CHAPTER-VIII

INSTITUTE OF RAIN AND MOIST DECIDUOUS FORESTS RESEARCH JORHAT

Institute of Rain and Moist Deciduous Forests Research, Jorhat, one of the eight Institutes under the auspices of the Indian Council of Forestry Research and Education, though still in the formative phase, has acquired and taken into possession the new building at Sotai which covers an area of 28.21 ha and has been named as **Deovan.** The Institute started functioning from its new location from end of March 2000.

PROJECTS COMPLETED DURING 1999-2000

Sl.No: 1

Project Identification No.: IRMDFR/SC/1.

Name of the principal investigator: Dr. Jasbir Singh

Title of the Project: Study of the successional changes in plant communities under shifting cultivation.

Year of start of the project: 1994-95.

Cost of the project : Rs.17.18 lakhs

Objectives: (a) To assess the plant inventory in fallow lands as well as in natural forests. (b) To estimate nutrient inventory of the organic matter. (c) To Evaluate the Successional changes of Plant Communities. (d) To enumerate the important species/life forms occurring in different fallow lands. (e) To prove that the species dominancy decreases with the increase of diversity in the fallow lands.

Scientific importance of investigations: The North-east region is endowed with the maximum bio-diversity in terms of flora and fauna. Many species, which are very important to human and animal, are endemic to this region. Owing to clearing and burning during shifting cultivation operation these species are disappearing at an alarming rate. Loss of soil fertility is also an evil of shifting cultivation. The study will asses the adverse effects of shifting cultivation.

Results/Achievements: *Lantana camara* and *Chromolaena odorata* alongwith *Saccharum arundinaceum* and *Imperata cylindrica* observed as early colonizer in abandoned fallow communities.

Chromolaena odorata and *Imperata cylindrica* found to decrease drastically with the increase of the fallow period.

The diversity index increases gradually due to gradual establishment of perennial species as well as decline of annual herbaceous plants.

The distribution pattern in all the communities showed random contagious trends but exhibited contagious pattern dominantly.

The index of dominance showed just a reverse trend to the diversity index, proving the fact that the decrease of species dominancy is inversely proportional to the diversity.

Majority of the plants recorded in the jhum fallows are in high demand among the jhumias. A large number of species like *Costus specious*, *Ageratum houstinianum*, *Phyllanthus urinaria*, and *Globba* sp. etc. are used as indigenous medicine. Various wild edible plants and fodder plants are also observed.

Plant biomass study in the fallow vegetation shows that the total biomass increases with the fallow age.

Lantana camara and *Chromolaena odorata* are the highest biomass contributor in the fallow vegetation.

The nutrient concentration of the species follows the order K>Ca>Mg>N>P.

Phytosociological studies of the natural forest observed that *Vatica lanceaefolia* and *Elaeocarpus tectorius* alongwith *Castanopsis* sp. get priority in the dominance in the primary forest while *Hydnocarpus kurzii* and *Dysoxulum procerum* were found dominant in the disturbed forest.

Sl.No: 2

Project identification No.: IRMDFR/FE/4

Name of the principal investigator: Dr. Sudhir Singh

Title of the project: Microbial Control of Major Forest Insect Pests of North-East India.

Year of start of the project: 1994-95.

Cost of the project : Rs.17.68 lakhs

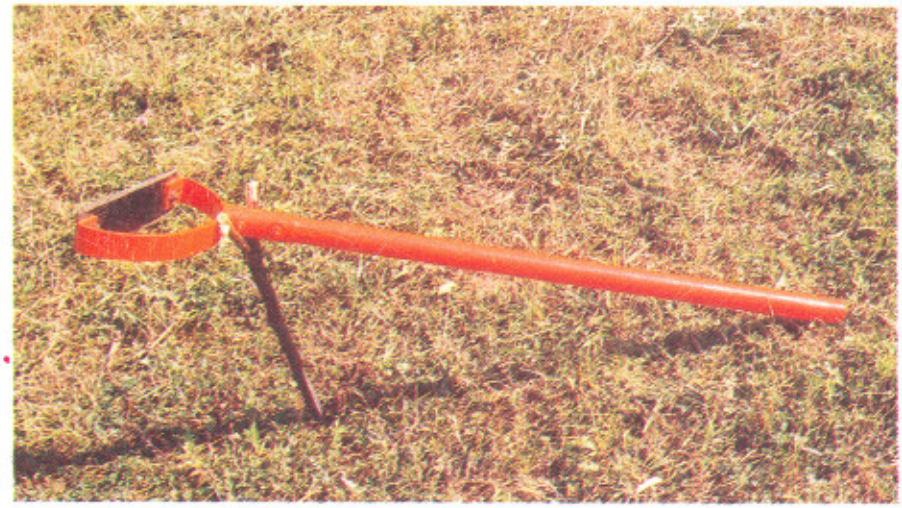
Objectives: (a) To explore possibilities of controlling insect pests of forests with the help of microbes, especially entomo-pathogenic fungi, bacteria and viruses which form an important component of Ecologically Based Pest Management (EBPM). (b) To screen the pest populations for their pathogens and build up their collection, which can be used later in biocontrol of the pests.

Scientific importance of investigations: Microbial control is amongst the best control measures of the forest insect pests and is eco-friendly. In India very little work has been done in the field and considering the bio-diversity in this region, there is great possibility of discovering several insect pathogens.

Results/Achievements: Different concentrations of spores of two entomogenous fungi viz. *Beauveria bassiana* and *Metarhyzium anisopliae* on different larval instars and adults of *Calopepla leayana* were tried to control this pest in Laboratory condition. Both the fungal species were found to be significantly pathogenic to all the larval stages as well as adults of *C. leayana.* However, *B. bassiana* was found more virulent as compared to *M. anisopliae*. The I- instar larvae were more susceptible to both of the fungi, but susceptibility gradually decreased with the increasing age of the larvae.

Similarly microbial control experiments on *Eupterote geminata* (on *Gmelina arborea*), *Epiplena quadricaudata* (on *Anthocephalus chinensis* and *Heortia vitessoides* (on *Aquilaria agallocha*) were also done with significant results. Compiled results from bioassay experiments on *Calopepla leayana* and prepared the manuscript for publication.

In an another study field efficacy of fungi *Aspergillus* sp., *Fusarium* sp. and *B. bassiana* on *C. leayana* was tested. All the fungal species were found to be significantly pathogenic to the larvae. However, in both the laboratory as well as field conditions, *Fusarium* sp. at the concentration of $2x10^7$ spores/ml was found to cause highest mortality.



Weed Cutting Tool

Transportation of Plants in Hills by the Plant Carrier

Uprooting of Lantana Bush by Stalk Puller

Sl.No: 3

Project identification No.: IRMDFR/FE/5

Name of the principal investigator: Dr. Sudhir Singh

Title of the Project: Biological control of *Calopepla leayana*, a major defoliator of *Gmelina arborea*.

Year of start of the project: 1994-95.

Cost of the project: Rs.16.53 lakhs

Objectives: To explore the natural enemies associated with the pest *Colopepla leayana* for possible biocontrol.

Scientific importance of investigations: *Gmelina arborea* is an important fast growing timber species but due to heavy damage caused by the pest this species is not attracting mass scale plantation by various agencies. A promising biological control of *Calopepla leayana* shall solve the problem and make this species more lucrative among the end users.

Results/Achievements: Bio-control potential of *Brachymeria excarinata* against *Calopepla leayana*

From the fecundity experiment it has been found that each female can pierce / oviposit into 170 pupae killing 86-92% of them. Mortality percentage include pupae both from which parasitoids emerged (52.6-68.4%) and from which neither *Calopepla leayana* adults nor parasitoids emerged but died of wasp's sting (24.5-34.2%). This parasitoid can be of immense biocontrol potential. It should be mass reared in the laboratory and released in months of April-May and Aug-Sept when the pupae of first and third generation appear at Jorhat.

Sl.No: 4

Project identification No.: IRMDFR/FE/2

Name of the principal investigator: Dr. S. Chakarborti

Title of the project: Studies on the micro-faunal components of litter ecosystem and their changes in relation to shifting cultivation.

Year of start of the project: 1994-95.

Cost of the project: Rs.18.45 lakhs

Objectives: (a) Impact of shifting cultivation on the litter micro-fauna in terms of species diversity, density and distribution. (b) To assess the entomo-faunal diversity of the above ground vegetation and their changes in relation to shifting cultivation. (c) To assess the trends in entomo-faunal succession in forests and litter ecosystem.

Scientific importance of investigations: Entomo-faunal diversity is a good indicator of disturbances in the ecosystem. On shifting cultivation sites, the damage to the ecosystem can be measured in terms of arthropod diversity, which is an important factor in pest-parasite-predator relationship, recycling of nutrients in forest litter, etc.

Results/Achievements:

Litter arthropods

(A). Species composition and density in relation to shifting cultivation practices.

During shifting cultivation practices like slashing, burning, and cropping, there tends to be a complete disruption indicated by poor trends in arthropod diversity as well as density in the litter ecosystem. There is a total elimination of several important species during burning. Even during cropping and after harvesting their absence is notable. A comparison of the population density of dominant species, the collembola and mites before and during shifting cultivation practices showed a considerable decrease in the population level after the burning of fields. A significant negative correlation is evident between the populations of collembola with the advancement of time since burning of fields. During cropping season and after harvesting also the density remains low and stable.

(B). Species composition and density in relation to fallow period

A comparative assessment of the litter fauna in various fallow areas like 1 year, 5 year, 10 year, and 20 year showed varying species diversity and changeing species density in relation to fallow period. Species collected include centipede, millipede, polyxenids, glomerids, isopods, collembolans, blatids, dermapterens, coleopterens, formicids, acarri, pseudoscropionids and solfugeae. Vegetation in one-year fallow sites constituted mostly weeds like *Lantana camara* and *Chromolena oderata*. Besides crop plants of the previous cultivation in isolated patches, *Pavata indica* and *Ricinus communi* found. Early fallow areas were less in insect groups with very low population per group per unit area. Collembolans constituting major group, increased from an average of 42.25 ± 1.09 individuals/ sq. ft. in one fallow to 189 ± 16.75 individuals / sq. ft. in 20 year fallow areas. Mites also showed a similar trend. In 10 year and 20 year fallow, along with a thick cover of weeds, species like *Melocana baccifera, Thysanoleana maxima, Dendrocalamus hamiltonii* and tree species like *Alstonia scholaris, Bombax ceiba* were present. Natural forest composition includes mainly *Ficus* sp., *Dillenia indica, Aesculus assamica, Dysoxylum procerum, Bischofia javanica, Garcinia* sp., and *Baccaura sapida* besides a thick under story. Late fallow area like 10 and 20 years showed a more complex structure as compared to early fallow like 1 year and 5 year. In all the cases collembolans and acari were characteristically dominant ranging from 50% - 60% of the total arthropods. A significant positive correlation was found between number of collembolans and mites with the increase in fallow. Other groups which showed an increasing trend in population were dermapterens, coleopterans, formicids, solphugids and pseudoscorpions. Spiders like Clubionidae, Lycosidae, Ageleididae along with Atypidae, Gnaphosidae and Ctenizidae were found in the litter and soil. In some cases Salticids Oxyopids were also detected.

Natural forest litter also sustained a complex group of arthropods of high population density but more or less stable in population fluctuations. Natural forest litter was devoid of predatory forms like dermaptera, coleoptera and araneae.

Standing crops and the surrounding weeds harboured a significant insect pest populations which was harmful for the nearby forest stands or the crops maintained elsewhere. The termites and wood boring insects in wooden stumps also posed a threat for the standing trees and household construction material.

During fallow periods, due to regeneration of some vegetation, terrestrial insect population started to recover. Though it was not the same as in the natural forest, there was tendency towards complete disruption of terrestrial arthropod diversity due to drastic changes in original vegetation and insect fauna associated with it. Comparatively high population of biological control arthopods like Hymenoptera, Neuroptera and spiders, indicated natural forest conditions.

During cropping season, among the insect population in the above ground vegetation, homopteran formed the major group followed by coleopterans, hemipterans, dipterans and spiders. During post harvest season, orthoptera formed the major group followed by homopterans, mites, coleopterans, heteropterans, lepidopterans, hymenopterans and dipterans. But in two year fallow, homopterans took the lead followed by dipterans, spiders, thysanopterans, coleopterans, orthopterans, heteroptererans, and lepidopterans. Similarly in natural forest (actually the sampling was done at a time when the forest was being cut). Diptera was the major group followed by hymenopterans, homopteraans, spiders, coleopterans, lepidopterans, thysanopterans, orthopterans, heteropterans, neuropterans, collembolans and odonates.

Sl.No: 5

Project identification No: IRMDFR/FP/1

Name of the principal investigator: Rajib Kumar Borah

Title of the Project: Study of changes in microflora including mycorrhiza due to shifting cultivation.

Year of start of the project: 1994-95.

Cost of the project : Rs.10.98 lakhs.

Objectives: To assess the status of microflora including VAM fungi in different phases of shifting cultivation as well as in various sites of different fallow periods.

Scientific importance of investigations: The forests of North-Eastern India are being destroyed on a large scale by extensively used practice of shifting cultivation. The clear cutting and burning of forest affects the distribution of soil microflora. Information on the dynamics of microbes is scanty in relation to the disturbances. Therefore, present study was undertaken to study the population dynamics of microflora including mycorrhizae at different soil depths during different phases of shifting cultivation as well as in the different fallow sites.

Results/Achievements: The experimental site was selected at Silonijan in Karbi-Anglong district of Assam. Soil samples were collected at least once in three months from different jhum-fallows of four ages (viz. 1 year, 2 years, 3 years and 4 years old) as well as during different phases of shifting cultivation viz. before burning, after burning during cropping and after harvest. Soil samples were also collected from the nearby natural forest (i.e. Nambar Reserve Forest) for comparison. Following the removal of the surface vegetation, a pit was dug down the profile and the soil samples were taken from three depths (0-10 cm: 10-20 cm and 20-30 cm.). Soil collected from a single pit represented a sample and three such samples were collected from each site. Before processing, the randomly collected samples were mixed separately to make a bulk composite sample of each set in order to minimize local variations in the microbial populations. Population dynamics of soil microflora was analysed.

The effect of burning was found to be prominent in case of VAM, bacteria and fungi. As a result of burning, the bacterial population was found to decrease but opposite trend was noticed in case of fungi and VAM.

Microbial population dynamics in jhum fallow of different ages revealed an increasing trend in bacteria and actinomycetes population as the length of fallow period increased from 1 year to 4 years. Quantitatively, both VAM and bacterial population were much higher as compared to fungi and actinomycetes population. The microbial population at lower depths of soil was always less as compared to the surface layer and there was a decreasing trend with soil depth. A total of thirty-seven species of fungi were isolated. *Pythium* sp., *Trichoderma* sp., *Penicillum* sp. and *Aspergillus* sp. were the most dominant forms. Qualitatively, the composition of fungal species was almost identical in different phases of shifting

cultivation as well as in jhum fallow of different ages. Two genera of VAM fungi viz. *Glomus* sp. and *Gigaspora* sp. were isolated. Of these, *Glomus* sp. was most frequently isolated.

Sl.No: 6

Project identification No: IRMDFR/FP/2

Name of the principal investigator: Rajib Kumar Borah

Title of the project: Studies on VAM association of economically important Forest tree species in wet evergreen forest of Arunachal Pradesh.

Year of start of the project: 1994-95.

Cost of the project : Rs.14.12 lakhs

Objectives: (a) To assess the status of VAM association in economically important forest tree species of wet evergreen forests. (b) To establish *ex-situ* maintenance of pure VAM spores of identified species.

Scientific importance of investigations: The study of soil microbial population may be important area where VAM fungi may be used as a tool because of its contributions for seedling establishment and extensive revegetation in the degraded waste lands.

Results/Achievements : A total of 32 nurseries and 35 plantations in different localities of North-Eastern States of India were surveyed and rhizosphere soil and root samples were collected to study the VAM fungi status.

In addition to main study species, 34 different tree species were studied. The highest no. of VAM spore/50 g soil was recorded from SCCP social forestry nursery, REC campus, Silchar, Assam, whereas the highest percentage of VAM infection was found in the roots of *Melia azedarach* from Turial Miscellaneous nursery, Aizawl, Mizoram. No definite correlation could be established between spore count and mycorrhizal root infection. However, an understanding of the edaphic factors may also give a clear picture of the VAM association.

Sl.No: 7

Project identification No.: IRMDFR/FE/6

Name of the principal investigator: Dr. Sudhir Singh

Title of the project: Preparation of an Atlas of the Important Forest Insect Pests of Northeast India.

Year of start of the project: 1994-95

Cost of the project : Rs.12.12 lakhs

Objectives: To provide the field workers and experts an easy identification of the insect pests of the tree species and their damage potential in the plantations and nurseries.

Scientific importance of investigations: Identification of the any organism is the first step in any biological investigation. These days, with the decline in number of taxonomists, this field guide will make easy the process of identification of important forest insect pests of the region.

Results/Achievements: Detailed survey in various states of North-east resulted in collection of various pests associated with forest trees in nurseries, plantations and natural forests. Photographic presentation of their life

cycle stages and damage done to the host plants were prepared. Compilation of information on their distinguishing characters, distribution, host plants, nature of damage, damage potential, life cycle, and control measures were also prepared. Documentation on following species has been completed *Urostylus punctigera* (on *Michelia champaca*), *Calopepla leayana* (on *Gmelina arborea), Heortia vitessodies* (on *Aquilaria agallocha*), *Eupterote geminata* (on *Gmelina arborea*), *Metanastria gresea*, *Cryptorrynchus rufescens* and *Dioryctria castanea* (on *Pinus kesiya*), *Dihammus cerevinus* (on *Tectona grandis*), Undet. spp. of Lepidoptera and Coleoptera (on *Dipterocarpus retusus*), *Epiplena quadricaudata* (on *Anthocephalus chinensis*), *Podontia affinis* (on *Spondias pinnata*), Undet. spp. of Curculionidae (on *Bombax cieba*), *Prioptera maculipennis* (on *Gmelina arborea*), *Alcides gmelinae* (on *Gmelina arborea*), *Indrabela quadrinotata* (Polyphagous), *Glyphodes hilaris* (on *Anthocephalus chinensis*), *Astycus lateralis* (on *Anthocephalus chinensis*), *Trabla vishnou* (on *Terminalia* spp.), *Catopsila crocle* (on *Cassia* spp.), *Apion* sp. (on *Cassia* spp.), *Hyblea purea* (on *Tectona grandis* and *Oroxylum indicum*) and *Euschema militreris* (on *Garcinia morella*), etc.

Sl.No: 8

Project identification No.: IRMDFR/FE/3

Name of the principal investigator: Dr. S. Chakraborti

Title of the project: Bio-ecological studies on the predatory efficiency of certain carnivorous lepidoptera of Assam.

Year of start of the project: 1994-95

Cost of the project: Rs.13.12 lakhs

Objectives: (a) To study and explore the aphid species that produce plant galls in *Styrax* sp. (b) To study the nature and extent of damage caused to the tree due to aphid infestation.

Scientific importance of investigations: Till date no work was carried out on the insect pests infesting *Styrax* sp. This study will generate useful information in this regard.

Results/Achievements: After detailed taxonomic study, using technical keys of Fauna of India Aphidoidea, it is found that there are two separate species of aphids that cause banana and coral gall in *Styrax*. One of them is *Astegopteryx* sp. of the sub family Cerataphidinae, producing coral galls. The other one is probably a new aphid species of the sub family Hormaphidinae. Like other Cerataphidinae aphids, in *Astegopteryx*, soldier morphs were also found having a pair of sharp horns. These horns are used to attack predatory caterpillars of *Conobathra aphidivora* (Lep: Pyrallidae).

From April to December these aphids remain in *Styrax* sp. But thereafter migrate to alternative hosts. Thick population was found on bamboo leaves in different areas of the reserve forest. There is a possibility that these aphids alternate between *Styrax* and Bamboos.

Sl.No: 9

Project Identification No.: IRMDFR/FP/3

Name of the principal investigator: Rajib Kumar Borah

Title of the project: Study of the diseases of important tree species in nurseries, plantations and natural forest of North-eastern region of India.

Year of start of the project: 1994-95

Cost of the project : Rs.15.38 lakhs

Objectives: (a) To identify the causes and describe the symptoms. (b) To study epidemiology and work out suitable control measures for the disease of economically important tree species.

Scientific importance of investigations: Studies on the diseases of forest nurseries and plantations will help in minimising damage to seedlings in the nurseries and plantations.

Results/Achievements: A total of 60 (sixty) phyto-pathogenic fungi are recorded so far in different forest nurseries, plantations and natural forests of North-East India. Nine are new fungi-host combinations from North-East India. *Scaphidium* sp. recorded in *Bambusa balcooa* is a new host record as well as new addition to fungal flora of India. Bamboo blight in *B. balcooa* caused by *Fusarium equiscti* is a major disease in *B. balcooa* plantation in Assam. This also makes a new report from India.

During a survey of *Albizia procera* plantation in Lanka Reserved Forest, Nagaon, Assam, mortality was observed over almost all the 5 ha of plantation. About 15-20% trees died completely and remaining tress were in various stages of infection. Due to this disease, a loss of around Rs. 2000/- per tree has been estimated. The studies on etiology of this disease are in progress.

OLD PROJECTS CONTINUED DURING 1999-2000

Sl.No: 1

Project identification No.: IRMDFR/FP/5.

Name of the principal investigator: Rajib Kumar Borah

Title of the project: Studies on production of disease free seedlings in forest nursery.

Year of start of the project: 1999

Target year of completion : 2001

Cost of the project: 31.40 lakhs

Objectives: (a) To evolve system for producing disease free seedlings. (b) To develop system to check Air-borne diseases. (c) To workout economics of above activities.

Scientific importance of investigations: The proposed project may yield suitable prophylactic measures to manage the diseases in nursery and harmful seed microflora.

Results/Achievements: The test sample of *Gmelina arborea* seeds obtained from Lanka Reserve Forest exhibited heavy infestation of seed borne micro-fungi mainly of storage nature. These included several species of *Aspergillus*, *Chaetomium, Rhizopus* and *Penicillium*. Among the fungicides screened against this mycoflora, Captan was found most effective.

The seeds of *Dipterocarpus retusus* were examined and it was found that species of *Phoma* and *Phomopsis* are responsible for decreased seed viability and complete rotting.

Sl.No: 2

Project identification No.: IRMDFR/FE/7

Name of the principal investigator: Dr. S. Chakraborti

Title of the project: Control of Nursery Pests with Synthetic and Microbial Insecticides.

Year of start of the project: Sept. 1999

Target year of completion :2002

Cost of the project: 14.14 lakhs

Objectives: (a) Screening naturally occurring viruses specific to the insect pests of tropical forest trees. (b) Extraction, purification, enumeration, identification and cryo-preservation of insect-viruses. (c) Use of baculovirus alongwith chemical insecticides to control insect pests.

Scientific importance of investigations: The project will help in development and field utilisation of vitral pesticide against key and potential insect pests of important trees of tropical forests.

Results/Achievements: Caterpillers of *Discophora tullia*, a lepidopteran defoliator of bamboo, were reared to examine virus infection among them. Infected *Calopepla leayana* larvae were collected from field also and cryo-preserved.

Sl.No: 3

Project identification No.: IRMDFR/FP/6

Name of the principal investigator: R.K. Bohra

Title of the project: Integrated disease management of forest tree species in nurseries and plantations of North- eastern region of India.

Year of the start of the project :1999

Target year of completion: - 2003

Cost of the project: 28.26 lakhs

Objectives: (a) Disease appraisal and assessment of losses. (b) To study the epidemiology of the diseases and their chemical and biological control. (c) To identify the resistant clones/planting material. (d) To devise integrated disease management of important forestry tree species.

Scientific importance of investigations: Keeping in view the exorbitant cost of chemicals, environmental and human health hazards, increased resistance of pathogens to chemicals, this project aims at identification and management of serious disease problems of important tree species through integration of chemical control, biological control and plant resistance in a compatible manner.

Results/Achievements : Among the fungicides, *Bavistin* was found to be the most effective against leaf blight of *D. retusus*. Indofil M-45 was found to be the most effective against leaf spot of *A. mangium*. Among the botanicals, the leaf extracts of *Sterostiphnos unitus* was found to be the most effective against leaf blight of *D. retusus* whereas in case of leaf spot of *A. mangium* leaf extracts of *Ocimum sanctum* was found to be the most effective. Out of six antagonistic micro-organisms tested against *Fusarium oxysporum*, the cause of root rot in *A. mangium* and *Pseudomonas flouresence* was found to be most effective.

Sl.No: 4

Project identification No.: IRMDFR/TI/1

Name of the principal investigator: Dr. (Ms.) M.Kundu

Title of the project: Study of seed biology of selected forest species of North eastern India.

Year of start of the project : 1998

Target year of completion: 2002

Cost of the project: Rs. 71.80 lakhs

Objectives: (a) To identify the seeds as orthodox or desiccation tolerant and recalcitrant or desiccation-sensitive. (b) To study the desiccation sensitive seeds in relation to their storage. (c) To carry out storage trials of desiccation tolerant seeds. (d) To conduct maturation studies of recalcitrant seeds in companies of orthodox seeds.

Scientific importance of investigations. The study will help to determine the best collection time of seeds; the proper germination procedures and storage methods; and provide information on the causes of low storability of particular type of seeds.

Results/Achievements: Maturation study of the recalcitrant seed *Aquilaria agallocha* was conducted to determine the collection time. Seed storage behaviour of *Terminalia myriocarpa* has been identified and that of *Bischofia japonica* is continued. Maturation studies on *Pongamia pinnata* is in progress. Desiccation studies on *Dipterocarpus macrocarpus* seeds have been started.

Sl.No: 5

Project identification No.: IRMDFR/SM/01

Name of the principal investigator: S. Pattanaik

Title of the Project: Standardisation of nursery techniques for selected bamboo species of N.E. India.

Year of start of the project: January 1999.

Target year of completion: Dec. 2003.

Cost of the project : -Rs. 10.66 lakhs

Objectives: (a) To develop package of practices. (b) To develop reliable method of propagation from cuttings. (c) To establish and maintain a wide genetic base. (d) To select superior genotypes. (e) To study improvement and productivity of bamboo plantations.

Scientific importance of investigations: A truly successful method for vegetative propagation of bamboos has not been found (Banik, 1980). The recent methodology of macro-proliferation hold promise for mass multiplication of bamboos.

Results/Achievements :

Experiment -1: The experiment on standardisation of basal media for root and rhizome induction in *Bambusa tulda* cutting was continued and growth data on parameters like survival percent, time of emergence of new shoots, number of shoots/cutting, average height of shoots/cutting, etc. were recorded at 15 days interval.

Mensurational studies involving functional relationship among various growth parameters in species *Bambusa tulda, Bambusa nutans* and *Bambusa balcooa* were done and some useful results were obtained.

Experiment -2 : Effect of method of planting on macro-proliferation of bamboo shoots.

The experiment was laid in CRD to standardise the size of the propagule in macro-proliferation of *Bambusa arundinaceae*, *Dendrocalamus hamiltonii* and *D. strictus*. The treatments were :

T_0 = Whole shoot

T_1 = Rhizome and shoot with one node

T_2 = Rhizome and shoot with two node

T_3 = Rhizome only.

Preliminary observations show that the propagule having rhizome and shoot portion with two nodes is better in terms of survival percent and new shoot formation.

Sl.No: 6

Project identification No.: IRMDFR/SM/02

Name of the principal investigator: B. Goala

Title of the project: Fertiliser response studies in nursery for some important tree species of N.E. region.

Year of start of the project : 1999

Target year of completion : Dec. 2002

Cost of the project : Rs. 22.71 lakhs

Objectives: (a) To study the effect of different doses of NPK fertiliser on growth and biomass production of some indigenous species. (b) To reduce the period of producing seedlings of healthy stock with sturdy root system for transplantable size. (c) To minimise the cost of production of seedlings. (d) To study the suitable potting media for production of healthy seedlings.

Scientific importance of investigations: There has been only a few studies on the fertiliser application to the soil and consequent effect on different species like teak, gamhar, khair and bamboos etc. The out come of this project will be very useful to cut short the period required to obtain healthy stock with sturdy root system capable of surviving and growing successfully when transplanted in the field. This will not only reduce the formation cost but also decrease the rotation appreciably.

Results/Achievements: Germination as well as biomass growth response trials of *Gmelina arborea* were observed under different treatment by following randomization method. The well grown seedlings were separated to study the biomass to compare them with the control ones.

Sl.No: 7

Project identification No: IRMDFR/TI/06

Name of the principal investigator: Dr. Ashok Kumar

Title of the project: Clonal propagation of important forest species.

Year of start of the project: 1998

Target year of completion: 2000

Cost of project: Rs. 25.15 lakhs

Objectives : To standardise macro-propagation protocol for *Dipterocarpus retusus*, *Gmelina arborea* and *Michellia champaca.*

Scientific importance of investigations: Protocol for clonal propagation of *Dipterocarpus retusus, Gmelina arborea* and *Michellia champaca* will be used for large scale production of planting material.

Results/Achievements: *Dipterocarpus retusus* :-A simple bubble bath has been designed. The cuttings have been collected from the nursery of *D. retusus* and kept for rootings. *Gmelina arborea :* The protocol of vegetative propagation through grafting has been standardised. To develop protocol of vegetative propagation through rooting of cuttings, branch cuttings have been collected and set for rooting in mist and mistless systems of propagation.

Fabrication of shade house : A shade house of 25x25 m size has been fabricated at Deovan for enabling vegetative propagation and hardening of vegetative propagules.

Fabrication of propagation units : As many as three propagation units made up of bamboos and poly sheet have been fabricated to propagate different forest trees species vegetatively.

Fabrication of graft houses : As many as 2 graft houses of size 6x3 m have been fabricated at Deovan.

Sl.No: 8

Project identification No.: IRMDFR/TI/02

Name of the principal investigator: Ajay Thakur

Title of the project: Genetic improvement of *Dipterocarpus retusus.*

Year of start of the project: 1998

Target year of completion: 2002

Cost of project: Rs. 48.72 lakhs

Objectives: (a) To identify the plus trees. (b) To develop protocol for clonal multiplication of *D. retusus*. (c) To survey and analyse seed production area. (d) To establish progeny test. (e) To establish seedling seed orchard/clonal seed orchard. (f) To establish seed production area. (g) To study genetic improvement of *D. retusus* for higher merchantable biomass

Scientific importance of investigation: Genetic improvement of the local species and increase in productivity.

Results/Achievements: Sampling survey has been done for creation of 5 ha. seed production area. 0.7 ha. seedling seed orchard has been developed at Jeypore in Assam. Maintenance of 1.0 ha. seedling seed orchard at Jorhat was continued. Vegetative propagation work has been speeded up during this year. Though it was difficult to root, a rooting per cent up to 20 has been achieved. This is first report regarding rooting of cuttings of any Dipterocarpaceae in India.

Sl.No: 9

Project identification No. IRMDFR/TI/03

Name of the principal investigator: Dr. Ashok Kumar

Title of the project: Genetic improvement of *Gmelina arborea.*

Year of start of the project: 1998

Target year of completion: 2002

Cost of project: Rs.86.64 lakhs

Objectives: (a) To select and multiply the superior biotypes. (b) To assess the stability test of various clones and progenies for different characters. (c) To establish Seed Production Area and Seed Orchards.

Scientific importance of investigations: Increase of the productivity by establishment of gene banks of diversified individuals and vegetative multiplication garden.

Results/Achievements: The branch cuttings of plus trees were collected and grafted at the vegetative propagation complex of the Institute at Deovan.

A number of plus trees of *G. arborea* in different locations in Arunachal Pradesh, Mizoram and West Bengal were selected.

The extension of VMG at Deovan was carried out by planting newly selected clones. In Assam and Manipur, clonal seed orchards have been created.

Different clones are being multiplied for raising clonal trials in different geographical regions.

Sl.No: 10

Project identification No. IRMDFR/TI/05

Name of the principal investigator: N.D. Khobragade

Title of the project: High value merchantable biomass Production of teak (*Tectona grandis*) through genetic improvement.

Year of start of the project: 1999

Target year of completion: 2002

Cost of project: Rs. 35.75 lakhs

Objectives: (a) To identify the superior stands based on phenotypic characters. (b) To select, collect and multiply the superior biotypes. (c) To test the genetic worth of phenotypically selected superior trees based on the performance of their progeny at different silvicultural zones. (d) To establish Seed Orchards.

Scientific importance of investigations: Production of high value merchantable biomass by creation of seed production areas and establishment of seed orchards.

Results/Achievements: A number of plus trees of *Tectona grandis* at different locations have been selected in Assam, Mizoram and Meghalaya.

The SPA of *Tectona grandis* were established by surveying enumerating the trees and analysis was carried out in Mizoram and Assam.

As many as 135 promising clones have been established in a clone/gene bank.

Established 0.5 ha. VMG of Teak at Deovan by planting 135 clones. Out of 135 clones, 82 clones were collected from Maharashtra Vana Sanasodhan Santha, Chandrapur and rest 53 were selected from different locations of North-Eastern States.

Established clonal seed orchard of Teak at Imphal and Manipur.

Sl.No: 11

Project identification No.: IRMDFR/TI/07

Name of the principal investigator: N.D. Khobragade

Title of the project: Introduction and genetic improvement of *Tectona grandis* and *Terminalia myriocarpa.*

Year of start of the project: 1999

Target year of completion:2002

Cost of project: Rs. 43.69 lakhs

Objectives: (a) To identify the superior stand based on phenotypic characters. (b) To select, collect and multiply the superior biotypes. (c) To estimate genetic gain of clones over seed raised plants. (d) To identify most promising clones with high genetic gain.

Scientific importance of investigations: The genetic improvement will lead to higher production of merchantable biomass and reduce mortality due to insects and diseases.

Results/Achievements: In Arunachal Pradesh, SPA of 5 hectares at Ruskin Forest Range under Pasighat Forest Division has been selected. The enumeration of the trees and analysis of data has also been completed.

Sl.No: 12

Project identification No.: IRMDFR/TI/4

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

Title of the project: Genetic conservation and improvement of bamboo and canes.

Year of start of the project: - 1998

Target year of completion : 2001

Cost of the project : Rs. 31.43 lakhs

Objectives: (a) To conserve the bamboo and cane germplasm. (b) To seek genetic improvement of bamboo and canes.

Scientific importance of investigations: Due to excessive population pressure and rapid industrialisation in the region many of the wild gene pools are on the verge of extinction. Hence survey, selection and collection of superior strains of wild gene pool of bamboos and canes would conserve the genetic diversity.

Results/Achievements: Survey have been made in the states of Mizoram, Meghalaya, Arunachal Pradesh and Assam for selection of candidate plus clumps. Total of 34 plus clumps have been collected from Assam and Meghalaya and are being conserved at Deovan, IRMDFR, Jorhat.

Sl.No: 13

Project identification No.: IRMDFR/FP/4

Name of the principal investigator: R.K. Borah

Title of the project: Production of organic wastes based quality compost for forest nursery.

Year of start of the project : 1999

Target year of completion: - 2001

Cost of the project: 32.24 lakhs

Objectives: To develop suitable technology for production of potting media from organic wastes.

Scientific importance of investigations: In tropical and sub-tropical countries, the majority of trees planted are raised in containers. Importing the vast quantities of potting mixtures or their components which would be needed is too costly. Considering the huge reserve of forest based biomass in N.E. India, this project has a good scope for evaluation of these biomass for production of quality compost.

Results/Achievements: Literature review is partially completed. Partially decomposed leaf samples were collected from forest floor. Microbial analysis of leaf litter revealed seven fungal species and five bacterial species, which were preserved for future identification. Commonly available weeds in the Institute's nursery were identified for use as compost material.

Sl.No: 14

Project identification No.: IRMDFR/SC/2.

Name of the principal investigator: Dr. Jasbir Singh

Title of the project: Study of the Changes in Morphological Physical and Chemical Properties of Soil under Shifting Cultivation.

Year of start of the project: June 1997.

Target year of completion : 2000

Objectives: (a) To assess the soil nutrient inventory in shifting cultivation cycle, fallow lands as well as in natural forest. (b) To measure nutrient fluxes as well as pools so that nutrient status of the soil can be prepared. (c) To analysis the nutrient cycles using ideas from system ecology.

Scientific importance of investigations: Most of the forests of north-east India have become degraded by the process of shifting cultivation. It has also become a major cause of deforestation. Not only vegetation of the area gets affected, the soil nutrient pool also depleted to a great extent. This study will help restore soil fertility.

Results/Achievements: The analysis of soil samples of shifting cultivation sites and natural forest in different season of the year revealed that soil under all land use type studied was sandy loam in texture.

Moisture content was significantly higher in natural forest. Percentage of moisture content increased with depth. Bulk density of fallow lands shows the following sequences: 1st year > 2nd year > 3rd year > 4th year fallow and least in natural forest pH value gradually decreased in cropping and harvesting period and increased with the age of fallow land. In natural forest, soil was comparatively more acidic compared to disturbed forest. Conductivity gradually decreased in cropping and harvesting period. Conductivity was higher in natural forest compared to fallow land. Variable percentage of carbon content was found in fallow land.

Total Nitrogen content declined upto fourth year fallow. Higher nitrogen content recorded in surface layer was compared to deeper layer. Depletion of nitrogen content continued upto cropping and harvesting period. Maximum amount of N_2 was recorded in natural forest. Available phosphorus increased after burning and gradually declined upto 2nd year fallow after which it continues to increase in 4th year fallow .The value of exchangeable cation such as K+, Ca++ and Mg++ increased considerably in surface layer and declined sharply in deeper layer. Quick release of exchangeable cations was observed immediately after burning. The loss of cation was noticed in cropping phases.

Sl. No. 15

Project identification No: IRMDFR/ SC/3

Name of the principal investigator: Dr. Anup Chandra

Title of the project: Development of ecologically viable alternative models to shifting cultivation.

Year of start of the project : 1999

Target year of completion: 2002

Cost of the project: Rs.17.05 lakhs

Objectives: (a) To develop agro-forestry models as an alternative to shifting cultivation. (b) To improve the physical and chemical properties of soil. (c) To identify the best tree crop models for jhum land. (d) To study the ecology and economics of different models. (e) To utilise jhum land sustainably.

Scientific importance of investigations: Shifting cultivation is a major problem in the hilly regions of the north-east India. Owing to the shortened fallow period, it has become menace to the environment. Productivity of the land is also reduced. Therefore, it is essential to develop an alternative system to contain this practice. In this direction, agroforestry can play a vital role because it has the potential to control soil erosion, maintain soil organic matter and physical properties, augment nitrogen fixation and promote nutrient cycling. Suitable tree crop combination will not only enhance the productivity of the land but also minimize the deleterious effects of shifting cultivation.

Results/Achievements: Project is to be modified as per the suggestions of RAG members. All other formalities like selection of land, permission from state department etc. has been completed.

Sl.No: 16

Project identification No: IRMDFR/FP/7

Name of the principal investigator: Rajib Kr. Kalita

Title of the project: Development of VAM as bio-fertilizer for some economically important forest plant species of Assam and Arunachal Pradesh.

Year of start of the project :1999

Target year of completion : 2002

Cost of the project : 34.21 lakhs

Objectives: To develop suitable technique for mass production of VAM to be used as bio-fertilizer for some economically important forest plant species of North-eastern India.

Scientific importance of investigations: Although there are few reports on the occurrence/status of VAM fungi with certain forest plant species of north-eastern India, no detailed study on VAM fungi has been undertaken so far. This project will generate useful informations which can be used for better establishment of forest species.

Results/Achievements: Soil and root samples were collected from two sites of Deovan, Jorhat to study the VAM status. The VAMF spores found were ranging from 113 to 705 per 50g of soil from one site and 124-872 per 50g of soil from another site. The root infection study of indigenous plants, mostly weeds, was done. In Bamboo, VAMF spores were 118 per 50g soil and percentage of root colonization was 28.75. Maintenance work of VAM spores collected from different places using maize as trap plant is in progress.

Sl.No: 17

Project identification No: IRMDFR/FP/8

Name of the principal investigator: Dr. (Mrs.) J.P. Borah

Title of the Project: Isolation and evaluation of *Rhizobium* from leguminous forest trees in nurseries of three districts of Assam.

Year of start of the project : 1999

Target year of completion: 2002.

Cost of the project: Rs. 29.77 lakhs

Objectives: (a) To isolate and identify the *Rhizobium* strains from leguminous forest tree species. (b) To evaluate the efficiency of isolated strains to fix atmospheric nitrogen. (c) To test the selected isolates in nurseries and plantations. (d) Mass culture of the efficient *Rhizobium* strains. (e) To prepare carrier based inoculants to use the efficient *Rhizobium* strains as bio-fertiliser.

Scientific importance of investigations: In recent years an alternate technology to the use of costly inorganic fertiliser is being sought worldwide. Legume-*Rhizobium* association enriches the fertility of soil by contributing nitrogen through symbiotic nitrogen fixation. To increase the productivity of crops through Rhizobial inoculation has already become a universally accepted practice in agriculture but information regarding its application in forestry is meagre. Therefore there is an urgent need to test this technology in forest nurseries and plantations.

Results/Achievements: Altogether 87 Nos of strains were isolated from the nodules of leguminous forest tree seedlings collected from different nurseries of Golaghat, Jorhat and Sibsagar district. Among these 23 strains were isolated from *Dalbergia sissoo*, 22 from *Samania saman*, 18 from *Acacia auriculiformis* and 24 from *Albizia procera*.

Plant test for authenticating the strains is in progress. 9 strains from *Albizia procera* and 7 strains from *Samania saman* showed good nodulation in aqua culture. Various biochemical tests, microscopy etc. are in progress for identification of strains. Growth study of different strains was also conducted.

NEW PROJECTS TAKEN UP DURING 1999-2000

Sl.No: 1

Project identification No.: IRMDFR/EE/1.

Name of the principal investigator: V.R.S. Rawat

Title of the project: Ecological monitoring of biological diversity and strategy of conserving thereof in the Kaziranga National Park of Assam.

Year of start of the project : 1999

Target year of completion: 2002

Cost of the project: Rs. 29.08 lakhs

Objectives: (a) To initiate eco-restoration efforts for maintenance of biological diversity in the different ecosystems and communities. (b) To study the present status of biological diversity in different ecosystem and identification of areas that need bio-diversity conservation efforts. (c) To study the population dynamics of plant communities including rare and threatened species. (d) To estimate the organic productivity of grass-lands and Savannah ecosystems in the park.

Scientific importance of investigations: This study is expected to maintain and conserve the species diversity and gene pool of rare and threatened species in the hot spot bio-diversity areas of north -east. By analysing the various structural and functional aspects of the ecosystems in the park, required silvicultural manipulations can be applied to manage the park sustainably.

Results/Achievements: Project is in the preliminary state.

Sl.No: 2

Project identification No.: IRMDFR/EE/2

Name of the principal investigator: Dr. S. Trivedi

Title of the project: Evaluation of current status of tropical moist forests with special reference to Dipterocarps.

Year of start of the project : 1999

Target year of completion: 2002

Cost of the project: Rs. 34.40 lakhs

Objectives: (a) To prescribe silvicultural practices for sustainable management of forest. (b) To examine the current conservation status of Dipterocarp forests. (c) To evaluate changes in the structure and composition of tropical moist forests. (d) To evaluate regeneration status of important species.

Scientific importance of investigations: The findings of the project will ensure sustainable management of tropical moist forests. It will also help in conservation of biological diversity.

Results: Project is in the preliminary stage.

EXTENSION

Transfer of technology

Participation in exhibition at Kisan Mela held at AAU, Jorhat.

Farmer's Fair (RD Project)

Training and Demonstration (UNDP)

Trainees of UPSFD, Tikri (Gonda) Attending Training-Cum-Demonstration programme under UNDP

Farmer's Training (NOVOD Project)

Publication:

Technical report on Seed production area were published.

Singh, J, Bhuyan T.C., Thakur, A. Sinha and N. D. Khobragade (1999): Seed production Area of *Tectona grandis* (Teak), Hmawngkhawthlir : 1 (SPA/MZ/TG/1). Division of Tree Improvement & Propagation, IRMDFR, Jorhat.

Singh, J, Bhuyan T.C, A. Thakur, A. Sinha and N. D. Khobragade (1999) : Seed production Area of *Tectona gradins* (Teak), Hmawngkhawthlir : 2 (SPA/MZ/TG/2) Division of Tree Improvement & Propagation, IRMDFR, Jorhat.

Singh, J, Bhuyan T.C, A. Thakur, A. Sinha and N.D. Khobragade (1999) : Seed production Area of *Tectona grandis* (Teak), Bilkhawthlir (SPA/MZ/TG/3). Division of Tree Improvement & Propagation, IRMDFR, Jorhat.

FINANCIAL STATEMENT FOR THE YEAR 1999-2000

I. PLAN			
Sl.No.		**SUB-HEAD**	**Expenditure (Rs. in lakh)**
1.	**A.**	**REVENUE EXPENDITURE**	
		a. Research	100.53
		b. Administrative Support	46.09
		c. Others specify	0.00
		Total for Revenue Expenditure 'A'	**146.62**
	B.	**LOAN AND ADVANCES**	
		a. Loan Advances (Conveyance)	1.13
		b. House Building Advance	1.86
		Total for 'B'	**2.99**
	C.	**CAPITAL EXPENDITURE**	
		a. Building & Roads	0.00
		b. Equipments, Library Books	0.00
		c. Vehicles	0.00
		d. Other specify	0.00
		Total for 'C'	0.00
		GRAND TOTAL FOR A+B+C(PLAN)	**149.61**
II. NON-PLAN			
1.	**A.**	**REVENUE EXPENDITURE**	
		a. Research	0.00
		b. Administrative Support (Salary)	0.00
		Total Non-Plan	0.00
		TOTAL FOR PLAN + NON-PLAN	**149.61**
III. FUNDED PROJECT			
	A.	World Bank Project	49.81
	B.	UNDP Project	0.22
	C.	NABARD Project	0.00
	D.	FORTIP	0.00
	E.	Energy Plantation Project	2.39
	F.	IDRC Project	0.52
		GRAND TOTAL for (A+B+C+D+E+F) FUNDED PROJECT	**52.94**