate microbial activities for bio-degradation of organic matter and overall development of a suitable ecosystem.

Scientific importance of investigations: For eco-restoration of mined areas, successful rehabilitation is very important because the spoils are refractory in nature and deficient in nutrients and biological activity. Successful rehabilitation of these lands will increase forest area and decrease pollution.

Results/Achievements: Spatial variability of spoil nutrient status in age series of overburden dumps of coal mine and adjoining natural forest was studied. On the basis of regression analysis of data pertaining to nutrient status of dumps of different ages and natural forest, it was concluded that it will take about 54 years for dump surface soil to reach the status of natural forest surface soil. However, allogenic inputs will hasten the process of eco-restoration. Similar studies were conducted for manganese mine overburdens of different ages around Balaghat (M.P.). Multiple regression analysis revealed that it will take about 79 years for the surface spoil of manganese mine overburdens to reach the status of adjoining natural forests surface soil. IInd phase of rehabilitation of iron ore mine overburden has been completed with a number of experiments conducted to find out species suitability, mulches, amendments, boosters etc. Sites for IIIrd phase activities were visited and discussed with SAIL authorities. MOU has been prepared and is likely to be signed soon. Analysis of samples and data pertaining to rehabilitation of copper mine overburdens is in progress.

Sl. No.: 10

Project identification No.: TFRI-98/Ecol-15

Name of the principal investigator: Dr. A.K. Singh

Title of the project: Development of afforestation methodology for different types of mined over areas, degraded and wastelands – Ecological evaluation of rehabilitated areas.

Year of start of the project: 1998

Target year of completion: 2008

Cost of the project : Rs. 13.00 lakhs

Objectives: (a) To evaluate the present level of productivity of plantations and projected values for future growth. (b) To determine present and projected values of nutrient enrichment. (c) To determine environmental benefits of plantation in economic terms and also to find out benefit cost ratio at present level and projected value for future.

Scientific importance of investigations: From the practical management point of view ecological evaluation of rehabilitated areas is essential. This will provide ideas for further improvement.

Results/Achievements: Nutrient uptake and soil enrichment by *Dalbergia sissoo* planted in a highly eroded (skeletal) soil are being assessed under different sets of treatments. Growth and biomass have been studied and economic values are being calculated. Ground flora diversity and productivity changes due to plantation of different tree species in stress sites are being assessed and compared with open land (unplanted area). Spoil nutrient enrichment under age series plantations of one NFT and one non NFT species in coal mine overburden has been estimated. Regression analysis has been done for height and girth in relation to age of four nitrogen fixing tree species planted in bhata wastelands. Similar analysis is in progress for non nitrogen fixing tree species.

Sl. No.: 11

Project identification No.: TFRI-95/Chem-7

Name of the principal investigator: Dr. Sadhana Tripathi

Title of the project: Allelopathic effect of some forest tree species on agricultural crops.

Year of start of the project: 1995

Target year of completion: 2001

Cost of the project : Rs. 2.00 lakhs

Objectives: (a) To study the activity of different agroforestry /forestry tree root and leaf extracts on nodulation, growth and germination of agricultural crop (soybean). (b) To assess the chemical factors involved in the process. (c) To study the compatibility of tree species with agricultural crop.

Scientific importance of investigations : Investigations are needed on mechanism of chemical interactions and allelopathic behaviour of plants, and responses of crops, tolerant crops and significance of allelochemicals in the adaptation of species and plant communities for agroforestry systems.

Results/Achievements: Allelopathic activity of *Melia azadirachta*, *Acacia nilotica* and *Sesbania grandifolia* was studied in bioassays on germination, seedling growth, yield and biochemical changes of soy-bean. Aqueous extracts of leaves and roots were examined on soy-bean.

Strong inhibitory effect of both concentrations of extracts was observed on germination, root, shoot length; wet and dry weight of roots and shoots; plant biomass; nodulation; and number of beans per plant. Regarding biochemical changes, soybean leaf chlorophyll and carbohydrate were reduced significantly. Leaf and seed protein was adversely affected by all extracts except *S. grandifolia*. A concentration dependent effect was observed. Variable concentrations of phenols, flavonoids and sugars were found in *A. nilotica*, and *M. azadirachta* while *S. grandifolia* possessed small quantity of phenolics only. Hence, absence of other two allelochemicals may be responsible for reduced inhibitory activity of the species.

Sl. No.: 12

Project identification No. : TFRI-97/Chem-8

Name of the principal investigator: Dr. Avanish Jain

Title of the project: Screening of phytochemicals of forest species and their utility in pest control.

Year of start of the project: 1997

Target year of completion: 2001

Cost of the project : Rs. 2.50 lakhs

Objectives: (a) To isolate the biologically active phytochemicals (b) To evaluate the pesticidal activities against insects and other available pest. (c) To carry out biochemical analysis of seed cakes. (d) To assess the physico-chemical properties of soil amended with cakes.

Scientific importance of investigations; Exploitation of bioactive chemical constituents from some abundantly distributed but underutilised forest species against forest and agricultural pests may become possible.

Results/Achievements: Formulations were prepared using different additives and toxic constituents of *J. curcas* and Parthenium (from aerial part of *P. hysterophorus*) and tested against bamboo leaf roller, teak defoliators (*Hyblaea puera* and *Eutectona machaeralis*) under field conditions and against phytonematode *Meloidogyne incognita* in pot experiment. *Jatropha curcas* seed constituents showed antifeedant and

insecticidal activities at 10 % concentration. Physico-chemical properties of Neem, *Jatropha curcas* cakes and nursery soil were evaluated for the assessment of the potential of cakes in amendment of soil.

Sl. No.: 13

Project identification No.: TFRI-96/Chem-9

Name of the principal investigator: Ashutosh Tripathi

Title of the project: Screening of species (on chemical basis) tolerant in Lime kiln areas (Jhukehi, Katni) of Madhya Pradesh, India.

Year of start of the project : 1996

Target year of completion : 2001

Cost of the project : Rs. 2.50 lakhs

Objectives: (a) To evaluate the type and quantity of the pollutants in and around the lime kiln area (soil & air). (b) To survey and enumerate the vegetation present, both natural and planted, in the affected areas and study of pollution on them. (c) To select trees for polluted area on the basis of tolerance and chemical and biochemical alteration in tree species.

Scientific importance of investigations: A detailed study on tolerance and survival of forestry and fruit yielding species in lime kiln area is urgently required. Investigations of biochemical indicators would provide various inexpensive, convenient, reliable and practical monitoring parameters in the lime kiln area, which would be helpful in checking environmental pollution.

Results/Achievements: Phytosociological study of lime kiln area (at Jhukehi and Katni,) revealed that number of species increased as a function of distance from the lime kilns. Six communities were identified on the basis of IVI. Pollutant concentrations were studied in soil and atmosphere in different seasons. The impact of pollutants on biochemical parameters (Chlorophyll, protein, amino acids, sugar, proline, Ascorbic acid, catalase, peroxidase, nitrate reductase, polyphenols etc.) of *Butea monosperma*, *Calotropis procera*, *Pongamia pinnata*, *Azadirachta indica*, *Dalbergia sissoo*, *Acacia nilotica*, *Magnifera indica*, *Artocarpus heterophyllus*, *Citrus* spp., *Ziziphus mauritiana*, *Syzgium cumini*, *Psidium guajava*, *Peltophorum pterocarpum* and *Eucalyptus* spp. in lime kiln areas was studied. The reaction of plants to pollutants can be seen from qualitative and quantitative changes in the above mentioned biochemical parameters. These biochemical indicators helped in categorisation of selected species into (1) tolerant (2) resistant (3) and insensitive to lime kiln pollutants. Soil parameters and biochemical indicators chosen in the study may give an idea of possible mechanism operating in plants during pollution stress. This study will help in quantification of damage to selected local species as well as adaptation when subjected to pollution.

Sl. No.: 14

Project identification No. : TFR-97/Patho-10

Name of the principal investigator: Dr. Jamaluddin

Title of the project: Integrated management of diseases of seeds, nursery and plantations and their field application.

Year of start of the project: 1997

Target year of completion: 2003

Cost of the project : Rs. 8.47 lakhs



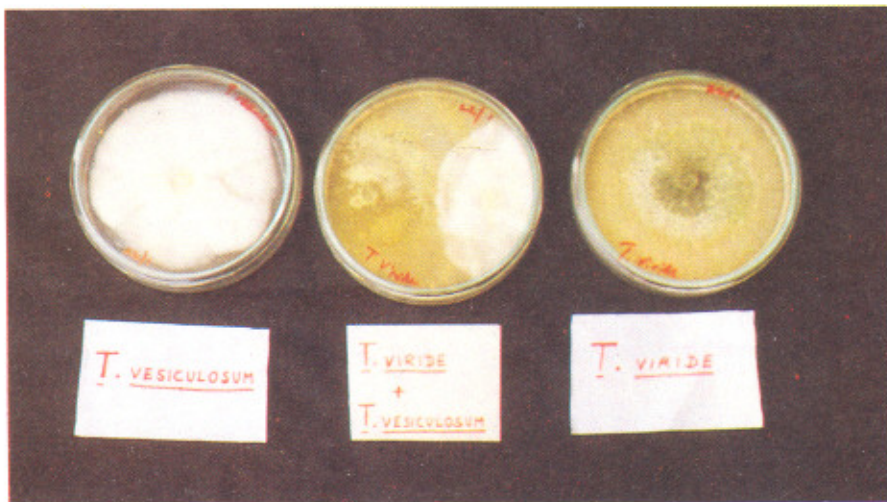
Eucalyptus tereticornis Inoculated with Biofertilizers Showing Better Growth when Compared to Control Seedlings Raised with Quartz Sand in Root Trainer



Medicinal Plant Safed Musli under Teak Plantation at TFRI



Attack of Bag
Worm on Tamarind



Effect of Biocontrol Agent (*Trichoderma viride*) against the Blister Bark Pathogen, *T. Vesiculosum*

Objectives: (a) To workout integrated management strategies for diseases in seeds, nurseries and plantations of selective trees species. (b) To study biological control of important soil borne plant pathogens. (c) To manage the important diseases through study of plants (tree species) resistant to diseases.

Scientific importance of investigations: Integration and manipulation of all the available control measures to get a healthy crop of plants by checking the disease below the economic threshold level at an effective cost will be achieved.

Results/Achievements: Seed mycoflora of *Tectona grandis*, *Gmelina arborea* and *Azadirachta indica* were recorded for different storage periods. *Aspergillus niger*, *A. flavus*, *Fusarium oxysporum* and *Memnoniella echinata* were recorded as dominant seed rot fungi. Diseases causing damage in forest nurseries in central India were studied. Disease severity of *Fusarium oxysporum*, *Rhizoctonia solani*, *Macrophomina phaseolina*, *Pestalotiopsis versicolor*, *Colletotrichum gloeosporioides*, *Alternaria alternata*, *Cercospora* sp., *Uncinula* sp., *Marvalia*, and *Ravenalia hobsonii* were recorded in different agroclimatic zones. Selection of nursery site, soil testing, irrigation schedule, seed treatment, and soil fumigation followed by foliar application of systemic fungicides were worked out as integrated management for control of nursery diseases.

Pseudomonas solanacearum a bacterial collar rot caused significant damage in teak. Hi-tech plantation and improvement gardens, 90 % atmospheric humidity and 30°C temperature with water logged sites favours the disease development. Field experiments were laid out to control *Ganoderma lucidum* root-rot in *Albizia procera* and *Dalbergia sissoo* plantation.

Wood block tests were conducted with a white rot fungus *Pycnosporus sanguinus* and a brown rot fungus *Gloeophyllum striatum* to test the efficacy of fine borate preservative. *Vitex nigundo* and *Cusuta reflexa* extracts have been found to control *Fusarium* damping off and wilt of *Albizia lebbek* and *Moringa pterygosperma*. Leaf extract of Marigold was found to check the growth of decay fungi in wood.

Sl. No.: 15

Project identification No. : TFRI-94\Patho-11

Name of the principal investigator: Dr. Jamaluddin

Title of the project: Researches on mass production of biofertilizer (VAM, rhizobium and other beneficial organisms) and their field application.

Year of start of the project: 1994

Target year of completion: 2001

Cost of the project : Rs. 12.67 lakhs

Objectives: (a) To isolate, culture and maintain different VAM fungi and growth promoting bacteria. (b) To produce biofertilizers in large scale. (c) To establish field experiments to study the effect of inoculation of plant growth promoting micro-organism and VAM fungi.

Scientific importance of investigations: Fortification of plant roots with suitable microbes like VAM rhizobium and growth promoting soil bacteria will provide a sustainable system to the plant to derive nutrients from soil and air.

Results/Achievements: Natural occurrence of VAM fungi in various clones of teak was studied. The percent root infection by VAM fungi varied in different clones. The cultures of VAM fungi isolated from teak, bamboos, *Albizia procera* and *Casuarina* were maintained in pots.

The cultures of Rhizobium isolated from *A. procera* were multiplied. Other nitrogen fixing bacteria were also isolated from teak roots.

The cultures of VAM, Rhizobia and free living bacteria namely *Azospirillum* and *Azotobacter* were multiplied in bulk.

One field experiment using biofertilizer was tried in teak. Maximum height and collar diameter in teak was recorded in the treatment containing VAM and *Azotobacter*. Another field experiment was conducted by using VAM fungi, rhizobium, *Azotobacter*, N, P and their combinations on growth of *Albizia procera*. After 12 months maximum height was observed in VAM + Rhizobium + *Azotobacter* treatment.

Sl. No.: 16

Project identification No.: TFRI-94/Ento-4

Name of the principal investigator: Dr. K.C. Joshi

Title of the project: Identify pests on forest seeds, in nurseries and plantations and assess levels of damage; to develop practical technique for the control of pests through cultural practices and bio-control technique.

Year of start of the project: 1994

Target year of completion: 2001

Cost of the project : Rs.37.50 lakhs

Objectives: (a) To investigate the key insect pests of teak, *Albizia procera* and bamboo, the damage caused by them. (b) To develop feasible, and economical pest management system in nursery, plantations, and forests.

Scientific importance of investigations: Behaviour of key pests, life cycle and seasonal history of a few recently identified pests, the loss caused by them and feasible control measures in field conditions and their application techniques are unknown. The present study will help develop a package for the means of control of the pests in field conditions.

Results/Achievements: Two species viz. the defoliator, *Hyblaea puera* and leaf skeletonizer, *Eutectona machaeralis* in teak; the seed borer, *Bruchus bilineatopygus* and shoot foliage feeder *Spirama retorta* in *Albizia procera* and a leaf roller, *Crypsiptya coclesalis* in bamboo are identified as pests in nursery and plantations in central India. The feeding habits, larval moulting behaviour, quality of food preferred, seasonal history and the damage caused due to defoliation in nurseries were studied. Nearly 18 teak clones, collected from Orissa, Maharashtra, M.P. & U.P. were found comparatively less attacked by its key pests. Similarly, Agartala (Tripura), Shakti and Raipur provenances of *A. procera* and Bhandara (Maharashtra) and Shahdol (M.P.) provenances of bamboos were also observed to be better than others. The biopesticides are effective without any ill hazards to the users and environment. The *Bacillus thuringiensis* var. *kurstaki* 0.1% kills the above key defoliating larvae, but the total cost of spray remains comparatively higher (Rs. 48,000 per hectare). Efforts are on to investigate some another microbes like *Beauveria bassiana*, *Metarhizium anisopliae* and *Fusarium* sp. Leaves of two plant species viz. *Annona squamosa* and *Lantana camara* extracted in methanol also proved effective in suppressing the population of key pests. Crude water extract and emulsifier of the above species were also effective in deterring insects as compared to control. On the basis of field trials conducted, it has been proved that foliar spraying of 0.002 % deltamethrin against teak pests, 0.002 % of either deltamethrin or cypermethrin or fenvalerate against *Albizia* foliage & shoot feeder and 0.08 % monocrotophos against bamboo leaf roller in nurseries and young plantations is highly effective in suppressing pest population. The total cost in spraying above insecticides in one hectare is calculated @ about Rs. 58 only. The parasitoids and predators also play a important role in checking the population of pests. Teak

defoliator and leaf skeletonizer are recorded to be parasitized by about 10 species of insects in central India. Of these, the polyphagous egg parasitoids, *Trichogramma* spp. parasitise 50 to 80 per cent of eggs of above pests. Mass multiplication technique of these egg-parasitoids has been developed and their performance in teak plantations are being studied.

Sl. No.: 17

Project identification No.: TFRI-97/Ento-6

Name of the principal investigator: Dr. K.C. Joshi

Title of the project: Population dynamics and behaviour of sal heartwood borer, and development of its control measures.

Year of start of the project: 1997

Target year of completion: 2001-2002

Cost of the project : Rs.44.48 lakhs

Objectives: To investigate the flight range, longevity, responses to the kairomones from the sal sap, oviposition behaviour of beetles, and develop control measures.

Scientific importance of investigations: Study will be helpful in developing a technique to attract the beetles to kairomone trap without felling a sal tree during monsoon which is the only technique practiced now a days to collect the borer beetles.

Results/Achievements: The emergence of beetles start from 2nd week of June. Early beetles are mostly males and a few females. The male/female ratio remains equal in the first half of July. They generally are not attracted to the electric light. The beetles oviposit in cracks on bark and after 2 to 4 days, the grubs hatch, soon bore the bark, and feed on sapwood. The grubs reach heartwood by December.

An insect predator *Alaus sordidus* and a fungal disease caused by *Fusarium* sp. are known to kill the grubs of this borer.

Extract of sal bark when sequentially separated on silica column resulted in a brown coloured compound having attractant property for the beetles of sal borer. Further purification of this compound resulted to a white compound which when dissolved in benzene attracted more beetles as compared to crude compound. Characterization of this compound is in progress which may be an asset in synthesis of a synthetic kairomone.

Sl. No.: 18

Project identification No. : TFRI-94/Econ-16

Name of the principal investigator: Horilal

Title of the project: Market survey of prevailing tree species and forest products.

Year of start of the project: 1994

Target year of completion: Continuous activity.

Cost of the project : Rs.2.00 lakhs

Objectives: (a) To find out the market ratio of forest products such as round and sawn timber of *Shorea robusta*, *Tectona grandis*, *Eucalyptus* spp. and bamboos at the end of each quarter from Nagpur, Raipur and Jabalpur districts. (b) Market survey of other forest products like fuelwood, fodder available in forests from the above mentioned 3 (three) districts on quarterly basis. (c) Compilation and analysis of data.

Scientific importance of investigations: The project will create awareness to provide information to various user groups such as traders, NGOs, SFDs etc.

Results/Achievements: Market surveys were carried out on quarterly basis to obtain the market rates of sawn and round timber of selected species viz. *Tectona grandis*, *Shorea robusta*, Bamboo and *Eucalyptus* spp. from Nagpur, Jabalpur and Raipur districts. Market prices of fuelwood and fodder were monitored from the above mentioned 3 (three) districts on quarterly basis. All the data were compiled, tabulated and analysed. They have been sent to ICFRE for publication in the quarterly bulletin.

Sl. No.: 19

Project identification No.: TFRI-98/Econ-17

Name of the principal investigator: Bipin Behari

Title of the project: Agroforestry models of Bamboo cultivation on degraded agricultural lands.

Year of start of the project: 1998

Target year of completion: 2001

Cost of the project : Rs. 3.00 lakhs

Objectives: (a) To study the biomass girth classwise and specieswise and the root biomass along with the morphological characters related to bamboo clumps. (b) To study the growth performance of *Dendrocalamus strictus*, *Bambusa bambos* and *Bambusa nutans* on IDRC fields where bamboo-agroforestry models have been developed. (c) To carryout the clump and culm study to assess bamboo yield potential.

Scientific importance of investigations: The models developed will be useful to farmers and help eco-restoration of degraded areas.

Results/Achievements: Recorded the growth performance of *Dendrocalamus strictus*, *Bambusa bambos* and *Bambusa nutans* regularly. Found the growth of *Bambusa bambos* always better than *Bambusa nutans* and *Dendrocalamus strictus*.

Carried out culm and clump study on IDRC fields where bamboo agroforestry models have been developed. The average number of culms per clump per annum varies from 3 to 7.17 during the 4th year of plantation. The average total production of culms per clump during the entire estimated life span of *D. strictus*, *B. nutans* and *B. bambos* came to 160.9, 307.1 and 314.8 respectively. The estimated annual net surplus from *B. nutans* and *B. bambos* exceeded Rs. 50,000/- per ha.

Sl. No.: 20

Project identification No.: TFRI-97/Bot-18

Name of the principal investigator: Dr. V. Nath

Title of the project: Collection of ethnobotanical data from various tribes of Central India.

Year of start of the project: 1997

Target year of completion : 2005

Cost of the project : Rs. 9.50 lakhs

Objectives: (a) Folklore survey and identification and documentation of plants used by tribes. (b) Conservation of primitive cultivars and wild species for *Ex-situ* conservation in Botanical garden. (c) Studies pertaining to impact of tribal culture on vegetation.

Scientific importance of investigations: These investigations will assist in documentation of traditional and primitive knowledge for conservation and various uses of wild plants.

Results/Achievements: Ethnobotanical studies were conducted in Central India – Madhya Pradesh. Plant species of ethnobotanical importance along with uses from Gond, Bhila Sahariya, Baiga, Bihor, Bhariyas, Hill korwas, Abujhmarias tribes were documented. During the folk lore survey 250 plant species have been documented. Data on tribal demography and census data on tribals from 1951 to 1981 were recorded and analysed. Baiga tribal region were surveyed and studies were conducted on the use of wild plants by Baiga tribal in Mandla, at Amarkantak, Bilaspur, Kawardha and Balaghat districts of Madhya Pradesh.

A case study at Rajbeda village in Kawardha district was conducted to evaluate resources available in locality for the livelihood needs of Baiga community and socio-economic factors responsible for decreasing dependency of tribals on forest.

NEW PROJECTS TAKEN UP DURING 1999-2000

Sl. No. : 1

Project identification No. : TFRI/Agro-1

Name of the principal investigator: Pushkar Srivastava

Title of the project: Utilisation of idle space in teak (*Tectona grandis*) plantations through cultivation of medicinal plants.

Year of start of the project: 2000

Target year of completion: 2002

Cost of the project : Rs. 0.10 lakhs

Objectives:

Long term: 1. To utilize optimum productivity of land under Teak plantations 2. *Ex situ* conservation of safed musli (*Chlorophytum borivillianum*) in its natural habitat. 3. Augmenting the availability of raw material of safed musli to drug manufacturing industries and exporters.

Short term: 1. Standardisation of cultivation technique of safed musli under Teak plantation on sustainable basis. 2. Transferring the technology to user agencies.

Scientific importance of investigations: The importance of the project lies in utilizing the productivity of idle space under Teak plantations on sustainable basis. The conservation aspect in case of safed musli is also adequately addressed. Further, investigations would also help check soil erosion, under plantations especially during monsoon season.

Results/Achievements: Safed musli (*Chlorophytum borivillianum*) was planted to utilize the idle space in Teak plantation. Four different levels of crown pruning [with 25 %, 50 %, 75 % and control (no pruning)] were tested in Teak. The 50 % level of pruning (50% shade) was found to be very encouraging as the highest biomass was realised under this treatment. Nematodes were found to damage the yield and affect the quality of tubers under field conditions. The tubers were damaged during storage. The causal organism was identified to be *Fusarium oxysporum*. A bulletin has been brought out on Safed musli cultivation.

Sl. No. : 2

Project identification No. : TFRI/NWFP-2

Name of the principal investigator: Dr. S.S. Bisen

Title of the project: Integrated Development of Tree Borne Oil Seeds of Forest Origin.

Year of start of the project: 2000

Target year of completion: 2002

Cost of the project: Rs.20.44 lakhs

Objectives: (a) Survey and collection of seeds from different agroclimatic zones. (b) Standardization of nursery and plantation technology to produce quality planting materials in different agroclimatic zones. (c) Development of 4.50 lakh of elite seedlings i.e. 50,000 Nos. each of Mahua, Jatropha & Karanj in each year. (d) To develop technology for storage and processing of the seeds. (e) To arrange trainings, workshops for extension works and prepare pamphlets and video films.

Scientific importance of investigations: Evaluation of quantitative characters i.e. oil content, fatty acid profile and protein content of Mahua, Jatropha and Karanj seeds collected from different agroclimatic zones of MP will be achieved.

Results/Achievements: Cuttings of Jatropha were collected from different places and planted in nursery beds for further growth and multiplication. Seeds of Mahua, Karanj and Jatropha collected during last season were analysed for their fatty oil and protein content.

Sl. No. : 3

Project identification No. : TFRI/Ecol-2

Name of the principal investigator: Dr. S.K. Banerjee

Title of the project: Development of Neem in various agro-ecological regions of India (M.P. & Orissa).

Year of start of the project: 2000

Target year of completion: 2002

Cost of the project: Rs. 33.14 lakhs

Objectives: (a) Seed collection and storage. (b) To evaluate the phenological behaviour and seed characteristics. (c) Tree improvement to get quality and reliable seed source. (d) To standardize techniques for macro and micro-propagation for mass multiplication. (e) To develop the village model plantations and agroforestry models. (f) To evaluate chemicals of seeds, standardize oil extraction methodology etc. (g) To develop data base for information and resources. (h) To enable training to target groups.

Scientific importance of investigations: Neem is an important tree species of India and has wide uses. It has high medicinal and pesticidal value. However, detailed information on neem with respect to seed production area, phenology of different provenances, chemical characters of oil of different sources, CPT identification etc. is lacking. The project will produce valuable information in this regard.

Results/Achievements: 300 plus trees have been identified in the states of Madhya Pradesh and Orissa. These provenances are Bilaspur, Seoni, Betul, Balaghat, Narsinghpur, Hoshangabad, Jabalpur, Chhindwara, Matkuli (Pachmarhi), Mandla and Raigarh. Raipur, Sausar, Darg, Gwalior and Khandwa. Sambalpur, Dhenkanal, Puri and Phulbani etc. In each provenance, 20 candidate plus trees were selected. Seeds were

collected from plus trees. A nursery has been established in Chhindwara where seedlings from different provenances and those received from different Institutes are being raised. Another nursery has been developed in T.F.R.I. campus. Soil samples collected from different seed sources have been analysed for available nutrient status, pH and organic carbon. Plantation sites have been selected for raising provenance trial and clonal orchard. Phenological studies are in progress. Vegetative propagation of Neem through stem cuttings procured from different provenances has been started. Two training programmes were conducted at Chhindwara and Jabalpur on "Integrated Development of Neem in Madhya Pradesh and Orissa". More than 100 farmers attended the training programmes.

The scientists of this Division published nearly 15 research papers during the current year.

Sl. No. : 4

Project identification No.: TFRI/Econ-3

Name of the principal investigator: Dr. Nanita Berry

Title of the project: Identification of the markets of NTFP's, their potential, prices and marketing pattern in M.P.

Year of start of the project: 2000

Target year of completion: 2000

Cost of the project : Rs. 4.68 lakhs

Objectives: (a) To study the marketing practices and economic value of NTFP's (non-timber forest products). (b) Quantitative and qualitative assessment of identified NTFP's. (c) To study the price variation in different markets, marketing agencies and various channels of marketing. (d) To collect the data on potential of production and subsequent statistical analysis for drawing meaningful inferences.

Scientific importance of investigations: The prices of NTFPs, their marketing potential etc can be very helpful for various user groups. Moreover, they can help in more effective management of NTFPs in the forests and villages.

Results/Achievements: NTFP market of Jabalpur, Kundam and Dhamtari have been surveyed, data collected and are being tabulated.

FORD FOUNDATION

Sl. No. : 5

Project identification No. : TFRI-95/FFP-21

Name of the principal investigator: Amit Sahai

Title of the project: Productivity Enhancement - Management for People's Participation.

Year of start of the project: 1995

Target year of completion: 2000

Cost of the project : Rs. 67.77 lakhs

Objectives: (a) To study the silvicultural options to be recommended. (b) To organise national seminar for sharing of the experiences. (c) To support activities for mushroom and medicinal plants cultivation rope making, pisciculture, etc. through village institutions. (d) To study the gender issues.

Scientific importance of investigations: Peoples participation in management will help conservation of flora and fauna more effectively.

Results/Achievements: Scientific achievements :

- Storage technique for storage of mahua seed developed.
- IVI of JFM sites studied and compared with vegetation of non-JFM areas. Former showed marked superiority over the latter.
- Regression equation for mahua fruit yield developed.
- Socio-economic indicators for potential JFM sites developed.
- Entry point activities to ensure JFM identified.
- Gender issues related to conflicts identified.

NABARD PROJECT

Sl. No. : 6

Project identification No. : TFRI-95/NABARD-22

Name of the principal investigator: Dr. A.K. Singh

Title of the project: Development of agroforestry model for various agro-ecological regions of India.

Year of start of the project: 1995

Target year of completion: 2000

Cost of the project: Rs.126.00 lakhs for four Institute of ICFRE

Objectives: (a) To conduct agroforestry D.D. Survey in identified micro watersheds, economic analysis of existing agroforestry models, and selection of MPTs for integration in agroforestry systems (b) To introduce biofertilizers in agroforestry plantations and evaluate their potential in increasing productivity, and design experimental models. (c) To seek improvement of crop productivity through introduction of suitable tree species and establish demonstration plot.

Scientific importance of investigations: Forest area is degrading due to various reasons and productivity is at decline. Forest cannot meet the demand of large population of India. The only option is to integrate trees/shrubs with agricultural crop in various agroforestry systems to fulfill the demand of people from their own fields. This investigation will help in bridging the gap between supply and demand.

Results/Achievements: Seedlings were planted in three micro watersheds viz., Saliwara, Gandagouri and Karaboh under different agroforestry models and block plantings. The plants were maintained during the period under report and casualty replacement of 1500 seedlings was done in Saliwara micro watershed. Necessary operations like weeding, watering, etc. were carried out. Farmers were persuaded to adopt agroforestry systems.

EXTENSION

Video Films :

- Under WB (FREE) Project, two Betacam Films, of telecast quality, titled - "Bamboo, a Gift of Nature", meant for general public and "Bamboo, Promising Gains", for technology users, have been completed.

- , Another film entitled - "Greening our Earth - Rehabilitation of Stress sites" has also been completed during December 1999. Two VHS copies of the film have been sold @ Rs.700/- per cassette
- "Tree Borne Oil-seeds" another film is likely to be completed by May' 2000, under the NOVOD Board Project.

Transfer of technology :

Trainings :

- A workshop on "Statistical Tools & Methods in Forestry Research" was conducted from 5/4/99 to 4/5/99.
- Demonstration and lectures were organised for IFS, Probationers from IGNFA, Dehra Dun, on 12th Jan 2000.
- Training on modern instrumentation was imparted to lecturers and readers from R.D. University, during Feb' 2000.
- An extension training programme on "Cultivation of bamboos for ladies and youth" was organized at the institute from 13-17 March, 2000.
- An extension training programme on "NTFP's for ladies and youth farmers" was held from 27-31 March, 2000 at the institute.
- A training programmes was organized on "Development of neem in different agro-ecological region of India" at Chhindwara and Jabalpur from 7-8 December, 1999 and 28-29 February, 2000 respectively.
- A farmers' training programme on "Integrated development of tree born oilseeds of forest origin- Jatropha, Karanj and Mahua in M.P.", was organized at Birhuli, Katni from 14-145 March, 2000.

Seminars/Workshops :

- A workshop on "National network programme on Integrated development of neem" was organised at the Institute 6-7/12/99 under NOVOD Board, Govt. of India.
- Five one day Workshop-cum-peer review on teak, safed siris, agroforestry, biofertilizer and Entomology were held at the Institute in Nov. 1999.
- A Zonal level workshop on "Wood Energy" was organised at the Institute from 20-21/01/2000 under IGNFA, Dehra Dun.
- A National Seminar on "Sustainable Forest Management through People's Participation"-was held from 7-8/2/2000 at the Institute under ICFRE Ford Foundation.

Publications :

Leaflets and technical bulletins :

1. Genetic Conservation and Clonal Propagation of Bamboos (in Hindi & English)
2. Tropical Forest Research Institute, Jabalpur, its Mandate and Strengths.
3. Conservation & Production techniques of NTFPs of Jabalpur district, in Hindi.
4. "Meteorological Data of TFRI, Jabalpur - July, 1995 to July, 1998", has recently been published.
5. "Mahua", "Jatropha" and "Karanj" in Hindi.

Following Brochures were published during the last one year :

1. Meteorological Data of TFRI, Jabalpur.
2. Plant Diversity in Preservation Plots of Orissa.
3. Draught type Drum Drier.
4. Plant Diversity in Preservation Plots of Maharashtra.

FINANCIAL STATEMENT FOR THE YEAR 1999-2000

I. PLAN		
Sl. No.	SUB-HEAD	Expenditure (Rs. in lakh)
1.	A. REVENUE EXPENDITURE : a) Research b) Administrative support c) Others specify	192.80 53.43 00.00
	Total for Revenue Expenditure 'A'	246.23
	B. LOAN AND ADVANCES a) Loan Advances (Conveyance) b) House Building Advance	1.99 5.00
	Total for 'B'	6.99
	C. CAPITAL EXPENDITURE a) Building & Roads b) Equipments, Library Books c) Vehicles d) Other specify	00.00 00.00 00.00 00.00
	Total for 'C'	00.00
	GRAND TOTAL FOR A+B+C (PLAN)	253.22
II. NON PLAN		
	A. REVENUE EXPENDITURE a) Research b) Administrative Support (Salary)	31.00 5.00
	Total Non-Plan	36.00
	TOTAL FOR PLAN +NON-PLAN	289.22
III. FUNDED PROJECTS		
	A. World Bank Project B. UNDP Project C. NABARD Project D. FORTIP E. SAIL F. Ford Foundation	117.58 1.62 0.68 0.00 2.45 13.74
	Grand Total for (A+B+C+D+E+F) FUNDED PROJECTS	136.07