

CHAPTER-V

INSTITUTE OF FOREST GENETICS AND TREE BREEDING COIMBATORE

The Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore has the mandate to effect genetic improvement and propagation of forest tree species. It also conducts research in eco-restoration and conservation of biological diversity in tropical evergreen forests of Western Ghats.

The Institute is endeavours to develop application oriented technology keeping in view the end use requirement through appropriate breeding and propagation techniques. 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 research divisions working in the above thrust areas are Genetics and Tree Breeding, Plant Biotechnology and Cytogenetics, Seed Technology, Agroforestry and Forest Productivity, Silviculture, Forest Protection, Bio diversity and Economics and Sociology. The Institute is implementing the Tree Improvement programmes through active collaboration with DFID, FORTIP, CSIRO, UNDP, FAO and World Bank. However, majority of the projects are funded by ICFRE, under Plan and Non Plan schemes.

PROJECTS COMPLETED DURING 1998-99

Project 1: Reclamation of limestone minespoils through afforestation.

Objectives: To develop a package of suitable species and soil amendments for reclamation of limestone minespoils and mine overburdens.

Results

Acacia auriculiformis, *Acacia holosericea* and *Eucalyptus tereticornis* were found to be good for planting on limestone minespoils based on their biomass production, rooting potential, drought tolerance and nitrogen fixing abilities. Soil amendments such as trenches made around the seedlings, application of biofertilizers, inorganic fertilisers and composted coir-pith along with sowing of seeds of *Tephrosia purpurea* and *Indigofera sumatrana* improved the soil nutrient status of limestone minespoils. The growth of *Acacia auriculiformis*, *Acacia holosericea* and *Eucalyptus tereticornis* planted in the limestone minespoils with the application of the combination of biofertilisers and inorganic fertilisers did very well.

Amongst the various amendments tried, the amendment containing coirpith, VAM, *Rhizobium*, Phosphobacteria, urea, single super phosphate and muriate of potash was found to have increased the biomass index of *A. auriculiformis* by 4.8 times, of *A. holosericea* by 20 times and that of *E. tereticornis* by 5.7 times over the controls.

Project 2: Standardization of root trainer size, potting mixture, watering regime and shade requirement for major plantation species of south India:

Objectives: To standardize the root trainer size, potting mixture, watering regime and shade requirement for Teak, Casuarina, Neem and *Eucalyptus* spp.

Results

The major organic waste products of industries in South India, viz., coir-pith from the coir industry, press mud from the sugar industry, spent mushroom beds from the mushroom industry, vermicompost from a local plant based drug industry, farmyard manure from animal farms, and inorganic waste, i.e. fly-ash from thermal power station were tried as potting mixtures for three species - *Casuarina equisetifolia*, *Eucalyptus* and Neem. The results showed that the combination of spent mushroom beds and sand in the ratio of 1:2 was the best for *Casuarina equisetifolia*, *Eucalyptus* and Neem. Spent mushroom beds has potential use as potting mixture in containerised nurseries located near such industries.

Project 3: UNDP- Strengthening and Developing the Indian Council of Forestry Research and Education.

Objectives: (a) To improve the research capability. (b) Research management c) To assist Indian Scientists in establishing contacts with institutions of excellence abroad. d) To develop effective extension mechanisms for speedy transfer of research results to the users.

Results

Supplied improved planting stock to user groups. Agroforestry systems established in the field. 3529 beneficiaries benefited by this.

96020 number of seedlings of various multipurpose economically important forestry and horticultural species were distributed to various target groups.

Extension activities

Name of the Training/demonstration Programme	No. of training conducted	No. of persons Trained
1	2	3
Training of forestry staff in seed technology	45	942
Training and demonstration courses for users about in identification and inoculation of VAM and Rhizobia	19	409
To develop short term extension courses and lectures on inoculation .	39	954
To organize training and demonstration courses for officials of State Forest Departments, Social forestry personnel, rural and tribal development officials, schools and aid NGOs to disseminate practical technology to farmers.	30	546

Contd.

1	2	3
To organize training and demonstration for farmers, women and tribal to impart practical knowledge on specific forestry practices	18	246
Specific grouping of training conducted		
Seed Technology	23	246
Biofertilizers	26	295
Forest Conservation	20	530
Social Forestry practices	22	190
Mass Propagation techniques	21	289
Agro forestry techniques	14	212
Pest and Disease Management	8	157
Total	285	5016

OLD PROJECTS CONTINUED DURING 1998-99

Project 4: Characterisation of the phenotypes and genotypes of *Emblica officinalis* natural populations in Tamil Nadu and Kerala.

Objectives: (a) Survey on the distribution of the species in Tamil Nadu and Kerala. (b) Development of herbaria for distinct phenotypes, and genotypic evaluation using biochemical and isozyme markers. (c) Establishment of germplasm bank based on the Tamil Nadu and Kerala collections.

Achievements

Natural populations of *Emblica officinalis* were surveyed in areas of Munnar and Nilambur of Kerala; and Anamalais, Dhumbam and Peechiparai of Tamil Nadu. Munnar and Nilambur populations showed high levels of variation within and between populations. Twenty seven phenotypes have been identified based on morphological characteristics such as leaf shape, size, number of branchlets, leaves per branchlet, fruit colour, shape and size, number of grooves, fruit weight and pulp weight. Biochemical constituents such as Vitamin C, Tannin, Fiber, Citric acid and total solids were also estimated for various populations.

Project 5: Genetic improvement of forest trees.

Objectives: To increase productivity of *Eucalyptus camaldulensis* and *Casuarina equisetifolia* through selection and breeding.

Achievements

Seedling Seed Production Areas (SSPAs) of *Eucalyptus camaldulensis* established during the year 1995 at Panampally field centre were thinned using index selection. Breeding populations of 182 families were established at three locations namely Panampally (Kerala), Pudukkottai (Tamil Nadu) and Sathya Vedu (A.P.) in the form of large progeny trials. These trials were evaluated for the first year growth to identify the superior provenances and families for the sites. The data were analysed using the software Genstat to estimate

the genetic parameters and the interaction of the genotype with the environment. Breeding populations of *Casuarina equisetifolia* were established at Balukhand (Orissa), Rajahmundry (Andhra Pradesh) and Sadivayal (Tamil Nadu) in the form of large progeny trials. 200 seed lots belonging to land races from eight countries like India, Malaysia, China, Kenya, Thailand, Vietnam, Papua Guinea and Solomon Islands were used in these trials. Early growth performance was evaluated to identify the suitable seedlots of different regions.

Project 6: Reproductive biology of tropical trees.

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

Achievements

A complete study was conducted on the pre-emergent reproductive success under natural selfing conditions in teak clonal populations. Such estimates are of extreme use in calculating the levels of inbreeding depression in the form of selfing that occurs in seed orchards. Successful controlled pollination could be done in teak using three months stored teak pollen under 5°C. Normal seed set could be obtained with 90 days stored Tamarind and 30-45 days stored *C. equisetifolia*.

Project 7: Evaluation of genetic variability in Teak in peninsular India.

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 strategies for genetic improvement of the species.

Achievements

Survey was conducted in Berbera (Orissa), Bori (Madhya Pradesh), Allapalli (Maharashtra), and Kalakkad (Tamil Nadu) teak regions. Study on Wood characteristics and bark thickness in seven populations from very moist, moist, and dry zones of Peninsular India revealed no significant differences between moist and dry zone populations. Sapwood percentage was found to be negatively correlated with growth rate and bark thickness. A preliminary investigation was made on genetic diversity of teak populations using Randomly Amplified Polymorphic DNA assay. Fourteen oligonucleotide decamers were used for the studies. Four teak populations from Konni (Kerala), Topslip (Tamil Nadu), Kalakkad (Tamil Nadu) and Allapally (Maharashtra) were investigated for intra and inter population variations. Considerable variation could be observed within all the populations. Gene diversity estimates based on 130 amplified products revealed Nei's Genetics distance between 0.09 - 0.16 between populations. The phylogenetic tree reflected the latitudinal relationship of populations.

Project 8: Production of high yielding propagules of Casuarina and Eucalyptus.

Objectives: To establish infrastructural facilities for vegetative propagation and to develop basic protocol for production of quality planting stock of Eucalyptus and Casuarina.

Achievements

A full fledged vegetative propagation complex is now fully operational. Standardised the clonal propagation technology through cuttings for *Casuarina equisetifolia*, *Eucalyptus tereticornis* and *Eucalyptus camaldulensis*. Clone bank of Eucalyptus and Casuarina were established. A total of 106 superior clones of

Casuarina equisetifolia and 33 clones of *Eucalyptus tereticornis* (14) and *Eucalyptus camaldulensis* (19) are available in the clone bank. In addition, about 80 *Eucalyptus* clones collected from ITC Bhadrachalam and J.K. Corporation were also planted. Hedge garden of *Casuarina* and clonal multiplication garden of *Eucalyptus* were established and maintained for further multiplication. The clonal materials of both *Casuarina* and *Eucalyptus* were mass multiplied and supplied to various user agencies like State Forest Departments and Forest Development Corporations.

Project 9: Assessing growth and physiological variations like photosynthesis in fast growing tree species for improving yield.

Objectives: (a) Survey and selection of superior performing plants of *Casuarina equisetifolia* and *Eucalyptus* spp. and standardization of the procedure for cloning them. (b) To carry out physiological and genetic studies to find out interclonal variations in the identified superior performers. (c) To identify the salinity tolerant clones of *Casuarina equisetifolia*.

Achievements

The clonal trial of *Eucalyptus tereticornis* raised by the Andhra Pradesh Forest Development Corporation (ITC clones) at Zaphisingaipalli, Hyderabad during 1993 was assessed using point grading system developed by IFGTB. Various parameters studied include total height, diameter at breast height, verticality, straightness, spiral bole, cross section, bole swelling, basal sweep, trunk curve, branch angle, branch thickness, self pruning, apical dominance, forking, foliar damage, and stem damage. It was found that out of 30 clones, clone numbers 3,93,7,147,4,32 and 74 showed superior growth.

To consider the utility of *Casuarina equisetifolia* clones in paper and rayon industry, wood samples of 15 clones from IFGTB clone bank were analysed for related traits. Among these, 5 clones (CHCE890201, CHCE890905, CHCE892604, CPCE890108 and CPCE893702) are promising for paper manufacturing. Total fiber yield from the pulp of these clones was more than 50 per cent. However, clone with more than 47 per cent fibre yield can always be considered in the factory for paper production purposes. The fibre length and fibre diameter for all the wood samples tested was found in the normal range of the hard woods for paper production.

The wood properties of *Eucalyptus tereticornis* clones raised by APFDC were studied. Various parameters like density, felting coefficient, Runkels ratio, Isenberg coefficient, coefficient of fibre flexibility and fibre content were analyzed for 16 clones. The clone number 130 showed better wood property.

Physiological parameters like net photosynthetic rate, stomatal conductance, and transpiration rate were studied in clones of *E. tereticornis* and *E. camaldulensis* raised at Panampally, Kerala. High photosynthetic rate was observed in the clones of *E. tereticornis* compared to those of *E. camaldulensis*. However, no significant difference was noticed in transpiration rate between these two species. Maximum photosynthetic rate was found in the clone numbers 130, 131 and 132 of *E. tereticornis*.

Flowering pattern in six identified clones of *Casuarina equisetifolia* grown as hedges in the clone bank of Institute revealed that sex change occurs in this species. Six clones (11 per cent of the population) changed their sex in various ways. Four clones viz., CHCE 1003, CHCE 2903, CPCE 0109 and CPCE 3702 were females originally, but changed their sex to become bisexuals. Clones CHCE 0401 and CPCE 3501 were originally males but transformed into monoecious by producing female clones approximately five years after introduction. Continuous hedging may bring out plasticity of sex expression in a small per cent of population.

An experimental site was set up in a salt affected area at Trichy (Anbil Dharmalingam Agricultural College and Research Institute) in February 1999. Seventy three clones of *Casuarina equisetifolia* collected by the Institute were selected for the study. The clones were planted at a spacing of 2m x 2m in Completely Randomized Block Design with 3 replications and 15 ramets per clone.

Project 10: Micropropagation and tissue culture studies on selected tree species including procedure for hardening, weaning and out planting.

Objectives: (a) To develop technique for micropropagation of important tree species like bamboos, Eucalyptus, Neem, etc. (b) To develop protocol for somatic embryo-genesis in bamboos.

Achievements

A strategy was developed for the selection of good quality seeds based on the seedling characters like vigour and growth habit. Cost-effective micropropagation protocols were developed for *Bambusa arundinacea*, *Dendrocalamus strictus*, *Bambusa nutans*, *Dendrocalamus membranaceus* and *Oxytenanthera stocksii* from the selected seedlings. The advantages of the technique developed for bamboos over other protocols are;

- (a) Liquid cultures decrease the cost of production and increase the frequency of shoot multiplication
- (b) Root induction is very easy and ex-vitro rooting produced 100% success.
- (c) Acclimatisation is simple, high humidity polytents serves the purpose.
- (d) Rhizome formation occurs within two months in micropropagated plants, which speeds up the macroproliferation.

Continuous cultures of all five bamboo species are maintained by adding new genotypes periodically.

Project 11: Biotechnology of trees.

Objectives: (a) To establish a nucleus of Scientists and develop laboratory facilities for non-conventional tree improvement programme. (b) To develop RAPD methods for identification of clones. (c) To develop micropropagation protocol for teak.

Achievements

1. Micropropagation of Teak

To secure sufficient supply of genetically improved planting stock of teak, micropropagation techniques were applied with two approaches: (a) To amplify the limited available seeds from CSO and speed up the use of improved planting material for future plantations. (b) Clonal propagation using buds from selected trees with desired characters.

Explants for initiating cultures of teak were obtained from aseptically grown seedlings. The medium used for shoot multiplication contains 0.5 mg / l benzyl aminopurine and 0.25 mg/l kinetin. Subculturing was done once in 45 days. The number of rootable shoots produced per flask was 3-4. Shoots with the height of 4 cm and above were used for rooting. Shoots harvested from cultures were transferred to shade house for *ex vitro* rooting. The bases of the shoots were treated with 1000 ppm Indole-3-butyric acid (IBA) solution for 5 minutes and planted on vermiculite. High humidity was maintained to avoid desiccation and

stress. Once rooting has occurred acclimatisation is started by loosening the polytents directly without any transfer, thus saving one step and reducing costs. Micropropagation of teak with juvenile or mature explants produces about 500 plants in one year from single seed or bud.

Micropropagation from mature tissue requires suitable rejuvenation techniques before culturing. To rejuvenate the buds of mature trees, buds from plus trees are grafted on juvenile rootstock. After serial grafting for 3 to 4 times, the buds will be used for multiplication. Further, the in vitro propagation techniques are necessary to take advantage of the recent developments in biotechnology.

2. Genetic divergence studies of *Casuarina* clones using RAPD markers

RAPD markers were used to assess the genetic divergence of the clones of *Casuarina equisetifolia*. PCR amplification methods were optimised and genomic DNA isolated from 12 clones were screened with 40 oligonucleotide primers to produce polymorphic bands. The results obtained were scored and analysed using NT-SYS programme. The genetic divergence found among the clones ranged from 0.56 to 0.70.

3. Tissue culture studies on Neem

Protocol was derived for micropropagation of Neem. Protocol for callus production and multiplication in dark and light condition was standardised. Suspension culture was initiated in liquid medium and its growth performance was studied. Protocol was also standardised for isolation of protoplasts from cotyledon and callus cultures. These were fused under electric pulse and hybridised colonies were obtained.

Genetic transformation studies in *Eucalyptus tereticornis*

As a prerequisite for genetic manipulation studies, plant regeneration protocol was developed for *Eucalyptus tereticornis* through somatic embryogenesis and organogenesis for the first time from seedling explants such as mature zygotic embryos, immature cotyledons and also from leaves collected from in vitro grown seedlings. Explants were cultured in MS medium containing different combinations of BAP, NAA and 30- 50g/l of sucrose. MS medium containing NAA 2mg/l and BAP 0.5 mg/l and 30g/l of sucrose was found to be the best medium for embryogenesis. Repetative somatic embryogenesis was observed in continued cultures in growth regulator medium. These somatic embryos were passed through typical globular, torpedo and cotyledonary stages during the course of their development till maturity. The mature embryos were germinated in growth regulator free MS medium with 30g/l sucrose. More than 80% of the embryos rooted in growth regulator free medium. The plantlets developed a typical tap root system which is advantageous over the adventitious root system

Induction of somatic embryogenesis was also obtained from mature leaves collected from trees growing in the clonal bank of IFGTB. The mature leaves were cultured in MS medium with different combinations of BAP, NAA, KIN and 2,4-D. Friable callus, formed as a result of continued sub-culturing in MS media with different growth regulator combinations and somatic embryos, was obtained. This is the first report of somatic embryogenesis induction in *Eucalyptus tereticornis* from mature tissues and is suitable for genetic manipulation studies.

For the selection of transgenic plants, an appropriate concentration of selectable marker has to be standardised. The somatic embryos were cultured in a medium with different concentrations of antibiotic and it was found that 75mg/l of antibiotic is the appropriate concentration for selecting transgenic plants.

Project 12: Studies on the seed life of *Casuarina equisetifolia* and working out the germination capacity.

Objectives: (a) To fix the optimum time and age for seed collection. (b) To study the life of seeds in different storage conditions. (c) To study variation in fruit and seed characteristics for different clones and its implications on the progenies.

Achievements

Influence of seed size on seedling vigour and performance in the field was studied in *Casuarina equisetifolia* by correlating the length, breadth, area, weight, roundness and aspect ratio of fruit and seeds with progeny growth. The influence of seed morphological characters on seed germination was also studied. Initiated study on the extent of heritability of fruit and seed characters from mother plant. Seed weight and shape characters like roundness and aspect ratio showed significant correlation with progeny growth. Grading seeds according to their weight, size, roundness may be aimed at to get better progenies.

The trial of the *C. equisetifolia* seeds collected during 1993 and stored in 3 conditions viz. Ambient, +10°C and -5°C was completed. The study revealed that the seeds can be conveniently stored at ambient conditions for 1-2 years and for storing up to 3 years, storage at 10°C is advisable. The results of the storage trial were presented in the IUFRO Symposium on Innovations of Forest Tree Science & Nursery Technology at Raipur during November, 1997.

Project 13: Studies on seed deterioration of oil-yielding species viz., *Pongamia pinnata* and *Jatropha curcas* under different environment conditions and standardisation of germination methods.

Objectives: (a) To study the different environmental parameters which influence the rate of deterioration under different storage conditions and find out suitable measures to control the deterioration. (b) To ascertain suitable collection methods, time, processing, treatment and storage for prolonging their viability. (c) To determine oil content and its influence on germination. (d) Estimation of bio-chemical contents of seeds collected from different sources.

Achievements

Repeated studies on source to source variation in seed weight, purity, germination, vigour index and oil content for *Pongamia pinnata*. Significant variation in germination with seed size was observed compared to other parameters.

Large size seeds gave good germination compared to small and medium ones. The viability of the large, medium and small size seeds were found to be approx. eight, seven and five months respectively. The concentrations of protein, carbohydrate and lipid in fresh seeds were 114.6 mg/g, 22 mg/g and 24% in large; 96.9 mg/g, 22.2 mg/g and 21% in medium; and 67.1 mg/g, 18 mg/g and 17% in smaller seeds. After 150 days of storage in ambient condition the concentrations of protein, carbohydrate and lipid were found to be 36.4 mg/g, 10.8 mg/g and 27% in large; 16.8 mg/g, 5.8 mg/g and 25% in medium; and 5.8 mg/g, 1.9 mg/g and 22% in smaller seeds. It was noticed that germination percentage, protein and carbohydrate contents decreased whereas the lipid content increased.

The biochemical studies revealed that protein, carbohydrate and lipid contents were higher in Salem provenance (23.5 mg/g, 4.1 mg/g and 38.2%) compared to Karur provenance (18.1 mg/g, 3.2 mg/g and 26%).

Source to source variation in properties was noticed in the seeds of *Jatropha curcas* collected from different localities. Number of seeds per kg, recovery percentage, purity, 100 seed weight, seed length, breadth and thickness were high in Attapady provenance followed by Walayar and low in Paripattu provenance.

Repeated storage trials were carried out on the seeds of *Jatropha curcas* collected from different localities by storing at ambient, + 10°C and -5°C. The seeds stored at ambient temperature lost their viability after 15 months. The seeds stored at -5°C were viable for 18 months whereas those stored at + 10°C retained their viability for more than 24 months.

Larger seeds were found to exhibit higher value of 100 seed weight, moisture content, germination percentage, vigour index and bio-mass production compared to medium and small sized seeds.

Project 14: Standardisation of optimum storage condition for *Azadirachta indica* and methods to prolong the viability.

Objectives: (a) To fix the optimum time for seed collection and standardise collection methods. (b) To study the effect of seed moisture content on the viability of seeds. (c) To study the effect of storage temperature and conditions on the viability of seeds. (d) To study the bio-chemical changes associated with seed deterioration. (e) To study the genetic variation within and between populations using biochemical/ molecular markers.

Achievements

Bio-chemical studies to ascertain loss of viability in Neem seeds are in progress. Studies were carried out on the effect of germination inhibitors on prolonging viability. Treating seeds with coumarin of different concentrations resulted in delaying the process of seed germination. Studies are in progress to find out whether such 'delays' can be initiated to improve the viability of seeds. Two enzymes, namely peroxidase and catalase, were studied as indicators of seed deterioration.

Storage trials with and without endocarp were continued. Seeds stored with endocarp gave better results.

Project 15: Standardisation of germination methods in *Tectona grandis* and evaluation of vigour for seeds from different sources.

Objectives: (a) To work out pre-treatment requirement to get optimum germination. (b) To study the factors associated with germination capacity. (c) To study source to source variation in germination capacity. (d) To study the dormancy mechanism operating in seeds.

Achievements

Various pretreatments aimed at enhancing the germination percentage were repeated. Alternate soaking and drying of seeds gave fairly consistent results, which was followed in subsequent studies. The effect of time of seed collection on germination percent has been studied. The fruits collected in the latter part i.e. March-April gave better germination. Other factors which influence the germination such as medium, light etc. are being studied. The mechanism of water absorption by teak seeds during alternate soaking and drying was studied.

Project 16: Standardisation of seed handling procedures for commercially important forest medicinal plants (*Aegle marmelos*, *Emblica officinalis*, *Feronium elephantum*, *Syzygium cumini*, *Pterocarpus marsupium*, *Strychnos nux-vomica*, *Terminalia chebula* and *T. bellerica*).

Objectives: (a) Collection of literature and identification of most important commercially exploited species. (b) Recording the distribution of identified species in Southern India. (c) To study the phenology of fruiting and maturation of fruit/seeds. (d) To study the extraction procedure and pre-treatment requirement for germination. (e) To standardize the optimum storage condition.

Achievements

Pretreatment studies in *Pterocarpus marsupium* were carried out.

The effects of storing seeds in different containers in different environment for *Syzygium cumini* were observed and it was found that the seeds can be stored for 2-3 months if stored at 10°C, whereas viability is only 15 days if kept in ambient condition.

Studied the effect of different pretreatments to improve germination percentage and vigour on seeds of *Strychnos nux-vomica*. It was found that the seeds treated with conc. H₂SO₄ for 15 minutes, and seeds put in dessicator at high humidity gave germination of 84% and 62% respectively, whereas the control gave only 12%.

Studies were carried out to find out the optimum time for seed collection, seed extraction methods and pretreatment requirements to improve germination of *Terminalia bellerica*. The seeds collected during the first week of February gave best results. Medium size seeds gave better germination and vigour index compared to small and big seeds. The seeds soaked in cold water for 24 hours after depulping gave better germination. The seeds treated with conc. H₂SO₄ for 30 minutes also gave good germination but the vigour index was poor compared to water soaked seed.

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 Panampalli, Kerala. The number of provenances included in the trial are 18 representing 8 countries.

Maintenance of Provenance trial of *Pongamia pinnata* and *Jatropha curcas*.

Recorded measurement of height and girth in different provenances established in Forest Campus, Coimbatore. Recorded growth variation within and between the provenances. Recorded variation in flowering and fruiting in *Jatropha curcas*.

Project 17: Reclamation of magnesite minespoils.

Objectives: (a) To develop a package of suitable species and soil amendments for reclamation of magnesite minespoils, and improving 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.

Achievements

Species trial with *C. equisetifolia* seedlings, *C. junghuhniana* seedlings, *C. equisetifolia* cuttings were laid to find the suitability of Casuarina species for the magnesite minedump at Burn Standard & Co. Salem. The Casuarina species were planted with mulching of decomposed coirpith for improving the water holding capacity and texture of magnesite minedump.

Growth measurements of two year old trees show that *C. equisetifolia* seedlings perform better than *C. equisetifolia* cuttings and *C. junghuhniana* seedlings with biomass indices of 3656, 3132, 2016 respectively.

Eight Candidate Plus Trees of *Casuarina equisetifolia* have been selected so far from the plantations existing on the minespoils. The fast growing genotypes of Casuarina species can be used for production of hybrids by controlled crossing.

Project 18: Screening of *Casuarina equisetifolia* and *C. junghuhniana* genotypes for plantation in problem soils of Tamil Nadu:

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

Achievements

By combing the 8-10 year plantations of the Tamil Nadu Forest Department, 51 Candidate Plus Trees of *Casuarina equisetifolia* have been selected from the salinity and drought affected areas of Rameswaram, Thanjavur, Chengalpet, Nagapattinam, Tiruvallur, Salem and Pudukottai districts and Magnesite minespoils of Burn Standard Co., Salem at a selection intensity of 1 in 10,000. Further selections are in progress. These CPTs have been cloned and included in the Clone Bank at Silviculture division's nursery. Many of the CPTs were included in the first generation clonal seed orchards at Nilambur and Pudukottai. The selected CPTs were exchanged with other agencies engaged in the selection of superior individuals of *Casuarina equisetifolia* viz., JK Paper Mills, Raygada and State Silviculturist, Rajahmundry.

Project 19: Nutrient cycling in Teak plantations of Tamil Nadu (World Bank Aided Project).

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 nutrient content in the standing crop of Teak plantation. (d) To quantify litter production. (e) To study nutrient uptake and nutrient cycling in Teak plantations. (f) To study nutrient cycling in young Teak plantations.

Achievements

Details of Teak plantations grown in Tirunelveli, Mudumalai, Tanjore and Coimbatore forest divisions were collected and compiled. Representative plantations covering various age groups were identified and sample plots were laid out. Soil profiles were studied and samples collected for analysing various physico-chemical properties. Chemical analysis of these sample is being carried out. Growth parameters of trees were also recorded from the sample plots.

Litter production and nutrient return were studied in a Teak plantation (age -24 yrs.) in Coimbatore forest division. Periodical data were collected from field and it was found that the total litter production

amounted to 9.9 t/ha. In the laboratory, the litter samples were analysed to estimate the nutrient return through litter. The nutrients return amounted to : N 161.325; P 1.543; K 114.88; Ca 215.880 and Mg 34.190 kg/ha.

Nutrient return through rain wash was also studied in the same Teak plantation. The nutrients returned to soil through stem flow and through fall amounted to: K 61.89; Na 17.09; Ca 343.91; Mg 84.0; P 12.93 and N 28.82 kg/ha.

Project 20: Development of agroforestry models for various agro-ecological regions (NABARD Project).

Objectives: (a) To conduct design and diagnostic 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-fertilisers in agroforestry plantations and evaluate their potential in enhancing productivity. (e) To design 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.

Achievements

Three micro watersheds were selected in Coimbatore district of Tamil Nadu. One village nursery was established in farmers field to raise seedlings to be planted in three micro watersheds. About 1,00,000 seedlings of different tree species and horticulture species were raised/ procured. 82,000 seedlings were planted under different models. Demonstration plots were established for recording growth of tree species and yield from agricultural crops for working out economic returns. Special care was given to class IV lands to make them more productive.

The most productive models identified were Teak-Casuarina and Casuarina-Moringa which gave high returns within a short span of 3 years. In these model, Casuarina attained a basal girth of 28 cm with total height of 7.1 m at the age of 3 years. Training was imparted to the farmers of three micro watersheds on nursery techniques, seed collection and handling, and development of different agroforestry models.

Project 21: Survey and evaluation of insect pests of forest tree species in nurseries and plantations.

Objectives: Regular and systematic pest surveys in nurseries and plantations aimed at assessing (a) pest spectrum (b) key pests (c) damage caused (d) biology and population dynamics of key pests (e) economic threshold and (f) causes and factors predisposing the plants to pest attack.

Achievements

Teak

Pest incidence was studied in plantations raised by the Forest Departments as well as Farmers, both in Tamil Nadu and Kerala. Outbreak of the defoliator, *Hyblaea puera* occurred in plantations located in Kerala during June, whereas the incidence was at low intensity in Tamil Nadu part during the same period. The attack of the defoliators (*H. puera* and *E. machaeralis*) reached moderate level during July - August and remained at low level from September to December at Walayar and nearby areas of Kerala. The 4½ years old plantation raised in Solavampalayam village in Tamil Nadu had moderate attack of the stem borer, *Indarbela quadrinotata*. Other pests of lesser importance recorded from young plantations include *Ptyelus nebulus* (sap sucker), *Hyposidra successaria*, *Myllocerus* spp. and grasshopper (defoliators).

Casuarina

Infestation of the stem borer, *I. quadrinotata* was found to be low in 2-3 years old plantations raised in Kerala. The incidence of the bark feeding beetle, *Niphona malacensis* was also low. Stray cases of infestation of the cottony cushion scale, *Icerya purchasi*, *Eurybrachys* sp., *Eumeta crameri* and *Mylocerus* spp. occurred in young and middle aged plantations raised in Coimbatore area.

Minor infestation of 3 years old saplings of *C. junghuhniana* by the bark feeding borer, *I. quadrinotata* was detected in a young plantation raised at Pondichery.

Eucalyptus

The beetles of *Celosternq scabrator* caused minor to moderate girdling of bark of young trees raised in the seedling seed orchard of *E. camaldulensis* and *E. tereticornis* at Sathyavedu (Andhra Pradesh) and Pondicherry, respectively.

Neem (*Azadirachta indica*)

The incidence of shoot borer, *Laspeyresia aurantiana* at severe intensity was observed in an experimental plantation raised at Panampally (Kerala).

Tamarindus indica

Severe defoliation of plants by a bagworm (species to be identified) was encountered in a 1992-93 plantation raised at Lokur area of Tamil Nadu during December. The intensity of attack came down during January.

Project 22: Studies on seed pests of forest trees and evolving prophylactic seed treatments against pest attack during storage.

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, and (e) Developing of sound storage practices.

Achievements

25-30% maturing seeds in the Teak plantation were infested by various insects. Coccids contributed 15%; thrips - 5%; tingids - 4% and borers 1-2%. Studies were continued to assess the impact of these pests on seed setting.

The extent of damage done to the Casuarina seeds by the chalcid, *Bootanellus orientalis* in different Casuarina growing areas was studied. The information so far collected shows that it is only a minor seed pests.

The essential oils of plants such as *Acorus calamus* and *Cymbopogon martinii* were tested on the *Tamarindus indica* pest, *Caryedon serratus*. It was found that the oil of *A. calamus* is very effective in causing mortality of the pest. Both these oils could produce oviposition deterrence response in the pest.

The chemical insecticides such as chlorpyrifos and fenvalerate were effective in controlling *C. serratus*, the former at 0.01% and the latter at 0.1% could bring about 100% mortality of the pest within 24 hours. A combination of dichlorvos and chlorpyrifos, even at a very low concentration was found to cause 100% mortality within 3-6 hours.

Project 23: Selection of pest resistant trees from wild population, provenance, exotic trials and progeny tests.

Objectives: (a) Survey to detect resistant individuals or races (b) Differentiating true resistance from pseudoresistance (c) Testing resistance under stress conditions, especially during epidemic infestation (d) Determining basic factors conditioning resistance and identifying inheritable resistance.

Achievements

Analytical studies conducted on the *Acacia nilotica*, ssp. *indica* leaf proteins, carbohydrates, lipids, phenols etc. showed that the variation of these primary and secondary metabolites have direct bearing on the resistance and susceptibility of the provenances to the defoliators such as *Selepa celtis* and *Pteroma plagiophleps*.

Project 24: Evolving biocontrol strategies for key pests.

Objectives: (a) Survey of parasites, predators and entomopathogenic microorganisms operating in the field (b) Evaluation of parasitic/predatory/biocidal potential and selection of suitable candidates (c) Augmentation of potential biocontrol agents in required situations (d) Introduction of suitable biocontrol agents, their mass-multiplication and storage and (e) Formulation of biocides.

Achievements

A commercial Bt liquid formulation was found very effective in controlling the defoliator *H. puera*. The product, at the concentration ranging from 0.001% to 0.1%, caused 100% mortality of the larva after 24 hours.

The Bt liquid formulation was also very effective on the stem borer, *Indarbela quadrinotata*, causing 100% mortality of the larvae at 0.3% and 0.5% concentration within 48 hours.

Studies conducted on the impact of *Beauveria bassiana* on the defoliating beetle, *Myllocerus viridanus* showed that the fungus was effective in bringing out 100% mortality of the pest within 8 to 10 days.

Project 25: Evaluation of plant derived materials for insect pest control.

Objectives: (a) Evaluation of the efficacy of various products from selected plants having insecticidal properties (b) Development of techniques through isolation of important active components from the above plant species (c) Isolation and testing of active principles on the key pests (d) Development of formulations and (e) Studies on the impact of the formulations on the natural enemies of the pest species under study.

Achievements

A commercial Neem product 'Neem Azal' when tested in the field at a concentration of 40 ppm gave good control of *H. puera*. Among various plant-derived oils tested, oils of a *Pongamia pinnata* and *Mentha* in 7 : 3 proportion @ 5 ml per kilogram of Tamarind seed gave good control of the pest.

Project 26: Survey and evaluation of the diseases of forest tree species.

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 and (e) biotic and abiotic factors pre-disposing the plants to disease attack.

Achievements

The fungal pathogen, *Ganoderma lucidum* caused drying of about 6% of *Casuarina equisetifolia* trees in the progeny trial cum seedling seed orchard established at Panampally. Sporadic incidence of wilt disease caused by *Trichosporium vesiculosum* was detected in the clonal seed orchard raised at Panampally.

Experiments were conducted to determine the antagonistic effect of biocontrol agents viz. *Trichoderma harzianum* and *T. viride* on the stem wilt pathogen, *T. vesiculosum*. The results obtained are promising.

Collar-rot caused by *Lasiodiplodia theobromae* was detected in 4 months old vegetatively propagated *C. junghuhniana* in Coimbatore.

Terminal drying and decay of basal portion of cuttings of *E. camaldulensis* due to the fungal pathogens, *Curvularia* sp. and *Fusarium* sp. were detected in polytunnels used for vegetative propagation. The *E. tereticornis* clones maintained at Coimbatore were affected by leaf-spot, blight and chlorosis.

Fusarium sp. and *Alternaria* sp. caused leaf drying and chlorosis in the grafted plants at Coimbatore. *Lasiodiplodia theobromae* was detected as the causative agent for drying of about 10% plants at pole stage in 4 years old plantation of Teak at Kovilpalayam village of Coimbatore.

Project 27: Evaluation, selection and application of mycorrhizae and root nodule microsymbionts (Biofertilizers) in forest tree species.

Objectives: (a) Systematic survey in nurseries, plantations and natural forest areas to identify the range of mycorrhizal fungi and root nodulating microbial strains (b) Isolation and multiplication of the dominant species/nodule microbes (c) Test for adaptation to edaphoclimatic conditions (d) Test of effectiveness for plant growth and nutrient uptake with test plant (e) Inoculation at large scale and (f) Field trials.

The composition and colonisation of Vesicular Arbuscular Mycorrhizal (VAM) fungi in the root as well as rhizosphere soil were studied. VAM, belonging to three genera such as *Glomus*, *Gigaspora* and *Acaulospora* were detected. The percent root colonisation and soil spore population of these fungi varied in different months. A strain of phosphobacterium was isolated from the soil collected from Teak plantation at Coimbatore.

90% root colonisation of VAM was noticed in *E. tereticornis* at Sethumadai.

Association of ectomycorrhizal fungus, *Pisolithus tinctorius* was detected in *E. camaldulensis* at Panampally and Walayar.

Seedlings of *Eucalyptus globulus* inoculated with the ectomycorrhizal fungus, *P. tinctorius* registered a considerable increment in growth parameters.

Project 28: Selection of pest/disease resistant phenotypes of Teak, Casuarina and Eucalyptus (World Bank Aided Project).

Objectives: (a) Periodical survey in provenance trials and progeny tests being conducted under the genetic improvement project for recording pest incidence (b) Assessing the provenances/progenies/individual trees for intensity of infestation of major pests (c) Preliminary selection of resistant provenances/progenies/ individuals and (d) Determining basic factors conditioning resistance and identifying inheritable resistance traits.

Achievements

Pest Resistance

Tectona grandis: Studies carried out on the incidence of defoliation by *H. puera* and *E. machaeralis* in the germplasm bank established at Nilambur (Kerala) showed that the clones APNPL-6, APNPL-10, APKKR-1 and APKKR-6 are either not attacked or attacked at a very low intensity. The clones, HAL-1, HAL-4, HAL-7, BHA-25, BHA-26 and TMT-24 exhibited moderate intensity of attack, while the clones APKKR-3 and APKKR-4 had heavy infestation.

Girdling of tender portion of shoots by the beetles of *Celosterna scabrator* was a serious problem in the progeny trial cum seedling seed orchard of *E. camaldulensis* laid out at Panampally. The intensity of infestation of *C. scabrator* on 182 families of *E. camaldulensis* was studied.

The incidence and intensity of attack of the stem borer, *Indarbela quadrinotata* were studied in the Casuarina International Provenance Trial laid out at Pondicherry. Provenances from Australia and Kenya continued to exhibit high level of resistance to the pest, while the provenance 'Hama' exhibited highest susceptibility, closely followed by 'Ranong' from Thailand.

Disease Resistance

Casuarina

Studied the incidence of blister bark disease caused by *Trichosporium vesiculosum* in the International provenance trial of *C. equisetifolia* laid out at Pondicherry. Out of 35 provenances, 14 provenances were attacked by the disease and 21 provenances remained safe. The maximum incidence of the disease was recorded on provenances from Sarawak, while the provenance NT Australia showed least incidence.

Project 29: Comparative Growth Studies of teak (*Tectona grandis*) in farmlands and waste lands of different agroclimatic zones of Tamil Nadu.

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

Achievements

Survey completed and required data collected from 4 zones. Three zones are yet to be completed.

Project 30: Socio-economic studies of some important medicinal plants in the tribal belts of Tamil Nadu.

Objectives: (a) To create database for the medicinal plants. (b) To identify the commercially exploitable wild medicinal plants. (c) To study the market trend for the commercially exploited medicinal plants. (d) To study the demand and supply to plant based industries. (e) To study the economics of cultivating medicinal plant and create awareness among the tribal on importance of medicinal plant and their role in forest conservation.

Achievements

Completed database for 250 medicinal plant species. Cost benefit analysis of cultivating medicinal plants in the farmers field worked out for *Gloriosa superba* species.

Project 31: Planting stock improvement programme.

Objectives: (a) To identify seed production area. (b) To establish seedling seed orchards and clonal seed orchards.

Achievements

Seed Production areas

In Kerala, selected 90 ha of teak plantation for converting into SPA. Ranking list was sent to SFDs for 40 ha for culling of inferior trees in the SPA. Analysis and preparation of ranking list for the remaining 30 ha has been completed and sent to the State Forest Department. A total of 5 ha Eucalyptus and 2 ha of *Acacia auriculiformis* was selected for SPA. Inferior trees were marked and culling was over in 20 ha of teak in Nilambur division.

In Tamil Nadu, 5 ha of *A. planifrons* plantation was selected in Chinnar and 20 ha of teak plantation was selected in Waragaliar. The enumeration data have been analysed and ranking list prepared and forwarded to State Forest Departments for culling. Selected 8 ha of Eucalyptus plantation in Ooty and 6 ha *A. ferruginea* in Salem MFP division. Complete enumeration list for 4 ha Eucalyptus has been received from SFD for analysis and ranking.

Seedling Seed Orchards

Seedling Seed Orchards of *Casuarina equisetifolia*, *Eucalyptus tereticornis*, *E. camaldulensis*, Acacias and Teak were established. These orchards are expected to yield quality seeds after six years. One ha of seedling seed orchard of Teak and one ha of *Casuarina equisetifolia* were established at Sadivayal, Coimbatore.

Clonal Seed Orchards

Clonal seed orchards of superior clones of *Casuarina equisetifolia*, *Eucalyptus tereticornis* and *E. camaldulensis* were established for the production of quality seeds. 1.5 ha of *Casuarina equisetifolia*, and 3 ha of *Eucalyptus camaldulensis* at Neyveli, and 3 ha of *Eucalyptus tereticornis* at Arimalam were established.

Clone banks and Multiplication garden

Multiplication gardens of Eucalyptus were established at Neyveli (4 ha.), Perungalathur (0.5 ha) and Kulathupuzha (1 ha). A Multiplication garden of *Casuarina equisetifolia* was established at Kulathupuzha (0.5 ha). A clone bank of teak was established at Nilambur (1 ha).

Model nursery

A model nursery for the purpose of research and demonstration is being established. Seedling production facilities were established and about 3,73,000 seedlings were supplied for the Planting Stock Improvement Programme and other projects funded by the FAO, UNDP and NABARD from 1995-96 to 1998-99. Non-misting vegetative propagation systems were established for clonal multiplication of *Casuarina* and Eucalyptus. Ramets were produced and supplied for the establishment of clonal seed orchards and multiplication gardens. A Green house of 300 sq.m. area, a mist chamber and a shade house were constructed. A composting yard was established and composting initiated with weeds, bagasse and *Eichornia crassipes*. Root trainers of different types- 150 cc blocks, 250 cc blocks, 150 cc, 250 cc and 300 cc single cells were procured and the nursery was changed to a root trainer nursery.

NEW PROJECTS TAKEN UP IN HAND DURING 1998-99

Project 32: Standardisation of seed handling techniques for tropical recalcitrant seeds.

Objectives: Short term objectives: (a) To estimate the effect of initial condition of seeds (like seed maturity, mechanical damage, initial viability and moisture content) on longevity of the 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 atmosphere on the longevity of seeds. (d) To estimate the effect of seed moisture content and influence of temperature on longevity of seeds. (e) To find out the longevity of seeds in different storage methods and containers.

Long term objectives: (a) To determine the factors affecting longevity of seeds during storage. (b) To find out a suitable short-term as well as long term seed storage methodology.

Progress made

Species to be studied were identified. Phenological studies were initiated in *Vateria indica* and *Hopea parviflora*.

Project 33: Productivity and Nutrient Dynamics in Agroforestry system.

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

Progress made

Farmers field were identified and a layout of the experimental plot prepared. Planted seedlings of Teak and Casuarina as per the layout plan. Initial soil sampling and growth measurements recorded. Further study is in progress.

Project 34: Investigation on wood properties of Teak in relation to variation in site factors and growth parameters.

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.

Progress made

Growth data of Teak plantations in Tirunelveli, Coimbatore and Tanjore were collected. Soil samples from respective plantations were collected and analysis is in progress. Wood samples were collected from Teak plantations growing in different eco-climatic zones.

Project 35: Management of *Casuarina equisetifolia* in agroforestry for sustainable economic returns.

Objectives: (a) To manage the tree crown to optimise 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 ascertain suitable density, espacement, and pruning schedule for maximising economic returns.

Progress made

Farmers fields were identified and a layout of the experimental plot prepared. Planted seedlings of Casuarina as per the layout plan. Initial soil sampling and growth measurements recorded. Further study is in progress.

EXTENSION

Transferred the clonal propagation technology of Eucalyptus to the Andhra Pradesh Forest Development Corporation on a consultancy basis. The consultancy was carried out by IFGTB as an institutional consultancy with Director being the overall incharge for the execution of the work with a team of seven officials of IFGTB. The following achievements were made in the consultancy:

- Development of infrastructure, training on man power in terms of clonal multiplication, management of propagation complexes, disease and insect management, and identification of new trees for cloning.
- Nearly 100 officials were trained.
- 200 ha of clonal plantations were established.
- 15 ha of clonal multiplication area was established.
- The APFDC has been positioned to plant 3000 ha of clonal material every year.

The clonal material of Casuarina and Eucalyptus were supplied to the 18 user agencies including ITC Bhadrachalam Ltd., J.K. Paper Mills, various research institute, State Forest Departments and universities.

(a) Facilities generated and service rendered.

Seedling seed orchard of Eucalyptus was established under the consultancy of clonal technology programme to the Andhra Pradesh Forest Development Corporation.

Consultancy was rendered to Associated Cement Companies, Walayar on Afforestation of limestone reject dump.

Plants and plant products slated for export were examined and 27 Phytosanitary Certificates were issued to various organisations/individuals for these exportable items.

Technical advice was rendered to the Andhra Pradesh Forest Department for procuring essential equipments/instruments for establishing Mycorrhiza (biofertilizer) laboratory.

Several queries from State Forest Department farmers and private establishments were attended and suitable pest and disease control measures suggested.

Over 200 plant samples were identified for researcher's from Bharatiar University and Forest College, Mettupalayam by scientist of Bio-diversity division.

(i) Library and Documentation

There is a good collection of 6500 books and 50 journals (both Indian and Foreign), 200 back volumes of periodicals and other research reports, national and international seminar proceedings, and gray literature in the library. The IFGTB library is a repository of literature on Forestry Biotechnology, Genetics, and Environment and Ecology. Databases on CD-ROM are also available. The library facilities are also made use of by the State Forest Departments, Research Institutes, Universities and colleges etc.

(ii) Computer Facilities

IFGTB is equipped with 57 computers in different divisions. The computer centre has hardware/software resources for diverse computing requirements of IFGTB. Windows NT based LAN is planned for connecting existing computers at computer centre.

Established Internet (TCP/IP) /Email connectivity for researchers need.

A dedicated computer system has been setup for genetic analysis of trials with Data Plus and Genstat has been developed in the Genetics and Tree Breeding Division.

(iii) Video films

One video film "Economic utilisation of Casuarina" is under progress and one film on UNDP programs has been completed.

(b) Transfer of Technology

(i) Training - eg. to farmers, NGOs, SFDs, institutes etc.

- A one month summer training course was organised during May 1998 on Molecular techniques and Tree hybridization to the Biochemistry undergraduate students of Avinashilingam Deemed University, Coimbatore.
- Training imparted to various target groups and NGOs on vegetative propagation, seed handling, nursery techniques, biofertilizer, importance of forestry, socio-economics of forest species, pest and disease management, and medicinal plant under UNDP, FREEP, NABARD.

(ii) Teaching support - eg. to various organisations

- IFGTB organised IFS officers compulsory course on 'Genetic Improvement and propagation of forest tree species' from Dec. 7 -11, 1998. Scientists of the institute delivered various lecture.
- Lectures delivered to B.Sc. (Botany) students of different colleges of on biotechnology.
- Teaching support was provided to State Forest Service College, Southern Forest Rangers College, and Bharathiar University, Coimbatore.
- Guest lectures on Tree measurement were delivered to trainees of Southern Forest Service College, Coimbatore.
- Scientist delivered lecture at Bharathiar University to college/school students on environmental awareness, forest conservation and biotechnology.

(iii) Exhibition, Kisan Mela etc.

- *Gass Forest Museum* : Magnificent collection of rare, exotic and educative exhibits related to Forestry and Natural History housed at the Museum were maintained and awareness created among the public and students by explaining their significance. About 19,889 people including many high dignitaries from India and abroad visited the Museum during the year.
- Participated in the exhibition during the workshop on Forests, Forest Products and Coastal population organised by IFGTB, IWST and Tamil Nadu Forest Department from 10-2-99 to 12-2-99 at Chennai.

(iv) Field Demonstration

- Application of biofertilizers for better establishment and growth of seedlings and management of agroforestry plantations, and soil and moisture conservation measures were demonstrated to farmers, NGOs etc., in the field under NABARD project by agroforestry division.
- Demonstrated establishment of nursery including preparation of nursery beds, biofertilizer cum pesticide application, and vegetative propagation methods at the Silviculture model nursery to farmers, NGOs and students.

(v) **Demonstration plantations**

- Provenance cum progeny trials of Casuarina, Acacias and Eucalyptus have been established with the help of Forest Departments of Orissa, Andhra Pradesh, Tamil Nadu and Kerala.
- A field trial was established at Karunyanagar using the seeds of CSO of *Casuarina equisetifolia* at Panampalli and the seeds from the local forest department plantations by Silviculture division.
- Demonstration plot to show the superiority of seeds collected from Clonal seed orchards has been established at Sadiyaval by extension wing.

(vi) **Seminars and Workshops**

- Conducted Industrial cum demonstration workshop on 'Clonal Forestry' on November 30, 1998.
- Workshop on Bio-diversity conservation was organized on 15th September 1998 at IFGTB, Coimbatore.
- Conducted Workshop cum Peer Review on Casuarina on 26th October 1998.
- Research Priority Setting Workshop was conducted at IFGTB, Coimbatore on 1st and 2nd Feb., 1999.

(c) **Linkages with other organizations/Institutes/States etc. - e.g. collaborative ventures etc.**

Clones of Eucalyptus, Teak and Casuarina were exchanged with the following organisations:

1. JK Paper Mills, Rayegada, Orissa.
2. State Silviculturist, Rajamundhry, Andhra Pradesh.
3. Andhra Pradesh Forest Development Corporation.
4. Forest Development Corporation of Maharashtra.
5. DCF, Genetics, Tamil Nadu Forest Department.

Seedlings required by Shanti Ashram, an NGO, under an agroforestry project, funded by UNDP, were raised and supplied.

(i) **Books published**

Genetic Improvement and propagation of forestry tree species.

(ii) **Brochures published/printed**

Field guide to Panampally

Brochures on IFGTB (reprint)

Breeding System and Hybridisation Techniques in Tamarind : B. Nagarajan, A. Nicodemus, Mohan Vargheese, K.R. Sasidharan and N.P. Mahadevan.

(iii) **Technical bulletin published**

The technology and productivity of Teak plantations in India by K.S.Mandal, Rambabu, Chena Mammal and Nagarajan. B.

FINANCIAL STATEMENT

I. PLAN		
Sl.No.	SUB-HEAD	Expenditure (Rs. in lakh)
1.	A. REVENUE EXPENDITURE	
	(a) Research	130.78
	(b) Administrative Support	48.37
	Total for Revenue Expenditure 'A'	179.15
	B. LOAN AND ADVANCES	
	(a) Loan Advances (Conveyance)	1.99
	(b) House Building Advance	4.00
	Total for 'B'	5.99
	C. CAPITAL EXPENDITURE	
	(a) Building & Roads	1.20
	(b) Equipments, Library Books	4.42
	(c) Vehicles	
	Total for 'C'	5.62
	GRAND TOTAL FOR A+B+C(PLAN)	190.76
II. NON-PLAN		
1.	A. REVENUE EXPENDITURE	
	(a) Research	16.99
	(b) Administrative Support (Salary)	57.89
	Total Non-Plan	74.88
	TOTAL FOR PLAN + NON-PLAN	265.64
III. FUNDED PROJECT		
	A. World Bank Project	123.39
	B. UNDP Project	5.57
	C. NABARD Project	12.95
	D. FORTIP	.18
	GRAND TOTAL for A+B+C+D (FUNDED PROJECT)	142.09