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TBGRI
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TROPICAL BOTANIC GARDEN AND RESEARCH INSTITUTE

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Foreword

The year gone by was unique with full of events for Tropical Botanic Garden and Research Institute (TBGRI) in going across very many challenges with exciting success. The Institute has witnessed various structural changes during this year. With the new building complex made available to the Institute, the projects and programmes of TBGRI experienced a quantum leap both at organizational and research levels. New R&D divisions established during the year are at the throes of development. This necessitated a restructuring of the management strategy by bifurcating the activities of the Institute into two wings viz, the Garden System and the R&D System. The action oriented R&D activities attempted are intensive and incisive intended at tapping the rich and varied, but hitherto untapped and underexploited floristic wealth of the nation to the best economic advantage and well being of the people. The infrastructural and reorganisational plannings envisaged in the previous year were well executed largely due to the blessing and cooperation of the Government of Kerala.

The productive efficiency of any organization depends on its life forces and lubricants viz., money which is a miserable component in the situation prevailing in the Third World by and large. Naturally our focus of attention has been to stimulate the world interest, interest of funding agencies in the world over and with a sense of humility and pride it can be said that we have taken rapid strides in this direction. Much to our delight and satisfaction, it has been possible to mobilize substantial financial assistance from the national and international funding agencies.

The international agencies like DANIDA and British Council have extended their benevolence in a big way. From the national sources the Government of India have also done a fair share in promoting our projects and programmes. The tour undertaken by the Director abroad had been very productive in carrying the profile of TBGRI. It has stimulated worthier interaction with various scientific centres in different parts of the world and he is confident that the same will fructify the research programmes with sponsorships and active participation of many leading international scientific bodies and institutions.

Recognizing the crucial role the botanic gardens play in conservation of plant diversity and environmental education and in line with the changing perception of the role of botanic gardens from passive exhibitors to a dynamic research centre and eco-education, TBGRI has oriented itself and assumed work on plant research. Our R&D activities are problem oriented rather than discipline oriented and a systems approach was adopted to achieve the best possible solutions.

I am fully confident that with the support of the Government of Kerala, guidance from the members of the Governing Body, Executive Committee and Research Advisory Committee, continued dedication of the members of the staff and generous funding from various national and international agencies, TBGRI can accomplish its cherished goals with very many promising research and development activities that can go a long way in the service of humankind.

P. Pushpangadan

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GARDEN SYSTEM

I. HORTICULTURE AND GARDEN DEVELOPMENT

1. Ornamental Plants

(a) Landscape plantings

The area surrounding the Victoria pond near the nursery was landscaped and planted with *Phyllanthus* sp. as the 'frame' of a box garden. Near the main building, the landscaping of the Victoria pond was completed with the preparation of four annual beds and planting of *Cycas revoluta* around the pond. Landscape plantings, turfing etc. at the meteorological station were completed in such a way as to make the area merge with the nearby woodland garden. A new foot path was made connecting the above two places. The woodland garden was extended by planting towards the peripheries after removing the sub soil. Also, the area between the generator house and the main building and the triangular area towards the library end of the main building were landscaped. Near the generator house, variegated *Cassava*, *Artemisia*, *Brownea* and *Chlorophytum* were planted while different coloured *Lantana* were planted at the area near the library, which appeared to be very attractive.

The design and plan for landscaping the earth cutting in front of the main building were prepared, which was duly approved and tendered.

Large number of *Clerodendron inermi*, along the right hand side of the road to the main building and *Allamanda nerifolia* along the left side of the canteen road were planted to make hedges.

(b) Display plantings

Over twenty annual beds were developed at different parts of the garden. They are being maintained with colourful flowering plants in rotation. For this purpose, sufficient annual plant seeds were purchased.

The variegated plants garden have about 70 different accessions. The woodland garden was enriched with a number of new shade loving plants and a few more evergreen tree seedlings. The collection of the Bromeliads were displayed by the side of the woodland garden.

Germplasm assembly of *Jasminum* was started and a number of varieties were collected from different sources including Tamil Nadu Agricultural University, Coimbatore and Indian Institute of Horticultural Research, Bangalore. About 30 plants belonging to 15 species/varieties were planted near old canteen, during the year.

The rose garden was maintained in very good condition. The display of plants and decorations using plants at different locations were also maintained with improved standards.

For displaying fossil wood, evolution chart, geological clock etc. three pockets were made on the earth cutting, by the side of the road to the nursery area, which will be covered by growing climbers and the work is in progress.

2. Central Nursery

Systematic propagation studies were undertaken in a number of rare and economically important indigenous plants. *Ochreinauclea missionis* a rare and endemic evergreen tree of medicinal value was successfully propagated using stem cuttings and the methodology was standardised. The effects of summer and monsoon seasons and that of different auxins on rooting of cuttings were also investigated. Vegetative propagation trials in *Terminalia chebula*, another medicinally important tree, is in progress. Apart from these, ideal methodology for large scale propagation of indigenous medicinal plants are being worked out as a combined programme of the seed bank and the central nursery. Germination, viability and storage life of seeds of the medicinal plants are also being studied in about 25 species.

Almost all the planting materials required for the different sections of the Garden were propagated and made available from the central nursery. During the year about 14,000 propagation materials in 490 batches were handled. Over 465 accessions of seeds including nearly 250 seed samples obtained through exchange were attempted for germination and healthy seedlings of about 240 species were raised and provided to the concerned sections. Altogether 12,600 plants belonging to 400 species/varieties were propagated and supplied to the three sections of the garden during the period under report.

Nearly 175 new accessions of living plants were added to the plant wealth of the garden during the year, out of which about 125 were from seeds received on exchange basis from other botanic gardens.

About 50 species of *Ficus* were successfully propagated through layering to meet with the great demand for the plants from other organisations outside the state and distributed for gardening and conservation purposes.

Apart from the above, plant materials brought to the garden by the exploration teams especially those of the Agasthyamalai project and those under the special assistance of Ministry of Environment and Forests for Ornamental Plants were also handled and nurtured properly. Plants for developing an 'Asokavanam' were also propagated and supplied. Transplantation of plants produced through micro-propagation, from flask to pots, were successfully done at the nursery. Plantlets of *Adhatoda beddomeii*, *Rauvolfia beddomeii*, *Woodfordia fruticosa*, *Plumbago rosea*, varietics of

Anthuriums and *Philodendrons* were successfully got established at the nursery.

A collection of cacti and succulents was started and about 40 varieties of plants are being nurtured at the nursery.

3. Medicinal Plant Exploration and Introduction

Plant exploration trips were conducted to different parts of Western Ghats such as Bonakkadu, Agastyamala, Cheenikkala, Kulathupuzha, Ranni, Mookkenpetty, Wagamon, Adimali, Peermade, Mananthavady and Kannavam. The plants were also procured from other Institutions like NBPGR Regional centre, Trissur, Agricultural University, Vellanikkara, NRCS, Kozhikode, Botanical Sanctuary, Wynadu and Ayurveda Research Centre, Poojappura.

As a result of these trips about 120 accessions of plants were collected and introduced to the garden. Plants were also gathered through seed bank. Following are some of the important introductions of the year.

1. *Coleus forskhoii*
2. *Barringtonia acutangula*
3. *Malaxis densiflorus*
4. *Solanum luteum*
5. *Zizyphus jujuba*
6. *Thunbergia fragrans*
7. *Vitex agnus-castus*
8. *Janakia arayaipatra*
9. *Garcinia mangostana*
10. *Pentapetes phoenicea*

4. Medicinal Plant Garden

This year the effort was mainly for giving a face-lift to the medicinal plant garden rather than extension of the planting area, which was being adopted in the previous years. The following works were completed in the garden with this objective.

Renovated the Conservatory, the main attraction of the visitors in the Medicinal Plant Garden, which harbours important medicinal plant species. The facility for planting representative sample plants in the house itself was made rather than keeping them in pots. The *Vanilla planifolia*, which adorned the sides and roof of the house were re-planted. The surrounding area of the house was made more attractive by making foot paths on either side of it and turfing with *Cynodon dactylon*, an important medicinal plant species. Made a new terrace in continuation of the terraces, above the *Centella* lawn. A permanent structure was made for the 'Pergola' near the green house. Permanent shade houses were also made in the demonstration

plots of the garden. Sixty plants were newly labelled with information on their botanical name, local name, sanskrit name and medicinal uses. About 15 trees and 12 shrubs were planted in the garden. Genus-wise groups of *Solanum* and *Piper* consisting of 13 and 15 species respectively, were displayed. A 'bonsai' collection of 12 medicinal plants were raised. *Adhatoda beddomei* (20 plants) and *Plumbago indica* (90 plants) raised through tissue culture were planted in the medicinal plant garden.

The staff of the section discussed developmental activities of the medicinal plant garden with Mr. Hans Fliegner, Asst. Curator, Kew Gardens, who visited TBGRI in February 1992 and sought guidelines from him for its future developmental programmes.

5. Arboretum

With the completion of the Arboretum project during 1990-91, the major work left out in the Arboretum was proper maintenance of the planted trees. This is being done regularly along with minor developments in the area.

During the report period saplings of about 50 species of trees were introduced to the Arboretum through plant exploration trips and through seed exchange programme. With this addition the total collection of the Arboretum has increased to 650 species.

6. Palmetum

During the report period, 15 species of palms were introduced to the garden from Royal Botanic Gardens, Kew. Now the Palmetum has about 170 saplings of 68 species, all well maintained.

7. Bambusetum

(a) Survey, Collection and Introduction

Four explorations were conducted for the collection of seeds, seedlings, offsets and specimens for Herbarium study.

A survey of bamboos growing in the forests of Ponnudi, Kallar and surrounding areas was conducted from 8 to 10 May 1991. During this tour the shola forests near lower sanatorium, the evergreen forests above Merchinston Estate and the valleys of Kallar and the surrounding forest areas were explored. In this sholas only one species of bamboo, tentatively identified as *Ochlandra travancorica*, was located. However this reed showed some variation in the nature of clump formation, culms, sheaths etc. with that of *O. travancorica* grown in TBGRI Bambusetum. 4 offsets/seedlings of this taxon were collected for introduction. No bamboo was found in the evergreen and comparatively undisturbed forests above Merchinston Estate. In Kallar, gregarious growth of *Ochlandra travancorica* was noticed.

During this trip 43 field numbers of other angiosperms were also collected. In the nursery, all the offsets/seedlings collected were planted in pots.

In June two collection trips were conducted, one to the forest of Kottoor and the other to the forest of Pandimutta, Chinikkala and Palaruvi. From Kottoor 4 offsets of *Ochlandra* sp. (possibly, *O. ebracteata* Raizada & Chatterjee) were collected. Two flowering clumps were critically observed and about 25 specimens were collected for future study. The reed vegetation near Vithura Jersey Farm was also explored in the same tour and flowering and fruiting clumps of *Ochlandra* sp. were noticed. From this locality about 30 specimens were gathered. Fruits were also collected for propagation.

From Taliat Estate in Pandimutta forests one offset and two cuttings of an *Ochlandra* sp. were collected. Two varieties of *Ochlandra travancorica* Bedd. were collected from Pandimutta and Chinikkala. *Oxytenanthera* sp. was found in flowering at Palaruvi and about 35 specimens and 3 offsets were collected. Moreover 19 field numbers of other species were also collected for Herbarium. The different planing materials were planted in the bambusetum and the other materials were handed over to the Herbarium for processing.

Another explorative tour was conducted to the forest of Nagachi in Kulathupuzha range in February 1992. The plantations of 'lathimula' and *Bambusa bambos* were observed and a few samples of culms were collected.

Seeds of the flowered bamboo (coll. No. 8616) were collected from the bambusetum. The seedlings self grown around the clump were collected and planted in poly bags. Freshly collected seeds were also sown to raise seedlings. The dried clump was later dug out for further study, measurements of culms, internodes etc. were taken.

Observation on the two flowered clumps of *Dendrocalamus strictus* in the bambusetum were continued and several specimens were collected for further study.

This year one clump of *Dendrocalamus membranaceus* started flowering and observations on the flowering were noted, specimens were collected for Herbarium.

A few cuttings of bamboo collected by Sri P.J. Mathew of TBGRI were planted in the nursery.

(b) Expansion, Maintenance and Other Activities

For further expansion of bambusetum, areas near the *Ochlandra* vegetation were cleared.

Selective clearing of the small trees, selfgrown as a result of regeneration, was carried out in July so as to provide sufficient sunlight and necessary space for the healthy development of culms. Several of the young plants were

fenced to protect them from wild boars and clearing of undergrowths was also carried out.

Apart from these, watering, weeding, clearing of paths etc. were done as and when required.

Video recording of the bamboos growing in the bambusetum was carried out during the Regional Workshop on medicinal plants held at TBGRI.

A 'bamboo hut' was made in the site with the help of two tribals.

8. Garden for Sacred Plants

Collection of a special group of plants, the "sacred plants" (plants related with Indian mythology and religion) has been started during the report period, in order to develop sacred vanas. So far 35 species were gathered and planting will be done soon.

9. Aquatic Plants

With the additions of 3 species of water lilies during the period, the garden's collection of water lilies has increased to 12 species/varieties. 15 species of other water plants were also introduced.

10. Seed Bank

After the inauguration of the main building, the seed bank was shifted from the guest house and was organised with more facilities. The concerned scientist visited the National Bureau of Plant Genetic Resources, New Delhi to see their facilities and to discuss various matters connected with the organisation of a well equipped seed bank with medium-term storage facility along with a cryopreservation unit and a Seed Biology Laboratory. Equipments such as balances, seed germinators, oven etc. were procured. Purchase orders were placed for the dehumidifiers and air conditioners required for the seed drying room and for seed blowers, seed cleaner cum grader etc. The engineering work for insulation of the seed drying room was tendered. Apart from these, seed containers, sieves for cleaning seeds, paper towels for seed germination, etc. were also procured.

Seed storage studies including germination and viability testing and seed moisture content determination etc. were taken up in *Michelia champaca*, *Careya arborea*, *Terminalia chebula* and *Ochreinauclea missionis*, with the available facilities. The studies are at different stages and are progressing well. The seed viability tests using Tetrazolium and indigo carmine are being standardized in a number of species after different durations of storage. Trials for determining ideal germination conditions for seeds of indigenous medicinal plants were continued as a joint effort of the seed bank and the central nursery. So far 25 species were taken up for the study with the ultimate aim of standardizing ideal propagation profiles. Seed development

and storage studies were initiated in *Syzygium cumini* and *S. aromaticum* which are also progressing well.

Seeds of about 300 species were collected from the plants in the garden, cleaned, dried and stored in room conditions for distribution/exchange. Procedures for extraction and separation of quality seeds, drying, germination etc. were being standardized. Different formats were also prepared for recording various data in the seed bank, from flowering stage to storage.

A reference collection of identified seeds was also developed at the seed bank and it has got nearly 700 seed samples.

The new index seminum 1991-92 was prepared, edited and printed, incorporating the accession number of the plants. The index seminum was distributed all over the world. As a result a good number of requests for supply of our plant seeds were received, mostly from foreign countries and the available seeds are being distributed. About 265 seed samples were sent on exchange basis to the following 21 Botanic gardens/Universities.

1. Botanical Garden, University of Nijmegen, The Netherlands.
2. Royal Botanic Garden, Sydney, Australia
3. Jardin Botanique National De Belgique, Meise, Belgium
4. Penn State University, University park, PA, USA.
5. ORTO BOTANICO, Universita Deigh Studi, Firenze, Italy.
6. Verwaltung der Bundesgarten, Alpengarten in Belvedere, Wien, Austria.
7. Palmengarten, der Stadt Frankfurt, Germany
8. Jardin Botanique, Universite Louis Pasteur, Starsbourg Cedex, France
9. University of Copenhagen Botanical Garden, Copenhagen, Denmark.
10. Rainforest Botanic, St. Leonards Gardens, Hove, E.Sussex England.
11. Botanischer Garten, der Universitat Zurich, Switzerland.
12. Botanical Gardens, Agricultural University, Wageningen, The Netherlands.
13. National Bureau of Plant Genetic Resources, New Delhi.
14. Auroville, Kottakuppam, S.A District, Tamil Nadu.
15. Progressive Friends Circle, Mukhed Dist. Nanded, Maharashtra
16. Regional Research and Study Centre, Mirzabazar, Midnapore, West Bengal.
17. Deputy Conservator of Forests, Dadra and Nagar Haveli (U.T.) Silvassa.

18. Department of Applied Botany, Mangalore University, Karnataka
19. Indian Institute of Horticultural Research, Bangalore
20. Seed Technology Department, Tamil Nadu Agricultural University, Coimbatore.
21. Progressive Friends Circle, Nagarjuna Nagar, Tarnaka, Hyderabad.

During the year, the seed bank received over 50 index seminum from around the world. Based on these indices, requests for seeds were sent and 250 seed samples including those of very rare and endangered conservation materials from the following 37 organisations, have reached. Using these seed materials seedlings were raised and about 125 exotic species of botanical interest were added to our collections.

1. Fruit Spirit Botanical Garden, Dorrroughby, N.S.W. Australia.
2. Royal Botanic Gardens, Kew, U.K.
3. University of Toronto, Dept. of Botany, Toronto, Ontario, Canada.
4. Botanic Gardens, Glasgow, Scotland.
5. Faculte des Science Agronomiques de Gembloux Service des collections Vegetables, Gembloux, Belgium.
6. The Harris Garden, University of Reading, Whiteknights, Berkshire, U.K.
7. Conservatoire Et Jardins Botaniques De Nancy, France.
8. Zentralinstitut fur Genetik and Kultur Pflazenforschung, Gatersleben, Germany.
9. Orto Botanico dell Universita, Padova, Italy.
10. Hortus Botanicus, Vacratot, Hungary.
11. Real Jardin Botanico, C.S.I.C. U.S Conservation Jardin, Madrid, Spain.
12. Hongkong Herbarium, Agr. & Fisheries Dept, Hongkong.
13. Waimea Arboretum and Botanical Garden, Haleiwa, Hawaii, U.S.A.
14. Mr Eddie Williamson, Charlotte, NC 28210, U.S.A.
15. Jardin Botanic De soller, Mallosca, Illes Balcars, Spain.
16. Alpengarten in Belvedere, Wien, Austria
17. Jardin Botanique, Terrasse du Jardin Public, Bordeaux, France.
18. The Morton Arboretum, Lisle, Illinois, U.S.A.
19. The Botanical Garden, University of Helsinki, Finland
20. Botanischer Garten, Hamburg, Germany
21. Hortus Botanicus, K.U.Nijmegen, Toernooiveld, ED Nijmegen, The Netherlands
22. Orto Botanico, Giardino Dei Semplici, Ferenze, Italy.

23. Station de Botanique et de Pathologie Végétale, Antibes, France.
24. Nippon Shinyaku Institute for Botanical Research Kyoto, Japan
25. Mount Coottha Botanic Gardens, Brisbane, Australia
26. Botanischer Garten and Botanisches Museum, Berlin, Germany.
27. Jardin Botanique National de Belgique, Meise, Belgium
28. Jardin Botanico De Cordoba, Spain
29. Hortus Haron, Haren, Netherlands
30. Gatard Jean-Luc Les Ouzinieres, Reaumur, France
31. Waimca Arboretum Foundation, Haleiwa, Hawaii, U.S.A.
32. Bereich Botanik and Arboretum, des Museums Fur Naturkunde, Berlin, Germany.
33. Jardin De Aclimatacion, De La Orotava, Islas Canarias, Spain
34. Botanischer Garten der Universitat Zurich, Switzerland.
35. Royal Botanic Gardens, Sydney, Australia
36. Hortus Botanicus Nanjingensis, Jiangsu, Peoples Republic of China
37. Auroville, Kottakuppam, S.A. Dist, Tamil Nadu.

For promoting cultivation of vegetables and raising kitchen gardens among the employees of the Institute, four types of vegetable seeds were distributed, which created a positive approach and the results were satisfactory.

11. Imported Plant Materials

Import formalities including procurement of import permits for plants or planting materials of scientific and conservation value from other countries were channelised through the National Bureau of Plant Genetic Resources, New Delhi. Last year palm seedlings belonging to 30 species and orchid seedlings of 10 species were imported from the Royal Botanic Gardens, Kew. Apart from these, we have obtained permits to import some other orchids, cacti and succulents, palm seeds etc. from the Kew Gardens and National Botanic gardens of Cuba. The Kew Gardens have agreed to supply more seeds or seedling of palms in the coming years so as to build up a duplicate collection of Kew palm collections at TBGRI.

12. Plant Exchange and Supply

- (a) Saplings of 30 species of *Ficus* were supplied to Karnataka Forest Department on exchange for about 20 species of sacred plants.

- (b) Saplings of 28 species of *Ficus* were given to the LSPSS garden, Pune for developing a *Ficus* garden there.

13. Gene-Pool Development and Bio-Systematic Studies on Piperaceae with Special Reference to the Genus *Piper* L. - Project funded by STEC, Government of Kerala.

Thirty taxa belonging to the family Piperaceae were added to the existing collection. It includes indigenous and exotic species of the three genera *Piper*, *Peperomia* and *Pothomorphe* and cultivars of *Piper nigrum*. *Piper hapnium*, listed as an endangered species is also present in this collection in addition to another rare species, *P. barberi*.

Building up of the 'Field Gene Bank' of *Piper* species was undertaken and as a part of this programme, 14 species of *Piper* were planted along the river side in the Medicinal Plant Garden. Also a collection of 27 local cultivars/landraces of *Piper nigrum* was raised. The cultivars were accessed, documented and planted systematically in a plot near the main building.

Taxonomic studies on 4 species of *Piper* and 3 species of *Peperomia* were carried out and determined their identity. Cytological studies on 10 taxa of the family were undertaken. Detailed mitotic and meiotic studies on *Piper barberi* were done. Vegetative and seed propagation studies on *Piper barberi* was also carried out.

14. Eco - Rehabilitation and Gene - Pool Development of Selected Endangered Medicinal Plants of Western Ghats - Project funded by STEC, Government of Kerala.

Six accessions (74 seedlings) of *Rauvolfia serpentina* and two accessions (67 seedlings) of *Cosciniium fenestratum* were collected.

The soil samples were collected from different habitats of the three following species and analysed chemically. The data revealed pH preference of the following species and it is as follows.

<i>Cosciniium fenestratum</i>	- 6
<i>Rauvolfia serpentina</i>	- 7
<i>Holostemma annulare</i>	- 5.5

15. Ex-Situ Conservation of the Rare and Endemic Plants of Agasthyamala at TBGRI-Project funded by Western Ghats Cell, Government of Kerala.

During the report period 8 plant collection trips were conducted to the different parts of Agasthyamala area. As a result about 300 saplings belonging to 45 species of rare/endemic plants were introduced to the Garden. This make the total collection to about 450 plants belonging to 70 species.

About 1700 field numbers were collected during the report period for the taxonomic studies. All these specimens were processed and mounted. 800 species were identified, which includes 75 species of rare/endemic plants, 2 new species and 4 species recollected after a period of over 80 to 100 years from the previous record.

The conservation plot for Agasthyamala plants was also developed during the report period, at the 25 acre land selected in the garden. Up to the end of the report period, 250 saplings belonging to 60 species of rare/endemic plants were planted at this plot. These plants are showing very good growth performance in the *ex-situ*.

The work on the publication of the rare plant manual is also going on well. Data sheet for each plant is being prepared.

16. Germplasm Collection, Evaluation of Yield Potential and Exploitation of the Fruit Crops of the Western Ghats - Project funded by Western Ghats Cell, Government of Kerala.

After surveying the entire area of the Garden a suitable nursery site was taken for the project. A temporary potting cum shade shed was made ready.

During this period, 16 collection trips were conducted to the reserve forests of Trivandrum district for the collection of fruits, seeds, seedlings and specimens for Herbarium. During these tours notes regarding habit, habitat, phenology, flowering and fruiting seasons, local names and uses etc. were gathered. A large number of seeds, seedlings etc. of different species were collected for nursery trials. An important observation made in the field was that in *Spondias pinnata* despite the high production of fruits, germination frequency of seedlings was very low. This is apparently due to the thickness of the fibrous endocarp.

- 17. Survey, Exploration, Collection, Evaluation, *Ex-Situ* Conservation and Propagation of Lesser known/hither to Unknown Wild Plants of Horticultural/Ornamental Value and some Rare and Endangered and Endemic Plants of Western Ghats (Kerala) - Project funded by Ministry of Environment and Forests, Government of India.**

Necessary steps were already taken for the execution of the above said project. About 115 species/varieties of varying plants of ornamental value were collected by conducting six trips to different parts of the Western Ghats. These plants are being nurtured at the nursery for possible introduction to the garden, after establishment and propagation.

RESEARCH AND DEVELOPMENT SYSTEM

II. PLANT BIOTECHNOLOGY

Consequent to the inauguration of the Laboratory cum Administrative Complex, a modern purpose-built laboratory with culture and transfer rooms was made available to the Division. Keeping a functional unit in the semi permanent building, the new laboratory was occupied in a phased manner. The following core groups were identified on a priority basis and the responsibilities distributed among scientists under the common umbrella of Plant Biotechnology.

a) Micropropagation Unit

To develop rapid multiplication protocols for rare taxa and commercially important horticulturals and to promote horticultural and floricultural activities in the state/country through skilled human resource development and other extension services.

b) Biochemical Physiology Unit

To specialise in such areas as seed biology of tropical taxa especially trees, screening and selection of native fastgrowing trees and physiological aspects of natural plant communities.

c) Bioproduction and Bioprocessing Unit

To develop strategies and appropriate methodologies for sustainable production of unique, plant-specific bioactive compounds and other raw materials and utilization of the same for traditional and modern medicine and industry.

d) Resource Development, Improvement and Management Unit

To expand the narrow genetic base of the prospective wild species through somaclonal variant selection/improvement and other biotechnological means, to develop appropriate biochemical/molecular probes to establish the genetic fidelity of the micropropagation systems and to devise cold/cryopreservation methods for rare plant germplasm.

Keeping this compartmentation of functions and associated infrastructural changes apart, R&D activities of the division continued unhindered during the year.

I. Micropropagation of Rare and Exquisite Taxa of Orchids

Three month old shoot cultures of *Habenaria crinifera* raised from the small number of infection free shoot tips of field-grown plants formed an excellent source of explants for increasing the stock of plants. Multiple shoot

regeneration (10-12 shoots) was induced within 8 weeks in 80% of the shoot tips cultured in woody plant medium containing 0.5 mg/l BA. Increase in the concentration (1.0 mg/l) of the cytokinin promoted the development of flower stalks with 4-6 greenish white flowers within 4 weeks in 40-60% of the shoots. Induction of flowering *in vitro* was dependent on pronounced vegetative growth. Higher concentrations of BAP (2.5- 10.0 mg/l) were toxic as evidenced from the browning and eventual necrosis of the tissues. The shoots were separated and easily rooted in presence of 0.2 mg/l NAA before planting in the field.

Runner node explants of yet another terrestrial orchid, *Nervilia aragoana* cultured in woody plant medium containing 2.0 mg/l BAP and 1.0 mg/l NAA produced a number of additional runners through axillary bud proliferation. The runners were branched and often showed rapid growth. Cytokinin alone when supplied at high concentrations (3.0 - 5.0 mg/l) promoted the development of runners and also a solitary leaf from the node(s) within four weeks. Subculture in auxin containing media induced the formation of innumerable cottony roots (~ 0.5 cm) around the base of the leaf within 2 weeks. It was interesting to note that low levels of BAP (0.1 - 0.5 mg/l) induced the formation of 5 - 7 cm long inflorescence with greenish flowers and additional runners. It was evident that suitable differences in the concentrations of BAP determined the relative rates of vegetative and flowering responses in this plant.

Seed culture method was standardised for *Angraecum rutenbergianum*. The seeds obtained as a gift from the Royal Botanic Gardens, Kew were germinated on the basal Mitra *et al.* nutrient medium supplemented with 20% tender coconut water. The chlorophyllous protocorms formed after 12 weeks of culture rapidly developed into leafy shoots in presence of 1.0 mg/l BAP.

2. Other Plants

(a) Insectivorous Plant

Stem nodal segments of different sizes developed from axenic seedlings of *Nepenthes khasiana* were cultured to produce a single shoot per node in 90% of the explants. A minimum of two nodes in an explant was essentially required for the expression of morphogenetic response. Shoot cuttings subcultured in growth regulator-free nutrient medium as well as those rooted in presence of 0.5 mg/l NAA produced typical pitchers at the tips of the leaves. Profusion of pitchers in shoots cultured in rich nutrient milieu indicated that pitcher formation neither an adaptogenic trait nor a *sine qua non* for the nutrition of the plant.

(b) Medicinal plants

The result obtained in the previous year indicated that shoot apices of *Trichopus zeylanicus*, a less known herb rich in saponins, responded better

than other explants in culture. Experiment conducted on axenic seedling-derived shoot tips during the current year resulted in the development of a rapid micropropagation protocol. The shoot regeneration response to cytokinin (BA) was concentration dependent. Single shoot and multiple shoots buds (30-40) were differentiated in low (0.1 - 05 mg/l) and high (8 - 10 mg/l) concentrations respectively.

Amassing of a large number of shoots was possible through the harvest of shoot buds at periodic intervals and reculturing the remaining unorganised tissue in high BA medium to produce multiple shoots in 5 - 6 weeks. The shoot-bud-free meristematic tissue served as a perennial source of shoot buds. The shoot buds recultured in low BA medium developed into leafy shoots in 8 weeks. Combinations of auxins (NAA and IBA) induced rooting in the shoot cuttings.

An *in vitro* regeneration scheme was also successfully developed for *Rauvolfia micrantha* through axillary shoot proliferation in stem nodal explant cultures. Murashige-Skoog medium supplemented with appropriate concentrations of BA and NAA promoted the development of a highly branched solitary shoot in 4-5 weeks. Reculture of the nodal explants produced 4-5 shoot buds the development of which into shoots was induced by reducing the concentrations of the growth regulators. Liquid nutrient medium in particular favoured robust growth of the shoot. The shoot cuttings were rooted in medium containing auxins in 3 - 4 weeks. Rooted plants were established in the fields at 70-80% efficiency without any hardening treatment.

The initial experiments on the regeneration of stem nodal explant culture of *Holostemma ada-kodien* were fraught with problems of callusing. In recent experiments, however, a solitary leafy shoot accompanied by the initiation of a number of undeveloped shoot buds was obtained in 30% of the culture. Non availability of adequate number of plants, and vegetative parts for the experiments especially during the dry season has seriously hampered the progress of the work. In related experiments, cytological analysis with root tip squashes of field established micropropagated plants of *Adhatoda beddomei* revealed clonal uniformity of the plants.

3. Development of Productive Cell/Root Cultures

As a sequel to our recent interest in the bioproduction of high value compounds and raw materials that find immediate application in traditional as well as modern medicine, attempts were made to establish cell/root cultures in certain plants. Cotyledonary explants excised from 3-5 week old axenic seedlings of *Cassia angustifolia* were cultured in medium supplemented 0.5 mg/l 2,4-D and 0.1 mg/l kinetin. The friable calli proliferated upon the explants were transferred to agitated liquid medium. In preliminary experiments, the cells registered a 25 - fold increase in fresh weight in 20 days at 150 RPM and could be repeatedly subcultured. In *Argemone*

mexicana, a berberine-yielding weed, nodal segments of 1-month old field grown plants cultured in MS medium supplemented with combinations of NAA and BAP produced calli in 4-5 weeks. In order to avoid browning and necrosis of the cells, subculture of the callus pieces was done in rapid succession. The cells cultured in liquid medium under agitated conditions released characteristic yellowish brown products into the medium which inhibited further growth of the cells. The conditions required for stable growth of the productive cells are being optimized.

Flower formation and fruit setting in field cultivated plants of *Trichopus zeylanicus* were monitored. Although profusion of flowers was common through out the year, fruit setting followed by maturation of seeds was a slow process invariably taking 4-6 months after flowering. 20-40% of the seeds were lost due to rodents. Seed germination trials indicated possible dormancy factors associated with the process. It was further evidenced that more than 60% of the GA₃ tested seeds germinated *in vitro*.

4. Conservation through Micropropagation of Rare and Exquisite Orchids of the Western Ghats - Project Funded by Ministry of Environment and Forests, Government of India.

The technical programme originally proposed for the first year of the research project on 'Conservation through micropropagation of the rare and exquisite orchids of the Western Ghats, was successfully completed. Out of the 26 field trips conducted for the purpose, a total number of 89 species and 3 varieties of orchids including 10 species listed out in the proposal was collected and reared in the nursery area of the garden. The spectacular Lady's slipper orchid, *Paphiopedilum druryi* which was considered endangered and possibly extinct in the wild was relocated and collected in the niches of Agasthyamala in an adventurous exploration trip on 18th March 1992. Photoprints of this prize collection were sent to various conservation minded agencies and scientists who overwhelmingly appreciated our efforts in rare plant conservation. The local media also gave adequate coverage of this collection. Among other orchids, those collected in the altitude range of 0-1000 mts were found to grow well in the garden site while others from the high ranges are yet to establish.

5. Studies on the photosynthetic performance of selected trees and woody vines of the sacred groves of Kerala- Project funded by STEC, Government of Kerala.

The project aims to evaluate the optimum productivity of biomass of selected sacred groves in Kerala. System analysis of four sacred groves of Nedumangad Taluk and the work on comparative productivity of the sun and shade leaves of trees have been carried out.

III. MICROBIOLOGY

In continuation of the studies on the Rhizosphere and Mycorrhizal fungi of the economically important and endemic trees of Western Ghats, periodic samples were collected from the Rhizosphere of *Dalbergia latifolia*, *Gluta travancorica*, *Humboldtia unijuga*, *Myristica malabarica* and *Bentinckia coddappanna* growing in the forests of the Western Ghats and in the Arboretum of TBGRI.

1. Isolation of Rhizosphere Fungi

(a) Rhizosphere fungi of *Bentinckia coddappanna*

Samples were collected from the rhizosphere and non-rhizosphere soil of *Bentinckia coddappanna* growing in the Agasthyamala forests, Chemunchi forests and also from the Arboretum of TBGRI. As usual the fungal organisms were found to be more in the rhizosphere compared to the non-rhizosphere soil in all the samples collected.

The R.S. ratio of the samples collected from the Arboretum of TBGRI was the lowest (1.44). The R.S. ratio of the samples collected from the Agasthyamala forest was 1.61, while the samples collected from the Chemunchi forests showed a higher R.S. ratio of 4.8. This shows the occurrence of high fungal population in the Rhizosphere of this palm growing in the forest area compared to that of the Arboretum.

The following fungi were also isolated from the rhizosphere and non-rhizosphere soil.

Rhizosphere	Non-rhizosphere
<i>Aspergillus</i> sp.	<i>Aspergillus</i> sp.
<i>Blastobotrys nivea</i>	<i>Fusarium solani</i>
<i>Emericella nidulans</i>	<i>Fusarium decemcellulare</i>
<i>Acremonium</i> sp.	<i>Fusarium oxysporum</i>
<i>Trichoderma</i> sp.	<i>Gliotrichum candidum</i>
<i>Trichoderma viride</i>	<i>Blastobotrys nivea</i>
<i>Penicillium</i> sp.	<i>Penicillium</i> sp.
<i>Verticillium tenerum</i>	

(b) Rhizosphere fungi of *Gluta travancorica*

Samples were collected from the rhizosphere and non-rhizosphere soil of *Gluta travancorica* growing in the natural forests of Agasthyamala and Chemunchi area. The R.S. ratio of the samples collected from Chemunchi area (5.37) was found to be very high compared to that from the Agasthyamala forests (1.11). The high R.S. ratio is due to the presence of large number of fungal organisms in the rhizosphere.

The following fungi were also isolated from the rhizosphere and non-rhizosphere soil.

Rhizosphere	Non-rhizosphere
<i>Trichoderma viride</i>	<i>Mycelia sterilia</i>
<i>Curvularia lunata</i>	<i>Rhizopus</i> sp.
<i>Fusarium solani</i>	<i>Aspergillus</i> sp.
<i>Trichothecium roseum</i>	<i>Fusarium</i> sp.
<i>Penicillium</i> sp.	

(c) Rhizosphere fungi of *Humboldtia unijuga*

Samples were collected from the rhizosphere and non-rhizosphere soil of *Humboldtia unijuga* growing in the forests of Agasthyamala and Chemunchi area. The R.S. ratio of the samples show that the fungal population in the rhizosphere is higher than that in the surrounding soil. The R.S. ratio of the samples collected from the Chemunchi area is higher compared to the samples collected from the Agasthyamala area. This clearly shows that the rhizosphere of the trees of the Chumunchi area is more conducive for the growth of fungi.

(d) Rhizosphere fungi of *Myristica malabarica*

Samples could be collected only from the natural forests of TBGRI. The R.S. ratio showed only a slight increase in the fungal population of the rhizosphere when compared to the surrounding soil.

2. Isolation and Identification of Vesicular-Arbuscular Mycorrhizal Spores

(a) VAM spores of *Dalbergia latifolia*

Soil samples were collected from the rhizosphere of *Dalbergia latifolia* growing in the natural forests of TBGRI. The spores were isolated following the wet-sieving and decanting method.

The following spores were identified

- Glomus etunicatum*
- G. manihotis*
- G. intraradices*
- G. clarum*
- G. pustulatum*
- G. maculosum*
- Acaulospora mellia*
- Sclerocystis pachycaulis*

(b) VAM spores of *Bentinckia coddapanna*

(i) Soil samples were collected from the rhizosphere of the trees growing in the Arboretum of TBGRI. Spores were isolated by the wet-sieving and decanting method.

The following spores were identified

Acaulospora sporocarpia

A. lacunosa

Glomus dimorphicum

G. manihotis

G. delhiense

G. clarum

G. etunicatum

(ii) Rhizosphere soil samples were also collected from the Chemunchi forests. VAM spores were isolated and identified.

The following *Glomus* species were identified

Glomus vesiculifer

G. citricolum

G. ambisporum

G. pansihalos

G. etunicatum

G. intraradices

G. pustulatum

G. fasciculata

G. secundisporum

G. multisubstensum

More *Glomus* species were isolated from the forests of Chemunchi area. But species of *Acaulospora* were isolated only from the Arboretum of TBGRI.

3. Assessment of VAM Infection in the Tree Roots

The intensity of VAM infection is determined by the intensity of the fungal colonization in the root tissue. For this purpose root samples were collected and preserved in FAA (90:5:5). The roots were washed in tap water and cut into 1cm. pieces. These root bits were kept in a beaker containing 10% KOH solution and heated at 90°C for 1 h. The specimens were then washed and treated with alkaline H₂O₂ at room temperature for 10-20 minutes. The specimens were then washed thoroughly and soaked in 5N HCl for 3-4 minutes. These specimens were then stained with lactophenol cotton blue or with acid fuchsin. The samples were then mounted on slides and observed under a microscope to assess the intensity of infection.

Fungal hyphae with arbuscules and vesicles were observed in the roots of *Bentinckia coddapanna*. The intensity of the infection is very good as tufts of fungal hyphae were present in the roots.

The roots of *Gluta travancorica* growing in the Agasthyamala forests had shown the presence of hyphae in the cortical region of the roots, but vesicles and arbuscules were not present.

Even though VAM fungi was noticed in the roots of *Bentinckia coddapanna* and *Gluta travancorica* no hyphae was present in the roots of *Humboldtia unijuga* growing in the forests of Agasthyamala. The roots were devoid of any fungal hyphae, vesicles or arbuscules.

4. Inoculation of VAM Spores

To ascertain the infection capacity of the isolated spores, onion seedlings were inoculated with three species of the genus *Glomus*, viz. *Glomus clarum*, *G. occultum* and *G. mosseae*. Hogland nutrient solution was poured to all pots containing the onion seedlings once in a week to supply essential nutrients. After six weeks, roots from the onion seedlings were removed and kept in FAA. The roots were then observed under the microscope following the method of Phillips and Hayman to ascertain the presence of VAM fungi in the roots. Of the three species tried, *Glomus clarum* showed a very high rate of infection. The other two species have shown only poor response.

In order to get enough spores to inoculate the trees, spores were allowed to multiply in onion roots. *Glomus clarum* was selected for further study as it had shown good response. The spores were harvested after six weeks and kept for inoculation of the trees.

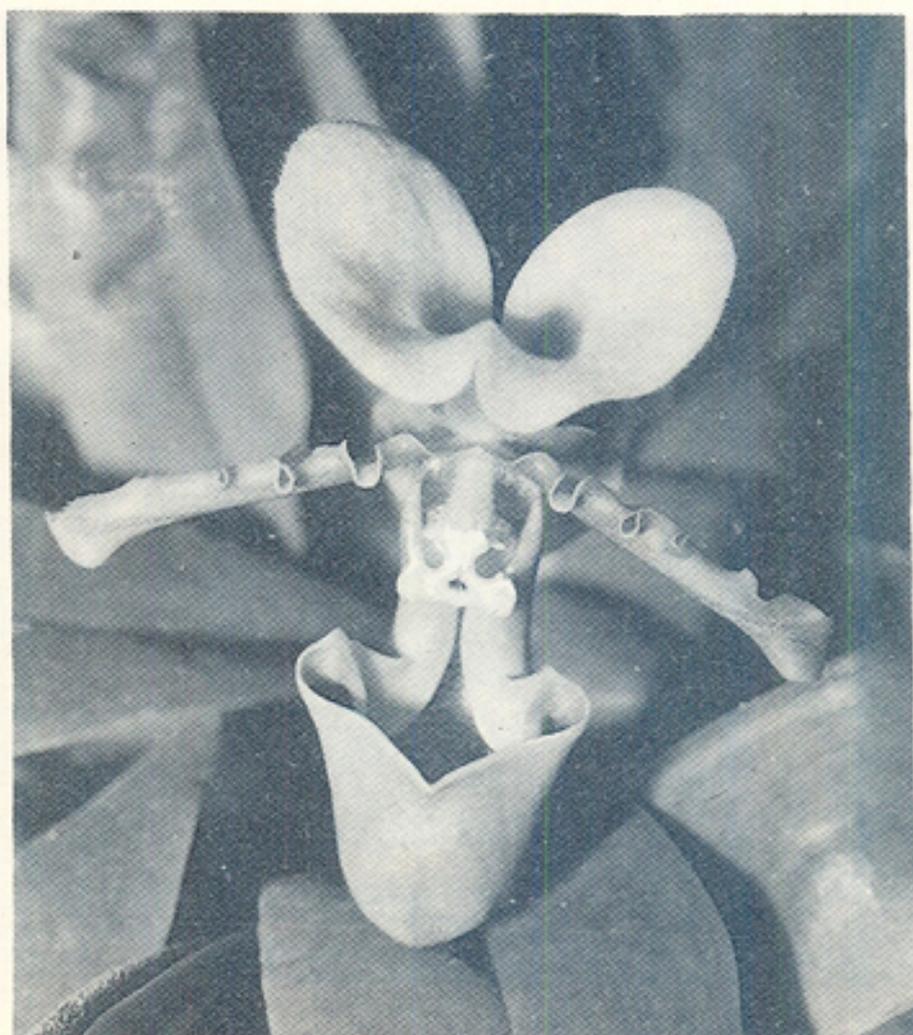
5. Inoculation of the Roots of *Bentinckia coddapanna*

One year old seedlings of *Bentinckia coddapanna* were selected for this purpose. The palms were inoculated with the spores of *Glomus clarum*. The inoculum used contained VAM spores, infected onion roots with spores and also the sand containing the spores. Per cent infection of the palm roots was determined following the usual methods. There was very good rate of infection of the roots of this palm by *G. clarum*.

The inoculated seedlings also showed marked increase in vegetative growth compared to that of the control seedlings.

6. Inoculation of the Roots of *Gluta travancorica*

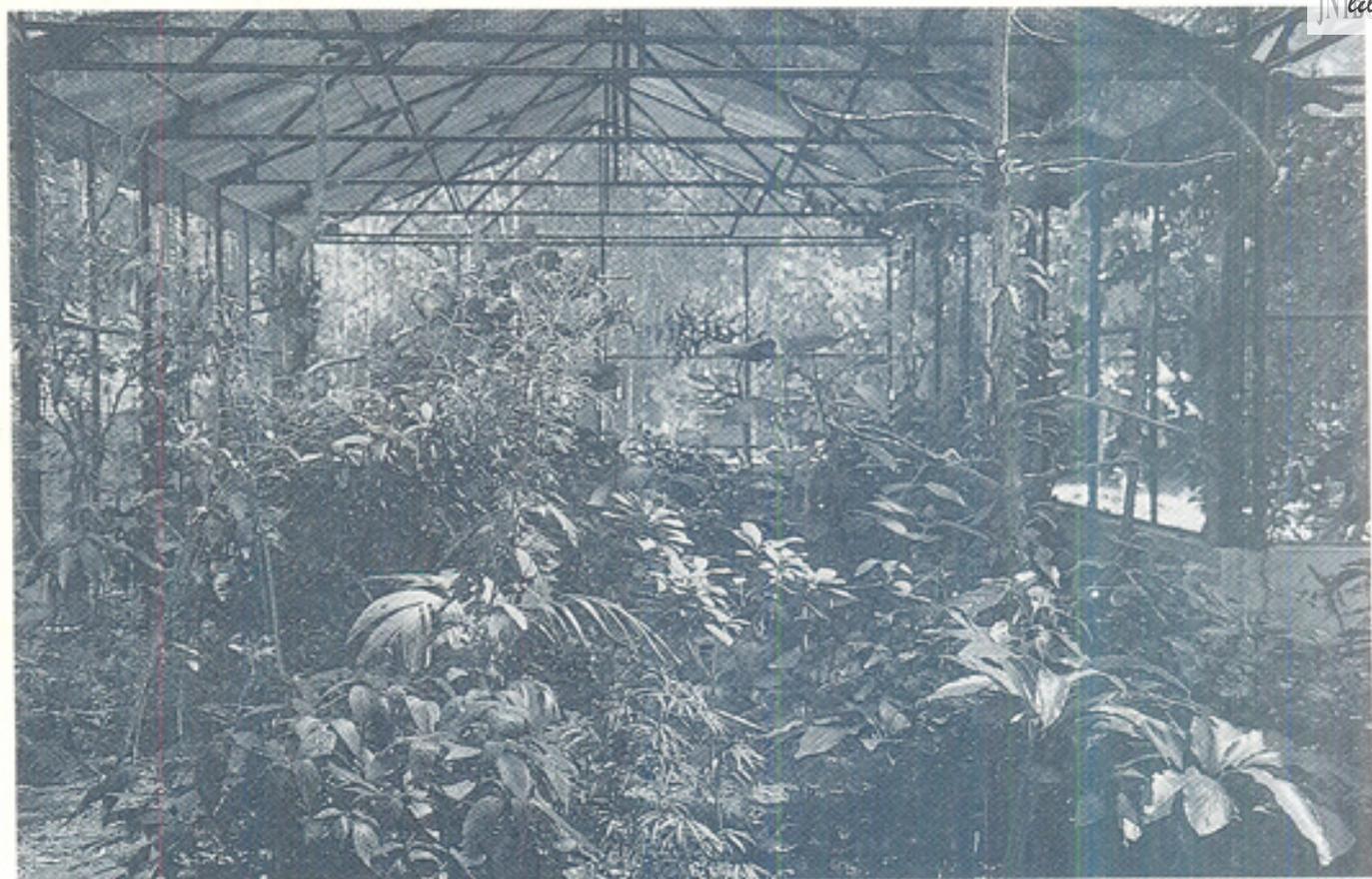
Three months old seedlings of *Gluta travancorica* were inoculated with *G. clarum* following the methods described earlier. The rate of infection of the roots of this tree was very low compared to that of *Bentinckia coddapanna*. There was not much difference in the vegetative growth of the inoculated seedlings compared to the control ones.



Paphiopedilum spicerianum (Reichb. f. ex Masters & T. Moore) Pfitzer. One of the most distinctive species of the genus, *P. spicerianum* occurs in Mizoram and Manipur in north-east India extending to north-west Burma. It was originally sent to England by Spicer's son who was a tea planter in Assam. Due to its desirability in breeding, this species is ruthlessly exploited from wild. Our plants, brought from Shillong, use to flower every year during September-October



Inaugural function of seminar on conservation of rare and endangered medicinal plants of India's Tropical Forests



The Conservatory for endemic and rare plants of Agastyamala at TBGRI



Paphiopedilum druryi in flower, the endangered Ladys' slipper orchid from the Western Ghats being released for exhibition by our Founder Director Prof. A. Abraham

7. Phosphate Uptake in Presence of VAM Fungi

Mycorrhizal fungi usually increase the uptake of phosphates from the soil. In order to study the phosphate uptake of *Bentinckia codappanna* the roots were inoculated with *Glomus clarum*. Superphosphate at the rate of 1g/kg soil was added to the inoculated as well as uninoculated control seedlings. The phosphate present in the inoculated seedlings after six weeks were estimated and compared with the control seedlings. Phosphates present in the soil were also estimated. About two fold increase in phosphate uptake was noticed in the inoculated seedlings.

IV (a). CONSERVATION BIOLOGY

Conservation Biology is a mission oriented discipline comprising both pure and applied science that focuses the knowledge and tools of all biological disciplines from molecular to population biology on nature conservation. It is comparatively a new field of integrated systems approach to understand the life supporting processes and their roles in regulating ecosystem function and dynamics.

Major research programmes and activities envisaged of this newly established Division include the study of plant diversity of the Western Ghats, extrinsic and intrinsic factors causing ecosystem degradation, habitat loss and rarity, plant-animal interactions, endangerment and extinction of species populations, conservation biology of threat-prone species of the Western Ghats, evolution of vegetation, processes of species radiation and species extinction in the flora of the Western Ghats.

To start with in the above line of integrated systems approach to study the vegetation of the Western Ghats, it was felt that a sound data base covering different aspects of the Western Ghats flora should be built up. Making use of the expertise presently available with the Division and associating with other experts in TBGRI the Division has already initiated work in this direction.

1. Pollen Atlas of the Western Ghats Flora

Discussions initiated by the scientists of French Institute, Pondicherry with concerned scientist of TBGRI helped reaching an agreement between TBGRI and IFP on a collaborative project on the study of the Western Ghats Pollen Flora.

The Western Ghats harbour different forest types viz. 1. Tropical evergreen forests (100-1500 m.). 2. Moist deciduous forests (500- 900 m). 3. Dry deciduous forests (300-900 m). 4. Scrub jungles (200-500 m) and 5. Sholas (above 1500 m.). Palynology of the Western Ghats will be studied mainly in terms of these forest vegetations. The collaboration between TBGRI and IFP will result in the publication of a pollen atlas of plants growing in the Western Ghats.

The atlas will be a valuable guide for TBGRI to undertake further indepth studies in pure and applied palynology. The work will be helpful in the investigation of the evolution of the Western Ghats flora and Shola vegetation. Data can also be applied in the systematics apart from aerobiology, melissopalynology, biostratigraphy and archaeobotany of the entire Ghats area. The work will be coordinated by Dr C Caratini (IFP) and Dr T S Nayar (TBGRI). An expert system for computer assisted identification of pollen will be worked out.

Work on Euphorbiaceae and Rutaceae of the Western Ghats has already been started at TBGRI and Ebenales at IFP. Thirty-eight species of Rutaceae and 260 species of Euphorbiaceae as could be estimated from published work on the Western Ghats flora have been identified as part of the study. Families under the order Rurales and Euphorbiales occurring in the Western Ghats will be covered eventually. Polliniferous materials of 130 species belonging to the families of these two orders have so far been collected for pollen study.

2. Resource Check-list of Kerala Flora

Though needed urgently, a comprehensive flora for a floristically rich and diverse state like Kerala may take some more years. But substantial information brought out by many authors on floristics, taxonomy, ecology and economic uses of the flora, which are very essential when we take up *in situ* and *ex situ* conservation measures and conservation biological studies, remain scattered in many a publication. This has unfortunately made the existing information on Kerala flora not readily available for reference and many other practical purposes. It is in this context the work on a resource check-list of Kerala flora was undertaken by the Division.

The envisaged work will bring out up-to-date nomenclature, distribution patterns, nativity, nature of introduction, conservation status, illustration available and important economic and other uses of angiosperm taxa occurring in the state.

Palynology Laboratory

Research activities in Palynology were intensified this year as soon as the new Laboratory Complex was occupied by the scientific staff. Initial attempt was focussed on establishing a Palynology Laboratory with basic requirements to carry out research in modern and fossil palynology. This has been to a great extent accomplished.

(a) Renovation of the Pollen Herbarium

The existing pollen herbarium was renovated accommodating them in new slide cabinets of thousand slide capacity. Prior to this the entire pollen slides were observed under microscope in order to sort out and discard slides with sparse or badly acetolysed pollen grains. In this process, out of the 1000 slides, 85 slides were discarded and the rest were arranged in the slide cabinet according to Takhtajan's System of Angiosperm Classification after conducting proper accessioning in the register with data on collector, locality and source herbarium. The slides represent plants from the Western Ghats.

(b) LM and SEM Photographs of Pollen Grains

Palynology Laboratory harbours about 1,500 LM and SEM photographs of 350 species of angiosperms occurring in the Western Ghats. This will be helpful in the identification of dispersed pollen grains, air borne, quaternary or of honey origin collected from this area.

(c) Reference work at French Institute, Pondicherry

To keep track with the current advances in palynological research, Palynological Laboratory of the French Institute, Pondicherry (IFP), a leading international centre for palynological research, was frequented two times during this year. This helped the concerned scientist to critically study 49 classical works (monographs and other research publications) apart from 79 research papers which were relevant to the proposed studies in Palynology at TBGRI.

Taxonomic Work

Taxonomic position of the family Lecythidaceae in different phylogenetic classifications and that of *Couropita guinensis* Aubl. in Lecythidaceae were studied. Nomenclatural history of *Deccusocarpus wallichianus* (Presl) Lamb. (Podocarpaceae) and *Tarakogenos macrocarpa* (Bedd.) Balakr. (Euphorbiaceae) was subjected to critical study.

Nomenclature and taxonomic description of 12 endemic grass species occurring in Maharashtra State were prepared in connection with a floristic monograph under preparation.

(b). ETHNO BOTANY**Ethnobotanical Survey of Sabarigiri Hills in Pathanamthitta District.**

Tribals in Kerala constitute only 1% of the total population. But there are more than 20 tribal communities in Kerala, who have been practising over centuries varied local health traditions dependent on plants and plant products of their surroundings. Much of the information regarding these health traditions have remained even today unknown to the outside world and thus untapped. Though developmental activities have encroached upon the tribal pockets in many parts of the state, the tribal communities have not whole heartedly embraced these developments to their cultural fold and have kept their traditional identities more or less intact.

No ethnobotanical study has been undertaken in the Shabarigiri tribal belt though the area is inhabited by more than 10 tribal communities. The area which comprises of Goodrical and Ranni forest ranges is constituted by ever green, semi-evergreen and moist deciduous forests.

Shabarigiri is inhabited by the following tribals; 1. Malappandaram 2. Malayoorali 3. Malayoozhi 4. Arayan 5. Ullader 6. Malaveda 7. Vettavar 8. Kani 9. Malakkurava and 10. Vazamkudu. Of all of them, Malappandaram constitutes more than half of the tribal population. They were nomadic but now show rather a settled life in the area. They are experts in collecting minor forest products like black dammar and honey which they exchange in the market for general house hold supplies. They depend on plants in the vicinity for treatment of various diseases and plants and plant products for their primary lively-hood. But very little is known about the local health tradition of these tribals. It is against these backdrops, the present investigation on the ethnobotany of tribals in the Sabarigiri Hills was undertaken by TBGRI. This STEC sponsored programme is manned and supervised by the Conservation Biology Division.

(a) Survey of literature

Indian as well as foreign journals and other works covering the subject of ethnobotany and ethnomedicine were screened to get an account of ethnobotanical investigations conducted in India. Two hundred and forty titles from eight journals and twelve books were critically studied for this purpose.

(b) Botanical exploration

Botanical explorations were conducted in the area covering different seasons so as to get acquainted with and collect as many plants as possible in flowering and fruiting as flowers and fruits hold key to correct identification. Herbarium sheets were prepared using wet method.

Prior to exploration of the forest, tribal informants who were well versed with local medicinal plants and their uses were identified and made to accompany the exploring party. Ethnobotanical information were collected on the spot where a particular plant species of tribal use was located. Detailed method and procedure of the use were gathered from the tribals including the local name of the taxa. At many places the study group stayed in the tribal inhabitation to have a close acquaintance with tribal life and culture.

During the year under report seven tours were conducted to the Shabarigiri Hills and places like Moozhiar, Attathode, Shabarimala, Guronathan Mannu, Bhayankaramudi, Adichippuzha, Kakki, Kattachirra, Kakkathodu and Pamba valley were visited for ethnobotanical study. Tribals surveyed were mainly Malppandarams and Malakkuravas.

(c) Results

Detailed ethnobotanical information on seventy five angiosperm species were collected from the tribals, which they put into use for about thirty different diseases and ailments in their day to day life.

Ten species of ferns which are of ethnomedical importance were collected from the area. Information on thirty five plant species used by tribals for food, home building and magical-religious purposes were also gathered during these field trips. Identification of seventy five species were confirmed and that the rest of the species is being continued.

(d) Study trip to KIRTADS

Tribals of Kerala make many musical and cultural instruments using plants and plant parts which occur in the surroundings. The tribal museum of KIRTADS at Kozhikode harbour many such instruments. A study trip was conducted to KIRTADS this year and many such instruments were subjected to preliminary study with reference to the plants and plant parts used for making them. The instruments demand indepth study to have an authentic evaluation of the technical skill developed by the tribals in this area.

V. AICRPE CO-ORDINATION UNIT

All India Co-ordinated Research Project on Ethnobiology (AICRPE) was launched under the Man and Biosphere (MAB) programme of the Ministry of Environment and Forests, Government of India in 1982. The project involves multi-institutional and multi-disciplinary research programmes and is aimed at undertaking indepth study and analysis of the multi-dimensional perspectives of Indian tribal life, culture and traditions. The project also covers the scope of developing strategies for conservation and preservation of traditional life knowledge system and resource utilization. This is with the intention to develop scientific basis for sustainable resource management and further, to evolve suitable welfare programmes to improve the quality of tribal life in agreement with their cultural ethos.

The AICRPE which runs now the fourth year of phase II programme has so far generated a broad spectrum of information on various aspects of tribal life, culture and traditions which will be helpful to policy makers, planners, scientists and those interested in our natural living heritage. The AICRPE is also documenting and evaluating the rich and self-managed systems of the tribal medicine.

This year the AICRPE co-ordination unit which had been operational at Regional Research Laboratory, Jammu since 1983 was shifted to TBGRI, Thiruvananthapuram. Co-ordination unit is carrying out the over-all supervision, data synthesis, promotion and smooth functioning of the constituent AICRPE units being operated at different centres all over the country. The unit works in this line with the aim of preparing national status report on tribal situation, comprehensive natural resource inventory, documentation of classified information and technical reports on tribal life, culture, folklore traditions, knowledge systems and socio-economic and technological capabilities.

There are 12 units at present excluding the co-ordination unit working on various aspects of the AICRPE: Botanical Survey of India, Southern Circle, Coimbatore, National Botanical Research Institute, Lucknow, Botanical Survey of India, Central Circle, Allahabad, Blatter Herbarium, St. Xaviour's College, Bombay, Botanical Survey of India, Howrah and Department of Botany, Nagpur University, Nagpur constitute the survey units. Regional Research Institute (DRUGS), Thiruvananthapuram, Central Drug Research Institute, Lucknow, Regional Research Laboratory, Jammu, Pharmacology unit, Regional Research Laboratory, Jammu and Department of Chemistry, Osmania University, Hyderabad serve as research or research cum survey units.

(a) AICRPE Annual Reports

The annual and other progress reports received from individual AICRPE units were subjected to critical examination by the co-ordination

unit. The raw data obtained were edited and consolidated into meaningful documents including AICRPE annual reports. The co-ordination unit also provides relevant information regarding various aspects of the projects to the Ministry of Environment and Forests as and when such informations were asked for to facilitate the smooth operation of the entire AICRPE system.

(b) Pharmacopoeia of tribal medicine

The tribal medicine if revived and revitalized can effectively meet the primary health care programme of the tribals. With this objectives in mind, the Co-ordination unit in association with the Ayurvedic Experts of the AICRPE unit at RRI Thiruvananthapuram and International Institute of Ayurveda, Coimbatore has initiated a programme to prepare a pharmacopoeia of tribal medicine.

(c) Compendia of other tribal aspects

With the completion of the project work, the coordination unit proposes to bring out comprehensive compendia on subjects like tribal life, tribal knowledge systems, tribal medicine and socio-economic problems of the tribals and solutions.

Literature / Research Material Collection

About 800 references on Ethnobotany, Pharmacognosy, Phytochemistry, Taxonomy and Cytology were documented. 105 colour transparencies of medicinal plants were prepared or procured and 225 anatomical slides were documented.

VI. HERBARIUM

1. Herbarium

(a) Reorganization

Reorganization of the Herbarium, started since the beginning of 1990 was the major work accomplished this year. The specimens housed in the Herbarium were checked thoroughly and classified. The families and the genera within families were arranged according to the system of Bentham & Hooker with modification by Hutchinson (1973). The species under each genus were arranged alphabetically. During the period covered by this report 2,299 specimens belonging to 54 families, starting from Convolvulaceae to Poaceae (family Nos. 101-173), were incorporated. These specimens belong to 763 species and fall under 396 genera. Collection dates of all the specimens were entered in the accession register. Species index cards were also prepared. The specimens under each species were kept in their respective species covers (white) superscribed with the valid names of the taxa. Up to date nomenclature of the taxa was provided by referring latest publications. These species folders were arranged under the respective genera folders (blue) with family numbers and generic names written on it. Lists of taxa represented in Travancore Herbarium (Flora Travancore Collections) and in General Herbarium were prepared and a combined list of all the taxa represented in the Herbarium was prepared for ready reference.

130 field numbers of herbarium specimens were added to the existing collection of medicinal plant specimens available in the Herbarium of the Institute. Taxonomic identity of 338 field numbers were determined and given to the Herbarium. Thus the classification and rearrangement of all the specimens housed in the Herbarium were successfully completed in September.

The position of the herbarium after the reorganization is:

Specimens	5,564 (Acc. Nos. 1-5564)
Species	1,852
Genera	964
Families	164

To this, 436 specimens were accessioned (Acc. Nos. 5564-6000) with the addition of 111 species 23 genera and 3 families.

(b) Specimens and Taxa Represented

The strength of Herbarium at present is:

Specimens	6,000
Species	1,963
Genera	987
Families	167

Typing work of the list of all the taxa housed in the Herbarium was completed in November, 1991. In the same month, typing of the new Index cards was started and towards the end of March (1992) 661 cards belonging to 53 families (Acanthaceae to Eriocaulaceae) were typed and arranged.

(c) Specimens Processed

Processing of specimens was another important work carried out this year. In this period 67 bundles of pickled specimens were pressed and dried, 116 bundles of dried specimens were poisoned; 2723 specimens were mounted and stitched; 224 specimens identified and returned to the herbarium were labelled.

(d) Renovations

Renovation of old sheets continued this year and 338 accessioned old sheets were renovated. New specimen index cards were designed to suit the requirements of the scientific documentation of species and specimens. Transferring data to these cards was also started. All specimens belonging to the family Cyperaceae housed in the Herbarium were checked and identified in August 1991.

2. Ethnobiology Museum

95 exhibits were added to the Ethno-biology Museum, consisting of identified raw drugs, charts and colour photographs of medicinal plants. Re-arranged the exhibits of the Museum and made the display self explanatory with labels.

3. Exhibition / Open House Programme

In connection with the National Science Day celebrations, Tropical Botanic Garden and Research Institute conducted an open house cum exhibition programme for the public from 25 to 28 February 1992. All the divisions of the TBGRI have actively participated in the 4 day session by displaying the various research and development activities presently carried out by TBGRI. Nearly twenty five thousand to thirty thousand people from all walks of life visited TBGRI during the programme.

TBGRI has participated and presented valuable exhibits in two exhibitions conducted by Peringamala panchayat, one at Palode and the other at Peringamala.

VIII. LIBRARY AND INFORMATION SERVICES

During the report period two hundred and twenty nine books were added to the library raising the total number of volumes to 4229. Subscription of 63 national and international journals have been made to the Library.

The total collection of Documents as on 31.3.92

(1) Books	4229
(2) Journals	63
(3) Maps & Atlases	76
(4) Reports	349
(5) Reprints	82
(6) Microfiche	52
(7) Video Cassettes	12

1. Services

In addition to the normal routine services of lending of books & journals, reference service has been provided to members as well as scientists and research students of other institutions. Photocopying facilities has been continued and News paper Clipping file has also been maintained for reference.

2. Reference Collection

The Library is equipped with a good number of general reference materials and reference books on Botany and allied subjects. A special collection of photographs and slides depicting the development of the garden was added to the existing collection.

OTHER SCIENTIFIC ACTIVITIES

1. Projects Sanctioned

(1) Germplasm collection, evaluation of yield potential and exploitation of the fruit crops of the Western Ghats - a 5 year project sponsored by Department of Planning and Economic Affairs (Western Ghats Cell) Government of Kerala.

(2) Sustainable development of skilled human resource in the rural sector through training in micropropagation and field cultivation of economically important horticulturals - a 2 year training programme sponsored by Council For Advancement of Peoples Action and Rural Technology, New Delhi.

(3) Survey, Exploration, Collection, Evaluation, Ex-situ Conservation and Propagation of Lesser known/hitherto unknown wild plants of Horticultural/Ornamental value and some rare and endangered endemic plants of Western Ghats (Kerala) Sponsored by Ministry of Environment and Forests, Government of India

2. Project Proposals Submitted

(1) Major project proposal on Conservation Biology

A detailed project proposal entitled "Establishment of a Centre of Excellence in *Ex-situ* and *In situ* Conservation of Tropical plants at Tropical Botanic Garden & Research Institute" was submitted for financial assistance to the tune of Rs. 57 crores to the Global Environment Facility (GEF) with a view, as the title indicated, to establish a 'Centre fo Excellence in Conservation Biology' at TBGRI.

Project adopted a multidisciplinary approach which included disciplines like Biosystematics, Ecology, Population Biology, Phytogeography, Vegetational History, Plant Biotechnology, Horticultural Science, Microbiology, Ethnobiology and Molecular Biology.

(2) Others

(i) Study of Pollen flora of Kerala with reference to the Environmental Pollution, Allergy, Vegetational History, Palaeoclimatology and Melisopalynology of the state submitted to the Ministry of Environment, Govt. of India.

(ii) Generation of skilled employment opportunities through application of conventional and non-conventional herbicultural and horticultural technologies in Ernakulam Biotechnology zone.

(iii) Productivity studies and Search for some Native Fast Growing Fuel wood species from Kerala State submitted to Non conventional Energy services, Government of India.

3. Participation in Training Programmes, Workshops, Seminars and Symposia

- (i) Jacob Thomas served as a resource person in the DANIDA sponsored workshop on 'Ex-situ conservation of Rare and endangered Medicinal plants of Tropical India' held at TBGRI during 31.3.1991 to 8.4.1991.
- (ii) S. Seeni served as a resource person and presented a paper on "Conservation of Medicinal Plants through tissue culture in the DANIDA sponsored Workshop on 'Ex-situ conservation of Rare and Endangered Medicinal Plants of Tropical India' held at TBGRI during 31.3.1991 to 8.4.1991.
- (iii) P.J. Mathew participated in the NSC workshop for organizations interested in ex-situ medicinal plant conservation conducted by LSPSS at TBGRI from 30 March to 7 April 1991.
- (iv) P.J. Mathew participated in the MPCA workshop conducted by LSPSS at Krishna Rajendra Hill Station from 26 to 29 April 1991 at Chickmangalur Dist., Karnataka.
- (v) N. Mohanan attended a 5 day workshop on *in-situ* conservation studies, held at Bangalore from 26 to 30 April 1991, sponsored by DANIDA.
- (vi) V. Sarojini Menon, S. Seeni, K.C. Kushy, N. Mohanan, P.C. Binoy, Mathew Dan and A.E. Shanavaskhan participated in the Symposium on Rare, Endangered and Endemic plants of the Western Ghats organised by the Kerala Forest Department held at Thiruvananthapuram on 30 to 31 August 1991.
- (vii) Mathew Dan attended a training programme on 'Pharmacognostical studies on Ayurvedic drugs' at Ayurveda Regional Research Centre, Poojappura from 23.9.1991 to 11.10.1991.
- (viii) A. Mohandas has attended a Leadership Training Programme on Nature Conservation and Eco-development held at the Anglade Institute of Natural History, Shembaganur, Kodaikanal from 16 to 20 October 1991.
- (ix) V. Sarojini Menon, S. Seeni, S. William Decruze, P.G. Latha and A. Ganga Prasad participated in the National Seminar on Orchid held at Indian Institute of Horticultural Research, Bangalore during 15 to 16 November 1991.
- (x) T.S. Nayar attended Birbal Sahni Centenary Celebrations at Environmental Resource Research Centre, Thiruvananthapuram on 14 November 1991.
- (xi) N. Mohanan and A.E. Shanavaskhan attended a seminar on 'Angiosperm Taxonomy in India' held at Calicut University on 14 to 15 December 1991.

- (xii) T.S. Nayar attended 'National Seminar on Frontiers of Science' held at University College, Thiruvananthapuram from 15 to 17 January 1992.
- (xiii) P.A. Jose, P.G. Latha and S. Sreeckumar participated in the IVth Kerala Science Congress held at Thrissur during the last week of February 1992.
- (xiv) T.K. Abraham participated in the National Seminar on 'Urban - Rural Alternate Energy Management' held at the University of Pondicherry from 7 to 8 February 1992.

4. Technical Help Imparted

- (i) On a request from the District Collector, Ernakulam, two staff members from Hill Palace Garden, Thrippunithura were given one month training in basic horticulture and arboriculture, during June 1991.
- (ii) Ronykurry Antony deputed from Peermade Development Society has undergone a training on 'Practical aspects on building up a Herbal Garden' for a period of one month at TBGRI. He has prepared a master plan of the Herbal Garden of Peermade Development Society.

5. Research Papers Published

- (i) Jose, P.A., Jacob Thomas and Krishnan, P.N. (1992). Effects of season and auxin on rooting of a rare and endemic tree - *Ochreinauclea missionis* (Wall. ex G. Don) Ridsd. In proceedings of the Fourth Kerala Science Congress, Feb. 1992, pp. 284-285.
- (ii) Krishnan, P.N., Latha P.G. and Seeni, S. 1992. Micromolecular changes during protocorm formation from *in vitro* grown embryos of *Spathoglottis plicata* Blume, a terrestrial orchid. In: Proc. IVth Kerala Science Congress, pp. 285
- (iii) Latha, P.G. and Gopinathan Nair, P. 1992. Effect of caffeine on radiation induced chromosomal aberrations in barley Proc. IVth Kerala Science Congress pp 250 - 252.
- (iv) Mathur, J. and Mukuntha Kumar, S. 1992. Micropropagation of *Bauhinia variegata* and *Parkinsonia aculeata* from nodal explants of Native trees. Plant Cell Tissue and Organ Culture 28: 119 - 121.
- (v) Sivadasan, M. and Mohanan, N. 1991. *Ixora agasthyamalayana*, a new species of Rubiaceae from India. Botanical Bulletin of Academia Sinica, 32: 313 - 316.
- (vi) Sreeckumar, S. and Seeni, S. 1992. Development of floricultural resource in Kerala: rapid micropropagation of Anthuriums. In: Proc. IVth Kerala Science Congress pp. 347-350.

- (vii) Vijayakumar, K. and Abraham, T.K. Rhizosphere and Mycorrhizal fungi of *Bentinckia coddappanna* Berry, an endemic palm of Western Ghats. Proc. IV Kerala Science Congress 1992. pp. 283-284
- (viii) Vincent, K.A., Bejoy, M., Hariharan, M. and Mathew, K.M. (1991). Plantlet regeneration from callus cultures of *Kaempferia galanga* L. a medicinal plant. *Indian J. Plant Physiol*, 34(4) 397-401.

6. Research Papers Accepted

- (i) Jacob Thomas and Rajvikraman, R. Woodland Gardens for Growing Indoor Plants Outdoor. *Indian Horticulture*.
- (ii) Nayar, T.S. Occurrence of *Voacanga grandifolia* (Miq.) Rolfe (Apocynaceae) in India and the Asian continent. *Bull. Bot Surv. India*
- (iii) Nayar, T.S. A concise review of forest flora of Kerala. *J. Bombay Nat. Hist. Soc.*
- (iv) Pushpangadan, P. and Nayar, T.S. Plant Diversity and Genetic Resources of Kerala. *National Resources of Kerala*. Department of Science, Technology and Environment, Thiruvananthapuram.

7. Research Papers Communicated

- (i) Binu, S., Nayar, T.S. and Pushpangadan, P. An outline of ethnobotanical research in India. *J. Econ. Tax. Bot.*
- (ii) Jose, P.A., Jacob Thomas and Krishnan, P.N. Vegetative propagation of *Ochreinauclea missionis* (Wall. ex G. Don) Ridsd. - A rare and threatened tree species of Western Ghats. *Indian Forester*.
- (iii) Koshy, K.C. On the occurrence of *Eriocaulon minimum* Lam. in India. RHEEDIA.
- (iv) Koshy, K.C. An addition to the flora of Gujarat State - *Mackenzia integrifolia* (Dalz.) Bremck. JBNHS, Bombay.

8. Research Papers Presented

- (i) Jose, P.A. 'Effect of season and auxins on rooting of a rare and endemic tree, *Ochreinauclea missionis* (Wall. ex G. Don) Rids' in the IVth Kerala Science Congress held at Thrissur on February 1992.
- (ii) Koshy, K.C. 'Bamboo collection at Tropical Botanic Garden, palode in the Symposium on Rare, Endangered and Endemic plants of Western Ghats held at Thiruvananthapuram on 30 to 31 August 1991.
- (iii) Latha, P.G. 'Antimutagenic effects of *Ixora coccinea*' in the National Cancer Conference held at Thrissur during 13 - 15 March 1992.
- (iv) Mathew Dan and Shanavaskhan, A.E. 'A glance to some rare medicinal plants of Western Ghats' in the Symposium on Rare, Endangered and Endemic plants of Western Ghats at Thiruvananthapuram on 30 to 31 August 1991.

- (v) Shanavaskhan, A.E. 'Host-Parasite attachment pattern and genetic delimitation of Loranthaceae of Kerala' in the national Seminar on Angiosperm Taxonomy in India at Calicut University on 14 and 15 December 1991.
- (vi) Mohanan, N. and Binoy, P.C. 'Rare and endemic plants located on the Western slopes of Agasthyamala coming in Thiruvananthapuram District of Kerala State' in the seminar on Rare, Endangered and Endemic plants of Western Ghats held at Thiruvananthapuram on 30 to 31 August 1991.
- (vii) Mohanan, N. 'Some rare and endemic plants of Agasthyamala' in the National Seminar on Angiosperm Taxonomy held at the University of Calicut on 15 to 16 December 1991.
- (viii) Seeni, S. 'Ex-situ conservation of rare orchids and medicinal plants through micropropagation' in the Symposium on Rare, Endangered and Endemic plants of the Western Ghats held at Thiruvananthapuram on 30 to 31 August 1991.
- (ix) Seeni, S. 'Embryo and tissue culture of selected orchids' in the National Seminar on Orchids held at Indian Institute of Horticultural Research, Bangalore during 15 to 16 November 1991.
- (x) Seeni, S. 'Secondary product synthesis in plant tissue and cell culture' in the National Seminar on Frontiers of Science held at University College, Thiruvananthapuram during 15 to 17 January 1992.

9. Research / Project Reports

- (i) AICRPE Co-ordination Unit (1990). All India Co-ordinated Research Project on Ethnobiology, Annual Report, 1990. Ministry of Environment and Forests, Government of India, New Delhi.
- (ii) Nayar, T.S. and Binu, S. (1991). An Ethnobotanical Survey of Shabarigiri Hills, Pathanamthitta District. Interim report. State Committee on Science, Technology and Environment, Government of Kerala, Thiruvananthapuram.
- (iii) Seeni, S. (1991). Conservation through micropropagation of rare and exquisite orchids of the Western Ghats, Progress report. Ministry of Environment and Forests, Government of India, New Delhi.

10. Honours / Positions

- (i) Dr T.S. Nayar is elected as the Joint Secretary to National Council, Palynological Society of India.
- (ii) Dr K.C. Koshy is recognised as a Research Guide in Botany, Science Faculty, University of Kerala.

EXTENSION AND RELATED ACTIVITIES

1. Public Hearing on Environment and Development

As a prelude to the 'Earth Summit' on June 1992 at Brazil, The People's Commission on Environment and Development, India (PCED), a forum in the spheres of Environmental conservation and Socio-economic Development is engaged in holding public hearings all over India to elicit perceptions of the people regarding Environment and Development.

Taking into account the common interest in the sphere of Environment Conservation, Tropical Botanic Garden and Research Institute and State Committee on Science, Technology and Environment share with PCED, a public hearing on Environment and Development conducted on 5th October 1991 at Thiruvananthapuram by TBGRI and STEC under the sponsorship of PCED, New Delhi.

About 125 Government and Non-Government Organizations representing Women, Youth, Industry, Labour, Peace, Human Rights, Environment and Development participated in the Hearing. Five lead papers focussing attention on key issues relating to the Environment and Development of the State were presented. This was followed by discussions among the participants. They were:

- (1) Water pollution in Kerala with respect to Eco-development and Economic Potentials of Estuaries (Prof. N. Balakrishnan Nair)
- (2) Protection and Preservation of Western Ghats Rain Forests (Dr. M.P. Nayar)
- (3) People's Participation in Environment Movement (Dr. P.K.K Nair)
- (4) On Sustainable Development - Some thoughts (Shri. John Kurien)
- (5) Environmentally sound Development Strategies : Kerala perspectives (Shri. C.V. Ananda Bose)

Dr. Karan Singh, Ex-Union Cabinet Minister and Chairman, PCED, chaired the session, Shri. K. Mohanachandran, Smt. Kamala Das and Shri. M. Somanathan served as commissioners. A summarised version of the inputs made available during the hearing will be presented at the Earth Summit at Rio de Janeiro in Brazil in June 1992.

2. Popularisation of Medicinal Plant Cultivation

- (a) Supplied planting materials of medicinal plants to the following Institutes / organizations - Indian Institute of Horticultural Research, Bangalore; Department of Horticulture, Agricultural University, Vellanikkara and Peermade Development Society, Peermade.

- (b) 50 plants each of *Adhatoda beddomei* and *Plumbago indica* were distributed to the public for nominal price. Distributed about 5000 pamphlets on 'Simple drug remedies for common ailments' to the public. Issued 250 booklets on cultivation aspects of 10 medicinal plants to the public for nominal price.
- (c) Shri. Mathew Dan delivered a talk on 'Conservation of Medicinal Plants' to the staff and students of Residential English Medium High School, Mallassery.
- (d) Dr P.N. Krishnan has given an interview in All India Radio, Trivandrum, on conservation of Medicinal Plants through Tissue Culture. The programme was broadcasted on 19th June 1991.

3. New Building Complex

TBGRI was functioning in Thiruvananthapuram city in rented buildings until 1986 though scientists of the Plant Biotechnology Division had shifted to a semi permanent building constructed at the Palode garden site in 1985.

In 1986 the whole staff moved to the Garden site at Palode and the Institute started functioning in the Visiting Scientists' Guest House. The main building complex was completed in 1990 and was inaugurated on 28 March 1991 by Shri Varkala Radhakrishnan, the then Speaker, Kerala Assembly. Soon the entire system was shifted to the main building complex which now accommodates laboratories, library and administration.

4. Emblem

The TBGRI was started in 1979 but there was no emblem for it. Out of 18 entries, the one designed and prepared by Shri Raj Vikraman of TBGRI was accepted by the Governing Body. The Emblem epitomises the following:



- The tropical band indicate the Institutes' primary areas of interest in research.
- The DNA double helix stands for the basic structural unit of life and also the three aspects viz., Tropical Botanic Garden and Research Institute.
- The garden shown in the centre with tropical plants and man denotes the interaction between man and the habitat.
- The central circular portion encircling the group of tropical plants stands for conservation of tropical plant wealth.

VISITS AND IMPORTANT VISITORS

1. Visits by the Staff

- (a) Shri Mathew Dan visited the Central State Farm at Aralam, Kannur from 22 - 26 July 1991 and helped the staff in the taxonomic identification of medicinal plant collection, conducted survey of medicinal plant flora of the Farm and gave suggestions on its cultivation.
- (b) Shri Jacob Thomas visited National Bureau of Plant Genetic Resources, New Delhi; National Botanical Research Institute, Lucknow; Industrial and Toxicological Research Centre, Lucknow and Central Institute for Medicinal and Aromatic Plants, Lucknow during July-August 1991 to see and study their various facilities and to collect details regarding certain equipments, etc. in order to organise the seed bank and seed biology laboratory.
- (c) Shri Raj Vikraman along with Shri K.P. Pradeep Kumar visited to New Delhi and Madras to see the Natural History Museums and related institutions in connection with the setting up of a museum at TBGRI.
- (d) Shri P.J. Mathew visited Horticultural section of FACT, Cochin Division on 10th December 1991 and helped in the taxonomic identification of medicinal plants of their collection.
- (e) Dr P. Pushpangadan visited the Royal Danish School of Pharmacy, Denmark from 17 to 27 January 1992 to finalise a collaborative project on medicinal plant research between TBGRI and RDSP, Denmark.

2. Important Visitors

- (a) Shri Hans J. Flegner from Royal Botanic Gardens, Kew, UK visited the Garden for the 4th time during 24th February and 6th March 1992. He held discussions with the Director and all the concerned scientific and technical staff members on the developmental activities of the different sections. Also he discussed the details of the construction of a lake with concerned engineers. Details for the training of TBGRI Scientists in UK, purchase of scientific books for the library and equipments for the propagation house and tissue culture laboratory, all through the financial assistance of the British Council, were finalised in his presence. A few cuttings of Budha's Belly bamboo - *Bambusa ventricosa* were given to him for introduction in the Royal Botanic Gardens, Kew.
- (b) Prof. (Dr) Fred Rickson, Professor of Botany, Oregon State University, U.S.A. visited the Institute in March 1992 for consulting the specimens belonging to the genus *Humboltia*.
- (c) Dr M.S Swaminathan
- (d) British Deputy High Commissioner

METEOROLOGY DATA 1991-92

Month	Precipitation	Evaporation	Maximum temperature	Minimum temperature	Relative humidity
	mm *	mm *	°C **	°C **	% **
April '91	194.50	164.70	35.96	22.85	82.08
May '91	208.40	147.20	32.62	23.38	82.90
June '91	1292.00	16.90	29.60	22.76	88.08
July '91	457.00	54.10	29.66	22.09	86.24
August '91	187.70	59.80	29.98	21.82	87.22
September '91	62.0	108.70	32.45	21.90	87.43
October '91	493.60	42.90	29.98	21.22	88.38
November '91	236.00	59.60	32.16	20.33	85.23
December '91	Nil	111.80	32.52	17.50	80.04
January '92	27.0	147.70	33.56	16.56	73.37
February '92	Nil	196.20	35.06	17.94	70.00
March '92	Nil	251.70	36.35	19.54	68.48
Total	3158.20	1361.30			

* Total of the month

** Monthly average

CIVIL WORKS

The Engineering Section of the Institute has completed the following civil works. A Canteen building and an Animal House, the second stage of water supply and irrigation system, Rolling Grills for safety doors, foot path and trench in the Medicinal Garden conservation area, side wall in the Phytochemistry laboratory, furnishing of the Biotechnology laboratory and fibre glass roofing in the hybrid Orchidarium were the major civil works done.

The following civil works are in progress.

- (1) Construction of Staff Quarters
- (2) Landscaping in front of the main building
- (3) Insulation of the seed bank store/drying room
- (4) Construction of a store room for the project on 'Fruit Crops'
- (5) Construction of 'Pandals' in the medicinal Garden and Open Orchidarium
- (6) Construction of Toilet Blocks in the Garden site
- (7) Re-painting of the Semi-permanent Building

STAFF CHANGES

Sri. N. Gopinathan Nair, Administrative Officer, returned to his parent department on 11th January 1992. Shri. N. Raveendran, Driver Gr. II, left the TBGRI during August 1991.

OBITUARY

Sri. Lazer Joseph, Night Watchman of the Institute expired on 4th January, 1992.

MEMBERS OF THE GOVERNING BODY

- 1 The Chief Minister, Kerala State : Chairman
- 2 The Chairman, State Committee on Science, Technology & Environment : Vice Chairman
- 3 The Secretary to the Govt. of Kerala Planning & Economic Affairs Department : Member
- 4 The Secretary to the Govt. of India or his representative, Dept. of Environment & Forests, Paryavaran Bhavan, CGO Complex, Lodi Road, New Delhi : Member
- 5 The Secretary to the Government of Kerala, Finance Department : Member
- 6 Vice-Chancellor, Kerala Agricultural University, Mannuthy, Thrissur : Member
- 7 The Principal Chief Conservator of Forests, Kerala State : Member
- 8 Head, Department of Botany University of Kerala, Kariyavattom : Member
- 9 Prof. H.Y. Mohan Ram, Department of Botany, University of Delhi, Delhi : Member
- 10 Prof. A.N. Namboodiri, 15/1082, Ulloor Lane, Jagathy, Thiruvananthapuram - 695 014 : Member
- 11 Dr M.P. Nayar, Ex. Director Botanical Survey of India, The Greens, T.C 19/315, Vattavila, Thiruvananthapuram - 695 006 : Member
- 12 Prof. B.G. Nagavi, Principal, JSS College of Pharmacy, Sivrathreeswara Nagara, Mysore - 570 015 : Member
- 13 Shri Darshan Shankar, Director, Academy of Development Science, 4 Saras Bagh, Deonar, Bombay - 400 088 : Member
- 14 Shri M. Somanathan, Planter, Brindavan Estate, Meencut (P.O), Via Chitrapura, Munnar, Idukki District : Member

- 15 Dr K.S.M Sastri, Retired CSIR Deputy
Director of Plant Pathology & Microbiology,
House No. 58, Ideal Homes Township,
Rajeswari Nagar, Bangalore - 560 039 : Member
- 16 The Director, Tropical Botanical Garden
and Research Institute, Palode
Thiruvananthapuram : Member Secretary

Members of the Executive Committee

- 1 Chairman
State Committee on Science, Technology &
Environment : Chairman
- 2 Secretary to Government, Planning &
Economic Affairs Department : Member
- 3 Head, University Dept. of Botany,
Kariyavattam, Thiruvananthapuram : Member
- 4 Director, Kerala Forest Research Institute,
Peechi, Thrissur : Member
- 5 Shri S. Chandra Basha, Chief Conservator of
Forests (Social Forestry) : Member
- 6 Director, Tropical Botanic Garden &
Research Institute : Member Secretary



STAFF OF TBGRI

Director

Dr P. Pushpangadan

Deputy Director

Dr G. Bhadran Nair

GARDEN SYSTEM

Horticulture and Garden Development

Sri Jacob Thomas	:	Scientist B
Sri P.J. Mathew	:	Scientist A
Dr C. Sathish kumar	:	Senior Scientific Assistant (on deputation)
Sri N. Mohanan	:	Senior Scientific Assistant
Sri P.K. Suresh Kumar	:	Junior Scientific Assistant
Sri Bejoy Mathew	:	-do-
Sri A.E. Shanavaskhan	:	-do-
Sri C Anil Kumar	:	-do-
Sri Mathew Dan	:	-do-
Sri Raj Vikraman	:	-do-
Sri P.A. Jose	:	-do-
Sri P.C. Binoy	:	-do-
Sri Cheriyen P. Koshy	:	Garden Works Manager
Sri G.K. Udayadas	:	Garden Maistry
Sri P. Mony	:	-do-
Sri K. Selvaraj	:	-do-
Sri J. Micheyal	:	Head Gardener
Sri U. Hamsa	:	Gardener
Sri G. Harikumar	:	-do-
Sri T. Jamaludheen	:	-do-
Sri M. Madhusoodhanan Nair	:	-do-
Sri G. Manoharan	:	-do-
Sri N. Salahudheen	:	-do-
Sri K.C. Thomas	:	-do-
Sri M. Raveendran Nair	:	-do-
Sri V. Venugopalan Nair	:	-do-
Sri B. Vijayakumar	:	-do-
Sri K. Vijayan	:	-do-
Smt S. Meenakumary	:	-do-
Sri A. Thankappan	:	Painter

RESEARCH AND DEVELOPMENT SYSTEM**Biotechnology**

Dr S. Seeni	: Scientist E2
Dr P.N. Krishnan	: Scientist C
Smt P.G. Latha	: Scientist C
Sri S. Mukunthakumar	: Senior Scientific Assistant
Smt C.G. Sudha	: Junior Scientific Assistant
Sri K. Sathishkumar	: Senior Research Fellow, CSIR

Microbiology

Dr T.K. Abraham	: Scientist C
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Conservation Biology

Dr T.S. Nayar	: Scientist B
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Herbarium

Dr K.C. Koshy (in-charge)	: Senior Scientific Assistant
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Library and Information Services

Smt V. Sujatha	: Junior Library Assistant
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Art/Photography

Sri K.P. Pradeep kumar	: Artist
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ADMINISTRATION

Sri C. Sukumara Pillai	: Accounts Officer
Sri C.M. George	: Purchase Officer
Sri K.G. Ajithkumar	: Public Relations Officer
Smt S. Radhalekshmi Ammal	: P.A to Director
Sri Suresh Chandran	: Senior Grade Assistant
Smt R. Sarala Devi	: -do-
Smt C. Syamala	: -do-
Sri P.P. Markose	: Engineering Supervisor
Smt V. Jayasree	: Assistant Gr. I
Smt A. Santha	: Typist Gr. I
Smt G. Subhadra	: -do-
Smt N. Rajalekshmi Ammal	: -do-
Smt C. Gracy	: Stenographer Gr. I
Sri M. Ramaswamy	: Driver Gr. I
Sri V. Rajendran Nair	: Driver Gr. I
Sri D. Mohanachandrakumar	: -do-
Sri A. Salim	: -do-

Sri R. Gopinathan Nair	:	Driver Gr. 1
Sri R. Bhargavan	:	Helper Gr. 1
Sri S. Chandran Chettiar	:	-do-
Sri B. Vijayakumar	:	-do-
Sri C. Sathyan	:	-do-
Sri T. Mohanakumar	:	-do-
Smt R. Valsala Devi	:	Sweeper

Security

Sri T.M. Abdul Salam	:	Security Officer
Sri V. Raveendran Pillai	:	Assistant Security Officer
Sri P.R. Chandrasekharan Nair	:	Security Guard
Sri P. Jain	:	-do-
Sri K. Ramachandran Nair	:	-do-
Sri A. Johnson	:	-do-
Sri K. Mohanan	:	-do-
Sri S. Chandran	:	-do-
Sri G. Somasekharan Nair	:	-do-
Sri C. Stanley	:	-do-
Sri N. Radhakrishnan Nair	:	-do-
Sri C.P. Somasekharan Nair	:	-do-
Sri S. Viswambaran Nair	:	-do-
Sri M. Bhuvanachandran Nair	:	Watchman

PROJECTS

All India Co-ordinated Research Project on Ethnobiology

Dr P. Pushpangadan	:	Chief Co-ordinator
Dr T.S. Nayar	:	Scientist B
Sri A. Mohandas	:	Research Fellow
Smt A. Raziya Beegam	:	-do-
Smt R. Prasannakumari	:	Clerk

Survey, Exploration, Collection, Evaluation, Ex-situ conservation and Propagation of Lesser Known/Hitherto Unknown Wild Plants of Horticultural/Ornamental Value and some rare endangered endemic plants of Western Ghats (Kerala)

Dr P. Pushpangadan	:	Principal Investigator
Sri Jacob Thomas	:	Co-Investigator
Sri E.S. Santhosh Kumar	:	Field Assistant

Sri M. Abdul Jabbar : Field Assistant
Sri P. Manikantan Nair : Gardener

Studies on the Photosynthetic Performance of Selected Trees and Woody Vines in the Sacred Groves of Kerala. An attempt to Evaluate the Optimum Productivity of these Ecosystem.

Dr V. Sarojini Menon : Principal Investigator
Dr A. Sasidharan : Co-investigator
Sri M. Rajandra Prasad : Research Assistant

Conservation through micropropagation of Rare and Exquisite Orchids of the Western Ghats, (Ministry of Environment and Forests, Government of India)

Dr V. Sarojini Menon : Principal Investigator
Dr S. Seeni : Co-investigator
Dr S. William Decruz : Research Associate
Sri A. Ganga Prasad : Junior Project Fellow
Sri K. Gopakumar : Field Assistant

Project on Germplasm Collection Evaluation of Fruit Crops of Western Ghats

Dr S. Seeni : Principal Investigator
Dr K.C. Koshy : Scientist B & Co-Investigator
Sri A. Nazaurudeen : Junior Project Fellow
Sri M. Salim : Field Assistant
Sri Muhammed Sherif : -do-
Sri Baburaj : Gardener

Development of Rapid Micropropagation Systems and Selection of Horticulturally desirable Somaclonal and Induced Mutant Phenotypes of *Anthurium* and *Philodendron* (STEC Project)

Dr S. Seeni : Principal Investigator
Sri S. Sreeksumar : Research Assistant



**Studies on Rhizosphere and Mycorrhizal Microorganisms of the Trees
growing in the Natural Forests of Western Ghats and in the Arboretum of
Tropical Botanic Garden and Research Institute (STEC Project)**

Dr T.K. Abraham : Principal Investigator
Sri K. Vijayakumar : Research Assistant

Ethnobotanical Survey of Sabarigiri Hills (STEC Project)

Dr T.S. Nayar : Principal Investigator
Sri S. Binu : Junior Research Fellow

**Ex-situ Conservation of rare and Endemic Plants of Agastyamala,
Western Ghats at TBGRI**

Sri N. Mohanan : Principal Investigator
Sri G. Raj Kumar : Research Assistant
Smt V.S. Usha : Herbarium Assistant
Sri K. Narendran Nair : Plant Collector

