CHAPTER-V

INSTITUTE OF FOREST GENETICS AND TREE BREEDING COIMBATORE

The Institute conducts national level research on the subjects of Genetics and Tree Breeding of important forest species. In addition, it also attends to the local problems of the States of Tamil Nadu and Kerala and the Union Territories of Andaman and Nicobar islands, Lakshadweep and Pondicherry.

The primary objective of the Institute is to conduct, at national level, research on all aspects of genetic improvement and propagation of forest tree species for the selection, identification and development of environmentally compatible types with desirable growth, timber/biomass and disease and pest resistant characteristics.

The following are thrust areas of research.

Genetic improvement of selected tree species; Clonal multiplication of superior types of teak, eucalyptus, casuarina and acacias; Tissue culture techniques for mass propagation of bamboos; Quality seed production and seed testing technologies; Intensive studies for the development of improved production systems of fuel-wood, pulp, small timber and fodder species; Eco-restoration and eco-development of Western and Eastern Ghats and mangrove forests; and *in situ* and *ex situ* conservation of forest genetic resources and biological diversity.

Research are carried out through divisions-Genetics and Tree Breeding, Plant Biotechnology and Cytogenetics, Silviculture, Seed Technology, Agroforestry and Forest productivity, Forest Protection, Biodiversity, Economics and Sociology.

The Institute has the following 3 centres for advanced studies :

Centre of Advanced studies for Forest Genetics; Centre of Advanced studies for Forest Biotechnology; Centre of Advanced studies for Silviculture.

PROJECTS COMPLETED DURING 1999-2000

Sl.No : 1

Project identification No. : IFGTB/SIL/RP 11/37/ICFRE

Name of the principal investigator : Dr. P. Devaraj

Title of the project: Reclamation of magnesite minespoil.

Year of start of the project: 1996

Cost of the project : Rs. 0.20 lakhs

Objectives: (a) To develop a package of suitable species and soil amendments for reclamation of magnesite minespoils. For improving the physical, chemical and biological properties of the mine overburdens. (b) To carry out afforestation trials with the species identified as suitable for magnesite minespoils with both seedling and vegetative propagules. (c) To carry out further genetic improvement of species found suitable for magnesite minespoils by selection, testing and establishment of seed production populations exclusively for afforestation of magnesite minespoils.

Scientific importance of investigations: The results of the investigation can be utilized for the affore station of magnesite minespoils by adopting the best soil amendment and the species found to be suitable.

Results/Achievements: Species trial on Casuarina with *C. equisetifolia* seedlings, C. *junghuhniana* seedlings and *C. equisetifolia* cuttings was laid to find the suitability of Casuarina species for the magnesite minedump at Burn Standard & Co., Salem. *C. equisetifolia* seedlings have perfomed better than their other propagules.

Eight Candidate Plus trees of *Casuarina equisetifolia* were selected from the plantations existing on the minespoils and their clones have been included in the Casuarina clone banks at Neyveli and Coimbatore.

Sl. No.: 2

Project identification No. : IFGTB/ ST/ RP 15/ 37/ ICFRE

Name of the principal investigator : B. Gurudev Singh

Title of the project : Standardization of optimum storage condition for *Azadirachta indica* and methods to prolong the viability.

Year of start of the project 1997

Cost of the project : Rs. 12.00 lakhs

Objectives: (a) To standardize seed collection technique. (b) To study the effect of seed moisture content, storage, temperature, and conditions on the viability of seeds. (c) To study the bio-chemical changes associated with seed deterioration. (d) To study the genetic variation within and between populations.

Scientific importance of investigations : *Azadirachta indica* is an indigenous species that has drawn worldwide attention as a potential source of medicine, insecticide and oil. It's seeds have short viability and their high moisture content is found to be detrimental for temperature storage. Therefore, the study will help optimizing the seed storage condition at different moisture levels and prolong the viability.

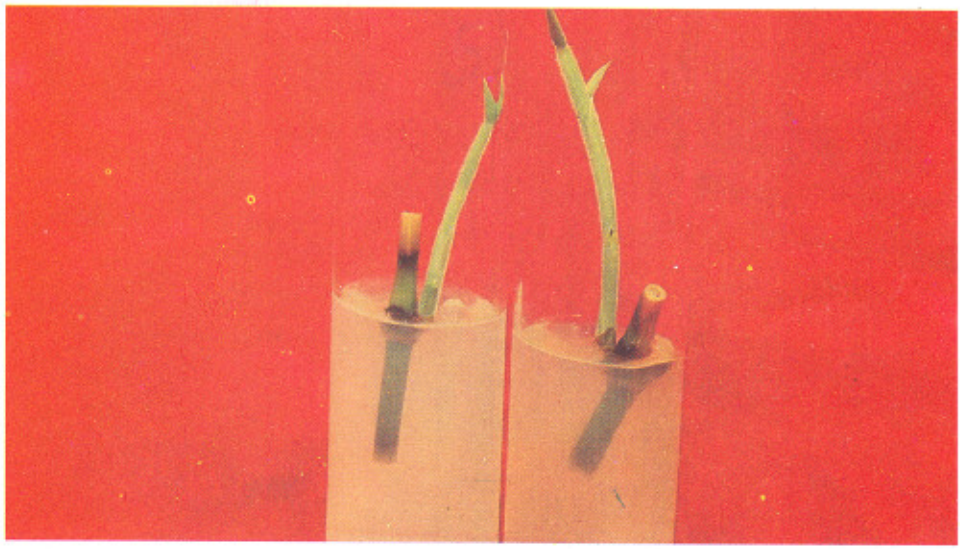
Results/Achievements : Seeds collected during June-July were found to be better compared to the seeds collected during December. The fruits collected from the ground were found to have lost their viability within a week's time due to fungal growth. Lopping of branches with mature green fruits and greenish-yellow and yellow fruits gave better results after withering the fruits in shade for two days. Seeds stored with high moisture content in deep freeze condition lost their viability within two days. Whereas, seeds stored with low moisture content (8-9%) in ambient and refrigerator conditions gave better result. The study shows that the seeds stored with endocarp at ambient condition gave better results. Bio-chemical studies were undertaken to find out the mechanism behind loss of viability. The enzymes associated with seed deterioration were identified namely peroxidase, *Polyphenol oxydase*, *Glutamine synthatase*, Lipase, Superoxy dismutase and catalase.

Sl. No.: 3

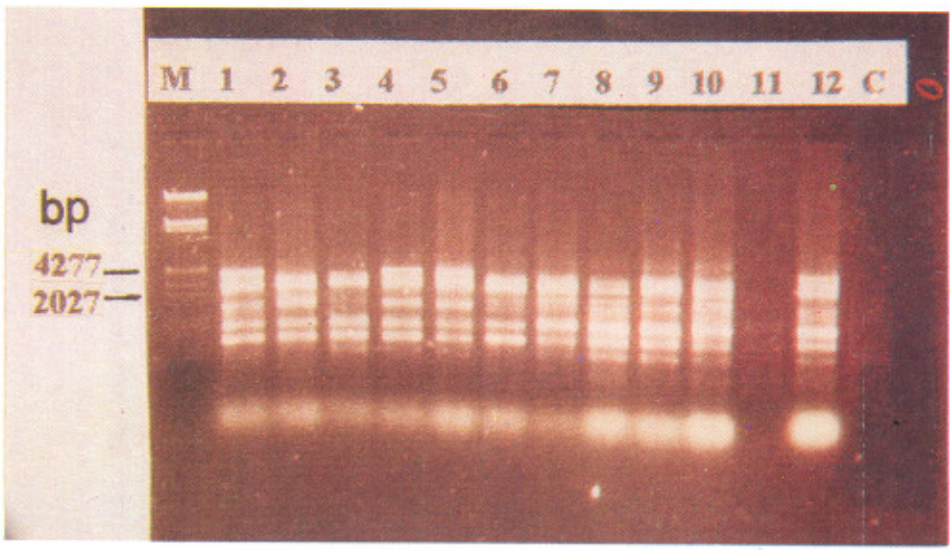
Project identification No.: IFGTB/ FP/ RP 25/ 37/ ICFRE

Name of the principal investigator : Dr. A. Balu

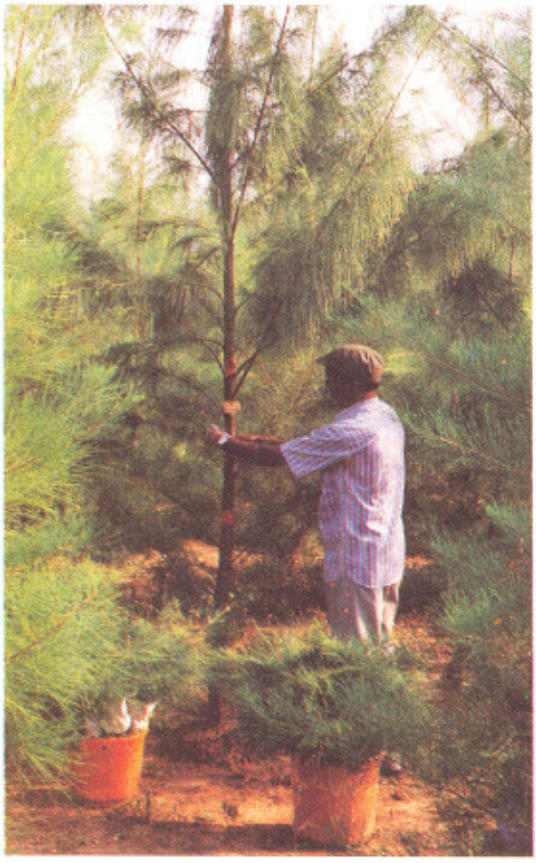
Title of the project: Survey and evaluation of insect pests of forest tree species in nurseries and plantations.



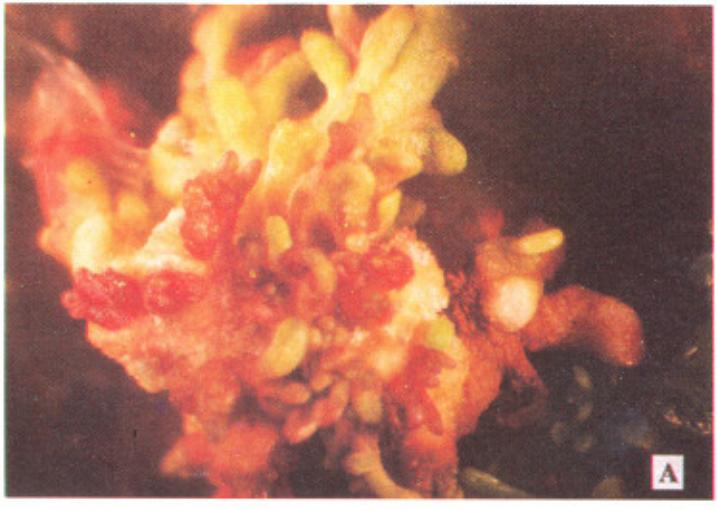
Bamboo - Axillary Bud Culture



RAPD Polymorphism of the Clones of Casuarina equisetifolia
(M-Maker DNA, 1-12 Sample DNA of the Clones, C-Control)



Collecting of Cutting from Selected ***Casuarina*** *Tree of PNG in Progeny Trail*



Shoot Buds Arising from the Callus

Year of start of the project : 1995

Cost of the project : Rs. 10.50 lakhs

Objectives: (a) Regular and systematic pest surveys in nurseries and plantations of the manmade species aimed to study. (b) pest spectrum. (c) key pests and damage caused. (d) biology. (e) seasonal intensity (f) causes and factors pre-disposing the plants to pest attack.

Scientific importance of investigations : The project will help in minimizing damage due to pest by suggesting pest control measures.

Results/Achievements :

Tectona grandis (Teak)

Six year old plantations raised at Solavampalayam village, in Coimbatore district had sporadic infestation of the bark feeding borer, *Indarbela quadrinotata*. The intensity of its infestation was found to increase in the month of May. The attack of leaf-skeletoniser, *Eutectona machaeralis* was found to start in October and peak in the month of December. In Coimbatore, area 10 to 20% saplings in 1 to 2 year old plantations raised in Konni Forest Division of Kerala State had the attack of the stem-borer, *Sahyadrassus malabaricus*. The infestation resulted in drying up of affected plants, as the larva of the pest excavated long, cylindrical tunnel, through the pith, extending to the tap root. The clones maintained in the germplasm bank at Nilambur had sporadic infestation of the defoliators viz., *Hyposidra successaria*, grasshoppers and weevils.

Casuarina equisetifolia

Six months old seedlings raised in the coastal area of Tamil Nadu, had died due to the the attack of root-grub. Incidence of 'Cottony Cushion Scale, *Icerya purchasi* was noticed on vegetatively propagated plants in the Silviculture nursery, at Coimbatore. The pest incidence ranged from 2.86% to 41.67%. The minimum attack was exhibited by the clone, PY-75 and the maximum by TNPK-2. Incidence of the bark caterpillar, *Indarbela quadrinotata* was studied in certain localities of Kerala and Tamil Nadu. The incidence of this pest was 5 to 7% in a 4 year old plantation at Panampally area of Kerala. The 9 - 10 year old plantations raised in Sirkali area of Tamil Nadu had 45 to 50% attack of *Indarbela*. Some of the infested trees were found to have the attack of 10 to 15 borers. Scanty infestation of the sap sucking pest, *Icerya purchasi* as well as the needle feeding lymantrid caterpillar, *Lymantria detersa* were detected in plantations raised at Panampally area of Kerala.

Tamarindus indica

Defoliation by a species of bagworm (to be identified) by the weevil, *Myllocerus viridanus*, was recorded in many parts of Tamil Nadu. Low intensity infestation by mealy bugs was also encountered in few localities of the state.

Azadirachta indica

The International Provenance Trial established at Panampally had attack of the Neem Scale, *Megapulvinaria maxima*, which resulted in drying of trees. Mass - drying of 3 year old plants due to the infestation of the sap - sucking pest, *Helopeltis antonii,* was also recorded in a few pockets of Coimbatore district.

Sl. No.: 4

Project identification No.: IFGTB/ FP/ RP 26/ 37/ ICFRE

Name of the principal investigator : Dr. J.P. Jacob

Title of the project : Studies on seed pests of forest trees and evolving prophylactic seed treatments against pest attack during storage.

Year of start of the project : 1995

Cost of the project : Rs. 10.50 lakhs

Objectives: (a) Enumeration of pre-harvest and post-harvest pests. (b) Detection of key pests and study of their biology. (c) Segregating sound seeds from infested ones. (d) Need for prophylactic treatments and study of their impact. (e) Developing sound storage practices.

Scientific importance of investigations : Elucidation of the impact of attack of various insects, during pre-harvest and post-harvest stage of forest seeds. Developing economically viable and environmentally friendly control measures to contain the pest problems.

Results/Achievements :

Tectona grandis (Teak)

Enumeration of pre-harvest pests showed that, Tingids infests 27-50% fruits, whereas the incidence of other insects like *Stigobium* sp., beetles, lepidopterans and coccids are less than 10%. Up to 58% pre-harvested fruits were found to have insect attack.

Tamarindus indica

Tested a commercial Neem product, 'Neem Azal' on the storage pest, *Caryedon serratus* and found that the product, at 30 and 40 ppm was able to bring about 80 to 100% mortality of the beetle. Another Neem formulation, 'Nibecidine' at 30 and 40 ppm was also capable of causing complete mortality of the beetle. The chemical insecticides like chlorpyrifos and dichlorvos at low concentrations, 0.01 and 0.05% a.i. when applied on gunny bags used for storing the seeds, could effectively protect the seeds from the infestation of *C. serratus*. The insecticides like malathion, methyl parathion, monocrotophos, carbaryl, endosulfan and lindane were used for impregnation of the storage bags and tested for their efficacy against *C. serratus* and *Sitophilus* sp. Among these, endosulfan, lindane and carbaryl brought about 80 to 100% mortality within 24 hours in all the insecticidal concentrations (0.01, 0.05 and 0.1%) applied. When seeds were treated with the above insecticides and exposed to *Sitophilus* sp., methyl parathion and endosulfan were found to be very effective. Dry leaf powder of *Adhatoda vasica*, @ 20 gm/200 gm seed was found to result in 90-100% mortality of *Sitophilus* sp. within a week.

The dry leaf powder was also found to have profound impact on pupal emergence.

Sl. No. : 5

Project identification No.: IFGTB/ FP/ RP 27/ 37/ICFRE

Name of the principal investigator : Dr. A. Balu

Title of the project : Evolving biological control strategies for key pests.

Year of start of the project : 1995

Cost of the project : Rs. 48.00 lakhs

Objectives: (a) Survey of parasites, predators and entomopathogenic micro-organisms operating in the field. (b) Identifying potential bio-agents. (c) Developing mass rearing technologies for the promising bio-agents. (d) Evaluating bio-agents available commercially in the market, against the key pests. (e) Attempting release of biocontrol agents in the field and studying their efficacy.

Scientific importance of investigations : Elucidation of the natural enemy complex associated with the pest species. Developing eco-friendly and economically viable pest control measures by deploying the potential bio-agents. Conservation of natural bio-control agents for suppressing the pest population below economic injury level.

Results/Achievements

Tectona grandis (Teak)

The laboratory evaluation of a particular strain of *Beauveria bassiana* against the skeletoniser *Eutectona machaeralis* resulted in 70% mortality of the skeletoniser larva in the laboratory condition. A powder form of the entomopathogenic bacterium, *Bacillus thuringiensis* when tested on the larva of *E. machaeralis* gave promising results in the laboratory condition. The same bacterium was also field tested on the skeletoniser, which gave 100% mortality at 0.2% concentration in 48 hrs. Concentrations below this were found to have slow action. A natural strain of the fungus, *Fusarium* sp. isolated from the field collected larva was subcultured and tested on the defoliator *Hyblaea puera* in the laboratory, which resulted in 74% mortality of the larvae. A strain of *Beauveria bassiana*, when sprayed on infested plants could yield 90 to 100% control of the bark feeding borer *Indarbela quadrinotata*, in the field condition.

Casurain equisetifolia

The efficacy of a natural strain of the entomopathogenic fungus *Beauveria bassiana* was studied on *I. quadrinotata* in the laboratory as well as in the field conditions. It was found that the fungus could cause 100% mortality at a concentration of 3.6×10^{6} spores/ml., after 192 hrs in the laboratory condition. The same fungal strain at a higher concentration of 3.6×10^{10} spores/ml results in 100% mortality of the pest larvae under field condition. The spread of *B. bassiana* in certain epidemic locations of Tamil Nadu where the attack of *I. quadrinotata* is severe, is being studied after spraying the trees with crude formulation of the fungus. Mass - production of *B. bassiana* was attempted by using different growth media, which showed that Sorghum powder was capable of producing more number of spores.

Tamarindus indica

A hymenopteran larval parasitoid capable of effecting 30% parasitization on the bagworm defoliator was detected from Deevattipatti area of Tamil Nadu. The potential of the entomopathogenic fungus *B. bassiana* to control the storage seed pest *Caryedon serratus* was studied which showed that the fungus is capable of causing 100% mortality of the pest within a weeks time.

Sl. No.: 6

Project identification No.: IFGTB/ FP/ RP 28/ 37/ ICFRE

Name of the principal investigator : K.R. Sasidharan

Title of the project: Evaluation of plant products for forest insect pest management.

Year of start of the project : 1995

Cost of the project : Rs. 24.00 lakhs

Objectives: (a) Evaluation of the efficacy of various plant products on the key pests. (b) Development of techniques for isolation of important active components. (c) Development of formulation and testing against the pests. (d) Investigation on the effect of these formulations on the natural enemies of the pest under study.

Scientific importance of investigations : Utilization of under exploited plant products for pest control. Characterization of various biochemical components capable of controlling the pests. Developing of eco-friendly and economic viable pest control measures. Conservation of biodiversity of natural enemies.

Results/Achievements: The effect of aqueous extract of Neem Seed Kernel on the bagworm *Cryptothelia crameri* was studied in the laboratory condition. The extract at 5% concentration was found to result in high deterrance and antifeedancy, but the mortality rate was not significant.

Sl. No.: 7

Project identification No. :IFGTB/ FP/ RP 29/ 37/ ICFRE

Name of the principal investigator : Dr. V. Mohan

Title of the project : Survey and evaluation of the diseases of important forest tree species.

Year of start of the project : 1995

Cost of the project : Rs. 28.25 lakhs

Objectives : Regular and systematic disease surveys in nurseries and plantations in order to assess. (a) Disease spectrum. (b) Damage caused. (c) Seasonal intensity. (d) Epidemiology. (e) Possible management strategies.

Scientific importance of investigations : Enumeration of various disease causing organisms associated with the tree species. Assessment of damage caused. Identification of major diseases. Elucidation of ecological factors responsible for epidemics. Possible management by adopting suitable cultural practices and detecting effective fungicides to contain the problems.

Results/Achievements

Tectona grandis (Teak)

The clonal plants of Maharashtra origin being grown by the Plant Biotechnology Division of the Institute had leaf-rust disease caused by *Olivea tectonae*. The disease incidence was found to vary from 20 to 70% among the different clones studied.

Casuarina equisetifolia

Survey trips were undertaken to the Casuarina growing areas to study the incidence of 'blister bark' disease caused by *Trichosporium vesiculosum*. Different isolates of *T. vesiculosum* were collected from the affected plants, cultured and stored for conducting various experiments. The soil samples were also collected from these localities and their nutrient status analysed. A progeny trial established at Coimbatore had 27% trees affected by blister-bark disease. Investigations made on the presence of the pathogen showed that, it mostly occurs in the soil, around the base of the trees. *Trichoderma viride* and *T. harzianum* fungi were tested '*in vitro*' on the pure cultures of *T. vesiculosum* isolated, which revealed that both are capable of inhibiting the growth of the pathogen *T. vesiculosum* in all the isolates.

Eucalyptus spp.

Leaf-spot and leaf-blight caused by *Alternaria* sp. and *Cylindrocladium* sp. were detected in the clonal nursery of *E. tereticornis* at Coimbatore. Artificial inoculation studies conducted on 4 clones of J.K. Paper Corporation showed that the clone No. 36 remained unattacked, while others were affected by *Alternaria* sp. and *Cylindrocladium* sp. Seedling blight caused by *Alternaria* sp. and Cylindrocladium sp. in root trainer raised plants of *E. camaldulensis* in Coimbatore was observed. Soil and mushroom waste was the potting mixture used. The extent of infestation was estimated to be 7 to 13%. Application of bavistin at 0.01% a.i. could contain the problem. The incidence of collar-rot disease caused by *Fusarium oxysporum* in root trainer raised seedlings at Coimbatore was also recorded to the extent of 20%.

Bambusa nutans

Fusarium sp. attacked over 50% tissue culture plants at Coimbatore. Foliar spray and soil drenching with bavistin 0.01% a.i. gave good control of the disease.

Tamarindus indica

Incidence of *Fusarium* sp. was detected in root-trainer raised plants. The occurrence of the disease was found to vary with different potting mixtures used. The maximum drying of 78.5% was observed in the potting mixture of sand and mushroom waste and the minimum of 3 to 5% was found in the mixture of sand, red soil and farmyard manure.

Azadirachta indica (Neem)

Fusarium sp. caused drying of 3 months old seedlings at Coimbatore. Application of bavistin at 0.01% a.i. at fortnightly interval could well contain the problem. Preliminary studies were conducted on the efficacy of various extracts made from two plant species, *Dirca palustris* and *Rudbeckia fulgida* on two pathogenic fungi *Fusarium* sp. (isolated from *Bambusa nutans*) and *Pestalotiopsis* sp. (isolated from Casuarina) in the laboratory condition. The results show that both the plant species have potential antifungal property.

Sl. No.: 8

Project identification No. : IFGTB/ FP/ RP 30/ 37/ ICFRE

Name of the principal investigator : Dr. V.Mohan

Title of the project: Evaluation, selection and application of Mycorrhizae and root nodule microsymbionts (biofertilizers) in forest tree species.

Year of start of the project : 1995

Cost of the project : Rs. 18.00 lakhs

Objectives: (a) Survey of nurseries, plantations and natural forests to identify the range of mycorrhizal fungi/ root nodulating microbial strains. (b) Isolation and identification of different species of mycorrhizhal fungi and other biofertilizers, testing cultures, and evaluating efficacy in field conditions.

Scientific importance of investigations : Exploitation of un-utilized/under-utilized microbial resources for increased survivability and production of biomass in forest tree species. Conservation and multiplication of micro-organisms and preservation of their biodiversity.

Results/Achievements :

Tectona grandis (Teak)

Root samples and rhizosphere soils were collected from plantations located in different parts of Tamil Nadu and Kerala, for estimating percent root colonisation and spore population of VAM. Spores of two genera of VAM fungi viz. *Glomus* and *Acaulospora* were found associated with this tree species with population of *Glomus* having pre-ponderance over *Acaulospora*. The VAM colonisation was found to vary with respect to different localities.

Eucalyptus spp.

Survey conducted in various localities of Tamil Nadu and Kerala revealed that Eucalyptus has association with two genera of VAM fungi viz. *Glomus* and *Acaulospora*. The population of *Glomus* was found to be predominant than the other. Association of the ectomycorrhizal fungus, *Pisolithus tinctorius* was detected in *E. tereticornis* and *E. camaldulensis*. The VAM colonisation was found to vary with respect to different localities. Studies on the efficacy of *Glomus fasciculatum*, *Pisolithus tinctorius* and a strain of phosphobacterium on the growth of *E. camaldulensis* seedlings showed that all the inoculated seedlings had better plant height and biomass than uninoculated ones. It could also be concluded that combined inoculation of these mycorrhizal fungi and the phosphobacterium was better than their individual inoculation.

Santalum album (Sandal)

Sandal was found to have association of VAM fungi like *Glomus* sp., *Acaulospora* sp. and *Sclerocystis* sp.

Bambusa spp.

The effect of inoculation of a strain of phosphobacterium on tissue culture raised plants was studied. The inoculated plants exhibited better growth and biomass over the uninoculated control.

The ecotomycorrhizal fungus, *Thelephora ramarioides* was detected on *Casuarina equisetifolia*, *Acacia auriculiformis* and *Acacia mangium*.

OLD PROJECTS CONTINUED DURING 1999-2000

Sl. No.: 1

Project identification No.: IFGTB/ GTB/ RP 1/ 37/ FREEP

Name of the principal investigator : Dr. Mohan Varghese

Title of the project: Genetic improvement of forest trees.

Year of start of the project: June 1995

Target year of completion: December 2001

Cost of the project : Rs. 14.50 lakhs

Objectives: (a) To increase productivity of *Eucalyptus camaldulensis* and *Casuarina equisetifolia* through selection and breeding. (b) To establish seedling seed orchards for production of improved seeds.

Scientific importance of the investigations: Breeding trees with pedigree is a very challenging area. Very few programs around the world have reached the second filial generation. The very idea of the project is to create a strong population base from which selection of genotypes in different species is conducted across sites for improving productivity and other qualitative traits such as pest and disease resistance.

Results/Achievements: Seedling Seed Production Areas (SSPAs) of *Eucalyptus camaldulensis* were established in 1995 at Panampally and were thinned using index selection. Breeding populations comprising 182 families were established at three locations namely Panampally (Kerala), Pudukkottai (Tamil Nadu) and Sathyavedu (Andhra Pradesh) in the form of large progeny trials. These trials were evaluated for first and second year growth for identifying site specific superior provenances and families.

Breeding populations of *Casuarina equisetifolia* were established at Balukhand (Orissa), Rajahmundry (A.P) and Sadivayal (TN) in the form of large progeny trials. 200 seedlots belonging to land races from eight countries viz., India, Malaysia, China, Kenya, Thailand, Vietnam, Papua New Guinea and Solomon Isles were used in these trials. The early growth performance was evaluated to identify the suitable seedlots for the different regions.

Sl. No.: 2

Project identification No. : IFGTB/ GTB/ RP 2/ 37/ FREEP

Name of the principal investigator : Dr. V.Mohan

Title of the project: Reproductive Biology of Tropical Trees.

Year of start of the project: June 1995

Target year of completion : December 2001

Cost of the project : Rs. 27.00 lakhs

Objectives: (a) To understand phenology and floral biology. (b) To know the breeding system and pollen biology. (c) To develop hybridisation techniques.

Scientific importance of the investigations: This project aims to understand the reproductive biology and breeding system of selected tree species.

Results/Achievements: Controlled selfing experiments were conducted in five ramets of SBL.1 teak clones in Walayar. Very clear self incompatibility could be observed. Embryological studies reveal that seed filling is hindered due to abnormality in endosperm development. Pollen storage using vacuum drying method up to three months produced normal fruit and seed set in Tamarind and Teak. Seedlings were healthy and normal in Tamarind. In *Casuarina equisetifolia* controlled crossing was carried out in four female and one monoecious clone (TNIPT7), selfing resulted in normal fruit set. Controlled pollination resulted up to 90% fruit set. Viability of seeds was high up to 90% in both monoecious and female trees in Casuarina. A comprehensive study was initiated on the fruiting and seeding behaviour of 13 different Provenances at the International Provenence Trial at Pondicherry. Provenances from India, China and Australia showed very good fruit and seed yield, while provenances from Kenya and Egypt produced very poor seeding despite showing excellent vegetative growth. Pre-emergent reproductive success varying from 0.3 - 0.6 were recorded. Progeny - Zygote ratio up to 0.8 was recorded which is quite a high value. A similar trend was also noticed in randomly selected monoecious individuals.

Sl. No.: 3

Project identification No.: IFGTB/ GTB/ RP 3/ 37/ FREEP

Name of the principal investigator : K. Subramanian

Title of the project: Evaluation of genetic variability in teak in Peninsular India.

Year of start of the project : June 1997

Target year of completion : December 2001

Cost of the project : Rs. 21.50 lakhs

Objectives: (a) To identify the natural populations of teak in Peninsular India and record morphological and physiological variability. (b) To estimate genetic variability existing within and among populations through molecular markers and to confirm the delineation of ecotypes and other varietal identifications. (c) To evolve appropriate selection and breeding strategy for genetic improvement of the species.

Scientific importance of the investigations: For teak, no systematic study has so far been carried out in India to evaluate the variability..Quantification of genetic variability assumes added significance while considering the long rotation age of the species, poor seed output from seed orchards and presence of distinct ecotypes within the species. This project aims at evaluating the genetic variability present in the natural teak forests of Peninsular India. It also seeks to understand the relationships between different populations/ecotypes of teak and recommend appropriate selection and future breeding strategies.

Results/Achievements: Survey and sampling has been conducted in distinct teak populations such as Dangs (Gujarat), Bori (Madhya Pradesh), Mudumalai (Tamil Nadu), Berbera (Orissa) and Dandeli (Karnataka). A comprehensive genetic variation study was conducted in four teak populations Randomly Amplified Polymorphic DNA assay at Konni, Topslip, Kalakkad from Southern India and at Allapally from Central India. Fourteen random oligonucleotide decamers were used for the study. The amplified products varied from 6 to 13 between primers. A clear trend of latitudinal relationship between populations was noticed. In general, variations within the populations were high, reflecting the high rates of outcrossing. All the four populations varied distinctly and could be broadly categorized under three major groups of which Central India population was the most distinct in comparison to the South Indian populations. A trial plantation consisting of 25 families from moist populations of Teak has been raised in 1.5 acre area in Sadivayal to understand the phenotypic expression and growth performance.

Sl. No.::4

Project identification No.: IFGTB/ PBT/ RP 4/ 37/ ICFRE

Name of the principal investigator : Dr. K. Gurumurthi

Title of the project: Assessing growth and physiological variations like photosynthesis in fast growing tree species for improving yield

Year of start of the project: 1992

Target year of completion: 2001

Cost of the project : Rs. 25.00 lakhs

Objectives: (a) To survey and select superior performing plants of *Casuarina equisetifolia* and *Eucalyptus* sp. and standardise the procedure of cloning. (b) To carry out physiological and genetic studies in order to find out interclonal variations in the identified superior performers. (c) To identify the salinity tolerant clones of *Casuarina equisetifolia.*

Scientific importance of investigations: Identification of physiological markers will help in selecting clones ideal for pulping. A simple cost effective protocol for screening salt tolerant individuals, will be developed. Rare phenomenon of change in sex expression in clones of Casuarina can be understood.

Results/Achievements: Rate of photosynthesis and wood fibre characteristics were studied in clones of *Eucalyptus tereticornis*. The study revealed that photosynthetic rate could be used as a marker to identify wood of good pulping quality.

A simple test method was adopted for screening salt tolerant trees involving soaking of leaf disc of different species in 1% sodium chloride solution and observing of leaf necrosios or browning. This method after further refinement could be used for preliminary screening of trees for salt tolerance.

Studies have been initiated to understand phenemenon of change in sexual system in clones of *Casuarina equisetifolia* at the molecular level. Protein profiles of the inconstant individuals were compared with those of the constant males, females and monoecious individuals. A reduction in protein content is noticed in the transformed plants when compared to the constant individuals. Electrophoretic studies are in progress.

Sl. No.: 5

Project identification No. : IFGTB/ PBT/ RP 5/ 37/ ICFRE

Name of the principal investigator : Dr. K. Gurumurthi

Title of the project: Micropropagation and Tissue Culture studies on selected tree species including procedure for Hardening, Weaning and Out planting.

Year of start of the project: 1992

Target year of completion: 2001

Cost of the project : Rs. 35.00 lakhs

Objectives: (a) To develop technique for micropropagation of important tree species like bamboos, eucalypts, neem, etc. (b) To develop protocol for somatic embryogenesis in bamboos.

Scientific importance of investigations: Development of bench level micropropagation protocols for the tree species like Teak, Bamboo, Eucalypts and Neem will be achieved and the micropropagation technology for large scale multiplication has to be transferred to user agencies.

Results/Achievements: Protocol has been developed for micropropagation of bamboo, *Oxytenanthera stocksii* Munro, which never flowered in the last hundred years, anywhere in India. The process developed for micropropagation was sent to NRDC for patent assistance. It is suitable for commercial propogations.

Twenty-nine years old putative hybrid of *E. citriodora* X *E. torelliana*, was successfully micropropagated from the axillary buds.

Germplasm of various clones of *Eucalyptus tereticornis* and *Eucalyptus camaldulensis* were maintained under *in vitro* conditions. New clones assembled in the clone bank were added in culture. The stock cultures are being transferred to fresh medium at three months interval.

Histological studies on the development of somatic embryos have been initiated.

Sl. No.: 6

Project identification No.: IFGTB/ PBT/ RP 6/ 37/ FREEP

Name of the principal investigator : Dr. K. Gurumurthi

Title of the project: Biotechnology of trees.

Year of start of the project: 1995

Target year of completion: 2001

Cost of the project : Rs. 33.10 lakhs

Objectives: To establish a nucleus of scientists and develop laboratory facilities for non-conventional tree improvement programme.

Scientific importance of investigations: Infrastructure will be Gealed and human resource will be developed for conducting advanced biotechnological research in forest trees. Methods for enhancing the genetically improved planting stock will be evolved.

Results/Achievements: Regeneration protocol was developed for *Eucalyptus tereticornis* Sm. through somatic embryogenesis and organogenesis from seedling explants.

Caulogenesis was obtained from mature needles and various seedling explant sources in *Casuarina equisetifolia*. However callus obtained from mature needles, cotyledonary tissues, and epicotyl tissues was found to be recalcitrant to regeneration. Hypocotyl derived callus are being tried for obtaining regeneration.

Crude protein extract from leaves of *Plumbago capensis* was found to inhibit *in vitro* spore germination of the blister bark pathogen, *Trichosporium vesiculosum* in *Casuarina equisetifolia*. Three medicinal plants, *Rauwolfia tetraphylla, Andrographis paniculata* and *Piper longum* were found to have a broad range of antifungal activity against several pathogens including, *T. vesiculosum, M. phaseolina, Aspergillus flavus* and *Coniella* sp.

To produce genetically enhanced planting stock of teak, micropropagation techniques were applied with the objective to amplify the limited available seeds from CSO. About 10 genotypes from six clones were established to scale-up the cultures for the production of plantlets for field demonstration trials.

Genomic DNA isolated from the clones of *Casuarina equisetifolia* was amplified with random 10 base primers. Of these, 6 primers were informative that could be used for finger printing of selected clones of *Casuarina equisetifolia*.

Sl. No : 7

Project identification No. : IFGTB/ SIL/ RP 12/ 37/ ICFRE

Name of the principal investigator : Muralidhar Rao

Title of the project: Screening of *Casuarina equisetifolia* and *C. junghuhniana* genotypes for plantation in problem soils of Tamil Nadu.

Year of start of the project: 1995.

Target year of completion : 2002

Cost of the project : Rs. 6.00 lakhs

Objectives : The project aims at carrying out selection from the plantations of *Casuarina equisetifolia* and *C. junghuhniana* and their hybrids raised under rainfed conditions and /or under conditions of drought, salinity and minespoils and screening them under such harsh conditions to evolve cultivars for environmental plantations.

Scientific importance of investigations : The selected individuals screened under harsh conditions of rainfed, drought and salinity will be suitable for environmental improvement.

Results/Achievements : Trials with material selected from diverse sites is in progress.

Sl. No. : 8

Project identification No. :IFGTB/ FPAF/ RP 20/ 37/ FREEP

Name of the principal investigator : Dr. M. George

Title of the project : Nutrient cycling in Teak plantations of Tamil Nadu (World Bank Aided Project).

Year of start of the project : 1994

Target year of completion : 2000

Cost of the project : Rs. 10.66 lakhs

Objectives : (a) To estimate the biomass and productivity of Teak plantations in Tamil Nadu. (b) To develop regression equation to predict dry matter production on a regional basis. (c) To estimate the nutrient content in the standing crop of Teak plantation. (d) To quantify nutrients return through litter and rain wash. (e) To study nutrient uptake and nutrient cycling in Teak plantations.

Scientific importance of investigations : The knowledge on productivity of Teak plantations in different age groups will be available after the completion of study. Regression equation to predict dry matter production on a regional basis will be developed for use by the foresters. A knowledge on Nutrient Cycling in Teak plantations will be available.

Results/Achievements: Sample plots were laid out in different age groups of Teak plantations in Tamil Nadu and growth parameters of trees were recorded. Sample trees were felled and fresh weight of biomass components recorded. Samples were collected for estimation of dry weight and chemical analysis for their nutrient concentration. Soil samples were collected for chemical analysis. Nutrient content in the standing crop is being worked out for different plantations at different ages. The dry matter production on unit area basis ranged from 142 t/ha at 25 years age to 497 t/ha in 35 years. The stem wood volume also showed variation from 136 to 426 m^3/ha. Productivity models on a regional basis is being worked out.

Litter production and nutrients return was studied in few plantations of different ages. The results were compiled. The total litter production amounted to 9.9 t/ha. In the laboratory, the litter samples were analysed to estimate the nutrient return on unit area basis. It amounted to : N, 161.3; P, 1.543; K, 114.9; Ca, 215.9 and Mg, 34.2 kg/ha. Nutrient return through rain wash were studied and the nutrients returned amounted to : N, 28.8 ; P, 12.9 ; K, 61.9 ; Ca, 343.9 ; Mg, 84.0 kg/ha. Growth performance of Teak trees in young plantation were periodically recorded. Nutrient Cycling in young Teak plantation is being worked out.

Sl. No. 9

Project identification No. : IFGTB/ FPAF/ RP 20/ 37/ NABARD

Name of the principal investigator : M. George

Title of the project: Development of Agroforestry models for various Agro-ecological regions (NABARD Project).

Year of start of the project :1994

Target year of completion : 1999

Cost of the project : Rs. 22.50 lakhs

Objectives : (a) To conduct diagonostic survey in selected micro watersheds/ villages. (b) To conduct economic analysis of existing agroforestry systems. (c) To select multipurpose tree species for investigation in

agroforestry system. (d) To introduce bio-fertilizers in agroforestry plantations and evaluate their potential in enhancing productivity. (e) To design experiments on models for improving land use in different agro ecological regions. (f) To design appropriate land use management plan for selected micro watersheds. (g) To seek improvement of crop productivity through introduction of suitable tree species. (h) To establish demonstration plots based on research findings.

Scientific importance of investigations: Agroforestry models developed will help farmers to increase farm productivity and revenue. Models for improving land use in different agro ecological regions will benefit the farmers.

Results/Achievements : This project is being carried out in three micro watersheds in Coimbatore district of Tamil Nadu. One village nursery was established in farmers field to meet the requirements of seedlings to be planted in the three micro watersheds. 1,00,000 seedlings of different tree species and horticulture species were raised/ procured and 98,000 seedlings were planted in 400 farmers field under different models. Soil and moisture conservation measures like contour bunds/ trenches, gully plugging, live hedges, mulching and water harvesting structures were adopted where ever necessary.

The most productive combinations identified were Teak-Casuarina and Casuarina-Moringa. These models gave high returns within a short span of 3 years. Training was imparted to the farmers on nursery techniques, seed collection and handling and development of different agroforestry models.

Sl. No. 10

Project identification No. : IFGTB/ FPAF/ RP 22/ 37/ ICFRE

Name of the principal investigator: Dr. S. Mohan

Title of the project: Productivity and Nutrient Dynamics in Agroforestry system.

Year of start of the project :1998

Target year of completion : 2003

Cost of the project : Rs. 1.88 lakhs

Objectives : (a) To study the dry matter production (including economic production) of Teak and Casuarina in Agroforestry system. (b) To work out the economics of Teak and Casuarina cultivation in Agroforestry. (c) To study the effect of Teak and Casuarina cultivation on agricultural soils. (d) To study the nutrient dynamics in tree and agricultural crop.

Scientific importance of investigations: Knowledge of biomass production of Teak and Casuarina in agroforestry system. Estimation of nutrient uptake, nutrients returned and nutrients retained of Teak and Casuarina in agroforestry system will give nutrient budget of the system. Tree crop interaction and partitioning of nutrients between Tree and agri-crop in agroforestry system will be established.

Results/Achievements: In the identified farmers' field, the experiment was laid out. Seedlings of Teak and Casuarina were planted as per the design. Initial soil sampling and growth measurements were recorded and the study is in progress.

Sl. No.: 11

Project identification No. :IFGTB/ FPAF/ RP 23/ 37/ ICFRE

Name of the principal investigator: C. Bhuvaneswaran

Title of the project: Investigation on wood properties of Teak in relation to variation in site factors and growth parameters.

Year of start of the project :1998

Target year of completion : 2001

Cost of the project: Rs. 1.16 lakhs

Objectives: (a) To study the influence of site factors on wood properties of Teak. (b) To study the wood properties of Teak in relation to growth parameters.

Scientific importance of investigations: The study will establish relationship, if any on formation and properties of wood to the following parameters.

a) Age and other growth parameters and

b) Edapho climatic factors

Results/Achievements: Growth data of Teak plantations from different regions of Tamil Nadu were collected. Soil samples were also collected and analysis is in progress. Wood samples were collected from different plantations and the study is in progress. Hartwood / Sapwood ratio was worked out for sample trees.

Sl. No.: 12

Project identification No. : IFGTB/ FPAF/ RP 24/ 37/ ICFRE

Name of the principal investigator: Syam viswanath

Title of the project : Management of *Casuarina equisetifolia* in Agroforestry for sustainable economic returns.

Year of start of the project :1998

Target year of completion : 2003

Cost of the project : Rs. 1.1 lakhs

Objectives : (a) To manage the tree crown to optimize the productivity of trees and agricultural crops. (b) To manage root distribution of Casuarina in relation to productivity of trees and crops. (c) To study the effect of Casuarina on the growth and yield of agricultural crop in Agroforestry. (d) To find suitable density, espacement, pruning schedule for maximising economic returns.

Scientific importance of investigations: Technical knowledge on crown and root management in Casuarina under Agroforestry system can help in minimising competition with agricultural crops under semi arid conditions.

Results/Achievements: Farmer's field was identified and experiment was laid out. Seedlings of Casuarina were planted as per the design. Initial soil sampling and growth measurements were recorded. The study is in progress.

Sl. No. : 13

Project identification No.: IFGTB/ ST/ RP 16/ 37/ ICFRE

Name of the principal investigator: B. Gurudev Singh

Title of the project : Standardization of germination methods in *Tectona grandis* and evaluation of vigour for seeds of different sources

Year of start of the project : 1995

Target year of completion : 2001

Cost of the project : Rs. 14.00 lakhs

Objectives : (a) To work out pretreatment requirement to get maximum germination. (b) To study source to source variation in germination capacity.(c) To study the dormancy mechanism operating in seeds.

Scientific importance of investigations : *Tectona grandis* is an important commercial timber wood species. Its seeds undergo multiple dormancy due to the presence of thick felty cover, stony endocarp and presence of germination inhibitors. The study will help increase the germination percentage.

Results/Achievements : The physiological changes associated with alternate wetting and drying were studied. Studies on duration of soaking, moisture content of seeds after every wetting and drying cycle were carried out.

The pathway of water movement into the fruits during alternate wetting and drying was studied.

Studies on the source to source variation in number of seeds/fruit, seed filling percentage, seed weight, shell weight and seeds to shell ratio were initiated.

Sl. No. : 14

Project identification No. : IFGTB/ ST/ RP 17/ 37/ ICFRE

Name of the principal investigator: V. Sivakumar

Title of the project : Standardization of seed handling procedures for commercially important forest medicinal plants.

Year of start of the project : 1997

Target year of completion : 2003

Cost of the project : Rs. 13.20 lakhs

Objectives : (a) To identify most important commercially exploited species. (b) To study the phenology of fruiting and maturation of fruit/seeds. (c) To evaluate the best extraction procedure and pre-treatment requirement for germination. (d) To standardize the optimum storage condition.

Scientific importance of investigations : Due to biotic pressure, there is increase in demand for medicinal plants. In the absence of proper seed handling procedure, raising of forest medicinal plants has become a tough task. The project emphasises to establish proper collection technique, pretreatment requirement, optimum storage condition and nursery technique which would help to meet the increasing demand for forest produce.

Results/Achievements : *Syzygium cumini*: Seed storage at different temperature ranges were continued.

Aegle marmelos: Initial germination percentage was found to be high. Storage studies were initiated. Fruit size variation was studied.

Feronia elephantum: Fruit size variation studies were carried out. Low temperature and desiccation tolerance studies were carried out.

Pterocapus marsupium: Storage of seeds at different temperatures was started.

Emblica officinalis: Initial germination was poor. Pretreatment studies were initiated.

Strychnos nux-vomica: Pretreatment studies were repeated.

Sl. No. : 15

Project identification No. : IFGTB/ ST/ RP 18/ 37/ ICFRE

Name of the principal investigator: V. Sivakumar

Title of the project : Standardization of seed handling techniques for tropical recalcitrant seeds.

Year of start of the project : 1999

Target year of completion : 2002

Cost of the project : Rs. 17.80 lakhs

Objectives: (a) To estimate the effect of initial condition of seeds (like seed maturity, mechanical damage and moisture content) on longevity of seeds. (b) To determine the bio-chemical changes associated with longevity of seeds. (c) To find out the effect of different atmospheric gaseous components in the storage container on the longevity of seeds. (d) To estimate the effect of seed moisture content on longevity of seeds. (e) To determine the influence of temperature on seed longevity (f) To find out the longevity of seeds in different storage methods and containers.

Scientific importance of investigations: Most recalcitrant tropical species are constituents of moist tropical forests, where conditions are conducive throughout the year for immediate germination. Where artificial regeneration is warranted for the conservation of such species, then the storage will be the major constraint for the large scale afforestation of these species. The study will be useful in successful regeneration of recalcitrant species.

Results/Achievements : Seeds of *Vateria indica* were collected from Mukkali, Kerala. Studies on seed moisture content and germination were initiated. Effect of storage temperature on viability were carried out. Studies on suitable storage method were initiated.

Other activities:

Maintenance of Seed Bank

Seeds of variouos important species viz. *Albizia amara, Acacia auriculiformis, A. leucophloea, Azadirachta indica, Bambusa arundinacea, Tectona grandis, Melia dubia, Casurina equisetifolia, Moringa oleifera, Tamarindus indica, Leucaena leucocephala, Delonix regia, Ceiba pentandra, Cassia fistula, C. siamea* and *Vateria indica* etc. were collected from different localities. Seeds of many of the above species were supplied to other divisions of the Institute, SFDs and NGOs on request.

Seeds of different species of *Acacia, Casuarina* and *Eucalyptus* (varying from 2 to 50 grams) received form Australian Tree Seed Centre, CSIRO Division of Forestry, Canberra were also supplied to different divisions of the Institute and other outside agencies for laying out trials.

Maintenance of International Provenance trial of *Azadirachta indica*.

Recorded the measurement of height and collar diameter for the plants in the International Provenance Trial of Neem established at Pannampally, Kerala. The number of provenances included in the trial are 18 representing 8 countries.

Sl. No.: 16

Project identification No. : IFGTB/ FP/ RP 31/ 37/ ICFRE

Name of the principal investigator: K.R. Sasidharan

Title of the project : Selection of pest resistant trees from wild populations, provenances and exotic trials and progeny tests.

Year of start of the project : 1993

Target year of completion : 2004

Cost of the project : Rs. 60.00 lakhs

Objectives : (a) Survey to detect resistant individuals or races in conditions of pest attack, especially epidemic infestation. (b) Determining basic factors conditioning resistance and identifying inheritable resistance traits. (c) Preliminary selection of resistant provenances/progenies/ candidates or individuals.

Scientific importance of investigations: Developing eco-friendly and economically viable pest control measures by selection and breeding for insect pest resistance. Elucidation of factors conferring resistance and identification of resistance mechanisms.

Results/Achievements :

Casuarina equisetifolia

The infestation of various provenances by the bark feeding borer *Indarblea quadrinotata* was studied in the two International Provenance trials established at Neyveli. These trials were laid out by Tamil Nadu Forest Department in 1991 and 1992. Out of 20 provenances available in the 1992 trial, 'Kilifi' seed source from Kenya continued to remain unattacked by the bark caterpillar. This was followed by the seed source 'Watamu' with a low susceptibility of 5.71%. The trees belonging to the local seed source exhibited maximum susceptibility of 58%. The three Indian Seed sources from Orissa included in the trial also showed high susceptibility ranging from 41.05% to 50%. In the 1991 Provenances trial having six seed sources, the plants belonging to seed sources 'Seventeen seventy (Qld) and 'Danger Point' are found to be promising in terms of resistance against the bark feeding borer *Indarbela quadrinotata*.

Albizia lebbek

Estimation of total carbohydrate and total amino acid content of leaves of six seed sources available in the provenance trial established at Sethumadai was carried out. The results reveal that 'Neyveli' and 'Salem' seed sources possess high carbohydrate and aminoacid content and 'Pudukkottai' seed source has low carbohydrate and amino acid content.

Sl. No.: 17

Project identification No. :IFGTB/ FP/ RP 32/ 37/ FREEP

Name of the principal investigator: Dr. A. Balu

Title of the sub-project : Selection of pest/disease resistant phenotypes of Teak, Eucalyptus and Casuarina.

Year of start of the project : 1997

Target year of completion : 2002

Cost of the project : Rs. 5.00 lakhs

Objectives: (a) Screening and identification of clones/progenies/provenances of the targeted tree species resistant to the key insect pests/diseases. (b) Distinguishing the pseudo and true resistance through analysis of insect/disease - plant interactions (Physical and chemical) and environmental factors. (c) Preliminary selection of resistant candidates for tree improvement programme.

Scientific importance of investigations : Developing eco-friendly and economically viable pest disease control measures by selection and breeding for insect pest/disease resistance. Elucidation of factors conferring resistance and identification of resistance mechanism.

Results/Achievements :

PEST RESISTANCE

Teak

The incidence of defoliators was studied in the Germplasm Bank established at Nilambur. The attack of *Hyblaea puera* in general was very low. Initiation of attack of *Eutectona machaeralis* occurred during November '99 and it continued at low to medium level till February 2000. Intensity of infestation of both these defoliators on 127 clones assembled in the Germplasm Bank was recorded. Preliminary works on histology and biochemistry of selected clones was initiated.

Eucalyptus

Families of certain CPTs belonging to the provenances, Gilbert River, Emu Cke Petford, Kennedy River and Morehead R Cape York either remained unattacked or exhibited low susceptibility to the bark feeding beetle *Celosterna scabrator* in the Progeny Trial cum SSO raised at Panampally. No incidence of the bark feeding beetle. *C. scabrator* could be noticed subsequently. No incidence of major pests could be detected in the progeny trial cum SSO of *E. camaldulensis* laid out at Pudukkottai and that of *E. tereticornis* raised at Pudukkottai and Pondicherry.

Casuarina

The progeny trial cum SSO of *C. equisetifolia* established at Panampally suffered infestation of the bark caterpillar *I. quadrinotata*. Out of 50 families available in the trial, 5 families had the attack with intensity ranging from low to moderate level. Attack of 'Cottony Cushion Scale' *Icerya purchasi* could also be detected on 8 families. Some of the Australian and Kenyan provenances which once remained unattacked by *I. quadrinotata* had slight infestation of the pest in the International Provenance trial at Pondicherry. But in general, the borer larvae do not prefer to feed on these provenances and desert the trees. One Australian Provenance (QL Australia) and a Kenyan provenance still remain unattcked by *I. quadrinotata*.

DISEASE RESISTANCE

Casuarina

Altogether 22 families available in the Progeny Trial cum SSO at Panampally had incidence of Blister bark disease caused by *Trichosporium vesiculosum*. Four families in the trial had root-rot disease caused by *Ganoderma lucidum*. Some of the families in the trial exhibited drying symptoms the cause of which is under investigation. Three Provenances-NT Australia, Egypt and Orissa available in the International Provenance Trial at Pondicherry had Blister Bark Disease.

Sl. No.: 18

Project identification No.: IFGTB/ E&S/ RP 35/ 37/ FREEP

Name of the principal investigator: S. Saravanan

Title of the project : Comparative Growth Studies of teak (*Tectona grandis*) in farmlands and waste lands of different agroclimatic zones of Tamil Nadu.

Year of start of the project : 1997

Target year of completion : March, 2001

Cost of the project : Rs. 7.50 lakhs

Objectives : (a) To study the growth pattern of teak plantations under different agro- climatic zones of Tamil Nadu. (b) To study the effect of spacing and cultural operations in total yield. (c) To study the irrigation effect on wood quality. (d) To study the climatic and edaphic factors in the study area to obtain optimum yield. (e) To study the impact of teak farming on socio-economic status on rural community.

Scientific importance of investigations: The output of this project will give a technical package to the farmers about teak cultivation on farm lands. Also it will give the approximate economic return within 20 years when compared to other agricultural crops.

Results/Achievements : Out of 7 agro-climatic zones survey in 4 zones was completed. North and south zone survey and sample collection is in progress. Analysis of collected wood and soil sample is in progress. After completion of the survey and sample analysis, results will be published.

Sl. No.: 19

Project identification No.: IFGTB/ E&S/ RP 36/ 37/ ICFRE

Name of the principal investigator: D. Raja suguna sekar

Title of the project : Socio-economic studies of some important medicinal plants in the tribal belts of Tamil Nadu.

Year of start of the project : March 1997

Target year of completion: Dec., 2000

Cost of the project : Rs. 11.50 lakhs

Objectives : (a) To study and record the important forest medicinal plants in the selected area. (b) To create awareness among the tribal and local people on importance of medicinal plant for cultivation by providing packages.

Scientific importance of investigations. The study would help in understanding the important medicinal plants utilized in medicines, approximate raw material requirement to raise the important forestry medicinal plants in the farm lands and waste lands in order to reduce the pressure on the natural forest.

Results/Achievements : Data base has been created for 250 commercially exploited medicinal plants. Cost benefit analysis of cultivation of medicinal plants was worked out for *Gloriosa superba.* Networking was established with an NGO based at Salem for marketing *Gloriosa superba, Mappia foetida* and other farm grown medicinal plants for farming community.

Serial No. : 20

Project identification No.: IFGTB/ PSIP/ RP 37/ 37/ FREEP

Name of the principal investigator: Siddappa.

Title of the project : Planting Stock Improvement Programme.

Components :

- Seed Production Areas
- Seedling Seed Orchards
- Clonal Seed Orchards
- Multiplication Garden
- Model Nursery and
- Seed Harvesting, Handling, Testing and Storage

Year of start of the project : 1994

Target year of completion : 1999 (Extended up to Dec 2000)

Cost of the project : Rs. 139.00 lakhs

Objectives : (a) Establish seed production areas, clonal seed orchards and seedling seed orchards as a source of quality seed production. (b) Establishment of vegetative multiplication garden of *Casuarina equisetifolia*. *Eucalyptus* sp., and *Tectona grandis* totaling 13 ha using clonal assemblages by way of selection of CPT's. (c) The project envisaged the establishment of a model nursery facility with a production capacity of 5 lakh plantlets (including vegetative propagules) with vegetative propagation structures viz. Green house, Shade house, Mist Chamber along with the usage of root trainer for quality seedling production to function as center of excellence offering demonstrations and training to the staff of the various user agencies viz. SFD, FDC, NGO's, plantation companies and the farmers.

Scientific importance of investigations : The large clonal assemblages of *Casuarina equisetifolia*, *Eucalyptus* sp. and *Tectona grandis* created under the project can be used to provide parental material for breeding, help understand the extent of genetic variability of the species concerned, obtain representative genetic or geographic samples of the species and proved replacements for the existing commercial clones. After the Characterization of these assembled clones, site specific or particular end use clonal material can be released among the user agencies for mass multiplication. The Model Nursery apart from offering demonstration and training facilities will also carry out trials to standardize the different nursery practices for the various tree species.

Results/Achievements

SEED PRODUCTION AREAS

Out of the target of 250 Ha assigned to the Institute of Forest Genetics and Tree Breeding, the Institute has identified about 217 Ha in Tamil Nadu and Kerala states. Culling operation have been completed in 75 Ha and culling in other areas has to be carried out by the State Forest Department and SFDs on the advice of the Institute. The species wise achievements is as follows :

CLONAL SEED ORCHARDS

27.7 ha. of Clonal Seed Orchards have been established against a target of 27 ha for four species namely *Casuarina equisetifolia* - 12.7 ha., *E. tereticornis* - 8 ha., *E. camaldulensis* - 3 ha. *Tectona grandis* - 4 ha.

SEEDLING SEED ORCHARDS

38.25 ha of Seedling Seed Orchards were established for five species namely, *E. camaldulensis* - 9 ha., *E. tereticornis* - 5.5 ha.. *C. equisetifolia* - 14.25 ha, *A. auriculiformis* - 4.5 ha., *A. mangium* - 4 ha and *Tectona grandis* - 1 ha.

VEGETATIVE MUTLIPLICATION GARDEN

Under this project, 351 clones of *Eucalyptus* sp., 216 clones of *C. equisetifolia* and 149 Clones of *Tectona grandis* have been collected and assembled at various places in Kerala and Tamil Nadu. Those clones that have been tested for their genotypic stability have been assembled in large numbers for the purpose of mass multiplication and deployment in the operation planting programmes. The untested clones and those selected recently have been assembled in clone banks with a large number of clones and a small number of ramets per clone.

MODEL NURSERY

A Model nursery over an area of 0.6ha. has been established with a production capacity of 5 lakh plantlets including vegetative propagules. Seedling production facilities have been established and 55,245 seedlings were produced during 1999-2000 of which 15,625 seedlings have been distributed to the PSIP and other projects funded by the UNDP, NABARD etc. A Green house of 300 m^2 area, shade house of 300 m^2 area and a mist chamber of 100m^2 area have been constructed for vegetative propagation and subsequent hardening. Using non misting vegetative propagation structure (polytunnels) vegetative propagules were produced and supplied for the establishment of Clonal Seed Orchards and Vegetative Multiplication Garden under the PSIP. A composting yard has been established to produce compost for using as a potting media component. Root trainer of different capacities and types along with their stands have been procured and are being used to raise seedlings.

SEED HARVESTING, HANDLING, TESTING AND STORAGE

The low temperature walk-in cabinet was put into operation and observed for its functioning. Seed testing equipments like seed germinator and table top laboratory oven are awaiting installation.

Seeds were collected from Clonal Seed Orchard and Seed Production Areas. The seeds were assessed through germination tests. After the testing, the seeds were stored in the seed bank to be supplied to the user agencies. The following qualities of seeds were supplied to the indenters : *Tectona grandis* (70 kg), *Acacia auriculiformis* (250 grams), *Ceiba pentandra* (500 grams), *Cassia fistula* (500 grams), *Cassia siamea* (250 grams), *Delonix regia* (700 grams), *Leucaena leucocephala* (500 grams), *Tamarindus indica* (5.0 kg) and *Casuarina equisetifolia* (1.0 kg).

NEW PROJECTS TAKEN UP DURING 1999-2000

Sl. No.: 1

Project identification No.: IFGTB/ PBT/ RP 7/ 37/ 2000/ DBT [IFGTB/PBT/RP/3/7/61/(24)].

Name of the principal investigator: Dr. K. Gurumurthi

Title of the project: Finger printing of Commercial Clones of Eucalypts and Casuarina.

Target year of completion: 2003

Cost of the project : Rs. 27.58 lakhs

Objectives: To develop techniques for fingerprinting of clones.

Scientific importance of investigations: This is of great importance in typing the clones and maintaining the identity of clone. This method will help to identify the variability of such material and enable IFGTB to function as agency to determine the genetic purity of the material.

Results/Achievements Preliminary studies were carried out to optimise the RAPD assay in *Casuarina equisetifolia*. Work is in progress to screen various primers to identify the polymorphism.

Sl. No: 2

Project identification No.: IFGTB/ PBT/ RP 8/ 37/ 2000/ ICFRE
[IFGTB/PBT/RP/2/7/61(19)]

Name of the principal investigator: N.V. Mathish

Title of the project: Genetic transformation of eucalypts and Casuarina to enhance salinity tolerance.

Target year of completion: 2005

Cost of the project : Rs. 67.35 lakhs

Objectives: (a) Evolving a standard protocol for routine transformation of *Eucalyptus tereticornis* and *Casuarina equisetifolia* using *Agrobacterium* mediated gene transfer and molecular analyses of transgene expression. (b) Transforming *Eucalyptus tereticornis* and *Casuarina equisetifolia* with P5CS gene and confirming the gene transfer using GUS assays, PCR and Southern blotting. (c) Raising R1 plants and assessing their tolerance to salinity.

Scientific importance of investigations: Evolving a transformation protocol for Eucalyptus and Casuarina will pave the way for engineering biochemical pathways to enhance salinity tolerance as well as incorporating other desired traits. Enhancing salinity tolerance levels of highly productive clones will make Eucalyptus and casuarina a remunerative proposition in addition to its intended use in soil reclamation.

Results/Achievements: A regeneration protocol for Eucalyptus clone was developed after rejuvenation in tissue culture. Work is in progress to develop a regeneration protocol for *Casuarina equisetifolia*.

Sl. No.: 3

Project identification No.: IFGTB/ PBT/ RP 9/ 37/ 2000/ ICFRE
[IFGTB/PBT/RP/5/7/61(26)].

Name of the principal investigator: K.C.S. Warrier.

Title of the project: Variability studies with special emphasis on physiology, biometry and biochemistry in selected tree species for tree improvement.

Target year of completion: 2005

Cost of the project : Rs. 41.41 lakhs

Objectives: (a) To grade the clones of Casuarina, Eucalyptus and teak assembled by IFGTB based on physiological, morphological and biometrical characteristics. (b) To study the comparative performance of planting

used from cuttings and seeds with reference to physiological parameters. (c) To determine the tissue characteristics of juvenile and adult materials at the molecular level. (d) To investigate the mechanism of change in sex expression in clones of Casuarina. (e) To identify stress tolerant clones by measuring the levels of stress metabolites. (f) To establish juvenile adult correlation.

Scientific importance of investigations: Successful and rapid improvement in tree species is possible only if adequate information on variability is available. Identification of certain correlative markers that can be used for superior yielders in the juvenile stage will help in predicting the yield. The results will help in identifying superior clones for specific end-use. The outcome of the study will back up various biotechnological studies including genetic transformation, somatic hybridization, synthetic seed production etc. and thus will be complementary to the ongoing projects of IFGTB on yield improvement.

Results/Achievements: A field trial was established at Anbil Dharmalingam Agricultural College and Research Institute, Trichy, Tamil Nadu, to screen salt tolerant clones of *C. equisetifolia* during September 1999. 73 clones at 2m. replacement in a Randomized complete block design have been planted in 3 replication with 4 ramets per clone.

Sl. No.: 4

Project identification No.: IFGTB/ PBT/ RP 10/ 37/ 2000/ ICFRE
[B/PBT/RP/7/7/61(42)].

Name of the principal investigator: Ms. Modhumita Ghosh.

Title of the project: Identification and cloning of gene(s) encoding protein toxic to *Trichosporium vesiculosum* Butler.

Target year of completion: 2005

Cost of the project : Rs. 37.53 lakhs

Objectives: (a) Identification, purification and partial characterisation of antifungal proteins against *Trichosporium vesiculosum*. (b) Isolation and cloning of the gene(s) encoding the antifungal protein.

Scientific importance of investigations: Identification, isolation and cloning of an antifungal protein gene(s) will be a major break-through in the molecular pathology in forestry since such work is very limited in forest tree species.

Results/Achievements: A preliminary study was conducted to identify a source for antifungal proteins. The leaf proteins of *Plumbago capensis* was found to be inhibitory to *Trichosporium vesiculosum*. Characterisation of the protein component is in progress.

Sl. No : 5

Project identification No. : IFGTB/ SIL/ RP 13/ 37/ 2000/ ICFRE
[IFGTB/SILVI/RP 6/8/61(45)]

Name of the principal investigator: Muralidhar Rao.

Title of the project : Impact assessment of intensive silvicultural practices on Seed Production in Seed Orchards/Seed Production Areas in South India with reference to teak.

Target year of completion : 2003

Cost of the project : Rs. 11.65 lakhs

Objectives : (a) To assess the impact of intensive silvicultural practices on seed production in the Seed Orchards and Seed Production Area. (b) To standardize and develop a package of silvicultural packages in teak seed orchards and Seed Production Areas for different rainfall zones of Tamil Nadu and Kerala.

Scientific importance of investigations : The study will help in standardizing a package of silvicultural practices for the establishment and management of Seed Production Areas and Seed Orchards of Teak.

Results/Achievements : Experimental plots to carry out the trials have been identified at six location in Tamil Nadu and Kerala. Treatments have been started.

Sl. No : 6

Project identification No.: IFGTB/ SIL/ RP 14/ 37/ 2000/ ICFRE
[IFGTB/SILVI/RP 4/8/61(29)]

Name of the principal investigator: Siddappa.

Title of the project : Afforestation and productivity studies in the problem soils of Tamil Nadu.

Target year of completion : 2005.

Cost of the project : Rs. 12.00 lakhs

Objectives : (a) To study the factors responsible for the degradation of soils in the problem areas. (b) To identify suitable remedial measures to ameliorate the soils. (c) To select suitable tree species that can be grown on these soils after amelioration.

Scientific importance of investigations : By developing suitable remedial measures for the amelioration of the problem soils along with the identification of suitable tree species for planting in the problem soils, these non productive soils can be made productive.

Results/Achievements: Seedlings of *Eucalyptus tereticornis, Casuarina equisetifolia, Acacia auriculiformis* and *Acacia holosericea* were raised in 300 cc individual cell root trainers filled with magnesite and minespoils quart sand dump material inoculated with *Rhizobium. Azospirillum*, VAM, Frankia and Phosphobacteria. Growth measurements are being recorded periodically.

Sl.No. : 7

Project identification No.: IFGTB/ ST/RP 19/ 37/ 2000/ NOVOD

Name of the principal investigator: B. Gurudev Singh.

Title of the project : Development of Neem in various agro-ecological regions of India (Tamil Nadu, Andhra Pradesh and Karnataka).

Target year of completion : 2002

Cost of the project : Rs. 30.00 lakhs

Objectives : (a) Assessment of seed sources of southern states of India. (b) Selection of trees with higher fruit yield. (c) Developing suitable vegetative propagation method for clonal planting and establishment of clonal seed orchard. (d) Studies on phenology of flowering and fruiting (e) Studies on medium and long term

storage of neem seeds. (f) Evaluation of chemical composition of neem seeds in different sources. (g) Developing technology package for cultivation of neem. (h) Developing model village for transfer of technology on neem cultivation.

Scientific importance of investigations : There is high variability in terms of oil and azadirachtin content among the populations of neem. Seeds are the source of these compounds. The main aim of the project is to assess the seed sources in Southern States and identify better population having high oil content, azadirachtin content and correlation with morphological and physiological characters.

Results/Achievements : Survey was conducted to select trees with high fruit yield in two agro-climatic zones of Tamil Nadu (Annur and Ramanathapuram).

Recorded observations on selected trees for phenotypic and fruit characters. Fruits were collected from selected CPTs and despatched to TERI and NBPGR and also to other collaborating Institutions.

Recorded various physical and physiological characters of the collected seeds.

Sl. No.: 8

Project identification No.: IFGTB/ BIO/ RP 33/ 37/ ICFRE
[IFGTB/BIO/RP 2/6/61 (17)]

Name of the principal investigator: Ms. Manisha Thapliyal.

Title of the project: Conservation of some endangered and endemic plants of Tamil Nadu, Kerala and Andamans (including cryopreservation including medicinal plants).

Target year of completion: 2004-2005

Cost of the project : Rs. 34.06 lakhs

Objectives: (a) To Prepare an enumerative list of red listed plants of Western ghats of Tamil Nadu, Kerala and Andamans. (b) To survey and record morphological characters of various populations of RET plants in the wild. (c) Conducting periodical observations on the phenology of these plants in the field. (d) To collect the plant materials for studies and germplasm collection. (e) Tơ develop *in situ* and *ex situ* conservation programmes for some selected RET species.

Scientific importance of investigations: Conservation of biodiversity, developing techniques for *in situ* and *ex situ* conservation will enhance knowledge about the RET plants of Western ghats of Tamil Nadu, Kerala and Andamans. Information generated about the medicinal plants can encourage people to cultivate them, which can fetch good economic returns improving the socio-economic status of the rural community.

Results/achievements : An elaborate list of about 100 endangered and endemic plants of South India has been prepared from the red data books and published information on various aspects viz. habit, habitat, distribution, phenology, uses, etc.

Field trips were undertaken to forest areas of Siruvani, Anaikatti, Sadivayal, Kanjikhode, Dhoni for studying the species in the wild and also collecting some medicinal plants. About 30 rare medicinal plants have been collected for the germplasm establishment in the botanical garden of IFGTB.

Sl. No.: 9

Project identification No : IFGTB/ BIO/ RP 34/ 37/ ICFRE
[IFGTB/BIO/RP 3/6/61 (32)]

Name of the principal investigator: S.S.R. Bannet

Title of the project : Developing a Suitable Database on Biodiversity.

Target year of completion : 2004

Cost of the project : Rs. 36.00 lakhs

Objectives : (a) To collect all published and unpublished informations and data on biodiversity of Tamil Nadu and Kerala from the identified research organizations and Universities working in the field of biodiversity and make the information available to user agencies.

Scientific importance of the investigations : The database on biodiversity will provide the maximum available information on the biodiversity of Tamil Nadu and Kerala which can be utilized for many aspects of research on flora and fauna. Database will save a lot of effort of the researchers in collating the background informations for their biodiversity related studies, and filling up the existing gaps in biodiversity research.

Results/Achievements : A detailed format consisting of informations on the name, taxonomy, habit, habitat, distribution, phenology, status, utilisations of various plant parts, etc. have been prepared and information on about 17 endangered and endemic plant taxa of western ghats has been collected from various books, journals, herbarias, etc. in the prepared format.

The plant species are:

Actinodaphne bourneae, Eugenia discifera, Michelia nilagirica, Podocarpus wallichiana, Campanula alphonsii, Cyanotis burmanniana, Senecio kundaicus, Youngia nilgiriensis, Syzygium travancoricum, Euonymus angulatus, Hydnocarpus macrocarpa, Vateria macrocarpa, Humboldtia bourdilloni, Nothopegia aureofulva, Memecylon flavescens, Hildegardia populifolia, and *Syzygium gambleanum.*

EXTENSION

Facilities generated and services rendered.

Consultancy to various agencies e.g. testing of samples etc, time spared and revenue earned.

- A consultancy service on the afforestation of quartz sand dump was given to Associated Cement Companies Limited, Madukkarai, Tamil Nadu during September to December 1999.
- Plants and plant products slated for export were examined and 88 Phytosanitary Certificates were issued to various organisations/individuals. The total revenue earned out of this is Rs.8,800.00.
- Services were rendered by the Scientists and Staff in analysis of various research samples of entomological/pathological/biofertilizer importance from other Institutions and individuals on charge basis.

Video Films - time spared and revenue earned

The Institute prepared two video films namely Economic utilization of Casuarina and Clonal Multiplication. These video films are used for creating awareness among farmers, NGOs, State Forest Departments and students .

Transfer of Technology

Training - e.g. to Farmers, NGOs, SFDs, Institutes etc.

The Institute Conducted the one week training course for IFS officers in February 2000.

- A training programme on "Tree Improvement and Clonal Technology" was conducted to the officials of the Forest Development Corporation Maharashtra (FDCM) during 21-26 February 2000. A total of 23 officials attended the training.
- A 30 day training programme on Molecular genetics, Tree Breeding and Tree hybridization was given to II year Biochemistry Under Graduate students of the Avinashilingam Deemed University, Coimbatore.
- Hands on training on Forest Seed Handling was given to 10 officials of the Maharashtra Forest Seed Centre, Forest Development Corporation of Maharashtra Limited during February, 2000.
- Training on Management of SPA and preparation of ranking list was given to the official from Kerala Forest Department during Jan./Feb., 2000.
- The Institute has organised under UNDP project, 13 training programmes. About 590 participants (students, farmers, lecturers, village women, tribals, range officers, foresters, forest guards attended the training programmes). The subjects covered during the training are importance of tree planting, tree hybrids, vegetative multiplication, nursery techniques, seed collection and storage method, collection of medicinal plants, bio-fertilizer and pest disease management".
- Under NOVOD Board sponsored Neem Project, the Institute organized training course to the farmers of Chettipalayam. 35 farmers participated in the training programme.

Exhibition, Kisan mela etc.

An Exhibition was organised by the IFGTB during the Workshop on Transfer of Forest Technologies, Dec.17-18, 1999. The representatives from Forest Departments, Forest Development Corporations, forest based industries visited the stalls. Technical posters on following topics were prepared and displayed: Clonal technology, neem seed handling, determination of moisture content on wet and dry weight basis, estimation of seed requirement, pests and disease problems of forestry and wild ornamentals of Western Ghats.

Kisan Melas

The Institute organised 4 Kissan melas in the villages of Agali (Kerala), Koppattur and Vellingiri (Tamil Nadu). Around 232 villagers took part in these melas. Posters and demonstrations were organised on Nursery techniques, Vegetative propagation, Seed Technology, Agro-forestry and Forest Protection.

Field Demonstration

Application of bio-fertilizers for better establishment and growth of seedlings, management of agro-forestry models, soil and moisture conservation measures and productivity and nutrient cycling studies were demonstrated to farmers, NGOs etc.

Established demonstration plots for medicinal plants under UNDP.

Field demonstration on Tree improvements were given to IFS in service compulsory training and to the IFS probationers from Dehra Dun

Demonstration Plantations

Trials of Eucalypts, Casuarina, Teak, Neem established at Panampally (Kerala), Karunya (Tamil Nadu) and Pudukottai (Tamil Nadu) already serve as demonstration plantations. Agro-forestry models have been established in various micro watershed system in Coimbatore district.

Seminars, Workshops

Organised by IFGTB

- A National Workshop on Transfer of Forest Technologies was convened at Institute of Forest Genetics and Tree Breeding, Coimbatore during December 17-18, 1999.

Publication and extension Literature brought out by the Institute

- Seedling Seed Orchard for Breeding Tropical Trees (Genetic Improvement Series-1) - by Mohan Varghese,
- Genetic Improvement and Propagation of Forest Trees. Eds. S.S.S.R. Bennet, and others

Brochures

- Breeding system and hybridisation techniques in Tamarind (ICFRE Technical Bulletin) - by B. Nagarajan, and others.
- Tree Improvement and productivity enhancement- Forest Technology packages developed by IFGTB (ICFRE Technical Bulletin). K. Subramanian, and others.

FINANCIAL STATEMENTS DURING 1999-2000

S. No.		I. PLAN	Expenditure (Rs. In lakh)
		SUB HEAD	
1	A.	**REVENUE EXPENDITURE**	
		a) Research	107.35
		b) Administrative Support	16.00
		c) Office expenses (R)	29.00
		d) Office expenses (A)	11.00
		e) Travelling expenses (R)	4.00
		f) Travelling expenses (A)	0.50
		g) Publication	0.50
		h) Materials & Supplies (Lab. C)	0.50
		i) Minor works	20.00
		Total for Revenue Expenditure `A'	**188.85**
	B.	**LOANS AND ADVANCES**	
		a) Loan Advances (Conveyance)	2.00
		b) House Building Advance	5.00
		Total for `B'	**7.00**
	C.	**CAPITAL EXPENDITURE**	
		A) Building & Roads	-
		b) Equipments, Library Books	-
		c) Vehicles	-
		Total for `C'	-
		GRAND TOTAL FOR A+B+C(PLAN)	**195.85**
		II. NON- PLAN	
1.	A.	**REVENUE EXPENDIUTRE**	
		a) Research	19.00
		b) Administrative Support (Salary)	57.00
		Total Non-Plan	**76.00**
		TOTAL FOR PLAN+NON-PLAN	**271.85**
		III. FUNDED PROJECT	
	A	World Bank Project	139.97
	B	UNDP Project	1.95
	C	NABARD	0.56
	D	FORTIP	0.21
	E	FDCM	2.13
	F	FRI CONSULTANCY	1.60
	G	KFDC	0.09
	H	NOVOD	2.73
	I	BIO-TECH	0.17
	J	APFDC	3.86
	K	SHANTI ASHRAM	0.61
		GRAND TOTAL for A to K FUNDED PROJECT	**153.88**