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TROPICAL BOTANIC GARDEN AND RESEARCH INSTITUTE
THIRUVANANTHAPURAM

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FOREWORD

Tropical Botanic Garden and Research Institute leaves behind a cherished record of one year with events resplendent with distinction. The present Director assumed office in November 1990 inheriting a newly constructed Laboratory-cum-Library complex along with an awe inducing, accomplished garden—the envy and inspiration of any committed scientist.

This year the projects and programmes of the Institute attained a fresh impetus both at organizational and research arenas soon after the shifting of the System into the Main Building Complex took place from the Scientists' Guest House in the campus where it had been steered since 1986. The entire R & D structure was reorganized and brought under five major divisions with new orientation, consolidating the objectives of the Institute and incorporating important subjects like Ethnobiology and Ethnomedicine which deal with the survey, study and formulation of wild medicinal plants to which the Institute from the very inception has been committed.

The role of Botanic Garden in conservation need not be over emphasized. Plant resource development through collection and introduction of precious germ plasm into the garden with the aim of their conservation and propagation has been part of the botanical culture of the Institute from the very beginning. This year 60 live angiosperm species were introduced into the Garden from the forests of Kerala; besides, 45 wild species of horticultural value and 40 rare and endemic species from Agastyamala region were brought in for *ex-situ* conservation. 200 species/varieties of plants from India and abroad were procured as seeds and planting materials for introduction. The three special groups of collection viz. *Ficus*, Bamboo and Palm were updated with 75, 36 and 60 species respectively. The *Ficus* collection at present is by far the best available within the country.

Successful *in vitro* regeneration of high value horticulturals like *Phllo dendron* and *Anthurium*, root culture of *Plumbago rosea*, a source of Plumbagin, embryo and leaf meristem culture of valued orchids like *Vanda tessellata* and *Eulophia nuda*, micropropagation techniques devised for rare and endangered taxa like *Adhatoda beddomei*, *Woodfordia fruticosa*, *Anacetochilus* sp. and *Helminthostachys zeylanica* are other exciting results achieved during this year.

Efforts to revive and revitalize the traditional herbal medicine and to investigate uses of plants employed by tribals has been a priority area throughout the world. The Institute presently being the place of Coordination Unit of the multi-institutional and multi-disciplinary 'All India Coordinated Research Project on Ethnobiology' (AICRPE) under the Ministry of Environment and Forests, Government of India and the present Director being the Chief Coordinator, the work in this line has been intensified this year. A technical programme to prepare crude drugs based on information from tribals and to test them through pharmacological and pharmaceutical means was drawn up and to complement this, plans for constructing an animal house is finalised.

Microbiologists of the Institute are investigating the rhizosphere and mycorrhizal fungi that play vital role in mobilizing the nutrients required for rare and endemic species.

This year has also witnessed a remarkable increase in the number of externally funded projects being operated at the Institute with simultaneous increase in the number of project staff.

Already the Institute has been accorded of an unique recognition this year as a Potential Centre of Excellence in Conservation Biology and Research in Plant Science by the Centre of Science and Technology for Non-Aligned and Other Developing Countries (NAM S & T Centre). Another outstanding event of the year was the visit to the Institute of an Overseas Delegation from the Scandinavian Countries which included four scientists from Denmark, Norway and Sweden and two scientists from India that included the present Director in his capacity as the National/WHO Consultant in medicinal plants with the mission of a pre-appraisal on the project proposal for strengthening the Medicinal Plant Resource Base in India. Financial assistance to TBGRI for the promotion of conservation and propagation of rare and endangered medicinal plants of the tropics has also been positively considered during this occasion.

Initial formalities for a collaborative programme on phytochemical investigation of ethnomedicinal plants were completed this year between TBGRI and Royal Danish School of Pharmacy, Denmark. Overseas Development Agency of the U. K. has also taken keen interest in the development of the Institute and

promotion of its activities. During these occasions, we had the good fortune of welcoming a large number of national and international dignitaries who inspired us with their unreserved approval of our projects and programmes.

In line with the socio-economic objectives of the Institute to deliver fruits of the Institute's R & D activities to the weaker section of the society, a number of programmes were initiated during the year under report. In a 3-day workshop-cum-training on 'Cultivation of Medicinal Plants' conducted in February, 20 participants took part from different regions of the state. Hundred and twentyfive women selected from 5wards of Thiruvananthapuram City Corporation were given training in Orchid Cultivation in the same month. The hybrid seedlings, mericlones and mature plants of orchids reared in the Institute were regularly sold to the public at very reasonable price and this year the sale was to the tune of Rs. 55,000/-. One thousand seedlings of 12 medicinal plant species were distributed to the locals by the Institute through the Peringamala Panchayat. The Institute also took active part in local programmes and exhibitions with a view to create awareness among the people about plants, their uses and conservation.

As a prelude to fulfil the long-felt need of the employees of the Institute for assessment promotion, rules of Merit and Normal Assessment Scheme (MANAS) for Scientific and Technical Staff on CSIR scale of pay and assessment promotion, rules for Administrative and other staff on State Government scale of pay were formulated and incorporated in the Service Rules of the Institute. Measures were also initiated this year to form a Cultural Forum with the active participation from the staff of the Institute to promote their talents in arts and sports.

The necessary integral components of the system viz. the Scientific Research and Development with the essential infrastructure are still to be moulded into a dynamic reality. The potential of the small band of young and dynamic scientific staff of the Institute still awaited to be explored to their fullness with necessary fillip and incentives. This has been the focus for the new Director and he has left no stone unturned in this direction.

New programmes and projects of national and international dimensions have been chalked out and the System is poised for ambitious developments. In ensuring excellence in scientific

adventures, our connections with the national and international funding agencies certainly steer us with unrestrained hopes and inspiring lessons of fulfilment.

I feel confident that with the sustained support and guidance of the Government of Kerala, Governing Body and Executive Committee of the Institute as well as with the full cooperation of the staff, we shall be able to accomplish the cherished goal of establishing an International Centre of Excellence in Tropical Plant Research.

P. Pushpangadan

DIVISION OF HORTICULTURE & GARDEN DEVELOPMENT

1. Seed Bank

Following the computerisation of the plant records, a programme was made to incorporate all relevant information related to the functioning of the seed bank. Data of all plants enlisted in the Index Seminum—1988 were prepared and stored based on the International Transfer Format. The stored data include accession number, accession status, scientific name and family, flowering and fruiting periods, location and frequency, IUCN status etc.

Seeds of over 300 species growing in the Garden were collected, processed and stored in room conditions for distribution/exchange purpose. Initial germination tests were also conducted with seeds of certain species.

Under the seed exchange programme about 40 seed samples were sent to the following seven institutions on their request :—

- Fruit Spirit Botanic Gardens, Dorrroughby, Australia
- National Botanic Garden of Belgium, Meise, Belgium
- Institute of Field and Vegetable Crops, Novi Sad, Yugoslavia
- Botanic Garden of the University of California, Berkeley, California, USA
- Rain Forest Botantics, Hove, Sussex, UK
- National Botanical Research Institute, Lucknow
- Agrartudományi Egyetem Botanikus Kert, Godollo, Hungary.

Apart from these, large quantities of the seeds of *Hopea parviflora* were collected and sent to Jodrell Seed Physiology Laboratory, Royal Botanic Gardens (Kew), Wakehurst Place, W. Sussex, UK for storage studies and those of *Syzygium aromaticum* to the Unit for Advanced Propagation Systems, University of London, Kent, UK for micropropagation studies.

Over 70 species of various plants were introduced to the Garden by means of seeds obtained from the following four organisations :—

- Royal Botanic Gardens, Kew, UK
- Research Institute of Ecology and Botany, Vacratot, Hungary

Fruit Spirit Botanic Gardens, Dorrroughby, Australia
Manipur Agricultural College, Imphal, Manipur.

The seeds were handed over to the nursery for suitable germination trials.

Seeds of about 40 species were collected by TBGRI Scientists during exploration/study trips.

Due to the new seed import regulations and delay in obtaining import permits the large number of seed lists received by the Institute from gardens outside India could not be utilized to obtain seeds for plant introduction.

2. Ornamental Plants

(a) *Landscaping/Landscape Plantings*

The landscape plantings at the rear of the main building was completed with the planting of an additional batch of nearly 100 new introductions. The area has been made more attractive with the globular topiaries made of *Pogonatherum*, planted by the upper side of the turfed steep slope all along the building complex and the alternative planting of *Mussaenda luteola* and *Tecomaria capensis* along the tread made in the middle of the turfed slope.

In continuation to the above landscaping, the triangular area bordered by the approach road to the Main Building, road to the central nursery and the area of wild flowers was landscaped to form an extension of the adjacent landscape. The plants selected and planting pattern followed were also almost the same as the adjacent area so that after two-three years the whole area will appear like a single landscape. A curved foot path with steps of wooden poles was also made through the area as a feature of the informal design. Altogether over 300 plants of 135 spp./var. were planted in the above two sites, most of them were new to the Garden.

After the construction of the main building and the approach roads, a small area was left over at varying contours, at the right hand side of the building. Firstly a pond was constructed at the site for the giant water lily, as a water feature. Then the remaining area was landscaped to manageable slopes preventing erosion and turfed with carpet grass. All these made the site attractive and suitably landscaped.

The meteorological station and its surrounding area was relandscaped in a formal design. Flowering shrubs of varying heights were planted to conceal the earth cutting behind the meteorological instruments. A formal hedge was made using *Thunbergia erecta* all along the two open sides. This work is in progress.

The two small shaded areas in between the three blocks of the main building complex were very effectively landscaped and made attractive by planting suitable plants in groups.

The landscaping of the front yard of the guest house was completed with the turfing of the unplanted areas using carpet grass. A foot path was also made connecting the guest house and the steps leading to the main gate.

Designs were suggested for the construction of two water tank/ponds in the garden.

(b) *Ornamentation and displays*

A large 'carpet bed' (12 m x 6 m) was designed and laid showing the structural details of a typical plant cell using *Alternanthera* (red and green) near the main gate, which is an attraction to the visitors as an educational display. Another carpet bed using the same plants was made near the medicinal garden following an embroidery design. A third one demonstrating the chinese theme 'Yin and Yan' was also laid near the main gate by the upper side of the *Ficus* display.

Twelve new annual beds in informal (irregular) shapes were taken in the shrubbery, to make the area more colourful. Annual flowering plants were planted in rotation in each bed so as to have different colour in different periods. One more 'island bed' was made by the side of the shrubbery to display contrasting plants in groups.

The small area in front of the generator house was beautified by planting the 'standard' plants developed using different *Lantanas*. *Portulaca grandiflora* was planted in between the *Lantanas* as ground cover and a variegated *Chlorophytum* was planted in tufts as a border.

The surrounding areas of the Woodland Garden was cleared off the subsoil, the remains of the construction of the arboretum road, and the garden has been extended by planting 75 more new additions. The shrubbery was also enriched with 25 more species.

The rose garden was renovated by replacing nearly 120 old plants with new bud roses, along with annual hard pruning and mulching.

The variegated plants collection near the guest house was also enriched by planting 80 more numbers belonging to 50 species/varieties.

About 140 new accessions were added to the collection of ornamentals during the year. All the collections of the ornamental section were accessioned which come to over 800. The plant records are now kept as index cards and in registers.

Apart from these, all the planted areas, plants, lawns, etc., were better maintained throughout the year.

3. Central Nursery

The central nursery with all the new facilities became the major centre of activity in the Garden. Various propagation works were carried out through the year as per the demands of the different sections. The number of planting materials handled were well over 20,000. About 475 batches of vegetative propagations of different sorts were initiated and 300 batches of rooted materials were transplanted to pots/polybags. Seeds of over 300 species/varieties received from the seed bank or from field collections were sowed during the period, half of which were new introductions. Out of this seeds, about 115 species germinated and seedlings were raised. This year nearly 8000 plants in 400 batches were supplied to the ornamental unit, about 500 plants of 30 spp. to medicinal plants unit and about 300 plants of 60 spp/var. to Arboretum/ Palmetum unit.

Germplasm collection of *Jasminum* was initiated and at present, the Garden has got 12 different accessions. A nursery level collection of Cacti and Succulants have also been started. Nearly 20 new additions of Begonias were also made this year.

Over 35 new varieties of ornamental *Coleus* were developed at the Central Nursery by 'Selection' for attractive foliage from among the seedlings raised after allowing cross pollination between the stock plants. By this practice, the number of total varieties of *Coleus* in the garden was raised to over 65.

A detailed study programme has been started as a joint effort of the seed bank and central nursery to study the propagation methods of important indigenous medicinal plants. Under this, ideal

germination conditions, dormancy breaking techniques, tests of seed storage viability etc., are being worked out. In cases where seed germination or seed availability is difficult, attempts are made to find out the best vegetative propagation method. So far seed germination and storage studies have been started for 28 species. The work is in progress.

Another vegetative propagation study has been taken up in *Ochreinauclea mlssionis*, a rare and endemic tree of Western Ghats, in order to save the species from extinction by conservation. Experiments were conducted with cuttings of different ages and the cuttings were treated with auxins like IAA, IBA and NAA to study their effect in induction of rooting and the effect of different seasons in rooting, etc. This work is also in progress.

DIVISION OF CONSERVATION BIOLOGY

1. Forest Exploration

(a) General

Botanical explorations were conducted during the year under report in the forests of Munnar, Moozhiar and Silent Valley and about 650 specimens of angiosperms belonging to 110 species were collected for taxonomic studies. The species were identified after critical study and examination.

(b) Bamboos

An exploration trip to Moozhiar and Sabarigiri forest areas of Pathanamthitta district was conducted in March for the collection of bamboos. During this trip 10 offsets of *Ochlandra* sp. were collected. One species was observed in flowering and about 50 specimens were collected for herbarium. Of the offsets collected, 3 were planted directly in the field and 7 in the nursery.

(c) Orchids

Forests of Angamuzhi, Anathode, Karimala, Vettiayar, Pampa, Valiyanavattom and Sabarigiri were explored during March and Orchids like *Acampe ochracea*, *Cottonia peduncularis*, *Cymbidium aloifolium*, *Dendrobium macrostachyum*, *D. ovatum*, *Kingidium deliciosum*, *Kingidium mysorensis*, *Luisia evangelinae*, *Smithsonia straminea*, *S. viridiflora*, *Liperis viridiflora* were collected during this trip. As new to South India, *Saccolabiopsis pusilla* (Lindl.) Scidenf. & Garay was collected from Sabarigiri. With this, the genus *Saccolabiopsis* finds recorded for the first time in South India.

(d) Agastyamala

Agastyamala situated at the southernmost end of Western Ghats has a very unique and one of the most diverse vegetation in the Western Ghats. Many species here are endemic and some of them are rare and endangered. TBGRI located very near to Agastyamala (only 40 km

away) on the foot-hills of Western Ghats has ideal situations to take up conservation studies. The work initiated during the year under report aims at—

- screening of the vegetation of Agastyamala to determine the conservation status of the plants.
- developing an ex-situ conservation area for suitable plants at the garden.
- publication of a manual for the rare and endemic plants of Agastyamala.

During the initial stages, emphasis was given on data collection from the existing literature. As a result, data pertaining to about 235 interesting species belonging to the southernmost end of Western Ghats were gathered along with their varying conservation status.

Five plant collection trips were conducted to Agastyamala and nearby areas during the period and about 150 saplings belonging to 30 species were introduced to the Garden. 1300 field numbers were collected for the herbarium and taxonomic studies.

A separate nursery for Agastyamala plants was established in the garden. Work on the construction of irrigation system was also initiated.

The first planting in the conservation plot selected for growing Agastyamala plants was done in July 1990 by Prof. A. N. Namboodiri, the then Director. About 30 saplings belonging to 12 species of trees were planted during the report period.

2. Arboretum

During the period under report about 60 species of trees, shrubs and woody climbers were introduced to the Arboretum. Of this about 40 species were introduced through plant exploration trips conducted to different areas of Western Ghats such as Agastyamala, Chemungi hills, Neyyar sanctuary area and Silent Valley National Park. About 20 species were got through seed exchange programme with Botanic Gardens in and outside the country.

Planting of about 1 hectare was done at the Arboretum during the period. 60 saplings belonging to 35 species of trees, 20 species of herbs and 5 species of climbers were planted. With this a total of 605 species are growing at the Arboretum.

The growth data of trees planted are recorded regularly. All the trees are showing healthy growth and the trees planted during 1985 have attained an average height of 5 m and a girth of 45 cm.

The trees flowered and fruited at the Arboretum will be included in the new edition of *Index Seminum*.

3. Bambusetum

During this year 3 species of Bamboo established in the bambusetum flowered. Three clumps of *Thyrsostachys regia*, after their gregarious flowering, died out. Ample flowering specimens were collected for Herbarium. Seeds were collected and grown in the nursery. The details regarding the clumps, rhizome etc., were noted. A lone clump of an unidentified species also started flowering. Observation of this species was carried out and details regarding flowers, clumps etc., were noted. Seeds were collected and stored. Some of the seeds were sown in the nursery and the seedlings were transplanted into poly bags. Two clumps of *Dendrocalamus strictus* introduced from Papanasam, Tamilnadu also started flowering. About 120 specimens were collected and preserved for future study. The bambusetum now harbours 35 species.

Different activities such as transplantation of seedlings to poly bags, watering of plants, fencing of individual plants, weeding etc., were also carried out during this period in the Bambusetum.

4. Orchidarium

A preliminary checking of Indian Species of orchids kept at the Species House was done. Labelling of about 220 species was completed. Multiples of many orchids like *Dendrobium moschatum*, *D. fimbriatum*, *Agrostophyllum planicaule*, etc., were given separate labels.

10 species of Orchids collected from Trichur district were identified. They are *Gastrochilus bigibbus*, *Oberonia brunoniana*, *O. recurva*, *O. rhizophoretii*, *Eulophia nuda*, *Kingidium deliciosum*, *K. niveum*, *K. mysorensis*, *Pachystoma pubescens* and *Pomatocalpa spicata*.

5. Palmetum

During the period under report 10 species of palms were introduced from Royal Botanic Gardens, Kew, U. K. The Palmetum has now about 130 saplings belonging to 65 species of palms. All are growing well.

6. Ex-situ Conservation and Bio-systematic Studies on Piperaceae

As part of this programme, 10 out of 15 species of *Piper*, 4 out of 7 species of *Peperomea* and the only one species of *Heckarla* reported to be present in Western Ghats were collected and introduced to the garden. Moreover, 20 cultivars (already land races) of *Piper nigrum* were collected from various parts of Kerala. Studies on morphology, cytology and ecology of the family are in progress.

7. Eco-Rehabilitation and Gene Pool Development of Rare and Endangered Medicinal Plants of Western Ghats

Three endangered medicinal plant species viz., *Holostemma annulare*, *Rauvolfia serpentina* and *Coscinium fenestratum* are the species under study in this project. During the period under report 45 plants of *Rauvolfia serpentina* from Munderi, Peruvannam and Kallar, 80 plants of *Holostemma annulare* from Kallar, Attayar and Uthivanchi and 40 plants of *Coscinium fenestratum* from Thendakkad, Chempenkallu and Attayar of Western Ghats were collected. Plants established in the nursery were transferred to the field and being maintained.

8. Aquatic Plants

A pond for growing water plants was constructed and about 9 species/varieties of water lilies were planted.

9. Other Studies and Surveys

(a) Studies on the distribution patterns of Indo-Malesia-Australasian orchid genera:

A preliminary survey on the various orchid genera represented in the Indo-Malesio-Australasia was made.

(b) Study and Survey of Wild Flowers of Kerala

45 wild species which are of horticultural value and aesthetic appeal were introduced in the Garden during this year as part of conservation of genetic diversity. More than 60 live specimens belonging to 25 species were collected for introduction from Munnar and Silent Valley forests while the rest were spotted out from local forest areas. Total number of wild plant species at the site has now come to more than 75, most of them belonging to annuals and perennials. 60 wild plant species were recorded with field data for habitat study and

future introduction into the Garden. 20 species were photographed in the natural habitat during this year.

Propagation of wild plant species by vegetative and reproductive methods is being practised to increase the population of the species already existing in the site. A considerable population has been established in case of certain herbs like *Ipomoea* and rhizomatous perennials like *Alpinia* by these methods.

10. Palynology

About 1000 pollen slides belonging to 340 angiosperm species which formed the nucleus of Pollen Herbarium of the Institute were re-examined and cleaned by alcohol to keep off fungal hyphae. Arrangement was completed to accommodate the pollen slides in slide cabinets following the Takhtajan's system of Angiosperm classification (1980) for future reference.

Fresh polliniferous materials of about 30 angiosperm species were collected for palynological work this year during the forest exploration to different parts of the state.

11. Herbarium

Reorganisation of the herbarium started in October 1989 is in progress. The families and genera are arranged according to Bentham & Hooker's system incorporating the modification by Hutchinson.

During this period specimens belonging to 86 families from Malvaceae to Ehretiaceae were incorporated. In this process 2778 specimens belonging to 483 genera and 937 species were filed. For this generic and specific names were written on folders and specimens were arranged accordingly. Up to date nomenclature of the taxa was provided by referring latest books and publications. Collection dates of all these specimens were entered in the accession register. Lists of taxa represented in Flora Travancore collections and in General Herbarium were prepared. A combined list of all the taxa represented in the Herbarium was also prepared for ready reference.

Processing of specimens was continued this year. 1440 specimens were pressed, dried and poisoned. 628 were mounted and stitched. All these sheets were handed over to the respective collectors for identification.

Renovation of sheets deposited in the herbarium was yet another major work carried out. A total of 1382 sheets were stitched and renovated.

DIVISION OF ETHNOBIOLOGY AND ETHNOMEDICINE

1. Development of Medicinal Plant Garden

The area planted with succulent species of medicinal importance was extended and 12 more species suited to the biotope were planted. 10 evergreen trees/shrubs were planted in the existing gap of evergreen natural vegetation present along the river side. About 10 *Jasminum* plants were planted on the side of steps to the conservatory from the entrance of the medicinal garden. 25 trees/shrubs were planted in the newly developed area on the slopes near the pump house. 4 aromatic shrubs — *Atlantia monophylla*, *Triphasia trifolia*, *Murraya koenigii* and an unidentified aromatic species were planted in the aromatic plant section. The plot of undershrubs/herbaceous beds was redesigned with a garden trail through the central part of the plot with beds of each species on either side. A 20m. hedge using *Clerodendrum inerme* was made and the shrubbery near the hybrid Orchidarium was beautified. 10 Zingiberaceae members — *Curcuma longa*, *C. aromatica*, *C. amada*, *Zingiber officinale*, *Z. zerumbet*, *Kaempferia galanga*, *K. rotunda*, *K. angustifolia*, *Costus speciosus* and *Alpinia calcarata* were planted on beds in between established trees present in the terraces. A new permanent shed was constructed for plants which needed special care, especially plants in need of controlled watering, protection from heavy rains and those which are of arid regions. Some of the plants housed in this shed are *Mentha arvensis*, *M. piperita*, *Berberis aristata*, *Actinopteris radiata*, *Solanum trilobatum*, *Cissampelos pariera* var. *hirsuta* and *Commiphora mukul*.

2. Medicinal Plant Explorations

Plant exploration trips were conducted to different agroclimatic areas for collecting and introducing medicinal plants and to replenish the existing living plant collection of the garden. Following are the places visited during the period under report: 'Valley of Flowers; Chamoli Dist., Badarinath (U. P.), Munnar, Vattakotta, Peruvannum, Kallar, Silent Valley, Bonaccord, Dellenoy Fort, Cheenikala, Nilambur and Calicut. As a result of these trips about 140 spp. of live plants belonging to Orchidaceae, Piperaceae and of medicinal importance were collected and introduced to the garden. In addition, 600 field numbers for the Herbarium of the Institute were collected.

3. Ethnobotanical Study of Pathanamthitta District

An extensive bibliographic work on recent Indian Ethnobotany was completed as a preliminary step of this study.

Ethnobotanical survey has been conducted in Pathanamthitta District by intensive explorations for the forest area of tribal inhabitation. Areas like Muzhiar, Shabarimala, Attahodu, Gurnathan Mannu, Bhayanakaramuzhi, Adichippuzha, Kakki and Pamba were covered so far and detailed ethnobotanical data of more than 100 plants from the forests of the district were collected. Apart from medicinal use, study has also been extended to plants used by tribals for food and culture including magico-religious purposes. Ethnobotanically important data gathered during this study are being consolidated.

4. Ethnobotanical Museum

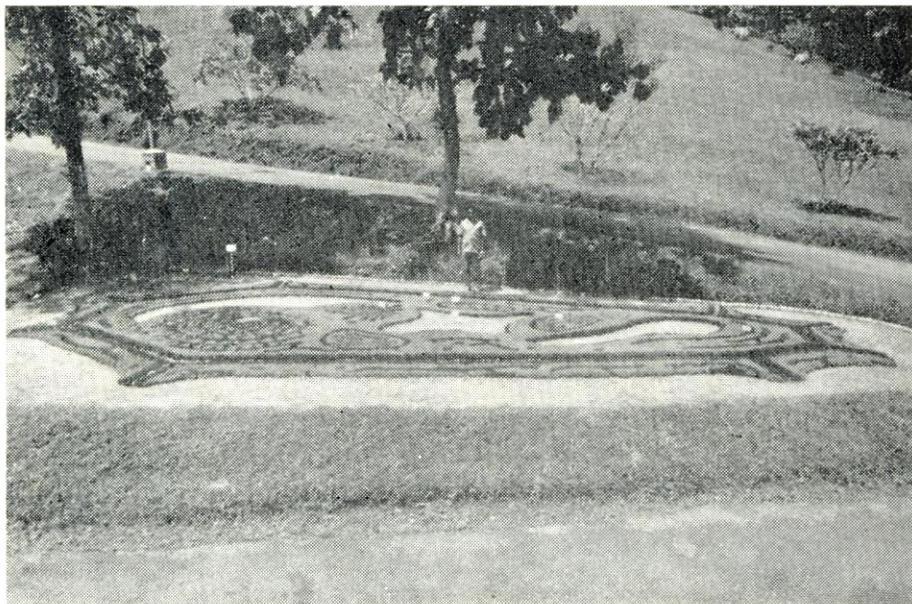
The Ethno-botanical museum was shifted to the new Laboratory-Library complex and the exhibits were reorganised and classified under 12 different titles for making them more self explanatory.

5. Manual on Nursery Techniques of Medicinal Plants

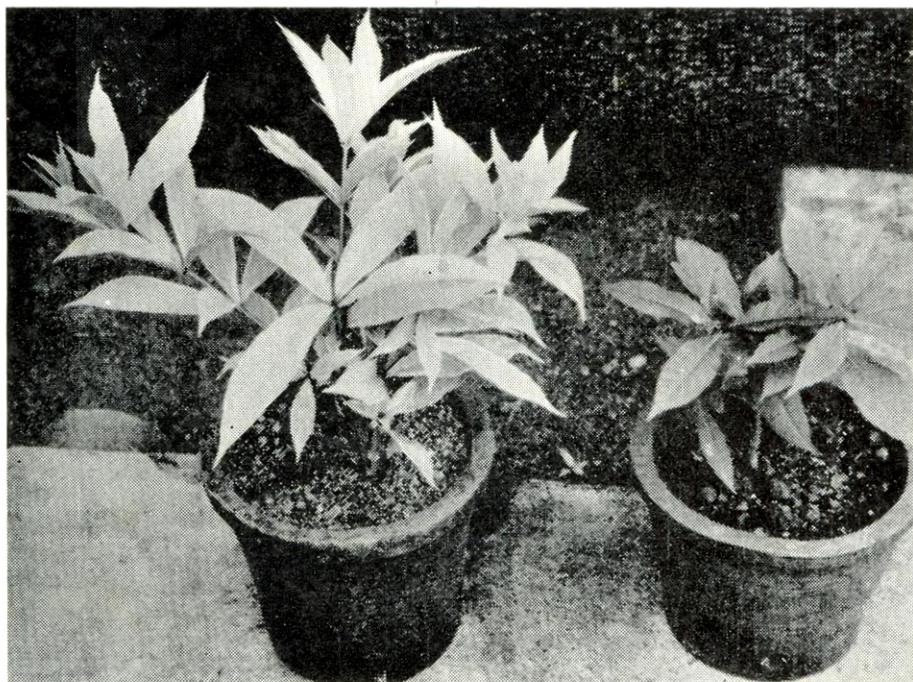
It was decided to publish manuals on nursery techniques of 300 medicinal plants in series. As a follow up programme, an 8 day workshop on Nursery Techniques of Medicinal Plants was conducted in January 1990. The manuscript of the first number in the series consisting propagation aspects of 50 medicinal plants was prepared.

6. Training Programme on Cultivation of Medicinal Plants

A 3-day training programme on cultivation of medicinal plants was organised at TBGRI from 14th-16th February 1991 in connection with the Science Day celebrations. 23 persons representing Ayurvedic Physicians, small scale farmers, non-Governmental organisations and tribals participated in the training programme. The participants were trained on cultivation aspects of 10 medicinal plants such as *Holostemma annulare*, *Desmodium gangeticum*, *Strobilanthes heyneanus*, *Adhatoda beddomei*, *Baleospermum montanum*, *Kaempferia galanga*, *Plumbago indica*, *Alpinia calcarata* and *Indigofera tinctoria* used in the indigenous systems of medicine. A booklet on cultivation aspects of the above mentioned plants was published and the copies were distributed to the trainees. As a part of the training programme a study



Carpet bed design of a plant cell with *Alternanthera betzckina*



A variegated spontaneous mutant of *Allamanda nerifolia*, isolated at the Garden, along with a normal plant.



Nothopegia aureo-fulva Bedd. ex Hook. f. (ANACARDIACEAE) rediscovered by TBGRI Scientists from Agasthyamala, after a period of over 100 years from the first collection.



Training programme for women on orchid cultivation



Ixora agasthyamalayana Sivadasan & Mohanan (RUBIACEAE), a new specie described by TBGRI Scientists, from Agasthyamala



The Danida Pre-appraisal team visiting the Institute



The first planting at conservation plot for rare and endemic plants of Agasthyamala by the Director, Prof. A. N. Namboodiri in June 1990

tour was conducted to the medicinal plant farms of Kottaackal Arya Vaidya Sala at Kottapuram and Kanjirapuzha.

7. Survey and Ex-Situ Conservation of Plants Used Against Cancer by Tribals of Kerala

During the period under report 30 tribal settlements in six districts of Kerala—Palakkad, Malappuram, Kozhikode, Idukki, Kasarkode and Kannur—were visited and information on plants having ethnomedicinal claim of anti-cancer property used by tribals of these areas were recorded. In addition to the above information, notes on medicinal plants used by tribes for curing their various ailments were also gathered from medicinemen. Selected informations were tape-recorded. These plants were located by the help of informants from nearby forests and planting materials were collected for introduction to the garden and herbarium specimens to determine taxonomic identity of the species.

8. Extension Programme

1,000 poly bags of plants belonging to 12 medicinal species such as *Aloe vera*, *Plumbago indica*, *Adhatoda beddomei*, *Tylophora indica*, *Kaempferia galanga* etc. were distributed to the public through Peringamala Panchayat. As a part of the programme on popularisation of cultivation of medicinal plants, a pamphlet with uses and hints on their rearing were prepared and distributed.

Medicinal plants were also distributed to the following institutions/associations; Shaliacary Estate, Punalur; AKG Nagar Residents Association, Thiruvananthapuram; Navajyothi School for Mentally Retarded, Thelliyoor; Mithra Niketan, Vellanad.

DIVISION OF MICROBIOLOGY

The programme of work on the rhizosphere and mycorrhizal microorganisms of the endemic trees of Western Ghats was continued during this year. Further study-cum-collection trips were conducted to the Agasthyamala area. The samples collected were analysed for the presence of rhizosphere fungi, the mycorrhizal fungi (VAM) and also for the carbohydrate and protein content.

As in the case of samples collected earlier, the number of fungi present in the rhizosphere was found to be more compared to the surrounding soil. In case of the trees like *Dalbergia latifolia*, *Humboldtia unijuga*, *Myristica malabarica* and *Gluta travancorica* the number of organisms present in the soil and in the rhizosphere had risen considerably in the collections made in 1990-91 compared to those made in 1989-90. But in case of the endemic palm *Bentinckia coddapanna* no considerable change was noticed.

In addition to those species isolated earlier, species like *Curvularia indica*, *Aspergillus* spp., *Rhizopus* spp., *Neurospora* sp. and *Fusarium* sp. were isolated from the soil of *Dalbergia latifolia*. From the rhizosphere of this tree *Fusarium solani*, *Curvularia andropogonis* and *Circinella mucoroides* were also isolated.

In order to verify the presence of VA mycorrhizae in the roots of *Bentinckia coddapanna*, the roots were treated with 10% KOH, Alkaline H₂O₂ and finally with 5 N HCl. The treated roots were stained with lactophenol-cotton blue.

Observations of the roots under the microscope showed the presence of vesicles and arbuscules confirming the presence of VA mycorrhizal fungi in the root tissue. VA mycorrhizal fungi of this palm were also isolated from the rhizosphere and identified. All the identified VAM fungi belonged to the family Endogonaceae. These include *Glomus aggregatum*, *G. albidus*, *G. ambisporum*, *G. manihotis*, *G. magnicaulis*, *G. maculosum*, *G. occultum*, *G. pustulatum*, *G. tenerum*, *Acaulospora elegans*, *Entrophospora infrequens* and *Gigaspora* spp.

1. Estimation of Carbohydrates

Carbohydrate content in the soil was estimated periodically to observe the change in carbohydrate in the rhizosphere. Of the trees growing in the arboretum of TBGRI, maximum amount of carbohydrate was present in the rhizosphere of *Gluta travancorica* (150 $\mu\text{g/g}$ soil). But this was found to be less in the rhizosphere soil of the samples collected from the Agasthyamala forests (102.5 $\mu\text{g/g}$ soil). But in case of *Bentinckia coddapanna* the carbohydrate content was less in plants growing in the arboretum (97.5 $\mu\text{g/g}$ soil) compared to those growing in the Agasthyamala forests (112.5 $\mu\text{g/g}$ soil). Samples collected from the same place after six months had shown that the carbohydrate content had diminished considerably. This may be due to the utilization of carbohydrates for the growth and metabolism of microorganisms.

2. Estimation of Protein in the Rhizosphere

Protein content in the rhizosphere was also estimated periodically. It was found to be more in the rhizosphere of the trees growing in the arboretum of TBGRI, compared to those in the Agasthyamala forests. Slight decrease in protein content was noticed in case of some trees while marked increase was noticed in case of *Myristica malabarica* and *Bentinckia coddapanna* when samples were collected after six months from the same place.

DIVISION OF PLANT BIOTECHNOLOGY

Being a part of the long-term commitment, the projects on the development of appropriate micropropagation schemes for identified rare and endangered orchids and medicinal plants were continued. The emphasis during the year was, however, on the near perfection of foliar and nodal meristem culture systems with *Anthuriums* and *Philodendrons*. Hundreds of clonal plants of these high value ornamentals are already transferred to and established in the nursery. They would be made available to the public soon. Even more impressive was the bioproductivity of *Plumbago rosea* tissue culture. Micropropagated plants of this herb rapidly produced plumbagin rich tubers during post transplantation and its root cultures exhibited remarkable ability to yield biomass and the active principle. The results are encouraging and in turn have evidenced the scope for fruitful research in selected herbs.

1. Micropropagation of Rare and Endangered Orchids and Ferns

Apart from working out a rapid propagation method for the North-eastern Red Vanda (*Renanthera imschootiana* Rolfe) the micropropagation technique was extended to some rare terrestrial orchids and ferns of the Western Ghats.

(a) *Orchids*

Habenaria crinifera Lindl.

Meristematic tip portions of the tuber produced leafy shoots (10 shoots/explant) in 3 weeks of culture on a modified Whites Medium supplemented with varying con. of BA. Withdrawal of BA induced rooting on these shoots'. *In vitro* flowering was observed on these shoots.

Anoectochilus regalis Bl.

Approximately 40% of the contamination free rhizome nodal explants produced vigorous shoots in modified White's medium containing cytokinin. Rooting of these shoots was achieved when cytokinins were withdrawn from the medium. About 95% of the rooted plants established in community pots two weeks after planting.

Nervilla aragoana Gaud

The swollen tuberous tips of the lateral branches of the sub-terranean stem of this rare terrestrial orchid has been successfully cultured to produce shoot initials on modified White's medium supplemented with auxins and cytokinin, within 4 weeks of culture. Eventually these shoot initials attained green colour. Rooting is yet to be initiated.

(b) *Ferns*

Rhizomatous meristems of rare and medicinally important forms have been successfully cultured on modified Dyer's Medium to produce a single shoot. Due to the peculiar growth pattern, the shoot buds subtending the newly formed shoots are meristematic and likely to form new shoots *in vitro* eventually. This is being investigated in depth.

Schizaea species

This rare fern is available only in a small pocket of the forest patch of TBGRI. As a preliminary step, the tender curved fronds have been cultured on Dyers' Medium and they have attained a swollen appearance suggestive of organogenesis. This needs to be investigated further.

(c) *In vitro culture of Nepenthes Khasiana* Hook. f - the Indian Pitcher Plant

Difficulty had been encountered in inducing rooting of the shoots produced from the stem nodes of aseptically grown seedlings. However after trying several hormonal combinations, this difficulty has been surmounted and at present we have several rooted *in vitro* plantlets and about 10 plantlets have been transferred to the field for establishment.

2. Micropropagation of Rare and Endangered Medicinal Plants

Woodfordia fruticosa Kurz, a rare medicinal plant from South India reported to possess antitumour activity and anti-HIV activity is one of the plants, clonally propagated at the Biotechnology Unit.

Apical and axillary shoot buds produced multiple shoots, on modified SH medium supplemented with plant growth regulators within 4 weeks after culture. Rooting could be induced when auxins were used at low concentration. Rooted plants established successfully in the field at a rate of 75%

Trichopus zeylanicus Gaertn.

This rare herbaceous perennial grows in the Agasthya Hills of Kerala. It is believed that the regular intake of the kernels and concoctions made from other parts of the plant help to maintain youthful vitality and promote disease resistance and longevity of life.

Apical buds from field grown and *in vitro* raised seedlings were cultured on modified SH medium with low concentration of BAP to induce growth in size of the shoot buds which later transformed into callus in 3 weeks from which, in due course globular structures developed. These structures are presently being induced to develop into shoots.

Floral meristems of this plant were also cultured on modified SH medium with varying concentration of BAP and it was observed that small buds, 3-4 in number appeared along with the opened flowers in 10 weeks of incubation. These explants with the initiated buds have been subcultured for subsequent growth and development of healthy shoots.

Adhatoda beddomei C. B. Clarke

Nodal meristems of field grown plants produced multiple shoots (8-10/node) on SH nutrient medium, which were rooted with ease, using low concentrations of auxins in the same medium. Rooted plantlets transferred to community pots established at a frequency of 90%. The regenerated plants were phenotypically identical to the original stock plants as was confirmed by cytological studies

Commiphora mukul Engl.

Shoots produced *in vitro* from nodal explants could not be induced to root *in vitro* despite several attempts using a wide range of auxins and auxin-cytokinin combinations. Incorporation of 10% tender coconut water to the nutrient medium helped in internodal elongation of the shoots which were otherwise stunted. However rooting of these shoots is yet to be achieved.

Rauwolfia beddomei Hook. f.

Dry clipped seeds of this plant were germinated and nodes and shoot tips from these seedlings (4-5 month old) were harvested and used as explants to initiate multiple shoot production without callusing in

modified SH medium with plant growth regulators. The nodes from these *in vitro* raised shoots were split and subcultured on nutrient medium to produce 8-9 axillary shoots per split half. Experiments are being conducted to induce rooting on these shoots.

3. Bioproductivity of *Plumbago rosea* tissue cultures

Callus free axillary shoots proliferated upon the nodes were rooted in hormone free MS medium and the plantlets established at a frequency of 95% under green house conditions. The roots of the plantlets began to swell in 3 weeks, producing distinct tuberous structures in 12 weeks. Product synthesis (Plumbagin) coincided with the swelling of the roots and continued atleast upto 12 months. The rapid growth and tuberisation properties of the micropropagated plants in the field indicated the desirability of using such plants for early harvesting of tubers.

Callus, cell suspension and root cultures were established from various explants and their growth and biosynthetic character were studied. The stem callus-derived cell cultures registered a two-fold increase in growth but were far less productive (0.15-1.6 mg plumbagin g^{-1} dry wt.) than the roots (11.2mg g^{-1} dry wt.) at given period of culture. Plumbagin was mostly stored in the cells and seldom released into the medium. Differences in growth and plumbagin synthesis between root cultures of diverse origin were insignificant. The results suggest that root culture may be a useful source of plumbagin if growth rates are substantially increased.

(a) Field Survey and Establishment of a Gene Bank

A number of field trips were conducted to collect orchid species of interest from known forest habitats viz. Agasthyamala, Kulathupuzha, Munnar and Silent Valley and adjacent areas of the Western Ghats. The living plants were categorised into rare, endemic and exquisite species and introduced into the natural forest segment in the garden site for developing ex-situ field gene bank. Specimens of each species were also processed for herbarium.

(b) Tissue and Seed cuttings

The pods and vegetative parts especially shoot tips and leaf bases excised from whole plants were used for the initiation of embryo and tissue cultures. Accordingly the embryos of *Vanda tessillata*, *Eulopia*

nuda, *Dendrobium hetero-arpum* *Rhyncostylis retusa*, *Dendrobium macrostachyum* cultured in appropriate nutrient media swelled in size and developed into protocorms. Proliferation of meristematic tissue leading to the formation of protocorm-like body formation was noticed in *Dendrobium macrostachyum*, *R. retusa* and *Acanthephippium bicolor*. Multiple shoot formation was noticed in stolon segments of *Nervilia* spp.

4. Development of a rapid micro-propagation system for horticulturally desirable phenotypes of *Anthurium* and *Philodendron*

(a) Organisation of a collection

A collection of 92 plants of *Anthurium* including 25 floriferous hybrids and 13 foliage types and 33 *Philodendrons* falling into 9 hybrids was made. The prices of each plant varied from Rs. 10/- to Rs. 500/-.

(b) Micropropagation of *Anthuriums*

Factors contributing to the development of a rapid propagation scheme were investigated. Among the different explants lamina segments derived from young fully expanded leaves with major veins showed maximum regeneration potential.

Petiole explants from these leaves were also regenerative but the frequency of regenerants (45, 60%) and number of shoots (2-3) produced from the cut ends were less. Leaf explants with their abaxial surface in contact with the medium and petiole explants with their ends placed above the medium responded better than others. Shoot regeneration was always preceded by nodular callus formation which was pronounced in 30-35 days after culture. Callus production and shoot regeneration were dependent on the use of semi solid medium (0.4% agar) and the presence of cytokinin in the medium. Although shoot production occurred in all the concentrations (0.5-5.0) of BAP, maximum caulogenesis occurred at 1.5 - 2.0 g/l BAP. After the formation of nodular callus and shoot buds in the dark, the cultures were transferred to basal medium in the light to simultaneously regenerate both shoots and roots. Individual shoots may also be separated and placed horizontally in fresh cytokinin containing medium to raise a crop of 12-15 shoot initials. The rooted plantlets were transferred to 2" pots filled with potting medium (sand, cowdung and charcoal 1:1:1) and hardened in a mist chamber for 3 weeks to achieve 75% establishment.

(c) *Philodendrons*

A practical scheme for rapid propagation of two hybrids of *Philodendron* viz. *P.* 'Blue Mist' and *P.* 'Painted Lady' was developed. Nodal explants were the only source for regeneration, devoid of an visible callus formation. Although 30% of the leaf segments with midrib produced nodular type of callus with occasional development of shoot buds. Semisolid nutrient medium supplemented with 1.5 to 2.0 mg/l BA was the best for initiation of callus-free shoot formation. Higher concentrations of cytokinins markedly induced callus formation. However the calli were highly regenerative, especially when they were transferred to basal media. The rooted plantlets were transferred to community pots where they got established at 95% survival rate.

5. Training Programmes and Workshop

An orchid cultivation training programme(5 days) was organised during March 1991 by the Biotechnology Unit, assisted by the Community Pot Centre. This programme was meant for unemployed rural women. About 110 participants were taught the various aspects of orchid cultivation. This programme was sponsored by STEC, Government of Kerala.

A 2-day training programme of *Protoplast Isolation, Purification and Culture* was conducted by the Biotechnology Unit for the Government College Teachers during March 1991.

A demonstration on *Tissue culture techniques of medicinal plants* was conducted by the Biotechnology Unit for Final Year Students of Government Ayurveda College during December 1990.

ONGOING PROJECTS

Survey and *Ex-situ* conservation of Plants used against Cancer by Tribals of Kerala, funded by STEC, Kerala State (concluded in March '91).

Eco-rehabilitation and Gene-pool Development of rare and Endangered medicinal plants of Western Ghats, funded under Western Ghats Development Programme (Started in May '89).

Studies on the Rhizosphere and mycorrhizal micro-organisms of the trees growing in the natural forests of Western Ghats and in the

arboretum of TBGRI, funded by STEC, Kerala State (Started in June 89.)

Development of a rapid micropropagation system and selection of horticulturally desirable somaclonal and induced instant phenotypes of *Anthurium* and *Philodendron*, funded by STEC, Kerala State (Started in December '89).

Ex-situ Conservation of rare and endemic Plants of Agastiyamala Western Ghats of Tropical Botanic Garden funded under Western Ghats Development Programme (Started in June 90).

An Ethnobotanical Survey of Shabarigiri Hills in Pathanamthitta District, funded by STEC, Kerala State (Started in November 90).

Conservation through Micropropagation of rare and exquisite orchids of the Western Ghats, funded by Ministry of Environment and Forests, Government of India (Started in January 1991).

SEMINARS/WORKSHOPS ATTENDED

Dr. T.S. Nayar attended a Seminar on 'Coastal Evolution, Dynamics and Environment during the quarternary' jointly organised by the University of Kerala, Geological Survey of India and Centre for Earth Science Studies in Thiruvananthapuram on 6th June 90. He participated in the field excursion conducted by the organisers along the Coast and Lagoon Barrier Complexes on 7th June 90.

Smt. P. G. Latha and Smt. C. G. Sudha attended a Seminar on 'Tools and Techniques in Biological Sciences' organised by the Kerala University Students Union, R. R. L., Pappanamcode from 21st to 23rd August '90.

Shri. Mathew Dan attended a Seminar on 'Cultivation of Medicinal Plants' organised by Pharmaceutical Corporation (Indian System of Medicine) Kerala Ltd in Thrissur on 20th October '90.

Shri Jacob Thomas, Smt. P. G. Latha and Smt. C. G. Sudha attended a Seminar on 'Frontiers in Plant Sciences' held at the Department of Botany, University of Kerala, Kariavattom on 25th January '91.

Shri P. J. Mathew, attended a Seminar on 'Ayurveda' organised by Kottakkal Arya Vaidya Shala at Kottakkal on 30th January '91.

Dr. T. K. Abraham, Shri K. Vijayakumar, Smt. P. G. Latha and C. G. Sudha attended the 3rd Kerala Science Congress organised by the Department of Science, Technology and Environment at Kozhikode from 28 Feb. to 3 March 1991.

Shri P.J. Mathew attended a Workshop on 'Ex-situ Medicinal Plant Conservation' organised by LSPSS at TBGRI, Thiruvananthapuram from 30th March 91 to 8th April 1991.

STUDY VISITS

Shri Mathew Dan visited Botanical Survey of India, Coimbatore from 3rd to 9th June 90 and determined the identity of 83 herbarium specimens.

Mr Russel Forbes, a horticultural Diploma Student from the Royal Botanic Gardens, Kew, U K spent a month in October 90 in the Garden on an Overseas Travel cum Study Project.

OTHER ACTIVITIES

(a) Spectrum '90 Flower Fair

TBGRI took part in the exhibition 'Spectrum 90 Flower Fair' during October at Kanakakunnu Palace. Our participation was made meaningful by arranging exhibits aesthetically appreciable and scientifically accurate, conveying the message of conservation. Altogether 10 pots of *Phalaenopsis* hybrids in bloom including the one mounted on tree fern block were displayed. This very exhibit attracted large crowds. The cultural procedures and history of moth orchids were explained to the public. Also on display were *Dendrobium densiflorum*, *D. wightii*, *Corymborkis veratrifolia*, *Gastrochilus biglbbus*, *Coelogyne ovals*, *Arundina graminifolia*, *Phalus luridus*, *Paphiopedilum spicerianum*, *Luisia abrahamii*, *Trias bonaccordensis*, *Bulbophyllum rheedei*, etc. A random selection of orchid books, stamps and journals were also on the show. A poster display designed on the sad plight of South India's lone lady's slipper orchid, *Paphiopedilum druryi*, was aptly informative and timely and was much appreciated by the public and the media.

Though the show was mainly the inauguration of the activities of the Cut Flower Producers Society, the public media projected on TBGRI exhibits.

The HINDU (dated Oct. 14, 1990) reporting on the Flower Fair devoted nearly the entire text on our exhibit titled 'Rare orchids on display'.

Malayala Manorama and Deepika (Dt. 14 Oct. 1990) wrote short story on *Paphlopedilum druryi* as the title piece of this event.

(b) Other Local Exhibition

TBGRI participated in the Attingal Educational District Science Exhibition at Nanniyode, Panchayat Exhibition at Government U. P. School, Poringamala organised in connection with School Science Day programme and the Cattle Market and Art Exhibition at Palode. The Institute displayed a number of important medicinal and horticultural plants in the above exhibitions.

RESEARCH PUBLICATIONS

Monograph Published

T. S. Nayar (1990) Pollen Flora of Maharashtra State, India PP XII + 150 : 67 plates, 1095 LM and 71 SE M photographs. Today & Tomorrow's Printers and Publishers, New Delhi and Scholarly Publications, Houston, TX 77083, USA. ISBN 81-7019-378-8 (INDIA), ISBN 1-55528-221-0 (USA)

Research Papers published

Bejoy. M, Vincent K. A. & M. Hariharan (1990) *In vitro* shoot regeneration of *Coleus parviflorus* Benth. *Indian J. Pl. Physiol.* 33:175-176.

Krishnan P. N. (1990) Nitrate uptake and Nitrate reduction activity in relation to dwarfism in pearl millet. *Proc. 2nd Kerala Science Congress* pp 69-71.

Latha P. G. & P. Gopinathan Nair (1991) Effect of seed moisture content on radiation induced damage in barley. *Proc. 3rd Kerala Science Congress* pp 116-118.

Seeni S. (1990) Micropropagation of some rare plants at the Tropical Botanic Garden and Research Institute, Trivandrum, India. *Bot. Gard, Microprop. News* 1:16-18.

Seeni S.(1991) Prospects of Commercial cultivation of floricultural crops in rural areas of Kerala. *Proc. 3rd Kerala Science Congress*; pp. 260-261.

Sudha C. G., Babuji M & S. Seeni (1991) Establishment of a rapid clonal scheme for Ashvagandha (*Withania somnifer Dunal*) using Tissue Culture. *Proc. 3rd Kerala Science Congress* pp 345-347.

Vijayakumar K & T. K. Abraham (1991) Rhizosphere fungi of *Dalbergia latifolia*. *Proc. 3rd Kerala Science Congress* pp 353.

Papers accepted

Latha P. G. & S. Seeni (1991) *In vitro* propagation of *Phalaenopsis* TOSI Journal.

Mukunthakumar S. & K. Vijayan (1991) A new record of *Calamus brandisii* Bocc. (Arecaceae) from Kerala Forest. *J. Eco. Tax Bot.*

Papers presented

Bejoy M & M. Hariharan (1990) *In vitro* induction of multiple shoots in soursop (*Annona muricata* Linn.) 7th International Congress on Plant Tissue and Cell Culture, Amsterdam, 24-29 June.

Mathew P J (1991) Arrangement of plants in a herbal garden a practical approach. Workshop on 'Ex-situ Medicinal Plant Conservation' conducted by LSPSS at TBGRI, Thiruvananthapuram. 30th March to 8th April.

Mukunthakumar S. & S. N. Mathur (1991) Micropropagation of *Bambusa vulgaris* and *Dendrocalamus brandisii* International Conference of Plant Physiology, Varanasi 25th January.

Mukunthakumar S., Mathur J. & S. N. Mathur (1991) *In vitro* studies on some economically important Bamboos. International Conference on genetic Engineering, Nepal, April.

Papers Communicated

Seeni S. & P. G. Latha (1990) Foliar regeneration of Red Vanda. *Plant Cell, Tissue and Organ Culture.*

Popular article (Malayalam)

Sathishkumar C. (1990) Rare Orchids of Agasthyamala. Deepika 11th Nov.

Library

In 1990-91 one hundred and twenty books were added to the collection raising the total number of volumes to 4000. Subscription of 75 national and international journals has been made to the library.

Services

This library, as a reference Centre, has been utilized by many scientists and research students from other institutions. Photocopying machine was made available for copying research papers and other articles to scientists and others of our and other institutions.

Special collections

The special collection of books, journals, articles, guide books and other transparencies of botanic gardens, which started in 1987 was enriched further with new additions during this period. The photographs and slides depicting the development of the garden was also added to the existing collection.

Other activities

Sale and distribution of publications of the Institute were done through the library.

METEOROLOGY DATA 1990-91

<i>Month</i>	<i>pre- cipitation mm *</i>	<i>Evapo- ration mm *</i>	<i>Maximum temperature °C **</i>	<i>Minimum temperature C° **</i>	<i>Rela- tive- humidity **</i>
April '90	64.4	254.2	35.6	—	74.1
May '90	416.0	128.9	31.7	—	80.2
June '90	336.2	28.4	29.9	—	84.8
July '90	337.4	34.2	29.0	22.2	87.2
August '90	127.4	57.9	31.0	22.5	84.3
September '90	89.4	99.1	31.9	21.7	82.5
October '90	464.8	70.7	31.1	23.0	89.0
November '90	338.2	85.0	31.1	21.5	83.8
December '90	70.0	152.4	32.3	19.59	80.0
January '91	83.0	150.8	33.4	18.6	74.6
February '91	32.6	187.1	37.7	18.7	75.6
March '91	118.6	182.2	34.6	21.8	74.8
Total	2478.0				

* Total of the month

** Monthly average

Civil Works

Construction of a Pandal and side drain at the nursery, a propagation shed with fibre glass roof near the potting shed and a propagation shed at the Arboretum were completed. Estimate for an Animal House has been prepared.

The following civil works were in progress during the report period :—

1. An open well for supplying drinking water to the new research block.
2. An underground sump near the Bambusetum and another one near the Arboretum and a Pump House near the Guest House.
3. Supplying and laying pipelines at the garden site for the project Ex-situ Conservation of the Rare and Endemic Plants of Agasthyamala.

Staff Changes

The Director of the Institute, Prof. A. N. Namboodiri retired on 31st July 1990. Prof. N. Balakrishnan Nair, Chairman, State Committee on Science, Technology and Environment was officiating as Director until Dr. P. Pushpangadan, Chief Co-ordinator, All India Co-ordinated Research Project on Ethnobiology, Ministry of Environment and Forests, Government of India, Regional Research Laboratory, Jammu took over as Director of the Institute on 12th November 1990.

Sri. R. Appukuttan Asari, Administrative Officer, returned to his parent department on 31st December 1990 and Sri. N. Gopinathan Nair, Under Secretary, Government Secretariat, took charge as Administrative Officer on 10th January 1991.

Staff of the Institute

Director

Prof. A. N. Namboodiri (Up to 31-7-1990)

Dr. P. Pushpangadan (From 12-11-1990)

Deputy Director

Dr. G. Bhadrans Nair

Research and Development*Horticulture & Garden Development*

Sri. Jacob Thomas	Scientist
Sri. Bejoy Mathew	Jr. Scientific Assistant
Sri. C. Anil Kumar	Garden Assistant
Sri. P. A. Jose	Garden Assistant
Sri. R. Raj Vikraman	Garden Assistant

Conservation Biology

Dr. T. S. Nayar	Scientist
Dr. K. C. Koshy	Sr. Scientific Assistant
Sri. C. Sathish Kumar	Sr. Scientific Assistant
Sri. N. Mohanan	Sr. Scientific Assistant
Sri. S. Mukunthakumar	Sr. Scientific Assistant
Sri. P. C. Benoy	Garden Assistant

Ethnobiology & Ethnomedicine

Sri. P. J. Mathew	Scientist
Sri. A. E. Shanavaskhan	Jr. Scientific Assistant
Sri. Mathew Dan	Garden Assistant

Microbiology

Dr. T. K. Abraham	Scientist
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Plant Biotechnology

Dr. S. Seeni	Scientist
Dr. P. N. Krishnan	Scientist
Smt. P. G. Latha	Scientist
Sri. P. K. Sureshkumar	Jr. Scientific Assistant
Smt. C. G. Sudha	Jr. Scientific Assistant

Library

Smt. V. Sujatha	Jr. Library Assistant
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Art/Photography

Sri. K. P. Pradeep Kumar	Artist
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Administration

Sri. R. Appukuttan Asari	Administrative Officer (upto 31-12-1990)
Sri. N. Gopinathan Nair	Administrative Officer (from 11-1-1991)
Sri. C. Sukumara Pillai	Accounts Officer
Sri. K. G. Ajithkumar	Public Relation Officer
Smt. S. Radhalekshmi Ammal	P. A. to Director
Sri. Suresh Chandran	Senior Gr. Assistant
Smt. C. Syamala	Senior Gr. Assistant
Smt. V. Jayasree	Assistant Gr. II
Smt. A. Santha	Typist Gr. I
Smt. G. Subhadra	Typist Gr. I
Smt. C. Gracy	Stenographer Gr. I
Smt. R. Valsala Devi	Part-time Sweeper

Purchase

Sri. C. M. George	Purchase Officer
Smt. R. Sarala Devi	Senior Gr. Assistant
Smt. N. Rajalekshmi Ammal	Typist Gr. I

Engineers

Sri. K. C. Eapan	Consulting Engineer
Sri. P. P. Markose	Engineering Supervisor

Drivers

Sri. M. Ramaswamy	Driver Gr. I
Sri. V. Rajendran Nair	Driver Gr. I
Sri. D. Mohanachandra Kumar	Driver Gr. I
Sri. A. Salim	Driver Gr. II
Sri. R. Gopinathan Nair	Driver Gr. I
Sri. N. Raveendran	Driver Gr. II

Helpers

Sri. R. Bhargavan	Helper Gr. I
Sri. S. Chandran Chettiar	Helper Gr. I
Sri. C. Sathyan	Helper Gr. II
Sri. B. Vijayakumar	Helper Gr. I
Sri. T. Mohanakumar	Helper Gr. II

Field Staff

Sri. Cheriyan P. Koshy	Garden Works Manager
Sri. G. K. Udayadas	Garden Maistry
Sri. P. Mony	Garden Maistry
Sri. K. Selvaraj	Garden Maistry
Sri. J. Micheyal	Garden Maistry
Sri. K. Vijayan	Gardener
Sri. G. Harikumar	Gardener
Sri. N. Salahudeen	Gardener
Sri. T. Jamaludeen	Gardener
Sri. N. Ravindran Nair	Gardener
Sri. U. Hamsa	Gardener
Sri. G. Manoharan	Gardener
Smt. S. Meenakumari	Gardener
Sri. K. C. Thomas	Gardener
Sri. B. Jayakumar	Gardener
Sri. M. Madhusoodhanan Nair	Gardener
Sri. V. Venugopalan Nair	Gardener
Sri. A. Thankappan	Painter

Security

Sri. T. M. Abdul Salam	Security Officer
Sri. V. Raveendran Pillai	Asst. Security Officer
Sri. P. R. Chandrasekharan Nair	Security Guard
Sri. P. Jain	Security Guard
Sri. K. Ramachandran Nair	Security Guard
Sri. A. Johnson	Security Guard
Sri. K. Mohanan	Security Guard
Sri. S. Chandran	Security Guard
Sri. G. Somasekharan Nair	Security Guard
Sri. C. Stanly	Security Guard
Sri. N. Radhakrishnan Nair	Security Guard
Sri. C. P. S. Nair	Security Guard
Sri. S. Viswambharan Nair	Security Guard
Sri. Lazar Joseph	Night Watchman
Sri. M. Bhuvanachandran	Night Watchman

Projects

- Sri. K. Satheesh Kumar, Senior Research Fellow, CSIR
 Sri. C. Muraleedharan Unnithan Research Assistant, STEC
 Sri. K. Vijayakumar, Research Assistant, STEC
 Sri. S. Binu, Research Fellow, STEC
 Sri. K. Sreekumar, Research Fellow, STEC
 Sri. D. Sabu, Research Assistant, STEC
 Sri. M. Rajendraprasad, Research Assistant, STEC
 Sri. A. Jayakumaran Nair, Research Associate, DOEn
 Sri. A. Gangaprasad, Project Fellow, DOEn
 Sri. Japarajkumar, Field Assistant, DOEn
 Sri. G. Rajkumar, Research Assistant, Western Ghats Cell
 Smt. V. S. Usha, Herbarium Assistant, Western Ghats Cell
 Sri. K. Narendran Nair, Plant Collector, Western Ghats Cell

Visitors

1. E. Pelinck, M. Keuken, H. Soree
Netherlands Embassy, New Delhi
2. T. N. Jayachandran
Commissioner & Secretary to Govt. of Kerala
Cultural Affairs Dept., Thiruvananthapuram
3. Dr. K. V. Sundaram, FAO Adviser
4. K. D. Saksena, Adviser, Planning Commission
Govt. of India, New Delhi
5. Dr. S. Mantell and
Dr. Ana Maria
Unit For Advanced Propagation Systems, University of London
(Wye College) Wye, Ashford, Kent, U. K.
6. Prof. N. Balakrishnan Nair, Chairman, STEC
7. Prof. V. K. Damodaran, Director, STEC
8. Dr. Y. L. Gortworst, Director, Geoplan, Holland
9. Meena Singh, Editor, ISOCS, New Delhi
10. Erling Bendsen, Even Bratberg & Darshan Shanker,
John Prag, Indian/Danish Pre-Appraisal
Mission on strengthening Medicinal Resource Base.

Educational Tours from Institutions to the Garden***Colleges***

1. Assumption College, Changanacherry
2. CMS College, Kottayam
3. Sree Narayana College, Varkala
4. Cochin University of Science and Technology, Cochin
5. Vaidyaratnam Ayurveda College, Ollur, Thaikkattussery
6. All Saints' College, Thiruvananthapuram
7. Kerala Agricultural University, Vellayani, Thiruvananthapuram
8. Kelappaji College of Agri. Engineering and Technology, Tavanur-679573, Malappuram
9. Academic Staff College, Kariavattom, Thiruvananthapuram
10. Iqbal College, Peringammala
11. St. Berchman's College, Changanacherry
12. The American College, Madurai Kamaraj University, Madurai
13. St. Peters College, Kolencherry
14. College of Horticulture, Vellanikkara, Thrissur
15. Karnatak University, Karnataka
16. Bharathidasan University, Tiruchirapalli
17. College of Co-operation and Banking, Mannuthy, Thrissur
18. St. Teresa's College, Cochin
19. Mar Ivanio's College, Thiruvananthapuram
20. S. N. M. College, Mallankara
21. Ayurveda College, Thiruvananthapuram.
22. Mahatma Gandhi College, Thiruvananthapuram
23. Sacred Heart College, Thevara, Cochin
24. Sree Narayana College, Quilon

Schools

1. Government L. P. S., Muttacaud.
2. S. P. T. P. M. Government U. P. S., Kuravankonam.

3. Arippa U. P. S., Chozhiacodu, Kulathupuzha.
4. S. N. V. High School, Anad, Nedumangad.
5. Government High School, Karippoore, Nedumangad.
6. Sivagiri High School, Sreenivasapuram, Varkala.
7. Kerala Forest School, Arippa.
8. V H S E, B. H. S., Attingal.
9. Jawahar Navodaya Vidyalaya, Vechoochira.
10. Panchayat High School, Puduppariyaram, Palghat District.
11. N. S. S. High School, Edanadu, Chengannur
12. Government High School for Boys, Kottarakkara
13. S. K. V. H. S., Nanniyode.
14. Government Model High School, Thiruvananthapuram.
15. Girls High School, Mithrummala, Thiruvananthapuram.
16. Karthika Thirunal Government Girls High School, Manacaud, Thiruvananthapuram
17. T. M. T. High School, Thalavady, Neerattupuram.

Others

1. Siva & Subbu, Chalai, Thiruvananthapuram
2. Staff Members of Electrical Major Section, Kilimanoor.
3. Sasthra Sahithya Parishath, Bharathannur Unit.
4. St. Mary's Catholic Mission, Vattakarikkam, Pacha.
5. F. A. C. T. , Marketing Division, Udyogamandal, Cochin.
6. Residents Arts and Sports Organization, Melarannur, Karamana, Thiruvananthapuram
7. Nadana Youth Club and Reading Room, Gandhipuram, Sreekariyam, Thiruvananthapuram
8. Marthoma Centre, Nedumangad.
9. Marthoma Centre for Rehabilitation and Development, Kolabhagom P. O. 689545
10. The Pharmaceutical Corporation, Kerala Ltd., Thrissur
11. Gospel Team, Church of God in India, Thiruvananthapuram

12. A. K. G. Nagar Residents Association, Peroorkada, Thiruvananthapuram
13. Church of South India, South Kerala Diocese, Nedumangad
14. Mitraniketan, Vellanad, Thiruvananthapuram
15. Jayamatha Training Institute, Nalanchira, Thiruvananthapuram
16. Bethany Ashram, Nedumangad
17. St. Xavier's Church, Vattappara, Thiruvananthapuram
18. The Rajagiri Rubber and Produce Company Ltd., Punalur
19. Allahabad Agricultural Institute, Allahabad
20. National Library, Keezhpalur, Vinobaniketan
21. Akila India Siddha Maruthuva Kazhagam, Kottar, Nagercoil
22. State Bank of Travancore, Kilimanoor
23. Patanjali Yoga Vedanta Ashram, Alancode, Nedumangad, Thiruvananthapuram
24. Kerala Sasthra Sahithya Parishath, Kidarakuzhi Unit
25. St. Thom Marthoma Church, Kidangannur
26. English Service Institute, Nanniyode
27. National Library, Vinobanikethan, Aryanad
28. C. S. I. Day Care Centre, Idinjar
29. Institute of Management in Government, Thiruvananthapuram
30. Krishi Vignan Kendra, Gandhigram Rural Institute, Tamil Nadu
31. Free Men's Club, Peroorkada, Thiruvananthapuram
32. Elankom Gardens Residents' Association, Thiruvananthapuram
33. Bose Institute, Plant Molecular and Cellular Genetics, Calcutta
34. Kerala University Women's Club, Thiruvananthapuram
35. Govt. Teacher Training Institute, Malappuram
36. P. T. P. Nagar Women's Club, Thiruvananthapuram
37. Kairali Grandhasala, Quilon

