REPORT AT A GLANCE

The Indian Council of Forestry Research and Education (ICFRE) is the premier forestry research organization of the country with the mandate to formulate, organize, direct and manage forestry research, transfer the technologies developed for states and other user agencies and impart forestry education.

Objectives of the ICFRE are :

- To undertake, aid, promote and coordinate forestry education, research and their application,
- To develop and maintain a National Forest Library and Information Centre for forestry and allied sciences,
- To act as a clearing house for research and general information relating to forests and wildlife,
- To develop forestry extension programmes and propagate the same through mass media audio-visual aids and other extension machinery,
- To provide consultancy services in the field of forestry research and education and allied sciences and
- Other things considered necessary to attain these objectives.

ICFRE has 8 Regional Research Institutes and 3 Centres in various parts of the country to cater the forestry research needs of different bio-geographical regions of the nation. The Regional Research Institutes are located at Dehra Dun, Shimla, Ranchi, Jorhat, Jabalpur, Jodhpur, Bangalore and Coimbatore and the Centres at Allahabad, Chhindwara and Hyderabad. The activities of these Institutes and Centres are described in separate chapters of the report.

FORESTRY RESEARCH

Project Formulation Division has updated status reports of research projects of ICFRE Institutes submitted to various national and international donor agencies. A database of 142 research projects submitted to various national donor agencies has been prepared. 45 research projects and 31 concept notes have been submitted to various international donor agencies.

Institute wise break-up is as follows

National projects : ICFRE: 17; FRI: 37; TFRI: 25; IWST: 15; IFGTB: 18; AFRI: 12; RFRI: 3; HFRI: 5; IFP: 7; FRC: 3. **Total : 142**

International projects : ICFRE: 5; FRI: 13; TFRI: 5; IWST: 3; IFGTB: 10; AFRI: 2; RFRI: 1; HFRI: 1; IFP: 5. **Total : 45**

Concept notes : ICFRE : 1; FRI: 5; TFRI: 2; IWST: 5; IFGTB: 3; AFRI: 3; RFRI: 2; HFRI: 4; IFP: 6. **Total : 31**

A large number of project proposals received from ICFRE institutes, MoEF, national organisations and other agencies were evaluated with regards to their suitability with the identified thrust areas. Linkages have been developed with various national and international research organizations.

Planning and Programme Division was created in the month of December 2002, after merging former Planning and Programme, under the Directorate of Research to deal with planning, processing and execution of new project proposals and review the ongoing research projects of all the ICFRE institutes. A meeting of Research Policy Committee (RPC), which is an apex body at ICFRE, was held on 26th June, 2002 under the chairmanship of Shri R.P.S. Katwal, D.G., ICFRE. Seventy (70) new and one hundred fifty nine (159) ongoing research projects were approved.

Research Advisory Group (RAG) meetings were conducted in all the eight research institutes to prioritize the new research proposals on the basis of index score in the year 2002. A total of 116 new research projects were approved as given below :

Name of institute	No. of projects
Forest Research Institute, Dehra Dun	34
Institute of Forest Genetics & Tree Breeding, Coimbatore	3
Institute of Wood Science & Technology, Bangalore	30
Tropical Forest Research Institute, Jabalpur	12
Rain Forest Research Institute, Jorhat	7
Arid Forest Research Institute, Jodhpur	13
Himalayan Forest Research Institute, Shimla	10
Institute of Forest Productivity, Ranchi	7

Bamboo Technology Mission has collected comprehensive data on bamboo resource from all over the India and prepared report for management of bamboo bearing areas covering aspects like estimation of state-wise bamboo bearing areas, measures for intensive management of bamboo forests for improving productivity, extent of impending gregarious bamboo flowering, utilization and regeneration of bamboo stock. Report was submitted to NTMB under Planning Commission.

A project proposal costing Rs. 5.52 crores was submitted to planning commission for establishing pilot plants for production of destructured wood from bamboo and for preservative treatment of bamboo in 12 bamboo rich states; viz. Assam, Arunachal Pradesh, Manipur, Meghalaya, Andhra Pradesh, Orissa, Madhya Pradesh, Maharashtra, Karnataka, Tamil Nadu and Chhattisgarh.

Environmental Impact Assessment (EIA) is an important management tool for ensuring optimal use of natural resources for sustainable development. Keeping in view of the recent development at international and national level in various fora including the World Summit on Sustainable Development, Climate Change and Convention of Biological Diversity, much attention is being paid for Environmental Impact Assessment. Indian Council of Forestry Research and Education being the only national organization in the field of forestry, environment and natural resources with its expertise and past experience in handling various environmental assessment related work, a wing was established during Dec., 2002, to take up national level EIA in coordination with its institutes situated under different agro-ecological zones all over the India. The division will identify and evaluate the potential impacts of development projects / activities on the environment. During the year the council successfully conducted and completed two Environmental Impact Assessment (EIA) studies for seismic survey for the exploration of Oil and Natural Gas in Krishna Godavari basin sponsored by Reliance Industries (Limited), Mumbai and second in connection with ropeway project for construction of ropeway from Tirupati to Tirumala visitors zone sponsored by Andhra Pradesh Tourism Development Corporation, Hyderabad. A Memorandum of Understanding (MoU) has been signed between Indian Council of Forestry Research and Education (ICFRE) and Himachal Pradesh State Environment Protection and Pollution Control Board (HPSEP&PCB) to provide comprehensive consultancy services under a single roof for Environment Impact Assessment including ecological studies and Environment Management Plan.

Mangrove vegetation at Krishna Godavari region

Proposed path for ropeway from Tirupati to Tirumala hills

Expression of interest has been sent to Indian Oil Corporation (IOC), Oil and Natural Gas Corporation (ONGC), National Thermal Power Corporation (NTPC) and National Hydro Power Corporation (NHPC) for carrying out the EIA for their developmental projects.

Biodiversity, Climate Change and Policy Research (BCC and PR) Division was created in Dec. 2002. The Government of India, as a party to the United Nations Framework Convention on Climate Change (UNFCCC) has undertaken various measures towards fulfilment of the objectives of the convention including preparation of the Initial National Communication in accordance with the provision of the Article 12 of the convention. The process of preparation of the National Communication was a comprehensive scientific and

Biodiversity of medicinal plants of Chopta forests.

Rhododendron campanulatum at Tungnath, 3500 metre height.

technical exercise with a participatory approach involving large number of institutions in various sectors. Indian Council of Forestry Research and Education has been actively involved at various levels in formulation of the National communication. The Land Use Change and Forestry (LUCF) have been critical in addressing climate change as well as the success of global negotiations. Under the umbrella of the Ministry of Environment and Forests, Government of India, the council formulated a wing to participate in the national and international negotiation on issues related to Biodiversity, Climate Change and Policy Research and forestry in December, 2002. Accordingly the council submitted the national views on issues related to modalities for the inclusion of afforestation and reforestation project activities under the CDM in the first commitment period, an option paper on modalities for addressing non-permanence, baselines, addtionality and leakages for discussion at Bonn, Germany thorough Ministry of Environment and Forests.

Also the council is working in close collaboration with the Ministry of Environment and Forests and United States Environmental Protection Agency (MoEF- USEPA)-under the FORCLIMIT project to critically assess the technical issues like determining baseline, financial and physical additionality leakage, the permanence of carbon sink, environmental and sustainable development criteria of different forestry projects to be implemented under CDM afforestation and reforestation activities. To analyze the policy and CDM potential, the council organized an International Workshop on "Forestry and Climate Change Assessing Mitigation Potential and Costs" at India International Centre, New Delhi on 23rd and 24th September, 2002 and a National Workshop on "Technological Innovations and Research Advancements for Application in Joint Forest Management" on 3rd and 4th February, 2003.

Workshop on Joint Forest Management

Sri Chandi Prasad Bhatt addressing in workshop on Joint Forest Management

The BCC and PR division, participated in the draft approval action plan meeting on the National Biodiversity Strategy and Action Plan for India based on Article 6 and suggestions were communicated to incorporate for better forest genetic resources conservation and emphasized importance and ways for implementation of bioprocess for intellectual property right and conservation of indigenous knowledge.

FORESTRY EDUCATION

Grant-in-Aid was provided to the Universities imparting forestry education in the country in order to strengthen the infrastructural facilities such as laboratory and field equipments, glass house/mist chambers, transport and camping equipments, computer center, mini computer/PC terminals, library, sports, games and other students' amenities, and to enhance the technical capabilities of the forestry faculties through organization of workshops/seminars /symposia, participation of teachers in national seminars, symposium, students' study tours, assistance for preparation of teaching manuals and aids etc. Overall Rs.250 lakhs was released under Grant-in-Aid to 16 Universities in the year 2002-2003, given as below :

Sl. No.	Name of University	Rupees in lakhs
1	2	3
1.	Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (H.P.)	21.00
2.	Tamil Nadu Agriculture University, Coimbatore (T.N.)	14.42
3.	Kerala Agriculture University, Trissur, (Kerala)	15.00
4.	FRI-Deemed University, Dehra Dun (U.A.)	46.33

1	2	3
5.	Punjab Agricultural University, Ludhiana (Punjab)	07.60
6.	University of Agricultural Sciences, Dharward (Karnataka)	10.00
7.	Dr. B.S. Konkan Krishi Vidya Peeth, Dapoli (Maharashtra)	15.01
8.	G.B. Pant University, Nainital (U.A.)	17.10
9.	Shere Kashmir University of Agriculture Sciences, Shalimar (J&K)	08.37
10.	CCS Haryana Agricultural University, Hissar (Haryana)	05.00
11.	Maharana Pratap University of Agriculture & Tech., Udaipur (Rajasthan)	08.70
12.	Indira Gandhi Agricultural University, Raipur (Chhattisgarh)	15.00
13.	C.S. Azad University of Agriculture & Technology, Kanpur (U.P.)	21.30
14.	Allahabad Agricultural Institute (Deemed University), Allahabad (U.P.)	23.72
15.	ASPEE College, Navsari (Gujarat)	11.10
16.	CSK, HPKV, Palampur (H.P.)	10.33
	Total	**250**

Forestry Statistics India, 2001 and **Timber/Bamboo Trade Bulletin (TBTB)** was published and distributed to SFD's and other users.

FORESTRY EXTENSION

The primary aim of technology generation is to address and tackle socio-economic problems of the end users through appropriate development and transfer of technologies. Indian Council of Forestry Research and Education came forward to provide the platform to the researchers and the end users where they can interact for the need based technologies development and improvement. ICFRE conducted eleven workshops/seminars during the year 2002-2003 where researchers, foresters, NGOs, industrialists, Govt. officials, farmers and other entrepreneurs participated. Linkages have been developed with State Forest Departments, Forest Corporations, farmers, wood based industries and other users.

Exhibition of technologies

Thirty five demonstrations of different technologies were arranged for different user groups at different places in the country. One hundred

ICFRE Newsletter

and ninety research papers on different aspects of forestry research have been published alongwith forty one technical bulletins on different forest species. Forty five training programmes on different disciplines of forestry were organized during the year for State Forest Departments, forest corporations, NGOs, farmers, industrialists, Govt. departments and other user groups. Books, pamphlets, posters and other extension materials were developed for the dissemination of research results to the end users. ICFRE society meeting was conducted on 21-10-2002 which was presided by the President and the Honourable Minister for Environment and Forests, Thiru T.R. Baalu. Progress made in the field of Forestry Research and Education was critically reviewed. ICFRE published and widely circulated quarterly Newsletter, which contains

Honourable Minister for Environment and Forests, Thiru T.R. Baalu presiding the ICFRE society meeting

current informations regarding research, education and other events held in ICFRE. Van Mohotsav, Environment day were celebrated by the institutes. On these occasions exhibitions-cum-demonstrations were arranged for students, villagers, small scale industries and other entrepreneurs. Institute wise details of extension activities are given in respective chapters.

XI All India Forest Sports Meet

XI All India Forest Sports Meet-2003 was successfully organized by ICFRE. The organizing committee was headed by Shri. R.P.S. Katwal, DG,

Hockey match at Forest Research Institute, Dehra Dun

ICFRE. The meet was inaugurated on 5th February, 2003 by his excellency, the Governor of Uttaranchal, Shri Sudarshan Agarwal. The Governor took the salute

Glimpses of XI All India Forest Sports Meet - 2003

of the impressive march past performed by the participating contingents from various states and organizations under MoEF. The contingent of ICFRE was adjudged the best marching contingent and was awarded the march past trophy. About one thousand seven hundred participants representing thirty teams participated in the meet.

The state of Madhya Pradesh secured the first position and was declared the champion of the meet followed by Kerala. The closing ceremony was held on 9th February-2003, Hon'ble Minister of Forests and Urban Development, Uttaranchal, Shri Nav Prabhat graced this occasion as chief guest.

Information Technology Division has prepared a new hardware at ICFRE for ICFRE Hqrs. and FRI. The procurement is done on buyback basis as per the provision available in the Information Technology Policy of ICFRE. Under this procurement 30 new P-IV computers have been inducted while considering 30 old machines for buyback. In addition to this 30 printers (Laser, Inkjet and DMP's) have also been procured under the buyback arrangement.

In view of considerable problems of virus / worms the division has taken initiative in procurement of Network Antivirus. This is a software which can be managed centrally and all client side computers can be scanned and upgraded for new upcoming viruses instantly. In addition to it, the software itself is capable of identifying new viruses and finding its cure by contacting its masters M/s CA. Regular review for the performance of this Antivirus is being carried out by the IT division.

The division has taken a lead in imparting training in basic computer awareness programme to the ICFRE / FRI officers and more than 70 officers have been trained in basic computer skills. Apart from this, successful efforts have been made in imparting training on Web Designing to the staff of Information Technology Division. The division is also actively engaged in providing educational support to various courses hoisted at the Deemed University, FRI.

Providing user level disk quotas was a mandate of the division and the strategic and cost effective planning of the division resulted in implementation of the service using the existing hardware with minor upgradation cost of only two lakh rupees. The service has been implemented successfully and is being used extensively by the users.

Continuous reviews of the IFRIS / MIS modules are being conducted and the problems are taken care of regularly and efficiently, resulting in a smooth functioning of the FAS, PAY, PIS and other modules. Strategies are being formulated to get the system implemented on client / server mode at the other Institutes of ICFRE as well by organizing a 4 weeks advance level Oracle and MIS training of computer scientists of ICFRE institutes.

MAJOR RESEARCH FINDINGS

- Structures of bioactive principles were elucidated using spectral data (UV, IR, NMR and MS) and were characterised as 7,4',7",4'"-tetra-O-methylamentoflavone; 4',7,7"-tri-O-methylamentoflavone; ginkgetin; sequioflavone; 2-(3-methoxy-4-hydroxyphenyl)-propane-1, 3-dioe (A); apigenin, apigenin-5-neohesperidoside (B); apigenin-5-(6"-acetyl

neohesperidoside; compound (C) and β- sitosterol. Compound A, B and C have been reported for the first time. Essential oils were isolated from leaves and flowering twigs and analysed by GC-MS. Fifteen compounds were identified in each of the oil with β- caryophyllene, germacrene-D, and γ-cadinene as the major constituent in both the oils. Ginkgetin was found to possess hepatoprotective activity in rats.

- Thirty five and twenty compounds were identified in the essential oil of leaves and flowering twigs of *Vitex negundu* with viridiflorol as the chief constituent.

- Temporal changes in the physical properties of soil and soil maturation, water stress, water logging, environmental stress and ecological succession are observed to the main causes for shisham mortality. Mortality could be minimize by growing in block plantation in sandy and sandy loam soils with low water table and controlled irrigation. In water logged areas mixed plantation of the shisham with other plant species gives better results.

- Seeds of *Cedrus deodara* and *Dalbergia sissoo* were found infected by fungi *Alternaria alternata, Aspergillus flavus, A. niger, Chaetomium globosum, Colletotrichum gloeosporioides, Mucor* sp., *Nigrospora oryzae* and *Penicillium* sp. during storage.

- Environmental friendly pulping of *Eucalyptus tereticornis* wood chips, carried out using different doses of formic acid treatment sandwitched between different doses of peroxyformic acid, yielded 50-65% pulp. Alkaline peroxide bleached pulps of about 75% ISO brightness possess adequate strength properties comparable to pulp made using conventional pulping and bleaching process.

- Floristic survey was conducted. Taxonomic studies and analysis of the data revealed 43 new plant species in the southern and central ridge forests, Delhi as new record for the fora of Delhi.

- High DP, high purity and high brightness (>80% ISO) was produced from cotton linter, *Eucalyptus tereticornis* and bamboo.

- Evaluation by volumetric assessment of Eucalyptus tree and coppice crop revealed that the total volume (over bark) was 17,410.85 m^3 ; total pole weight (debarked) was 1,50,66,431.97 kg and total firewood weight was 46,00,837.05 kg., respectively.

- Clonal propagation technology for teak has been standardized to produce quality planting stock.

- Seed extraction, pretreatment and germination methods for the medicinal plants such as *Aegle marmelos, Feronia elephantum, Emblica officinalis, Oroxylum indicum, Pterocarpus marsupium, Syzigium cumini, Strychnos nux-vomica* and *Terminalia bellerica* have been standardized. Storage techniques for *Aegle marmelos, Feronia elephantum, Emblica officinalis, Oroxylum indicum* and *Pterocarpus marsupium* have been optimized.

- Physical properties of soil, electrical conductivity and bulk density and soil chemical properties, nitrogen, potassium and calcium were found to have significant correlation with wood properties.

- Three species of insects viz. S*inoxylon* sp. (stem borer), *Anomalococcus indicus* (scale insect - sap sucker) and *Selepa celtis* (defoliator) were found to be serious pests, attacking young plantations of *Acacia nilotica* var. *indica*. In south India the seed source, "Ayyampulli" was found to be least susceptible to the scale insect *Anomalococcus indicus* as well as to the defoliator, *Selepa celtis*. The seed source, "Devadanam" was found to be highly susceptible to both the pests.

- Twelve clones of *Casuarina equisetifolia*, identified by IFGTB as superior performers, were selected for fingerprinting using RAPD and AFLP techniques. A total of 20 primers selected from the preliminary studies were tested with the 12 clones of *C. equisetifolia*. RAPD amplification of 12 clones of *C. equisetifolia* with 15 primers produced a total of 118 bands of which 57 bands (48%) were polymorphic. The minimum and maximum number of bands observed were 3 (primer OPC 12) and 13 (primer OPC 08) with an average of 8.5 bands per primer. The amplification products considered for scoring data ranged in size from 250 bp to 2150 bp shows the RAPD pattern obtained for the 12 clones with the primer OPE 02.

- A first generation progeny trial of *Eucalyptus tereticornis* was evaluated for growth traits at 4 years of age. Three hypothetical selection strategies were applied based only on the height growth of the trees without any consideration for the flowering and fruiting traits. Simple phenotypic selection based on height growth was found to be a safe strategy offering substantial gain at a given diversity level. Index selection gave maximum gain but was not good in conserving diversity.

- *Acacia auriculaeformis* (age: 8-13 years; average girth 42 to 60 cm) evaluated for anatomical and strength properties. Wood of higher age (13 years) is very heavy, very strong, moderately tough, hard and a steady timber, suitable for tool handles, oars and paddles, sleepers, construction, furniture and packing cases/ammunition boxes, furniture and handicraft.

- FTIR spectroscopy of pine and beech wood decayed by *Coniophora puteana,* a brown-rot fungi revealed that the fungi degraded carbohydrates preferencially, consequently, increasing the lignin carbohydrate ratio. In wood decayed by *P. chrysosporium*, white-rot fungi, the lignin content decreased as decay progressed, as did the xylan content. In the white-rot fungi, *Coriolus versicolor* decayed wood, lignin and carbohydrate reduction occurred at a similar rate.

- Out of 537 CPTs identified on the basis of seed bearing capacity and over all growth performance in three different agro-climatic zones of Gujarat and winter flowering trees of Jodhpur, 50 CPTs were finally screened in for high Az (more than 5000 ppm) and high oil contents. Germplasm (370 seed samples) of above CPTs are preserved. About 3,00,000 neem quality seedlings were raised for plantation, distribution to farmers and sale. 15 ha of model plantation was established at different location to carry out experiments on water harvesting technique, VAM interaction, type of seedling and spacing trials.

- Seedlings of *Bauhinia variegata, Toona ciliata, Terminalia tomentosa, Grewia optiva, Morus alba* and *Leucaena leucocephala,* preferred by the farmers, were raised in the nursery and established in the agricultural

fields of farmers in Bhangwanpur and Jorhon villages of Paonta valley (Himachal Pradesh) to demonstrate and develop agri-silviculture model.

- The application of *Trichoderma viridae* @ 15 ml suspension in the month of June on the tree trunk of infected deodar trees shown changes in the colour of needles from yellowish to green, increased about 35% in size and four times in weight of needles. This biological control agent of *Phytophthora cinnamomi* was found growing successfully in the infected forest and thereby arresting further growth of the pathogens.

- Two potential entomopathogenic fungi viz. *Beauveria bassiana* and *Metarhyzium anisopliae* have been investigated to kill the freshly hatched grubs of sal heartwood borer *Hoplocerambyx spinicornis*.

- Technology developed to utilise the industrial refuge of *Hyptis suaveolens* and *Cymbopogon maritnii* for preparing composites. The composite has been found suitable for making hardboard.

- Ethnobotanical data related to Bhariya, Gond, Korku and Hill Korwa tribes of central India revealed 158 uses of various plants of forest origin.

- Experiments conducted on teak to study the effect of carbohydrates on shoot multiplication indicated that the rate of shoot multiplication was maximum on glucose (4.45 fold) and sucrose (4.40 fold) and elongation was best on glucose. The shoots turned brown and died on mannitol and surbitol application. The treatment of 50 ml/l KH_2PO_4 along with 10 μM NAA resulted in highest percentage of rooting as well as maximum number of roots.

- Out of 16 species of *Trichogrammatid* egg parasitoids, recorded from teak growing areas, one indigenous species *Trichogramma raoi* was collected alive and multiplied in the laboratory. In order to enhance percentage of parasitism, the eggs were exposed at -8°, 4° and 10°C; exposed eggs at -8°C proved most effective. 73 lakhs of parasitoids (*Trichogramma* sp.) were multiplied and introduced in forest. Four exotic egg parasitoids viz. *Trichogramma brasiliensis, T. pretiosum, T. japonicum, T. chilonis* and an indigenous species *Trichogramma raoi* have been reared multiplied and introduced separately in 42 ha area of teak forest. It was observed that the exotics *T. chilonis, T. japonicum* and indigenous *T. raoi* are equally effective to minimise 50% defoliation caused by larvae of teak skeletonizer.

- Approximately 800 cft. of compost from abundantly available local species like bamboo, lucaena, neem, *Butea monosperma* and lantana was prepared for internal use and sale.

- 1156 plus trees of neem were identified in different agro-climatic zones of Madhya Pradesh, Chhattisgarh and Orissa. Neem nurseries were developed at TFRI, Jabalpur and CFRHRD, Chhindwara; about 2.45 lakh seedlings were raised and distributed to SFD, MP and farmers. Provenance variation in seed characteristics was observed and correlated for climatic conditions.

- Nursery technique for four bamboo species viz., *Bambusa tulda, Bambusa nutans, Bambusa balcooa* and *Dendrocalamus hamiltonii* has been standardized and a package of practices is developed.

- Total supply and consumption of fuel wood in the Jorhat district of Assam was assessed and found to be 4,70,083 and 4,94,102 tonnes per year, respectively with 5% difict. A total of 35 species are being used for fuel wood purpose. An evaluation trial of 20 fuel wood species revealed that *Mallotus albus, Anthocephalus chinensis, G. arborea* and *Alstonia scholaris* are the better wood species for energy plantation.

- 200 numbers of plantlets of *Dendrocalamus asper* were produced through tissue culture. Methods for shoot multiplication, subculturing, root initiation, primary and secondary hardenings of plants were standardized. Field plantation has resulted in 85% surviv.

- To assess growth variability, 66 superior trees of *Eucalyptus tereticornis* and 80 candidate plus trees of *E. camaldulensis* were selected. An index selection method has been evolved to select best performing genotypes giving major thrust to quantitative traits such as total height, clear bole height, GBH, number of branches and wood qualitative traits such as stem roundness, stem straightness and total health. Total variability in the selected population was reduced.

- A herbal garden comprising of nearly 200 medicinal and aromatic plants including several endangered/threatened species has been established at the centre. Cultivation technique of aswagandha (*Withania somnifera*), safed Musli (*Chlorophytum borivillianum*), sarpagandha (*Rauvolfia serpentina,*kalmegh (*Andrographis paniculata*) and lemon grass (*Cymbopogon flexuosus*) has been standardized. Agrotechnique was standardized for the cultivation of *Pogostemon plectranthoides*; *Cyperus scariosus* and *Curcuma caesia* rizome and volatile oils of the plants were analysed by GC-MS.

- Ten national provenance's of *Gmelina arborea* were screened against key pest and top drying in irrigated plantation noticed due to insect diseases complex. About 40% incidence of sapsucker *Tingis beesoni* followed by fungus *Hendersonula* sp. was observed. The infection can be controlled by spraying Decis @0.005% + Carbendazim 0.1%.

- Nursery techniques of *B. lanzan* on the effect of sowing methods (dibbling, line and broadcast), effect of mulching (dried grass, black polysheet, white polysheet, under shed control); effect of orientation and planting depth on the germination of seeds and performance of the seedlings were standardized. Grading of seeds of *B. lanzan* on germination and seedling growth revealed that medium size seeds preformed better than small and big size seeds.