Completed ICFRE Funded Project 2011-12

Project Sl. No.	Name of Project	PI	Thrust Area	Research Findings
1	Evaluation and characterization of clones of *Casuarina* with reference to yield, tree form, biomass, pulping characteristics and key nursery pests. (IFGTB/RP-44/ 2007-2012)	Dr Kannan C.S. Warrier & Dr A. Balu	Forest Genetic Resource Management and Tree Improvement	Significant difference was observed for tree height, diameter at breast height and biomass index among the casuarina clones in all the three locations tested namely, Mayiladumparai, Moorthipalayam and Sirugramam in Tamil Nadu. Among the two primary characters, DBH showed higher degree of variation than tree height in all the three locations. Variability parameters including genotypic variation (GV), phenotypic variation (PV), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), broad sense heritability (H^2) and genetic advance (GA) were calculated in all the three locations. Phenotypic coefficient of variation was higher than the GCV for all the characters and this indicated that these traits were influenced by non-additive gene action. At Mayiladumparai DBH registered the maximum value for heritability (0.44) closely followed by volume index (0.43). Tree height recorded the maximum broad sense heritability at Moorthipalayam (0.23) closely followed by volume index (0.21). At Sirugramam, volume index had the maximum value for heritability (0.31) followed by DBH (0.27). A decreasing trend with respect to broad sense heritability was observed over the three growth periods in all the three locations for all the three characters in general. Age-age correlations were worked out for the different growth phases. The genotypic correlation coefficients were higher in magnitude than the phenotypic correlation coefficients for all the traits at all the three locations indicating that the association between these traits was genetically controlled. Significant and positive correlations were recorded for tree height, DBH and volume index among all combinations of ages at phenotypic

				and genotypic levels at all the three locations. Selection for tree height, DBH, and volume index at age 3 using age 1 data would respectively be 88.3, 79.6 and 76.6 per cent as effective as selection at age 3 at Mayiladumparai. The respective values at Moorthipalayam were 87.6, 86.8 and 81.8 per cent. At Sirugramam, selection for these traits at age 2.5 using the first year's data would respectively be 100, 91.3 and 91.4 per cent as effective as selection at age 2.5. Genetic divergence studies were undertaken at all the three locations. Application of Mahalanobis' D^2 statistics and Tocher's clustering method grouped the 90 accessions into 10, 15 and 14 clusters at Mayiladumparai, Moorthipalayam and Sirugramam respectively. Five male clones namely, TNVM 2, CE 2003/4, CE 2003/3, CE 219 and CE 347 and 10 female clones TNPP 2, TN 111, CE 2002/1, CE 220, CE 268, CE 243, CE 9, CE 303, CE 281 and CE 2003/5 can be selected for further breeding programmes. Five monoecious clones namely, CE 2002/2, CE 329, CE 327, CE 224 and CE 83 also were found to be productive and divergent. They could be used as pollen parents in the breeding programme. The results on genetic divergence have got an immediate application in the establishment of clonal seed orchards. GxE interaction was analysed using stability parameters. Five clones namely, CE 220, CH 3001, CE 243, CE 224 and CE 2003/5 proved to be stable across the three locations with respect to volume index. Clones CE 243, CE 9 and TNPP 1 were found suitable for planting in sites with stress or favourable conditions. End-use specific clones have been identified based on the qualitative characters. When stem straightness, verticality and branch thickness were considered 27 clones were found suitable for pulp production. Trees with sharp leader shoot and narrow crown are ideal to be interplanted with agricultural plants in agroforestry systems. Small branches with acute branch angle help in the

				development of narrow conical crown. Based on these characters, 28 clones have been identified for wide row intercropping. Stem straightness and axis persistence are the two major characters important for form quality of poles. Twenty-seven clones were identified for the purpose of poles and scaffolding based on these attributes. Change in sex expression was noticed in three clones. Clones TNBS 1 and TNIPT 11 were males originally and transformed into monoecious trees at two locations (Mayiladumparai and Moorthipalayam) by producing female inflorescence / infructescence also. Clone TCR 120203 was originally female and changed its sex to monoecious at both Mayiladumparai and Sirugramam. However it remained as female at Moorthipalayam. Wood fibre, vessel and ray characteristics were studied for select clones during the project period. Clones with high Felting coefficient and Coefficient of fibre flexibility but low Runkel's ratio and Isenberg coefficient are ideal for pulp. In the present study it was observed that clones CE 83, CE 100, CE 268, CE 2003/3, CE 2003/4, TCR 120203, APKKD 6 and JKCE 8 in general were suitable for quality pulp production based on the above mentioned ratios. Thirty clones registered a specific gravity of more than 0.80. Five clones namely, TNVM 2, APVSP 14, TNCS1, CE 398 and CE 268 recorded a specific gravity of more than 0.90. Cellulose content ranged between 30.83 (TNRM 8) to 47.82% (CE 329). Thirty clones estimated a cellulose content of more than 35 per cent. Lignin content varied widely from 11.21 to 29.25%. Clones CE 398, CE 327, CE 276, TNVM 3, CE 2003/3, CE 2003/4, TNVM 2, TN 111, TNCS1 and CE 9 recorded a lignin content of less than 18 per cent. Wood materials with low lignin content are ideal for pulping. On the other hand clones, CE 268, CE 303, CE 224, TNIPT 16, CE 329, TNRM 5, CE 2002/1, TNPV 4 and TNPP 2 estimated a lignin content of

				more than 25 per cent. They are strong and suitable for poles. Based on the mean number of individuals of *Icerya purchasi* colonized and multiplied on one ramet of each clone, the 220 clones were categorized into 5 types namely resistant, very less susceptible, less susceptible, moderately susceptible and highly susceptible. Five resistant clones (PY-157, APKKD - 11, TNKP - 2, APKKD - 3 and TNIPT- 6) remained free of the targeted pest *I. purchasi* for the entire study period. Data collected in respect of the needle feeder, *Eumeta crameri* showed 89 clones were free from the attack of bag worm. The no-choice feeding experiment carried out in controlled condition to validate the field observation and to determine the true resistant nature of the clones for *I. purchasi* exhibited that those five clones observed to be resistant at the field experiment, were found truly resistant in the controlled condition experiment also. This was confirmed through the study on biology of the pest in controlled condition. The no-choice feeding experiment carried out under controlled condition to determine true nature of the resistant clones shortlisted at the field experiment revealed that out of 89 clones only 5 (TNKBM - 403, JKCE - 13, CE - 112, CE - 2003/4 and TNIPT - 6) were truly resistant to *E. crameri*. Resistance to insect should be a basic objective of crop improvement programmes. Similarly the development of tree crops resistant to insect attack should be an integral part of strategies for insect management. The sources of resistance where search can be made are generally natural stands, clonal seed orchards and seedling seed orchards. Outcome of the present study reveals the worthiness of searching for resistant candidates at the clonal germplasm bank also. It has been observed that the apparently resistant candidates were from different land races / provenances as compared to the highly

				susceptible candidates representing mostly from one or two land races.
2	Assessment of population structure using SSRs and molecular characterization of Casuarina clones using RAPD markers. (IFGTB/RP-52/ 2007-2010)	Dr. D. Thangamani & Dr. A. Shanthi (Co-PI)	Forest genetics resource management and tree improvement (Theme: Biotechnology)	The study showed an inter-simple sequence repeat (ISSR) polymerase chain reaction (PCR)-based enrichment technique for microsatellite-rich regions in *Casuarina equisetifolia* The four ISSR primers amplified in *Casuarina* DNA using optimized PCR condition. The total ISSR-PCR products were taken for cloning experiment. The PCR fragments were cloned with pTZ52R/T vector and transformed into DH5a competent cells. The cloning experiment was carried out using InsTAclone PCR Cloning kit (Fermentas). Positive clones were selected using blue/white selection after growth on IPTG- X-Gal media. The clones containing the insert were sequenced to identify the SSR motifs. The sequence showed "di" and "tri" repeats when trolled using WEBTROLL database. From the sequences four SSR primers were designed using Prmier3 software. The sequences were successfully deposited in NCBI database and the primers were synthesized. SSR-PCR parameters and conditions are optimized for the designed primers in Casuarina genome. All the four primers successfully amplified in the *Casuarina* genome. DNA profiling using ten RAPD primers was carried out in one hundred and fifty clones of *Casuarina equisetifolia* and genetic relationships of clones were studied using RAPDistance and NTSYS pc softwares
3	Identification of Biochemical markers (Isozyme) linked to sex determination in *Casuarina equisetifolia* (IFGTB/RP-61/	Dr. A. Shanthi	Forest genetics resource management and tree improvement (Theme: Biotechnology)	Twelve isozymes viz., Aspartate Amino Transferase (AAT), Peroxidase (POD), Esterase (EST), Glutamate Dehydrogenase (GDH), SuperoxideDismutase (SOD), Alcohol Dehydrogenase (ADH) Isocitrate Dehydrogenase (IDH,Glucose -6-phosphate Dehydrogenase (G-6-PDH), Malate Dehydrogenase (MDH), Malic Enzyme (ME), Polyphenol Oxidase

	2008-2011)			(PPO) , Lactate dehydrogenase (LDH)] were studied in *Casuarina equisetifolia*. These isozymes were grouped under hydrolase, Oxidoreductase and transferase. The structure of the isoenzymes were monomeric and in dimeric forms. In casuarina clones most of the isozymes expressed with two locus & two alleles. The result of this study helps to identify gender specific isozyme marker which would be useful in identifying gender at seedling level. Five enzymes (**Alcohol dehydrogenase (Adh), Malate dehydrogenase (Mdh), Lactate dehydrogenase (Ldh), Peroxidase (Pod), Isocitrate dehydrogenase (Idh,**) were more stable expressions towards gender specific among the twelve different enzymes which were optimized in this species.
4	Enhancing rootability and planting stock production of selected high yielding eucalyptus clones through micro and mini cutting technique. (IFGTB-RP-79/2009-2012)	Dr.V.K.W. Bachpai	Genetic Improvement (Vegetative Propagation)	1.Thirty clones were subjected to tissue culture and plantlets produced for establishment of vegetative multiplication garden 2.Tissue culture raised plants were rejuvenated showing high adventitious rooting competence 3.Genetic fidelity of the TC plants were confirmed using ISSR-PCR technique 4.Rejuvenated systems of mini cutting technique and micro cutting technique enhance the rooting potential of the poor and moderate rooters to the threshold value for economic consideration of mass multiplication 5.Rooting potential was enhanced for the clones released by IFGTB (IFGTB/ EC 1, IFGTB/ EC 2, IFGTB/ EC 3 and IFGTB/ EC 4)
5	Capacity building among tree farmers for handling farm forestry planting stock on large scale. (IFGTB-RP-92/2010-2012)	Dr.V.K.W. Bachpai	Genetic Improvement (Vegetative Propagation)	1.The training conducted on capacity building is a proven success in helping farmers to adopt and implement tree improvement activities and quality planting stock. . 2.The training imparted to farmers of different districts of Tamilnadu did not only provide information

				for farmers, but developed immense capacity and knowledge tree farming. 3.Learning through hands-on experience during training programmes facilitated the learning process, especially when the topics related to everyday practices such as nursery establishment, management, different propagation techniques used for *Eucalyptus, Casuarina equisetifolia* and Bamboos. 4. As most of the farmers had an idea regarding the importance of tissue culture in agricultural crops they paid more attention towards the role of tissue culture in improvement programmes and micropropagation with special reference to forerstry species. 5. Productivity enhancement through quality seeds and seeds of Clonal seed orchards was an eye opener for the farmer trainees as it was for the first time they had come across these terms with regard to forestry tree species and agreed that they were ignorant of the quality improved seeds till they attended this training. 6.Development of Hybrids in forestry tree species, Similarly, when hands on training was imparted regarding vegetative propagation techniques the trainees expressed that they were exposed to such activities for the first time regarding propagation techniques and usage of roots inducing harmones such as IBA and IAA. **7.** During participatory training, participants were encouraged to explore and discover themselves by which knowledge obtained this way is more easily internalised and put into practice.
6	Development of micro and macro propagation technology for planting stock production of	Dr. Rekha R Warrier	FGR Management	Micropropagation: Optimisation of sterilsation procedures for explants for contamination free cultures was carried out. It was observed that season played a significant role in the initiation of cultures. Experiments initiated during the period from

	Mela dubia. (IFGTB-RP - 70/2009-2011)			January – June when there was a new flush of leaves, were contaminant free. Subcultured tissues revealed contamination after repeated subculturing, when initiated during the off seasons. This could possibly be due to endophytes. Nodal explants were excised from seedlings, thereafter planted on Murashige and Skoog's medium supplemented with various growth hormones for multiple shoot formation. Twenty different combinations were tested in two basal media. Multiple shoot formation occurred on MS supplemented with BAP (0.1 – 2 ppm) either alone or in combination with Kinetin (0.5 ppm). Best results, however, were obtained on MS + BAP (1 ppm) where 4-5 shoots regenerated from a single shoot apex. It was also observed that initial treatment with BAP (2 – 4 ppm) for 2 - 3 weeks followed by transfer to lower concentration of BAP (0.01 - 0.1 ppm) or simple MS medium proved most effective in terms of new shoot production and shoot growth rate. WPM medium was also tested but shoot proliferation was low. Vitrification of shoots was also observed. The shoots were excised and transferred to different root inducing media both *in vitro* and *ex vitro*. For *ex vitro*, micro cuttings of various sizes (2-3, 3-4, 4-5 cm) in varying concentrations of rooting hormones – 1000, 2000 and 3000 ppm IBA (liquid formulations) for 5 minutes and rooted in vermiculite. 75 % rooting was obtained; however, transplantation resulted in poor survival of plantlets. Macropropagation: It involved determination of coppicing ability at different stump heights (30, 60, 90 and 120 cm), followed by rooting of these coppices. Also branch cuttings were included in the rooting experiment. Factors such as different hormonal treatments (control; IBA 1000, 2000, 3000 ppm – powder and liquid formulations), different media namely sand, vermiculite and coir pith were included in this experiment. Results indicated that 120 cm stumps gave the

				best survival percentage (60%) with the best coppice ability in terms of sprout number production (10). Though stumps of height 90 cm also produced sufficient coppice, the shoots did not survive. The difference observed in the coppice shoots arising from stumps of varied heights was diameter of the sprouts. Sprouts with diameter 0.5 cm or less (pencil thickness) showed poor rooting and survival ability. The rooting ability recorded was relatively low i.e. 16%, 18% and 11 % from 30, 60 and 90 cm stumps respectively. Sprouts from branch cuttings of pencil thickness diameter also rooted well, though the branch cuttings did not respond to hormonal treatments. They were also observed to be highly susceptible to fungal attack.
7	Studies on macro propagation of bamboo species. Duration: 3 Years 2009-2012 (Transferred project from FRC, Hyderabad) (IFGTB-RP-111/2009-2012)	K.S.Venkata ramanan	Genetic improvement (Vegetative propagation)	Established the basic need of low cost mini shade house for macro propagation studies of Bamboo species at FRC, Hyderabad. The present studies showed that positive results in rooting of 3 node thin branch cutting (6 to 7mm diameter) in *Bambusa bambos.* Farmers may adopt this simple method of producing quality planting stock of through collection of more branch cutting with less man power and without much damage to selected clumps. The present studies on macro proliferation showed 100% survival percentage in the species of *Bambusa bambos & Bambusa balcooa* after hardening in short period and this simple technique also useful for producing quality planting stock in large scale to the end users. Additional by the present studies showed positive result in rooting single node cuttings (1 to 1.5 diameters) of ornamental bamboo species of *Bambusa wamin* in Control treatment this simple and low cost technique may also useful for producing commercially for end users.
8	Selection, evaluation and identification of efficient bio-	Dr. V. Mohan	Managing Forests and Forest Products for	216 Plant Growth Promoting Rhizobacteia (PGPR) isolates and 26 different Arbuscular Mycorrhizal (AM) fungi were isolated and

	inoculants for quality seedling production of selected fast growing native tree species. (IFGTB/RP- 74/ 2009-2012)		Livelihood Support and Economic Growth (Theme: Mycorrhizae, Rhizobia and other useful microbes)	identified from the rhizosphere samples of 6 different fast growing native tree species viz., *Ailanthus excelsa, A. triphysa, Dalbergia latifolia, Gmelina arborea, Melia dubia* and *Neolamarckia cadamba* in Tamil Nadu and Kerala. All the isolates are maintained in the Institute's culture bank for further studies. Species level identification of the PGPR isolated from the rhizosphere of six different fast growing native tree species were made. Based on the molecular studies, some of PGPR viz., *Acinetobacter* sp., *Azotobacter beijernickii, Azotobacter chroococcum, Azotobacter vinelandii, Azospirillum amazonense, Bacillus lentus, Bacillus megaterium, B. subtilis, Pseudomonas fluorescens, Stenotrophomons* sp. were reported for the first time as new records. 16S rDNA Nucleotide sequences of 13 isolates of PGPR isolated from the rhizosphere of six different fast growing native tree species in Tamil Nadu and Kerala have been submitted to European Molecular Biology laboratory (EMBL) and National Centre for Biotechnology Information (NCBI) Database as accessions in their repository. This is first time in forestry such a study is undertaken at IFGTB. Screening of efficient PGPR isolates was done under *in vitro* by IAA production and phosphate solubilization and the best isolates were selected for nursery experiments. Seedlings of six different native tree species were raised and inoculated with selected PGPR and AM fungal bio-fertilizers (single and multiple inoculations) and maintained in the experimental nursery. It was observed that the seedlings inoculated with PGPR or AM fungi (both single and multiple inoculation) showed significant growth over uninoculated control with respect to shoot and root height, shoot and root biomass, total

				biomass, volume index, sturdiness quotient, absolute growth rate, relative growth rate and Microbial inoculation effect after 90 and 180DAI. The results also indicated that multiple inoculation of different PGPR and AM fungi showed better growth performance over single inoculation and control. Nucleotide Sequences of 13 different isolates of PGPR (Plant Growth Promoting Rhizobacteria) isolated from the rhizosphere of six different fast growing native tree species in Tamil Nadu and Kerala have been submitted to European Molecular Biology laboratory (EMBL) and NCBI Database and obtained the Accession Number for the repository. Total of 13 different PGPR isolates were submitted and obtained Accession Number 4 research papers were presented in National and International Seminars/ Conferences.
9	Identification of biochemical marker for salinity tolerance in *Casuarina equisetifolia* (IFGTB/RP-81/2009-2012)	Dr.R.Anand alakshmi	Tree improvement	10 clones were classified into 4 groups of saline tolerance based on survival. Proline as marker could successfully group the clones to the extent of 50%, Protein to the level of 60% and both Phenol and Phenol+Protein to the scale of 80%.
10	Status and influence of microbial inoculants associated with Eucalyptus clones in established breeding populations. (IFGTB/RP- 65/ 2008-2011)	Dr. A. Karthikeyan	Mycorrhiza and other beneficial microbes	In this project the microbial inoculants were tested in Eucalyptus clones for effective rooting and nutrient enhancement. Conventionally the rooting in Eucalyptus clones was achieved by application of chemical hormones (IBA) which is expensive. It was reported that the beneficial microbial inoculants such as *Azospirillum, Psuedomonas, Bacillus* and *Azotobacter* synthesizing hormones which induced rooting in trees. Hence the microbial inoculants (*Azospirillum, Pseudomonas, Bacillus and Azotobacter)* were applied for effective rooting in Eucalyptus clones on par with IBA treated cuttings as control under controlled conditions

				(37º C & 65 % RH). PGPRs inoculated stem cuttings responded rooting better than IBA treated cuttings under controlled conditions. These PGPRs were inoculated to the stem cuttings for rooting *B. megaterium* inoculated clone no 14 shows vigorous rooting after 14 days and found better than IBA treated cuttings. The Percentage of rooting is 81%. *P. fluorsecens* showed better root initiation in clone no 111 and 31, 16, 7,9, 188, 186, 16, 63 showed late response to 14 after 15 days of inoculation. The clones 1, 196, 19, PGPRs inoculation collected from Sathyavedu and Karunya. These clones produced rooting after 20 days of inoculation and the per centage of rooting was 45 – 58. The AM fungi and PGPRs inoculated clones (C111, C14, C19, C53) also showed higher content of P than control clones. Out of 30 clones, clone nos 111, 191, 116,76,101,154,186,14,69 and 123 showed better performance in root initiation, number of lateral roots, root length and shoot length. The nutrient status (P) was also studied in the microbial inoculants inoculated Eucalyptus clones and found that higher content of P in the microbial inoculants applied Eucalyptus clones.
11	Development of Agroforestry systems with economically important medicinal plants under industrial tree species of *Casuarina* and *Eucalyptus* (IFGTB -RP - 71/2009-2012)	Dr. K. Panneer Selvam	Managing Forest and Forest Products for Livelihood Support and Economics Growth	The highest growth parameters of trees (*Eucalyptus camaldulensis* and *Casuarina equisetifolia* and *C. junghuhniana)* and medicinal plants was recorded in Cuddalore followed by Jayankondam, Sendurai and Sivagangai. The *Gloriosa superba* produced maximum seed yield in open field compared to agroforestry system in Jayngondam.The Colchicine content in *G. superba* seed was high under *C. junghuhniana* at Sivagangai followed by *E. camandulensis* at Jeyangondam. The maximum shoot and root length in case of *Decalepis hamiltonii* were recorded in *E. camandulensis* plantation compared to *C. equisetifolia,and C. junghuhniana* and open field. The highest shoot and root length of *Hemidesmus indicus* were recorded in *C. equisetifolia* plantation compared to *C.*

				junghuhniana, *E. camandulensis* and open field.
12	IPM for the key pest of *Ailanthus excelsa, Gmelinaarborea and Dalbergiasissoo* in nurseries and in young plantation. (IFGTB/RP-75/2009-2012)	Dr. A. Balu	Managing forests and forest products for livelihood support and Economic growth	While the defoliators such as *Atteva fabriciella*, *Eligma narcissus* (defoliators in nurseries and plantations) and the sap sucker, *Maconellicoccus hirsutus* (plantations) are reported to be the major pests of *Ailanthus excelsa, Euptrote geminate* (in nurseries and plantations), *Sahydrassusmalabaricus*, *Indarbelaquadrinotata* and *Tingis beesoni* (in plantations) are considered as serious pests on *Gmelinaarborea*. Similarly, beetles such as *Myllocerus discolor* and *Myllocerusviridanus* (in nurseries) are found the major pests causing severe damage on *Dalbergiasiss*oo plants. In the present study development of species specific IPM was attempted involving cultural, mechanical, biological, botanical and chemical methods for management of the above said key insect pests. The findings are as follows. The bioassay study carried out with six commercial Insecticides, Chlorpyriphos20 EC, Quinalphos 25 EC, Monocrotophos 36 SL, Thiodicarb 35 SC, Imidacloprid 200 SL and Dimethioate 30 EC at five different concentrations such as 0.005%, 0.01%, 0.025%, 0.05% and 0.075%. against the insect pests *Atteva fabricilla*, and *Eligma narcissus* (*Ailanthus excelsa*) *Myllocerus discolor*, *M. viridanus* (*Dalbergiasissoo*) and *Eupterote geminata* (*Gmelinaarborea*) revealed that the concentrations 0.025 to 0.075% were effective against all the pests by resulting 100% mortality over a period of 24hrs. However the field evaluation of these effective concentrations against the pests studied showed only the chemical Monocrotophos at 0.25% was effective against all the pests resulting 100 % mortality at 24hrs. Whereas all other chemicals were found effective between 0.05 to 0.075%

				Bioassay studies with entomopathogenic fungus, *Beauveriabassiana* at 4 different concentrations ($10x^4$, $10x^6$, $10x^8$ and $10x^{10}$) against the bark feeder, *Indarbelaquadrinotata* and the stem borer, *Sahyadrassusmalabaricus* at the laboratory exhibited that the concentrations $10x^6$, $10x^8$ and $10x^{10}$ were effective in killing the larvae over a period of seven days. However the field evaluation revealed that spraying of fungal solution at $10x^8$ and $10x^{10}$ concentrations over the frass tunnels, feeding areas on the bark and applied over the bore holes in the case of *I. quadrinotata* and removal of frass mat and injecting or spraying into the bore holes in the case of *S. malabaricus* were found effective. Similarly the seed oils such as Jatropha, Pongamia and Neem tested at five different concentrations (1 to5%) showed that the concentration 5% could act as good antifeedant or repellent but they could exhibit only 30 to 40% mortality of the insect. A Neem based formulation Neem Azal 1% tested at 5 different concentrations (0.1 to 0.5%) expressed that the formulation 0.5% was effective against all the defoliators and sapsuckers studied in the present project. The product was able to result in 96 to 100% mortality of the pests in 24 to 48hrs. Crude Leaf extracts of *Ailanthus excelsa*, *Aegle. marmelos* and *Lantana camara* at 1, 2.5, 5, 7.5 and 10% tested against the targeted insect pests did not show any effect on any of the pest species studied. Cultural operations such as constant vigil to detect the occurrence of the pests, removal and killing of eggs, larvae and pupae of lepidopteran defoliators of Ailanthus and Gmelina, when they are at smaller proportion, use of light traps to attract adults of **Eligma** and **Atteva** and shaking of

				tree branches vigorously in the case of Myllocerus beetles were useful to reduce the insect population in the field .
13	Screening of high yielding clones and seed sources of Eucalypts spp. for gall insect pest, *Leptocybeinvasa* Fisher & La Salle. (IFGTB/RP-76/2009-2012)	Dr. A. Balu	Forest Genetic Resources management and Tree Improvement	About 221 high yielding clones of eucalyptus mobilised from ITC, JK paper mills, SPIC, Kerala Forest Research Institute (KFRI), State Forest Research Institute (SFRI), Mettupalaym, IFGTB, Biotechnology Research Centre (BRC), Tirupathi, Tamil Nadu Forest Development Corporation (TAFCORN) and Tamil Nadu Paper mills Ltd. (TNPL) including IFGTB raised in the trial at Satyavedu (Andhra Pradesh) and maintained at VMGs Panampally (Kerala) and Coimbatore (Tamil Nadu) were screened for gall insect attack for two continuous years . Observations on the incidence of the pest, oviposition damage gall formation, intensity of attack were collected at monthly and quarterly intervals on each clone. Based on analysis of two years data the status of 221 eucalyptus clones for the attack of the pest was categorized into resistant/tolerant, less susceptible, moderately susceptible and Highly susceptible. Categorization of 221 clones revealed the existence of 10 resistant/tolerant , 43 Very Less susceptible 62 less susceptible , 52 moderately susceptible and 54 Highly susceptible clones. A hymenopteran parasitoid, *Megastigmus* sp. operating as a natural enemy of the gall insect, *Leptocybeinvasa* was recorded and reported from the trial at Satyavedu. Influence of biotic factor (phenology of the host plant) and abiotic factor such as temperature and humidity on the incidence and intensity of attack of the gall insect were also assessed and discussed.
14	Development of appropriate integrated management methods for the *Eucalyptus* Gall	Dr. J.P.Jacob		Considering the adverse impacts of chemical pesticides and the difficulty in application in vast areas of plantations besides the concealed nature of the pest inside the gall, identification of integrated

	wasp problem in nurseries. (IFGTB-RP-93/2010-2012)			management measures for Eucalyptus gall wasp was attempted in nurseries involving methods like traps, plant based extracts, pesticides, classical biological control besides utilization of gall resistance in germplasm of eucalypts. Trap methods (Light trap, colour traps, sticky traps) did not reduce the gall wasp population in nursery beds. Application of plant based extracts and foliar application of pesticides also did not have significant impact on gall population except soil application of Phorate. Reduced watering regime to reduce the occurrence of new tender shoots which attract gall wasp did not show reduced gall infestation in nursery seedlings. Significant reduction in gall wasp population was observed when gall tolerant clones were deployed along with release of natural enemies *Quadrastichus mendelli* and *Megastigmus* sp. Results show that deployment of gall tolerant clones and release of biocontrol agents helped in significantly reducing the high cost of containing the pest in outbreak situations and avoids loss of planting material. Expected yield/ha tends to show a decrease leading to a projected economic loss of 40-50% due to gall infestation