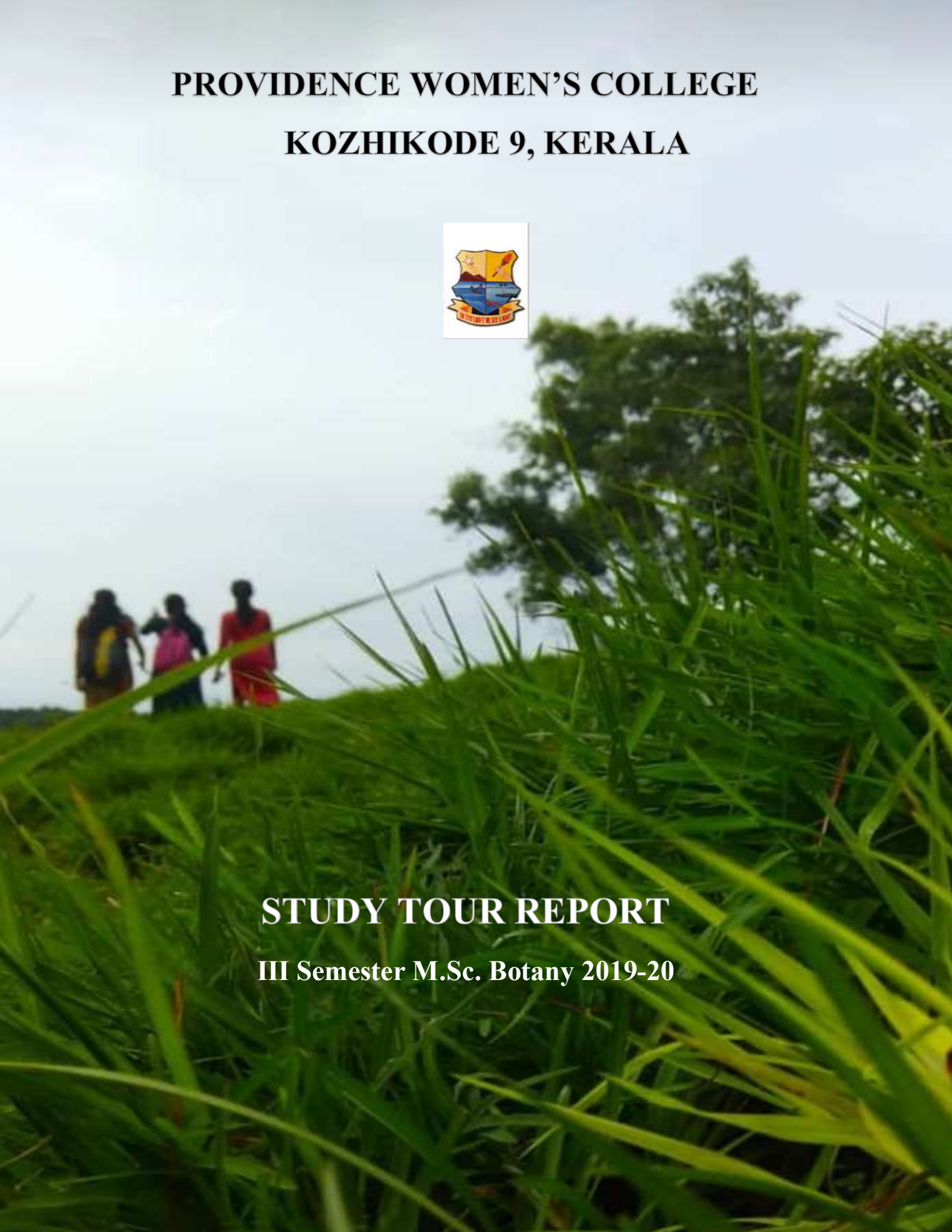
Experential Learning

- *Paryavarna*: Field visits for a better understanding of the environment
- Visits to Herbaria and Research Stations
- Demonstrations and Project works
- Management fest
- *Srishti*: Entrepreneurship Development club

PROVIDENCE WOMEN'S COLLEGE

KOZHIKODE 9, KERALA



STUDY TOUR REPORT

III Semester M.Sc. Botany 2019-20

DEPARTMENT OF BOTANY
PROVIDENCE WOMEN'S COLLEGE

CERTIFICATE

Certified that this is an authentic report of the field trips / study tours conducted by Ms.……..……..…….. (Reg No. **PWASMBT**……..,) of III Semester M.Sc. Botany, Providence Women's College, during 2018 - 20, as part of the curriculum of Third Semester of the M.Sc. Botany Programme of the University of Calicut.

Examiners:

1

2

REPORTS OF
VISITS TO HERBARIA/BOTANICAL MUSEUMS

INTRODUCTION

Study tours are important, as these trips emphasize the attentive mind, enabling a sense of discovery and a quality of quietness. Nature is vast and its beauty extends beyond the pages of our books and classrooms. Field study is a necessity as it gives us a firsthand knowledge of the highly variant vegetation as well as their natural habit and habitats. The distribution of diverse varieties of plants in different regions and a study based on their distribution is always quite interesting.

OBJECTIVES OF THE FIELD TRIP

1. To broaden student's horizons and knowledge through field observations
2. To impart training for direct observation of specimens in their habitat
3. To study different ecological habitats and the associated flora.
5. To explore the possibility of getting motivated to pursue research
6. To strengthen the healthy relationship among students, and between students and teachers.

❖ VISITS TO HERBARIA

1. Calicut University Herbarium (CALI)

We visited Calicut University Herbarium on 29 November 2018. This houses more than 28000 specimens. This covers mainly families like Araceae, pteridophytes, Malvaceae, Cyperaceae, Asteraceae, and Zingiberaceae. Specimens from India, especially Calicut, Silent Valley, Malabar Coast, Agasthyamala, Nilambur forests, Vellarimala, and Wayanad are kept here.

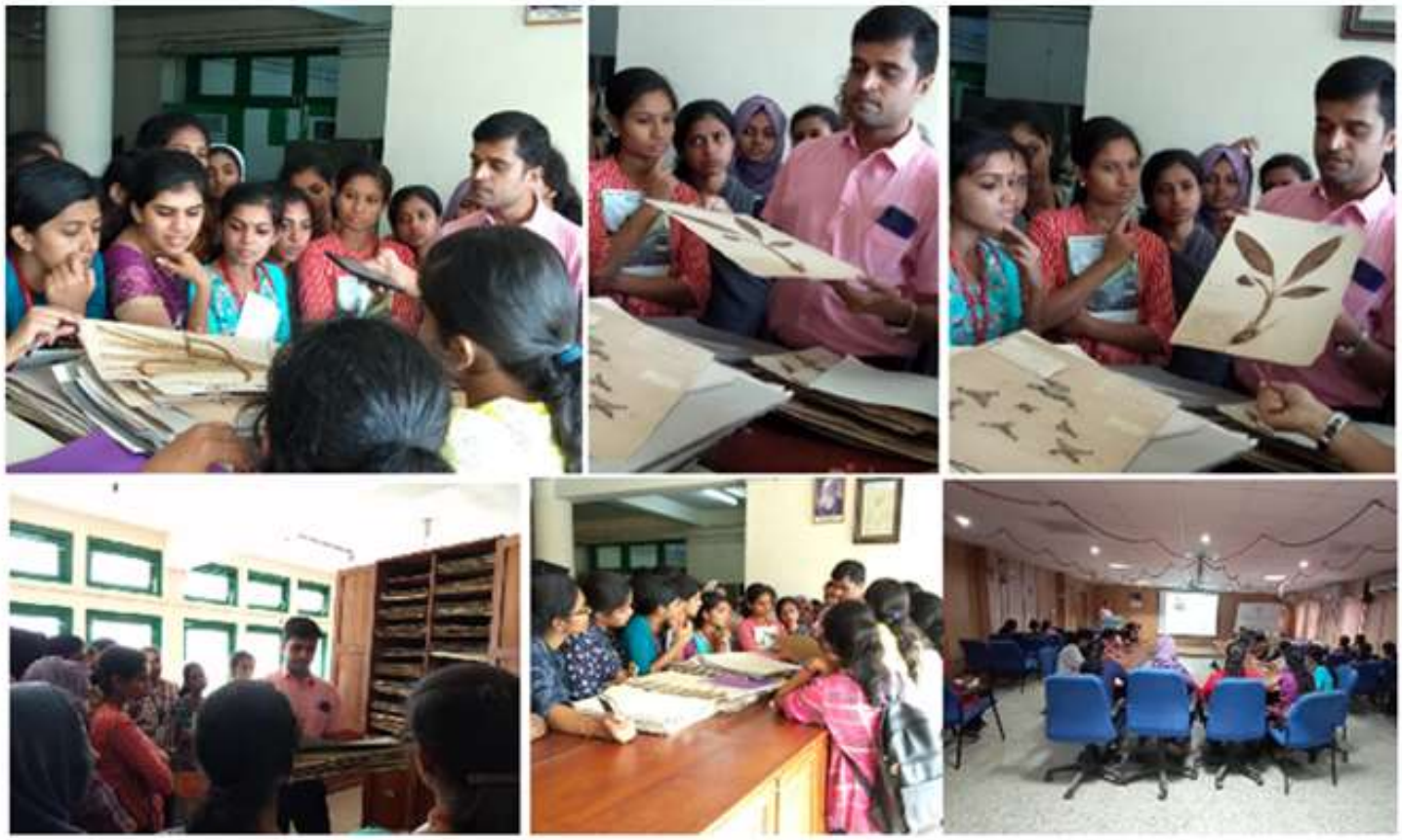
2. Madras Herbarium (MH), Botanical Survey of India, Coimbatore.

We visited Madras Herbarium (MH) on 4 February 2019. This is one of the oldest and renowned herbaria of the world housing many valuable classical collections of Rottler, Hooker & Thomson, Wight, Bourdillon, Beddome, Lawson, Barber, Gamble and Fischer. Besides the collections from Southern India, this herbarium also has specimens from the Indian subcontinent and of Europe, Africa, Australia, North & South America. The Madras Herbarium was established by Dr. HF Cleghorn in 1853. This was transferred from Madras to Coimbatore under agricultural department in 1909. Madras Herbarium was taken over by Botanical Survey of India in 1957.

The most significant feature is the possession of 2594 types representing about 800 taxa including about 300 from Sri Lanka. It houses a vast number of type specimens. At present, MH offers services like determination of plant specimens, supply of herbarium specimens, exchange of herbarium specimens, loan of herbarium specimens for monographic/ revisionary works, training in herbarium methodology, taxonomic advisory services etc.

Calicut University Herbarium

Madras Herbarium



❖ VISITS TO BOTANICAL MUSEUMS

Museum of BSI

We visited the museum of BSI on 13th January 2020. It has a huge collection of dried plant specimens including carpological specimens.






REPORT OF VISIT TO
TWO NATIONAL CROP RESEARCH INSTITUTES

M.Sc Botany (2019-2021)
Semester IV

Elective paper II:
Pathology of plantation crops and spices

PROVIDENCE WOMEN'S COLLEGE
UGC-College with Potential for Excellence; Reaccredited by NAAC with A+ grade (GP 3.52)
Affiliated to the University of Calicut
KOZHIKODE, KERALA 673 009, INDIA
www.providencecollegecalicut.ac.in

REPORT OF VISIT TO

CROP RESEARCH STATIONS

- MAJOR PLANT PROTECTION ACTIVITIES

(AT ICAR- INDIAN INSTITUTE OF SPICES RESEARCH, KOZHIKODE

And

ICAR-CENTRAL TUBER CROPS RESEARCH INSTITUTE, TRIVANDRUM)

REPORT OF VISIT TO

ICAR- INDIAN INSTITUTE OF SPICES RESEARCH, CALICUT, AND

ICAR-CENTRAL TUBER CROPS RESEARCH INSTITUTE, TRIVANDRUM

This is to certify that the report of visit to 2 crop based research institutions, submitted by Ms.…… ……..., M.Sc Botany (2019-2021), Reg No. ……..., is the report of virtual visit conducted as part of the curriculum.

Examiners

1.

2.

CONTENTS

ICAR- INDIAN INSTITUTE OF SPICES RESEARCH

The Indian Institute of Spices Research (IISR), Kozhikode(Calicut) a constituent body of Indian Council of Agricultural Research (ICAR) is a major institute devoted to research on spices. In 1976, it started as a Regional Station of the Central Plantation Crops Research Institute(CPCRI), Kasaragod engaged in research on spices. IISR research is guided by science with a human touch. By giving a human touch to agriscience, IISR dedicates its work to the farmers and spice industry of the nation. IISR has been recognized for its contributions to the nation by being awarded Sardar Patel Outstanding ICAR Institution Award, twice. The Department of Biotechnology, Ministry of Science and Technology, Government of India under its national certification system for tissue culture raised plants (NCS-TCP) has recognized IISR as its Accredited Test Laboratory, to provide support to Tissue Culture industry to facilitate production of quality planting material through tissue culture/ micropropagation. The organization of the laboratories, infrastructure is inspiring..

THE DIVISIONS

A. **Crop Improvement and Biotechnology Division** possesses world's largest germplasm collection in various spices. A total of 25 high yielding and high quality spices varieties have been released. Vegetative and micro propagation techniques were standardized. The Division has had a long and lustrous history that spans some 40 years. Since its inception, the Division has provided a home to innovative scientists who had made it their lives' work to reduce poverty through spices crop improvement research and significant advancements in spices science and technologies
B. **Crop Protection Division** focuses on undertaking research on plant pathogens, insects and plant parasitic nematodes and provides specialized services to the spice growers to protect their plants from pests and diseases. The Division is very strongly focused on developing eco-friendly, integrated management schedules to minimize the use of pesticides and reduce their risk, to obtain safe and clean spices.
C. **Division of Crop Production and Post Harvest Technology** focus on the development of suitable spice based cropping/farming systems, GIS and crop modeling based on microclimatic factors, production of quality planting material, organic farming, efficacy of biofertilizers, Integrated Plant Nutrient Management, identification of drought tolerant varieties, evaluation for high quality lines, basic studies on the biosynthesis of secondary metabolites, characterization of bioactive principles in spices and post harvest processing techniques in spices.
D. **The Social Sciences Division** deals with research pertaining to Statistics, Economics and Extension. It also manages the services of Agricultural Technology Information Center; a single window delivery system of technology inputs and products of the institute. The thrust areas of research include impact studies of institute services and technologies amended through research, development studies, computer and statistical applications in spices research through Agricultural Knowledge Management Unit(AKMU).

CENTRALIZED FACILITIES: There are Centralized Molecular Biology facility, Biochemistry laboratory, Soil Chemistry laboratory, plant protection lab, GCMS lab, Biocontrol facility, Bioinformatics lab etc. Various fields of scientific studies and practical works are going

on and updated. New varieties of plants with high yield and specifically high tolerant are studied at molecular level and coming up with great benefits to farmers.

MANDATES OF THE INSTITUTION

- Conserve genetic resources of spices and soil, water and air of spices agro ecosystem.
- Development of high yielding and high quality spice variety and sustainable production an protection system using traditional, and novel biotechnological approaches
- Develop post harvest technologies of spices with emphasis on product improvement and product diversification for domestic and export purposes.
- Act as a center for training and technology upgradation and coordinate national projects.
- Adoption of new technologies and research are targeted to the farming community.
- National center for storage, retrieval and dissemination of technological information.

MANDATE CROPS

The major spice crops on which research is being conducted at the institute included,

1. Black pepper (*Piper longum* Linn.)
2. Cardamom (*Elettaria cardamom*um Maton)
3. Ginger (*Zingiber officinale* Rosc.)
4. Turmeric (*Curcuma longa* Linn.)
5. Cinnamon (*Cinnamomum verum* J.Presl)
6. Nutmeg (*Myristica fragrans* Houtt.)
7. Cloves (*Syzygium aromaticum* Merr.& Perry)
8. Garcinia (*Garcinia indica* Choisy)
9. Vanilla (*Vanilla planifolia* Jacks.ex.Andr)

REPORT OF THE CROP PROTECTION LABORATORY AT IISR- INDIAN INSTITUTE OF SPICES RESEARCH

The Crop Protection Division focuses on undertaking research on plant pathogens, insects and plant parasitic nematodes and provides specialized services to the spice growers to protect their plants from pests and diseases.The Division is very strongly focused on developing eco-friendly, integrated management schedules to minimize the use of pesticides and reduce their risk, to obtain safe and clean spices

Major Achievements

Over the last three decades the Division has established the etiology and epidemiology of major diseases of spices, surveyed the spice growing areas of the country and catalogued the major pests and pathogens and developed integrated pest/disease management measures to control them. In pursuit of clean spices without any pesticide residues, the Division is actively engaged in developing pest/disease resistant lines and biocontrol agents that suppress the pathogens. Notable among the resistant lines developed are IISR Shakti (*Phytophthora* resistant black pepper line), Pournami (root knot nematode resistant black pepper line), IISR Vijetha ('*Katte*' resistant cardamom selection), IISR Avinash (rhizome rot resistant cardamom line), IISR Mahima (root knot nematode resistant ginger selection) and IISR Pragati (root knot nematode tolerant turmeric selection). The efficient strains of biocontrol agents developed by the Division like *Trichoderma harzianum*, *Pseudomonas* spp., *Pochonia chlamydosporia*, *Lecanicillium psalliote* etc. are quite popular among the farming community and are successfully commercialized. Highly reliable and sensitive diagnostic tools have been standardized for rapid detection of viruses, bacteria, fungi and nematodes infecting spices.

Research Programs

The major problems handled by the scientists of the Division are Phytophthora foot rot, slow decline, anthracnose, viral diseases of black pepper, rhizome rot and viral diseases of cardamom, soft rot and bacterial wilt of ginger, foliar diseases of turmeric and diseases of vanilla. Besides, insect and nematode problems of these spices are also addressed. Some of the ongoing research projects are:

Bio-Intensive management of pests in spices

- Survey and documentation of naturally occurring entomopathogens in spice cropping systems
- Outreach programme on management of sucking pests in horticultural crops
- ICAR-Consortium research project on borers in network mode

Integrated management of fungal and bacterial diseases of spices

- Integrated management of Phytophthora foot rot and slow decline diseases of black pepper
- Surveillance, documentation and development of decision support system for pests and diseases of major spice crops
- Spatiotemporal dynamics in relation to ecology and epidemiology of fungal foliar diseases in ginger and turmeric and management
- Revisiting wilt diseases of vanilla and exploitation of associated microbiome for its management

Diagnostic kits and integrated management of viral diseases of spices

- Identification, characterisation and development of diagnostics for unknown viruses associated with cardamom and ginger
- Characterization of episomal and endogenous pararetro-viruses infecting black pepper
- Development of microbial biostimulants for growth promotion and disease resistance in major spices
- Novel strategies for managing bacterial wilt and soft rot diseases of ginger
- Prevalence of lesion nematodes in turmeric growing tracts of India and their economic significance

Major Facilities

- The National Repository of Phytophthora
- Repository of biocontrol agents
- Accredited virus indexing facility
- Molecular plant pathology lab
- Insect biocontrol laboratory
- Nematology laboratory

TECHNOLOGIES DEVELOPED FOR COMMERCIALIZATION

A novel method of storing and delivering PGPR/ Microbes through biocapsules

- Easy and reliable technology of storing and delivering PGPR bioagents in hard gelatin capsule termed as biocapsule. It is a preparation of viable microbial agents in a capsule form.
- Technology details handed over to AgrInnovate India ltd. and ABI, ICRISAT for commercialization. Process for PCT filing is initiated.
- 20 capsule as against 20 kg of talc formulation.

- Applicable to all kinds of PGPR/ microbes.
- Enhances nutrient mobilization and use efficiency, growth and yield and provides protection against diseases at a negligible cost.
- Ecologically safe technology (no harmful byproducts, less amount of inorganic and inert material) with reduced cost of production.
- Easy transportation.
- Reduces the manpower requirement due to longevity of product.
- Does not require any refrigerated condition for storage, hence save energy.

Seed coating technology for seed spices

- The present technology is a novel process of coating efficient strains of PGPR on seed spices. The components consist of live plant growth promoting rhizo bacteria(PGPR),inert material and a binding agent. The process of coating is done at particular temperature which is congenial for the organisms to survive and the coated seeds can be stored at room tempeature.
- Commercialization in the process, selection of entrepreneurs done. Trials are being conducted in vegetables and other crops in collaboration with Kerala Agricultural University. Indian patent filed.
- Applicable to all kinds of seeds (seed spices, horticultural crops) with different PGPR/ bio-control agents.
- Less quantity of seed requirement.
- Free from any storage pest incidence.
- Enhances yield from 15 to 30% compared to uncoated seeds.
- Reduces the use of weedicides.
- Can be used in organic farming (eco-friendly).
- Huge potential in seed industry.

BiocontrolAgent – *Trichoderma*

Technology Name : Biocontrol agent- *Trichoderma harzianum.*

- For management of Phytopthorafoot rot and slow wilt diseases of black pepper, and rhizome rot of cardamom and ginger.
- Bioformulationbased on Trichodermaharzianumis made in sterilized talc powder containing minimum population of 108 CFU/gram and can be stored up to 3 months without significant reduction in viability. In black pepper 50 gram of the formulation is mixed with well decomposed farmyard manure or compost and applied to basin of the vine in the field twice a year during May-June and September-October.
- 22 companies has taken license for 1 yr agreement @Rs 1 lakhincluding toxicology data
- Rate of return: Rs. 7.5lakh/10 tonnes.
- Cost benefit: 1:3 (approx.)
- For an optimum output of 10 tonnes of biocontrolmaterial, an initial investment of Rs. 50,00,000/-is required for developing infrastructure facilities including building and equipment cost. For further production only input cost (raw materials and labour charges) is required

BiocontrolAgent – *Pochonia*

Technology Name : Biocontrol agent- *Pochoniachlamydosporia.*

- For management of root knot nematode(Meloidogyneincognita)infesting black pepper plants in nursery and field.

- Bioformulation based on *Trichoderma harzianum* is made in sterilized talc powder containing minimum population of 108 CFU/gram and can be stored up to 3 months without significant reduction in viability. In black pepper 50 gram of the formulation is mixed with well decomposed farmyard manure or compost and applied to basin of the vine in the field twice a year during May-June and September-October.
- Biocontrol agent / biofertilizer manufacturers, Farmers and corporate houses who own plantations,Traders who are involved in biofertilizer / bioagents marketing and horticultural / agriculture departments.
- Rs 1 lakhincluding toxicology data (negotiable).
- Rateofreturn:Rs.7.5lakh/10tonnes.
- Costbenefit:1:3(approx.).
- For an optimum output of 10 tonnes of biocontrol material, an initial investment of Rs.50,00,000/- is required for developing infrastructure facilities including building and equipment cost. For further production only input cost(raw materials and labour charges) is required.

Diagnostics for viruses infecting black pepper and cardamom

- Detection of two viruses (Cucumber mosaic virus and Piper yellow mottle virus) infecting black pepper in a single step using the multiplex-PCR, for production of certified virus-free plants.
- The method uses a single tube multiplex reverse transcription (RT) coupled (Polymerase chain reaction) PCR assay (mRT-PCR) for simultaneous detection of two viruses (Cucumber mosaic virusand Piper yellow mottle virus) infecting black pepper.
- Tissue culture companies and nurseries involved in black pepper planting material production.-50 Rs/ rn.
- Investment Required (1) + (2).
    1. Fixed Capital:
       Land & Building: Would vary
       Machinery & Equipment: 25 lakhs
    2. Working Capital:
       Raw Material and packaging material
       Utilities (Water, Electricity, Steam etc):
       Other Contingencies: (Maintenance)

Microbial consortium for black pepper-Talc formulation

- It can be applied both in black pepper nurseries and under field condition as soil drench. Roots when dipped in microbial formulation improves rooting and performance of plants.
- It can be applied both in black pepper nurseries and under field condition as soil drench or along with FYM. Roots when dipped in microbial formulation improves rooting and performance of plants

PGPR Talc formulation – Ginger

- GRB 35 - *Bacillus amyloliquefaciens* NCBI (FJ493538).
- Suspend 100g of PGPR talc formulation (109CFU/g) in 10 liters of water. Soak 5Kg of ginger rhizome bits(30g)in PGPR suspension for 1 hr prior to planting.
- The soaked rhizome can be planted on prepared beds. Drench the remaining suspension on ginger beds as a booster dose (1liter/bed).

- A second booster dose of PGPR can be given as a soil application at the rate of 1kg of talc formulation / ha as soil drench.
- This PGPR formulation is applied to rhizomes prior to planting. Booster doses of the same PGPR is given as soil drench either alone or with FYM. It enhances nutrient mobilization and use efficiency, growth and yield and provide protection against diseases at an Negligible cost.

ICAR-CENTRAL TUBER CROPS RESEARCH INSTITUTE, TRIVANDRUM

The ICAR-Central Tuber Crops Research Institute (ICAR-CTCRI) under the aegis of ICAR, solely involved in R&D activities of tropical root and tuber crops, started functioning at Thiruvananthapuram, Kerala in 1963. In order to address the issues of tuber crops and promote their development in the northern and eastern States of India, a Regional Centre of the Institute is also functioning in Bhubaneswar, Odisha. Besides, the All India Coordinated Research Project (Tuber Crops) is making concerted effort in creating awareness on the vast diversity and potentiality of tuber crops as a food and industrial crop in the traditional as well as non-traditional areas of the country and specially in the North-East India. The non-traditional crops like cassava and elephant foot yam are becoming popular in special pockets due to the efforts made by AICRP (TC). Improved varieties like Sree Vijaya in cassava and Gajendra in elephant foot yam which were introduced by the AICRP (TC) have now become very popular among farmersimmense nutraceutical value of tuber crops due to its anthocyanin and carotenoids content has so far not been exploited. Cassava cultivation is expanding to non-traditional areas of India especially in view of its new found importance as a industrial crop. However, there is a need to develop suitable varieties as well as management practices for these regions to enhance the productivity of the crop. Presently, there is a loosely knit linkage between the research, extension and clientele system in the case of tuber crops. There is no well defined Government policy for root and tuber crops development, both at Central or State Government levels except for 2 to 3 States. On the contrary in countries like Thailand and Indonesia, the major root crop viz.,cassava receives adequate development support from Government, both policy and finance-wise. In order to synchronize production of tuber crops with marketing, it is necessary to open new avenues for its better utilization, under the present context where traditional uses have almost stabilized. Tuber crops as such provide a vast scope for diversification and value addition and there lies a great opportunity for non-traditional uses of tuber crops in the form of convenience foods, functional foods, biofuels, starch based innovative products like biofilms, thermofoams etc. Agriculture is not just a commercial profession in India; it is a tradition in rural India. It takes longer time to make an appreciable change in the traditional way of agriculture being practiced in India. Moreover, the gestation period for agricultural technologies is considerably higher necessitating advance planning of work strategy to effect a desirable change in future. The Vision 2050 contemplates the realization of the above objectives to match with the global projections so that this group of crops could contribute to the energy and nutrient requirement of people living in tropical and humid tropics of India, simultaneously enhancing their socio-economic status. A greater thrust is needed in policies and programmes which support research, extension and value chain management, besides a concerted effort to bring down the cost of cultivation of tuber crops and expand their utilization spectrum which will help in the sustainable development of these crops in India.

Research on tropical tuber crops is the primary mandate of ICAR-CTCRI. Each division ICAR-CTCRI concentrate its research programmes on separate aspects of tuber crops. Crop improvement division focus its activities on collection germplasm of different tuber crops from different parts of the world and conserving it in field gene bank as well as in vitro. Development

of new varieties of tuber crops with higher yield and other attributes suitable for industrial applications as well as for food purpose is another important activity of this division. Crop production division is engaged in developing new agro techniques for tropical tuber crops in different agro climatic regions. Crop protection division develop strategies and products for managing pests and diseases affecting tropical tuber crops. Crop utilization division concentrates its activities on value addition and post harvest processing of tropical tuber crops. Section of Extension and social sciences is involved in transferring the technologies developed by ICAR-CTCRI to its clienteles.

Enhancing food security and sustainable livelihoods in the North-Eastern India through tuber crops technologies

Tuber crops play a crucial role in the food and nutritional security of the people living in the North-Eastern India. Though tuber crops are found in most of the homesteads under multiple cropping systems in this Region viz., homestead and mainly in Jhum areas. No systematic effort was undertaken to improve the efficiency of these production systems by careful application of improved tuber crops technologies. This project was implemented to enhance the food, nutritional security and livelihood of people in North-Eastern Region by careful application of improved tuber crop production and processing technologies. To start with the project was implemented in four NEH states namely Manipur, Meghalaya, Meghalaya and Nagaland. The project is in operation on partnership mode. The major partner of the project is ICAR Research Complex for NEH region (ICAR NEH) apart from partnership with Agriculture Department, Nagaland and Non government Organisations which include Ukhrul District Community Resource Management Society, Manipur, Volunteers for Village development, Ukhrui, Manipur, Shiba welfare, Nagaland , Divodhya Krishi Vignan Kendra(Sri Ramkrishna Seva Kendra, Kolkata) . Through the partners the project is executed by 10 implementing centres.

PLANT PROTECTION ACTIVITIES

Development of plant protection technologies for tuber crops is the mandate of this division. Research on various diseases and pests affecting tuber crops is the major activity. The areas affected by different pests and diseases are visited by the experts of the division and the methods to solve the problems are recommended and demonstrated for the benefit of the farmers. Biotechnological approaches for managing important viral diseases like cassava mosaic disease is one of the major research works going on here. The division had developed biopesticides from cassava leaves and it is being sold to farmers at a very nominal rate.

Activties

Some of the biotic stresses include cassava mosaic disease, sweet potato weevil, taro leaf blight, yam anthracnose disease and nematodes in yams, collar rot and viral diseases in elephant foot yam and the abiotic stresses include water and salinity stress, water logging, inconsistency in tuberization in sweet potato etc. Although these have been addressed in the earlier Plan years, there is the need for concerted research in the new context of climate change and increasing understanding of the mechanisms of spread of diseases using biotechnological approaches. Underutilization of biodiversity and genetic erosion as well as poor protein and vitamin content

in cassava are problems hitherto not well understood and need greater research efforts.Emerging pests and diseases due to climate change and introduction of invasive pests and pathogens are also main challenges. Appropriate technologies to contain such biotic stresses have to focus on refined eco-friendly methods. Availability of healthy planting material, particularly cassava free from mosaic disease is a challenge to meet the emerging demands. In vitro elimination of cassava mosaic virus, sweet potato feathery mottle virus, yam mild mosaic virus and dasheen mosaic in elephant foot yam have to be standardized using meristem and nodal culture combined with chemotherapy and thermotherapy. Strategy for mass multiplication of disease free planting materials has to be improvised. Production of large quantities of polyclonal antibodies and developing cost effective, easy and sensitive diagnostic kits for indexing the planting materials are necessary. Also some of the important fungal diseases like cassava tuber rot, collar rot of elephant foot yam, taro blight and yam anthracnose are disseminated through planting materials and soil. Efforts to provide healthy planting material by employing diagnostic techniques to identify pathogens are in progress and this needs to be strengthened. Pests and diseases of tropical tuber crops in farmers' fields are being monitored continuously to observe the occurrence of new biotic threats. This has to be continued to generate data for their effective management and prediction. The quarantine measures could be strengthened to avoid invasive pests. Significant pests and diseases are to be identified and by developing the prediction model, decision support system could be made available to farmers.

The tropical tuber crops are highly vulnerable to viral diseases and non-availability of disease free planting material to the farmers are of great concern in realizing the full potential yield of these crops. Hence special emphasis has to be given for identification and characterization of pathogens, development of diagnostic kits/ techniques and production of virus free mother plants of all tuber crops for mass propagation.

Ready-to-use diagnostic kits have to be developed for important viral diseases with special emphasis on cassava mosaic disease, sweet potato feathery mottle virus, sweet potato leaf curl, mosaic in elephant foot yam and other edible aroids, yam viruses and fungal diseases, viz., cassava tuber rot, elephant foot yam collar rot, taroleaf blight and yam anthracnose. New molecular detection techniques like microarray LAMP, utilization of nanotechnology for quick diagnosis etc. will also be explored. Production of polyclonal antibody for detecting viral and fungal diseases in large quantities and development of ELISA kit are the prime target in this plan. Pathogen specific primers are to be designed for PCR based detection of these diseases.

Studies have been carried out for biointensive management of important fungal diseases of tropical tuber crops and cassava mosaic disease. Nevertheless, large scale multiplication and delivery of bio control agents have to be improved. Further, studies on the effect of endophytes, vermicompost and other organic/bioproducts for the development of IDM for the management of important diseases should be addressed. Parasitoids and pathogens in combination with sex pheromones and semiochemicals should be utilized for sweet potato weevil management. The potential of natural enemies for biocontrol, especially in view of environmental pollution and health hazards of people, has to be exploited to control sweet potato weevil, cassava whitefly, cassava spiraling white fly, and storage pests. Formulation of the biopesticide extracted from cassava with other plant products, compatibility study of the biopesticides with synthetic insecticides, exploring the utility of the biopesticides against other field and stored- product insect pests etc. need further thrust during XIIthPlan. The role of endosymbionts in insect vectors has to be delineated to have a clear understanding of the mechanism of disease transmission.

Cassava mosaic disease being the most important disease problem in cassava, efforts to develop of transgenic cassava with resistance against cassava mosaic virus will be continued through different strategies and confirmation of resistance in transgenic cassava plants develoPed against cassava mosaic virus through challenge inoculation and clearance as per the bio-safety rules for further field trials. Apart from this, transgenic approach needs to be explored for developing resistance against dasheen mosaic virus, sweet potato weevil, taro leaf blight and viral diseases of taro and sweet potato etc. RNAi technology will also be utilized for pests and diseases management. Resistant gene mapping also needs to be done to facilitate marker assisted selection of breeding materials against major pests and diseases.

Cassava based biopesticides have been developed against papaya mealy bug, Aphids, Borer pests like Red palm weevil and storage pests, viz., Sitophilus oryzae, Rhizopatta dominica .The pilot plant for production of biopesticide has been installed in the institute

Crop rotation studies showed that paddy – sweet potato – cowpea can minimise weevil damage in sweet potato. A very effective IPM package with synthetic sex pheromone as the main component has been demonstrated successfully in 9 states for the control of sweet potato weevil. In addition a kairomone, Boehmeryl acetate, present in the periderm of sweet potato tubers promise in its control attracting both male and female weevils.

Natural enemies were identified for tuber crop pests viz. Scolothrips indicus and Coccinellid predators on spider mites, Encarsia spp and Eretomocerus spp on whitely. Biotypes of Bemisia tabaci have identified for the first time. Spiralling whitefly infestation was found to be severe in the cassava areas of Tamil Nadu where it has industrial importance.

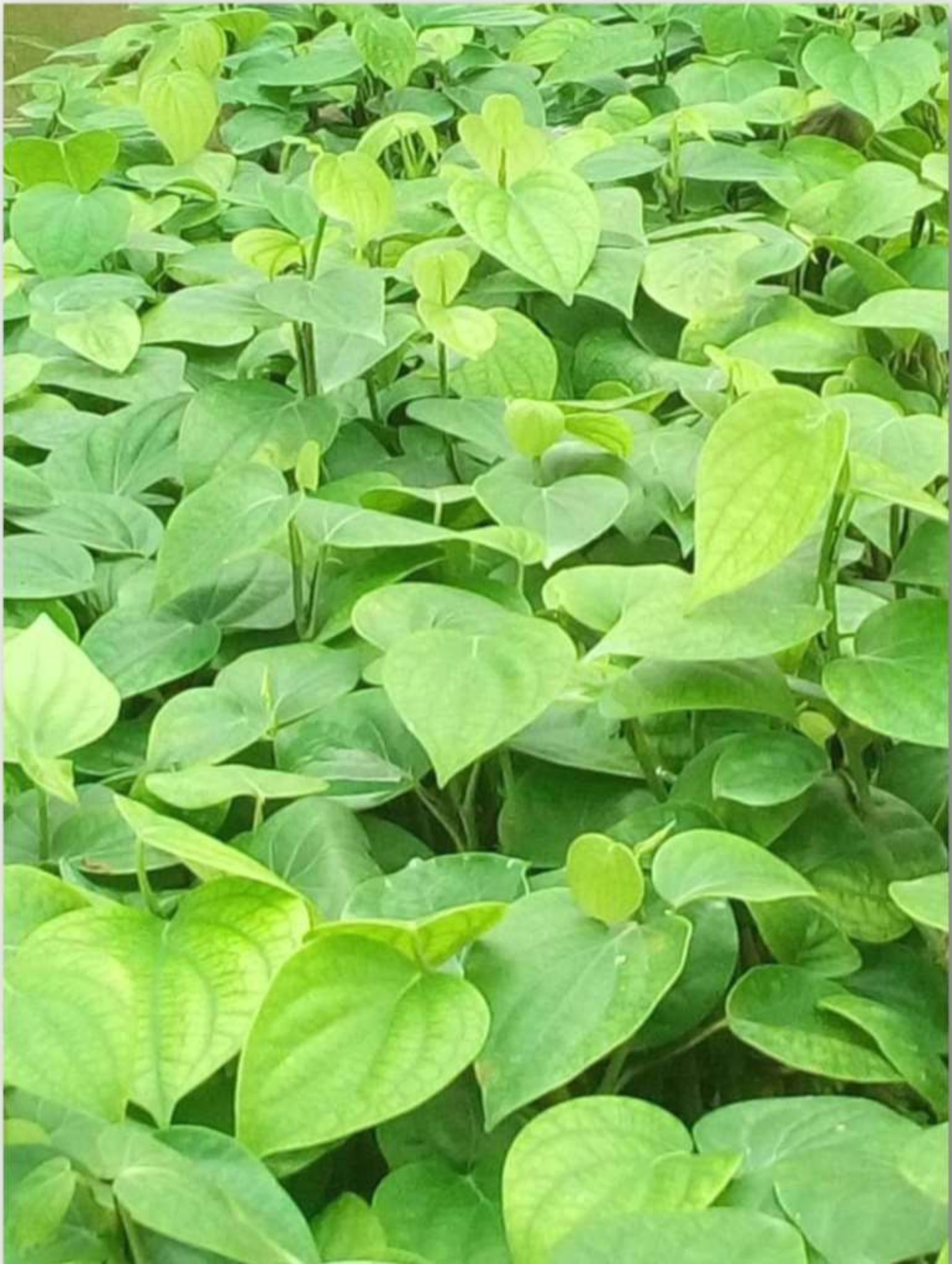
A process for enhancing shelf life of EPN has been developed and an EPN formulation has been standardized which is effective against ants, red ants and mealy bugs associated with them and termites found in and around houses, farms and lawn. Patent filed on "An entomopathogenic nematode for the effective biocontrol of ants and termites and their storage and packing for marketing.

Three bioactive molecules from the bacterial metamolite isolated from EPN effective against fungi (Fusarium oxysporum and Rhizoctonia solani) were purified, identified and their structure elucidated. These are also effective against human pathogenic bacteria and fungi. Ninteen bioactive molecules were separated and purified. Four have been registered for patenting

CROP PROTECTION PROJECTS

Eco-friendly strategy for the management of insect pests in tuber crops

Development and refinement of integrated disease management and forecasting system for improved tuber crop production



REPORT OF

VISIT TO A TISSUE CULTURE LABORATORY & COMMERCIAL TISSUE CULTURE UNIT

MSc Botany 2019-21

Elective I:

Plant Tissue Culture

PROVIDENCE WOMEN'S COLLEGE

FLORICAN HILL, MALAPARAMBA, KOZHIKODE 9

(Reaccredited by NAAC with A grade)

e mail: providencecollegecalicut@gmail.com

DEPARTMENT OF BOTANY

PROVIDENCE WOMEN'S COLLEGE,

KOZHIKODE 673009, KERALA

CERTIFICATE

Certified that this is an authentic report of the virtual visit to Tissue Culture Lab and report on a Commercial TC lab unit, by Miss. ……
……, Reg, No. … …..… during the course of her M.Sc Botany, 2019 - 2021.

Examiners;

1.

2.

CONTENTS

1. VIRTUAL VISIT TO A TISSUE CULTURE LAB

INTRODUCTION

Tissue culture is the process of development of new tissue for the further propagation of new plant without diseases and better yield capacity of fruits or vegetables of woods etc. Tissue culture involves production of genetically identical plant progeny through the cloning on a vegetative tissue or organ of the parent plant or ex-plants on nutrient medium containing growth hormones under sterile condition. It can be used for the production of hybrid seeds, for preserving rare plants, for the production of infection free plants for more rugged plants for improving plant output etc.

The demand for tissue culture plantlets of commercial plants both in agriculture and horticulture as well as in social forestry is growing day by day, because, the traditional method of propagation is very cumbersome and do not yield much. It may be pointed out that tissue culture laboratory can also be used to produce biofertilisers like rhizobium, azotobacter azospirillum, as well as mushroom spawn culture

Current Scenario

About 122 tissue culture labs with on aggregate of 245 million plants/annum have been set up in India.Realizing the potential of plant tissue culture technology in revolutionizing the commercial agriculture sector by enabling mass propagation of elite, high yielding and disease free plants throughout the year, the Department of Biotechnology (DBT) has identified it as a priority area and initiated a number of programmes aimed at development and commercialization of the technology in an integrated manner. A number of research and development projects in various research institutes and universities have been supported for perfecting protocols of important plant species.

In addition, based on the needs of the industry, National facilities for virusdiagnosis and quality control of tissue cultured plants (TCPs) have been set up at manyinstitutions in the country. These measures have contributed immensely in promoting the tissue cultureindustry. There are 46 established commercial tissue culture units. Their productioncapacity ranges between 1 million to 5 million and above plants per annum with anaggregate production capacity of 180 million plantlets per year. Most

of these tissueculture units are located in Maharashtra, Andhra Pradesh, Karnataka and Kerala.

These companies have been so far largely concentrating on exploiting the internationalmarkets and are facing a number of constraints such as short shelf life, stringent qualityrequirements and uncertainty of rejection of consignments.

Major advantages of Tissue-Culture:

The main advantage of tissue culture technology lies in the production of high quality and uniform planting material that can be multiplied on a year-round basis under disease-free conditions anywhere irrespective of the season and weather. However, the technology is capital, labour and energy intensive. Although, labour is cheap in many developing countries, the resources of trained personnel and equipment are often not readily available. In addition, energy, particularly electricity, and clean water are costly. The energy requirements for tissue culture technology depend on day temperature, day-length and relative humidity, and they have to be controlled during the process of propagation. Individual plant species also differ in their growth requirements. The commercial advantages of tissue culture technology over its conventional counterpart are summarized below:

- Tissue culture could be a useful way for circumventing or eliminating disease, which can accrue in stock plants.
- Tissue Culture Plants (TCPs) may have increased branching and flowering, greater vigour and higher yield, probably due to elimination of diseases.
- The method may succeed to propagate plants where seeds or vegetative propagation is not possible or difficult or undesirable. As the capital investment on mother plants is reduced to almost zero, it may be easier to adapt to changing conditions.
- Additionally, a better programming of the production is possible, because of the greater plant uniformity and the availability in the mass at any time.
- Enables storage and maintenance of stock plants/germplasm

A TISSUE CULTURE LABORATORY

We visited the Tissue culture lab, at Indian Institute of Spices Research, Kozhikode. Different sophisticated instruments are pooled in lab for efficiency usage and monitoring. Tissue culture plants of various spices are tested for virus infection and genetic fidelity.

We visited the aseptic inoculation room with cultures of ginger with micro rhizome. Other interesting feature of the lab was the abundance of callus culture.

Micro rhizomes from an important source of disease free planting material in rhizomatous crop like ginger and turmeric am are ideally suited for germplasm exchange ,transportation and conservation. *In vitro* induction of micro rhizome in ginger and turmeric *kaempferia* standardized at IISR is being utilized for multiplication and distribution of farmers .

Non availability of quality planting materials of improved varieties is one of the important constraints in Turmeric. Large number of plants can be produced *in vitro* through microrhizome technology and is advisable to check the clonal fidelity of these plants. Planting material production through microrhizome technology is a safe method for multiplication of true-to-type plants in turmeric.

LABORATORY FACILITIES

An ideal tissue culture laboratory should have at least two big rooms and asmall room .One big room is for general laboratory work such as preparation of medium, autoclaving, distillation of water etc. The other big room is for keeping cultures under controlled light, temperature and humidity. The small room is for aseptic work and for keeping autoclaved articles.

1. **GENERAL LABORATORY**

The general laboratory for tissue culture should be provided with the following arrangement

a) WASHING AREA

This is very important for a tissue culture laboratory it should be provided with alarge sink, running hot and cold tap water, brushes of various sizes, detergent and buckets of single distilled water for a final rinse of the washed glass goods.A number of plastic buckets are required for soaking the glass goods to be washed. Another separate bucket with lid is also required for disposing off the used or infected media before cleaning.Only this bucket should be kept outside the room or cleaning area and should be cleaned twice in a week. A **Hot airoven** is necessary for drying the washed glass goods. Large plastic trays are used to carry glass goods for different purposes.

b) MEDIA PREPARATION ROOM

This room should have storage space for chemicals, glass ware, culture vessels etc. A bench where media preparation procedures are carried out should be smooth preferably covered by an easily cleanable material. A **Refrigerator** and a freezer are necessary for the storage of stock solutions and some other temperature sensitive chemicals. A source of distilled or deionised water is essential, since tap water is unsuitable for plant tissue culture media. The most common and preferred method of water purification is deionization. Other essential equipment's include pH meter, a toploading balance, a stirrer and adjustable volume dispenser or other suitable device to dispense aliquots of media.

c) STERILIZATION AREA

An **Autoclave** or domestic pressure cooker is required for sterilizing media, culture containers and dissecting instruments. Both horizontal and vertical autoclaves are used here. The horizontal autoclave has a higher capacity and can accommodate more number of materials for sterilization at a time.

d) MEDIA STORE ROOM

Large number of sterilized medium that are prepared, is stored in this room for carrying out plant tissue culture work. To avoid contamination this room contains air-tight doors. Precautions are also taken while entering this room. This room also have an entry from aseptic area, inoculation room to access medium and other instruments used while inoculation.

2. **INOCULATION ROOM**

For transferring plant material to the culture media, an aseptic condition is needed. Aseptic work is carried out in a **Laminar Air-Flow** cabinet. The most desirable arrangement is a separate dust free room equipped with one or more laminar airflow cabinets and equipped with UV light. There is a LPG cylinder connected burner.

Various sizes of **scalpel** and **forceps** of stainless steel used for inoculation purpose.

3**.GROWTH ROOM**

A growth room with controlled environment conditions is preferred. However complete control is not absolutely necessary for some plant which can be maintained under a wide range environmental condition. An air conditioning unit and light facility is sufficient for temperature control. The temperature maintained around $25 \pm 2℃$ inside the culture room. This room is also provided with specially designed racks to keep culture vessels. The relative humidity of the culture room is maintained above 50%. The culture room should also have a shaker for suspension culture in moving liquid medium.

Cultures are normally illuminated by fluorescent lamp. Artificial light is usually provided by cool white fluorescent tubes of 400W. The photo period is controlled by means of time switches installed in each culture room or even in each set of shelves.

4**. HARDENING ROOM**

After the growth of the plantlets in plant growth room (in vitro condition), before planting in the field, the plantlets should undergo hardening techniques. In the hardening room, the environment is adjusted in such a way that, it is equal to the normal temperature outside the lab. This allows the plantlets for quick adaptation, when transplanted in the field.

5**.GREENHOUSE**

In order to grow the mother plants and to acclimatize in vitro produced plants,the tissue culture laboratory should invariably have a greenhouse or glass house or plastic house attached to it. The sophistication of this facility will depend on the resources and funds available. However, minimum facilities for maintaining high humidity by fogging, misting, or a fan and pad system, reduced light, cooling system for summers and heating system for winters is required. It should be desirable to have a potting room adjacent to this facility

CULTURE MEDIA

Nutritional requirement for optimal growth of a tissue in vitromay vary with species.No single medium is suitable for all plants.Most of the earliest tissue culture media were based on White's root culture medium and callus culture medium of Gautheret .A typical synthetic medium can be defined as a medium containing only chemically defined compounds.

TISSUE CULTURE WORK

PREPARATION OF STOCK SOLUTION

It is not possible to weigh and mix all the constituents just before the preparation of medium. It is time consuming and a tedious job. So it is convenient to prepare the concentrated stock solution of macro-salt, micro-salts, vitamins, aminoacids,hormones etc. All stock solution should be stored in a refrigerator and should be checked visually for contamination with microorganism or precipitation of ingredients. The widely used culture medium was formulated by Murashige and Skoog(MS medium) so the procedure for the preparation of stock solution of MS medium is given below:

Composition of MS medium and stock solution

Composition		STD mg/l	Actual Gram	Dissolved in	Conc.
Macronutrients					
Ammonium nitrate	NH_4NO_3	1650	33.0		
Potassium nitrate	KNO_3	1900	38.0		
Magnesium sulphate	$MgSO_4$	370	7.4	1000ml	50 ml
Calcium chloride	$CaCl_2.2H_2O$	330	6.6		
Potassium dihydrogen phoshate	KH_2PO_4	170	3.4		
Micro nutrients					
Boric acid	H_3BO_3	6.2	0.31	500ml	10ml/l
Manganous sulphate	$MnSO_4.H_2O$	2.23	1.115		
Potassium iodide	KI	0.83	0.0415	500ml	10ml/l
Zinc sulphate	$ZNSO_4$	8.6	0.43		
Sodium molibdate	Na_2MNO_4	0.25	0.0125	500ml	10ml/l
Cobalt chloride	$CoCl_2$	0.0025	0.000125		
Copper sulphate	$CuSO_4$	0.0025	0.000125		
Iron					
Ferrous sulphate	$FeSO_4.7H_2O$	27.9	1.3952	500ml	10ml/l
Sodium EDTA	Na2 EDTA	37.3	1.865		
Vitamin					
Nicotinic acid		0.5	0.025	500ml	10ml/l
Pyridoxine HCL		0.5	0.025		
Thymine HCL		0.1	0.005		
Glycine		2.0	0.1g		
Inositol		100	5g	500	10ml/l

PREPARATION OF CULTURE MEDIUM

In vivo plant cells, tissues and organs get their appropriate nutrient and growth requirements from the intact plant body for their organised growth and development. Isolated cell, tissues and organs also need nutrients for their in vitro growth and development. So, nutrients are supplied artificially according to the medium formulated by several workers.

Media should be prepared with care and following procedure is recommended:

a. Take DDH20 in a flask and add the appropriate amount of stock solution as given above table 1.
b. Pour sucrose, vitamins, amino acid, and hormone solution mixture into a one litre measuring cylinder. Make the final volume to 1 litre with DD H2O. Shake well to mix up uniformly.
c. Adjust the pH of the liquid medium 5.6- 5.8 with the aid of 0.1 N HCl or 0.1 N NaOH.
d. Add agar to the liquid medium to make solid medium .Heat to 60℃ to dissolve the agar completely.
e. Dispense the culture medium into culture tube(20ml/tube). Insert non-absorbent cotton plug wrapped with gauge cloth. Cover the plug with the help of paper and rubber band.
f. Medium is finally sterilized by autoclaving(120℃ for 20minutes).
g. Stored in media store room.

SPECIFIC TECHNIQUES

Several techniques have been adopted for in vitro plant tissue culture.Among them some are general techniques such as preparation of nutrient medium, sterilization, aseptic manipulation, maintenance of culture and some are specific techniques such as ;

MICROPROPAGATION

Plants can be propagated through their two developmental life cycles viz., sexual or asexual. In the sexual cycle new plants arise after fusion of the parental gametes, and develop from zygotic embryos contained within seeds or fruits. In most cases seedlings will be variable and each one will represent a new

combination of genes, brought about during the formation of gametes (meiotic cell division) and their sexual fusion. Plants selected and exploited by man also have different propensities for propagationby seed or by vegetative means. The micro propagation techniques are preferred over the conventional asexual propagation methods because of the following reasons.

- In this method only small amount of tissue is needed as the initial explant for generation of millions of clonal plants in a year.
- This method provides a means of international exchange of plant materials: the problem for introduction of disease can be solved.
- In vitro stock can be quickly proliferated, as it is not season depended.
- Valuable germplasm can be stored for long time.

  The process of micro propagation aims to produce clones .The process is usually divided intofive stages.

Stage-0: Pre- propagation steps or selection and pre-

Treatment of suitable plants

Stage-1: Initiation of explants- surface sterilization**,** Establishment of mother plant.

Stage-2: Subculture for multiplication /proliferation of Explants.

Stage-3: Shooting and rooting of explants.

Stage-4: hardening.

These stages are universally applicable in large scale multiplication of plants. The individual plant species, varieties and clone require specific modification of the growth media, weaning and hardening conditions.

STAGE-0: Mother plant selection and preparation

Before micro propagation commences careful attention should be given to the selection of stock plants. They must be typical of the variety of species and free from any symptoms of disease. It may be advantages to treat the chosen plant in some way to make in vitro culture successful. Procedures to detect and reduce or eliminate systemic bacterial and viral diseases may also be required. Disease indexing and disease

elimination should be a definite part of all micro propagation work. But these precautions are unfortunately often omitted, sometimes with adverse consequences.

The difficulties which may be encountered in trying to propagate chimeras by tissueculture methods.Its seems appropriate to include all procedures adapted in plant selection and pre-treatment with stage'0'.

STAGE 1: Establishing on aseptic culture

The customary second step in the micro propagation process is to obtain an aseptic culture of the selected plant material. This stage firstly requires that explants should be transferred to the cultural environment, free from obvious microbial contaminants, that this should be followed by some kind of growth (e.g. Growth of shoot tip or formation of callus). Usually a batch of explants is transferred to the culture of the same time.

STAGE 2: The production of suitable propagules

The object of stage 2 is to bring about the production of new plant growth or propagules. Which when separated from the culture is capable of giving rise to complete plants. According to the in vitro procedure that is being followed multiplication can be brought about from newly derived axillary or adventitious shoots, somatic embryos or miniature storage or propagative organs. In micropropagation method, stage 2 can also be used as the basis for further cycles of multiplication.

STAGE 3: Preparation for growth in the natural environment

Shoots or plantlets derived from stage 2 are small, and are not yet capable of self-supporting growth in soil or compost. At stage 3, steps are taken to grow individual or cluster of plantlets, capable of carrying out photosynthesis and survival without an artificial supply of carbohydrate. Some plantlets need to be specially treated at this stage so that they do not become stunted or dormant when taken out of the cultural environment. Rooting shoots is very important part of any in vitro propagation. Afew species from adventitious roots on shoots during the course of stage 3. In cultures micro propagation relies on adventitious or axillary shoots.

STAGE 4: Transfer to the natural environment

The methods where by plantlets are transferred from the in vitro to ex- vitro external environment are extremely important. If not carried out, transfer can result in significant loss of propagated material. Shoots developed in culture have been produced in high humidity and low relative light intensity. Tissue culture plants therefore lose water rapidly to the external conditions.

- Healthy explant was collected from field ground plant.
- Washed in tap water, cut & remove leaves after leaving a portion of petiole intact.
- Swab with wet cotton containing Tween 20.
- Kept in running tap water for 30 minutes to remove the dust, mud, etc. adhered to it.
- Treated with 0.1% copper oxychloride (COC) for 30 minutes.
- After thorough washing in distilled water the explants were treated with 0.1mg/l HgCl2 and tween 20 (2 drops in 100 ml) for 3-5 minutes and washed (3-4 times) with distilled water.
- Treated explants were taken to laminar airflow.
- Treated the explants with 0.1%HgCl2 for 5 minutes and washed 3-4 times with sterile distilled water to remove all traces of the sterilant.

Initiation of culture

Surface sterilized explants were transferred to aseptically to sterile brown paper. Then undesirable and dead portions of both basal and the top portion of the explants were removed. Then explants were cut into one node segments and shoot tips and inoculated into culture initiation medium. The shoot tip and nodal explants were placed in an erect position in the culture tube with the help of sterile forceps. In the case of seed explant the embryo was taken out from the seed and it was used for the inoculation. The culture vessels were kept in the growth room at 25± 2℃,with a photoperiod of 12hrs daylight and 12hrs night breaks under the cool white fluorescent light with an intensity of 2500-3000 lux.

2. REPORT ON A COMMERCIAL TISSUE CULTURE UNIT

Priority Plants For Commercial Tissue Culture

The plants prioritized for tissue culture propagation by the above consumersegments are banana, grapes, pineapple, strawberry, sugarcane, potato, turmeric,ginger, large and small cardamom, vanilla, aloevera, geranium, stevia, patchouli,gerbera, carnations, anthuriums, syngonium, lily and for few tree species namely teak,white teak, bamboo, eucalyptus and populous.

Priority plants of State Agriculture Departments are;

Horticulture: Banana, Papaya, Strawberry, Grapes, Apple, Sapota,Mandarin Orange, Passion fruit, Cherry, Walnut, Almond,Pecan nut, Pineapple, Fig

Spices : Vanilla, Ginger, Turmeric, Pepper, large Cardamom

Medicinal and Aromatic Plants : Aloe, Patchouli, Gloriosa, Senna, Aswagandha, Nightshade (S. khasianum), Phyllanthus (P niruri),Dioscorea, Neem, Geranium

Ornamental plants : Orchids, gerbera, Ant

Important R&D Laboratories working on Plant Tissue Culture

1. Regional Plant Resource Centre Nayapalli, Bhubaneswar : Banana, Rose, Chrysanthemum
2. BARC, Bombay : Sandal
3. Central Plantation Crop Research' Institute, Kasargod, Kerala: Coconut
4. Dept. of Biotechnology, Delhi University. Albizzia lebbeck, Acacia nilotica, Leucaena, Bamboo
5. Haryana Agril. University : Date palm
6. Indian Inst. of Science, Bangalore : Sandal
7. National Bureau of Plant Genetic Resources, New Delhi : Medicinal plants
8. National Chemical Laboratory, Pune : Bamboo, Teak, Eucalyptus
9. Indian Institute of Spices Research : Black pepper, cardamom, turmeric, ginger, vanilla, tree spices viz., cinnamon, clove, camphor, and seed and herbal spices
10. Kerala Agricutural University : Spices and horticultural crops

11. Indo-American Hybrid Seeds Bangalore : Banana, Rose, Orchids, Chrysanthemums, spices.
12. Hindustan Lever Lab : Coconut

APPROXIMATE ESTIMATE FOR A PLANT TISSUE CULTURE LABORATORY AND MOLECULAR BIOLOGY LABORATORY

Sl. No.	Requirement/item	Justification
1.	Sitting room and Store room	For sitting staff & to store chemical & glass wares
2.	Media preparation area	For preparation of culture media
3.	Inoculation room (A/C)	For aseptic transfer of cultures
4.	Incubation room (A/C)	Growth room for cultures
5.	Explant preparation and sorting of TC plants (if needed)	Preparation room
6.	Nursery / hardening facility, polyhouse, nethouse	For acclimatization of TC plants and newly collected medicinal plants
1.	Double distillation unit (1)	For distilled water for preparation of stock solutions, media etc.
2.	Autoclave (1)	For sterilizing glass wares, media, dissection instruments etc.
3.	* Balance (1)	For weighing chemicals (stock solutions, media etc.)
4.	pH Meter	For adjusting pH of media
5.	Magnetic stirrer (1)	For thorough mixing of chemicals
6.	Millipore Filter sterilization Unit (1)	For sterilizing thermo labile hormones etc.
7.	Laminar airflow units (2 nos.) with UV & steripots	For aseptic transfer of cultures
8.	Illuminated culture racks (10 nos) with timers and far red tube lights to give 3000 lux	For keeping and providing required light for cultures.
9.	Shakers (2 nos)	For maintaining liquid cultures/ suspension cultures
10	Refrigerator (1)	For storing chemicals/ stock solutions etc.
11.	Computer with UPS, printer	Storing data/media composition and reports
12.	AC units (4 nos.)	1 for inoculation room and 3 for growth room
12.	Hot air oven	For drying glass wares
13.	Racks for keeping culture tubes (test tube stands)	For keeping culture tubes in the incubation room.

1.	Chemicals	Required chemicals, vitamins, growth regulators etc for nutrient medium.
2.	Glass wares	Culture tubes, bottles, flasks, reagent bottles
3.	Contingency	Cotton plugs, polypropelene caps and other contingent expenses like peat moss, nursery mixture, sand, cowdung etc.
4.	TC skilled labour/ other labour (if needed)	For glass ware washing, lab cleaning, hardening and planting out
5.	Staff	To undertake tissue culture work and hardening To attend the day to day work
1.	For Molecular Biology work	
	3 Rooms	1 room for washing/autoclave 1 room for DNA isolation and other work place 1 room – Instrumentation room
6.	* Deep Freezer (-20^{O}C) (1)	For storing DNA, enzymes etc
7.	Refrigerators (2)	For stock solutions, Chemicals etc
8.	* Incubatory shaker	For growing bacterial cultures
9.	* PCR	For RAPD/AFLP work
10.	Micropipette set (2)	For accurate measurement in molecular Biology work
11.	Electrophoresis unit (Horizontal with 2 or 3 size gel tanks)+ power pack	For RAPD/AFLP work
12.	Electrophoresis unit (vertical with 2 or 3 size gel tanks) manual sequencing gel apparatus + power pack (3000 volt)	For RAPD/AFLP work
13.	Water bath	For DNA isolation
14.	Centrifuge (refrigerated, Imported)	For DNA isolation and other mol. Boil. work
15.	Microfuge (refrigerated)	RAPD work/routine lab use
16.	Gel Documentation system with software	For documentation of gel images for data analysis
17.	Computer with printer and UPS	For storing data, get pictures/reports/other important data.
18.	Air conditioners (4)	2 each for two rooms
19.	Vortex mixture	For routine lab use
20.	Hot air oven	For drying and sterilizing glass ware

21.	Microwave oven	For melting media, agarose etc.
22.	UPS (3 KVA for 3h)	To provide uninterrupted power supply to PCR, electrophoresis etc.
23.	Hood	For handling hazarduous chemicals, later can be used for handling radioactive materials
1.	Molecular Biology grade Chemicals	
2.	Glass wares/reagent bottles	
3.	PCr consumables, tips, eppendorf tubes etc.	
4.	Enzymes	
5.	Staff	

GOVERNMENT SCHEMES AND INCENTIVES FOR PROMOTION OF COMMERCIAL TISSUE CUTLURE LABS

Various Central and State Government departments have framed financial schemes and announced incentives for assistance tissue culture industry eg;

- The Department of Agriculture and Cooperation under the Ministry of Agriculture, Government of India has programmes and schemes for promotion of horticulture.
- Provision for assistance of upto Rs. 21 lakhs and Rs. 10 lakh for setting up tissue culture units in public and private sector respectively subject to a maximum of 20% of the project cost.
- Integrated Development of Fruits scheme assistance is given for purchase of planting material under the area expansion programme
- Department of Biotechnology (DBT) supports R & D projects across the country at the various laboratories in the universities and the research institutions for development and standardization of tissue culture protocols for various species through tissue culture.
- DBT has supported 150 projects so far for development of micropropagation related protocols for about 50 plant species. The new as well as existing tissue culture units must network closely with the research institutions working in the area to keep abreast with the latest research developments and modern equipments for improving their competitiveness.

In recent years, the demand for TCPs of elite plant varieties has grown tremendously in domestic market. Still the demand is greater for horticultural and forest species. The Working Group on Horticulture and Plantation Crops for the Eleventh Five Year Plan has projected the total requirement of planting material of fruits, coconut, cashew, black pepper, spices, arecanut etc. as 2000 million. It may not be possible to meet this requirement by conventional nurseries. It can be achieved only by supplementing the production of planting ma terial through commercial tissue culture labs.

PROVIDENCE WOMEN'S COLLEGE

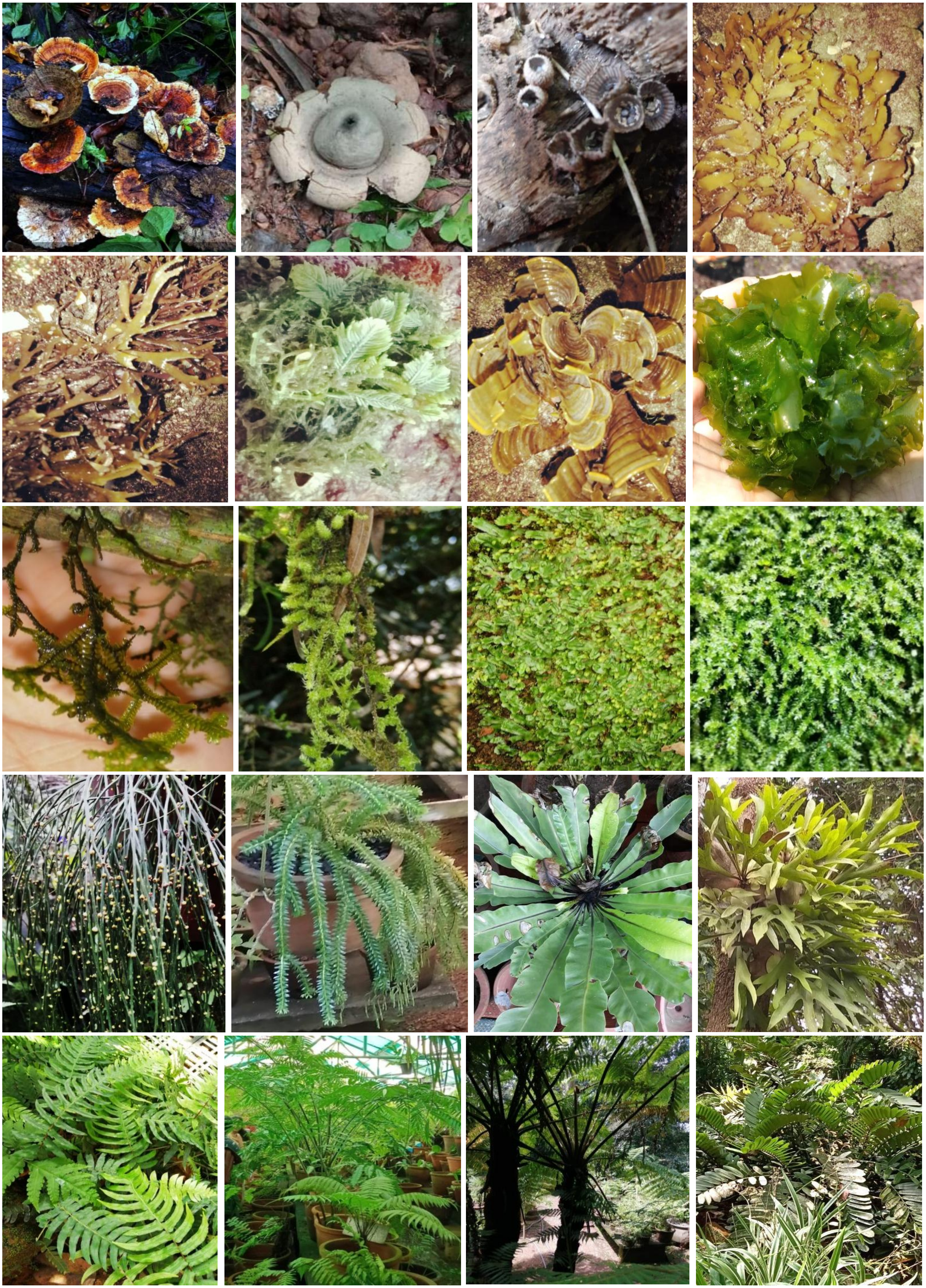
KOZHIKODE 9, KERALA

FIELD WORK REPORT

OF THE *IN SITU* STUDY OF LOWER PLANT GROUPS

M.Sc. Botany

Semester I 2019–2020



DEPARTMENT OF BOTANY

PROVIDENCE WOMEN'S COLLEGE, KOZHIKODE 9, KERALA

CERTIFICATE

Certified that this is an authentic report of the field trips / study tours conducted by Ms.…….……..…….. (Reg No. **PWATMBT**……...,) of I Semester M.Sc. Botany, Providence Women's College, during 2019 - 20, as part of the curriculum of First Semester of the M.Sc. Botany Programme of the University of Calicut.

Examiners:

1

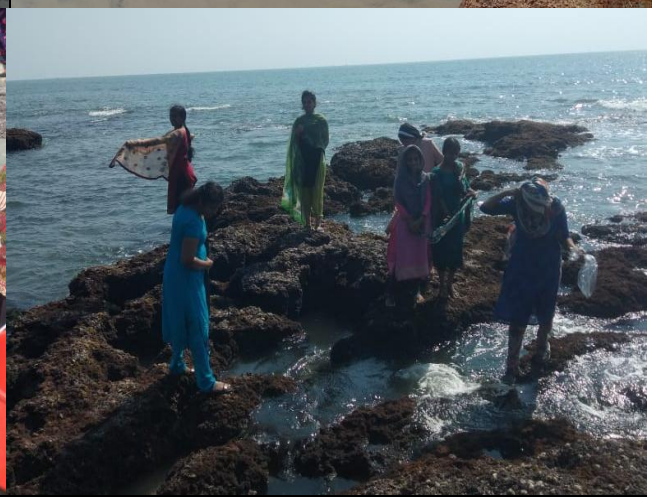
2

Visit to Thikodi beach







FIELD WORK REPORT OF THE *IN SITU* STUDY OF LOWER PLANT GROUPS

Study tour aims at providing travel experience with specific learning goals. The learning goals of each study tour varies, but are always spelled out in the course syllabus that is distributed to each learner. Study tour emphasizes experimental learning and offers both groups and self-directed activities, that enable learners to explore new territories, cultures, people while providing opportunities that lead to the development of a different and deeper level of understanding.

1. Visit to Coastal regions of Kozhikode District- Thikkodi Beach

India has a vast coastline of about 7500 km with diverse habitats and rich marine biota. This includes about 6100 km coastline of Indian mainland and about 1400 km coastlines of various Islands of the country. Kerala, a part of the south west coast of India and located in the extreme south west coast of the peninsular India, has about 580 km long coastlines. The Kozhikode district has a coastline of about 71 km ranging from Kadalundinagaram in the south to Mahe in the north.

The intertidal and shallow subtidal regions with rocky, calcareous and coralline substrata harbor luxuriant growth of diverse marine flora i.e. seaweeds, sea grasses and mangroves. Seaweeds or the marine macro algae constitute an important part of the Indian marine biodiversity.

Thikkodi beach is located in Kozhikode district near Koyilandy (11^0 28' 30.8" & 75^0 37' 04.5"). It's a drive-in beach. Thikkodi village connects to other parts of India through Koyilandy town. The nearest city is Kozhikode, which is 35 km from this village. Remains of an old lighthouse are seen in Velliyamkallu in Thikkodi. Thikkodi is also famous for its mussels. Thikkodi coast is a long and wide rocky coast with black ± clayish sand. The granite natural rocks and the artificially laid stones provide suitable substratum for the growth of a large number of seaweed.

We visited the coastal areas of Thikodi, on 10th December 2019 for the field study and collection of marine macroalgae. We started our journey from the college at 12.30 pm and reached Thikodi at 1.45 pm.

We could see a luxuriant growth of the algal flora attached to the rocks there and also could collect genera like *Ulva, Dictyota, Padina, Gelidium, Caulerpa, Gracillaria*, *Enteromorpha, Bryopsis* , *Sargassum* etc. We spent about two hours, studying the growth pattern of the macroalgae and collecting minimum number of specimens. The seaweed samples were collected randomly from the intertidal regions during low tides.

Visit to Gurukula Botanical Sanctuary

Collected samples were thoroughly washed with fresh water without damaging the specimens. Herbarium sheets were prepared for each species and labeled properly. Representative samples were preserved in 4% formalin solution.

2. Gurukula Botanical Sanctuary, Periya, Wayanad

The Gurukula Botanical Sanctuary is situated in Periya, a remote place 20 kms away from Mananthavady. This Sanctuary is dedicated to the plants of the Western Ghats, a mountain range running down the western coastline of peninsular India. Founded in 1981 by Wolfgang Theuerkauf, the Sanctuary is a garden of wild plant species grown at the edge of a rainforest reserve. Their intention is to rehabilitate endangered species and restore habitats in a highly fragmented landscape, in which only a fraction of original forest remains and a high percentage of species are rare, vulnerable or threatened by imminent extinction.

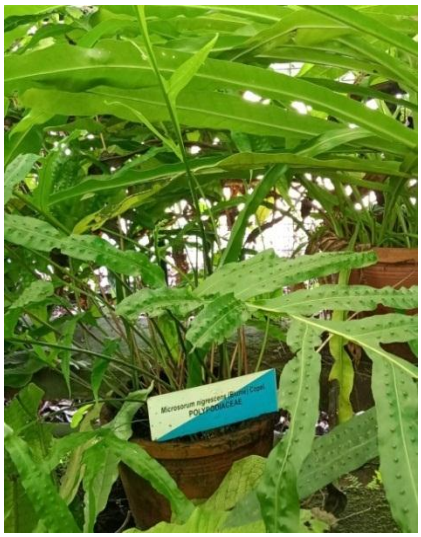
This conservatory houses a rare collection of Bryophytes and Pteridophytes. There are at least 2000 native species living in the garden, the swampy valley fields, the hillsides and by the stream: 40% of the native flora of the Western Ghats, ranging across at least 100 different botanical families, including every rainforest life-form: woody climbers, soft climbers, giant trees, epiphytes, tubers, herbaceous annuals, herbaceous perennials, shrubs, aquatic plants and succulents. There are also a number of species from other parts of India and elsewhere in the world. The Sanctuary is run by a small group of resident gardeners, naturalists and educators, and supported by a wide circle of well-wishers.

The work at the Sanctuary includes:

- *Ex-situ* conservation of native (rainforest) plants.
- Education and public outreach.
- Training local young women in horticulture and conservation.
- Habitat restoration in degraded areas of the Western Ghats
- Supporting recovery of natural forest within our lands.
- Research in biodiversity and conservation.
- Forest farming, growing food.
- Participation in regional conservation

We reached he garden a 10.30 am on 9th October 2019. We remained there for 3 hrs and could make a thorough study of the plant diversity housed there. The moist climate favoured thick growth of a wide range of Bryophytes. We could see Bryophytes like *Dumortiera. Asterella, Pallavicinia, Marchantia, Porella, Anthoceros* etc.

Visit to MBGIPS



We could also see many species of pteridophyes like of *Lycopodium, Lygodium, Selaginella, Asplenium, Osmunda, Gleichenia, Blechnu,Cyathea, Angiopteris* etc there. Stag horn fern, shoe string fern etc. were the main attractions there. Most of the 300 species of south Indian ferns (and their allies: the lycopods, horsetails and whisk ferns) are here in the fernarium and all over the Sanctuary. Ferns are ancient plants going back some 400 million years, reaching far into the primordial past to the times of the first forests. Along with mosses and liverworts, they are a critical indicator of the health of our rainforest. At the Fernarium many topics in plant evolution are explored with visiting students. Many types of lichens were present abundantly. Gymnosperms like *Gnetum*, many species of *Zamia, Cycas, Araucaria* etc. were also grown in in the garden,

3. Malabar Botanical Garden and Institute for Plant Sciences, Kozhikode

A one day field trip to Malabar Botanical Garden And Institute of Plant Science, Kozhikode was held on 18 June 2019. This is an institution of the Government of Kerala, administered by the Kerala State Council for Science and Technology and Environment (KSCSTE), dedicated to the conservation and research on aquatic plant diversity, lower group plants, endangered plants of the Malabar Region, as well as disseminating knowledge on various facts of plant sciences. The MBGIPS conserves the various groups in specialized sections viz., Sarovar and Aquagene (Aquatic Plant Conservatory and Nursery), Water Queene (Germplasm collection of Waterlilies), Sanjeevani and Sarpagandha (Herbal garden and nursery), Rheedea (live Hortus Malabaricus), Star forest (Mythological Garden), Apushpi (bryophytes and pteridophytes), Bodhi(Plants of epics), Janakiya (Endangererd plants in green houses), Sugandhi (spices garden), Rockery (Silaramam), Butterfly garden (Shalabaramam) and Gardenia (Ornamental garden. We could also listen to a presentation on Taxonomic Analysis of Fimbrystylis by Anoop K.P, research scholar on the same day.

Non-flowering plants

Wide varieties of Algae, Bryophytes, Pteridophytes and Gymnosperms are well grown in this conservatory. Endangered, exotic and native species of other habitats are cultivated in *ex-situ* manner. We could see many species of algae like *Chara, Spirogyra*, etc. Bryophytes included species *Riccia, Porella, Bryum, Anthocerose* etc. Pteridophytes were represented by Species of *Asplenium, Angiopteris, Blechnum* etc. The group Gymnosperms was represented by species of *Cycas, Pinus, Zamia, Gnetum, Araucaria* etc.

Osmunda with tassel (location: Kakkayam)

Marselia (location: Koyilandi)

Ceratopteris (location: Koyilandi)

Angiopteris (location: Kakkayam)

4. Kakkayam

Kakkayam is on the outskirts of the Western Ghats, a UNESCO world heritage site. Malabar Wildlife Sanctuary is a protected area located along the Western Ghats. The sanctuary is part of the Western Ghats, a biodiversity hotspot.

We visited Kakkayam forest area on 12th December 2019. On the way to the dam site we could see a few pteridophytes including *Osmunda*, near Urakuzhi waterfalls. Though we didn't collect any specimens of Osmunda, we could collect some other pteridophytes like *Blechnum, Angiopteris etc.* and a few Bryophytes.

5. Koyilandi

On 10th December 2019, on the way to Thikodi beach, we got down at Koyilandi, on seeing a marshy area where luxuriant growth of *Ceratopteris* and *Marselia* occurred. We could collect a few specimens of these two Pteridophytes from there. These specimens were pressed and preserved in the Dept. of Botany.

6. Florican Hill

During the months of August- November, we conducted a few days of field work around the florical Hill area to study and collect fungal specimens. We could collect a many specimens including *Xylaria, Geastrum, Auricularia, Cyathus, Ganoderma, Polyporus, Agaricus* etc. The specimens were brought to the laboratory and kept in the plant diversity museum of the Department of Botany.

PROVIDENCE WOMEN'S COLLEGE
KOZHIKODE 9, KERALA

PATHOLOGY LAB & FIELD VISITS REPORT

M.Sc. Botany 2019–2020

Semester I


भारतीय मसाला फसल अनुसंधान संस्थान
INDIAN INSTITUTE OF SPICES RESEARCH

DEPARTMENT OF BOTANY

PROVIDENCE WOMEN'S COLLEGE, KOZHIKODE 9, KERALA

CERTIFICATE

Certified that this is an authentic report of the field trips / study tours conducted by Ms.…….……..…….. (Reg No. **PWATMBT**……...,) of I Semester M.Sc. Botany, Providence Women's College, during 2019 - 20, as part of the curriculum of First Semester of the M.Sc. Botany Programme of the University of Calicut.

Examiners:

1

2

Pathology Lab & Field Visit at ICAR IISR, Kozhikode

REPORT OF FIELD WORK AND LAB VISIT FOR THE STUDY OF PLANT PATHOLOGY

VISIT TO ICAR IISR

The Indian Institute of Spices Research (IISR), a constituent body of Indian Council of Agricultural Research (ICAR) is a major Institute devoted to research on spices. In 1976, it was started as a Regional Station of the Central Plantation Crops Research Institute (CPCRI). Later on, NRCS, a National Research Centre for Spices was established in 1986 with its headquarters at Kozhikode, Kerala by merging the erstwhile Regional Station of CPCRI at Kozhikode and Cardamom Research Centre at Appangala, Karnataka. Realizing the importance of spices research in India this research centre was upgraded to Indian Institute of Spices Research on 1st July, 1995.

As part of curriculum we, the students of first semester MSc Botany visited IISR for a laboratory and field visit on 18th November 2019. Different sophisticated instruments were pooled in centralized laboratories under various divisions like pathology, molecular biology, biocontrol, nematology, plant protection, soil chemistry, biochemistry, microbiology etc. for efficient usage and monitoring. We visited the pathology laboratory first, where pathological studies of different species like pepper, cardamom, ginger, turmeric, nutmeg etc. were carried out. We were directed by Dr. Susheela, the Head of Pathology Division. She also gave an introduction to the facilities and works of the pathology division. Ms. Subila, research scholar briefed on the research works like studies on *Pythium* infection on black pepper.

We had the opportunity to visit the microbiology lab also. Mr. Navaneeth and Ms. Megha, research scholars explained their works on mycovirus. Demonstration of the use of various instruments was also done. From there we moved on to the Nematology laboratory. Scientist Dr.Saratha Ambal and research scholars gave a detailed account on the various infections caused by the Nematodes on spice crops.

Later we visited biocontrol laboratory, where we were given a good explanation on the biocontrol agent on various pathogenic infection on different spices. The two main species used as safe alternative to chemical fungicides - *Trichoderma harzianum* IISR–P26 (MTCC5179) and *Pochonia chlamydospora* (MTCC 5412) against plant parasitic nematodes were introduced to us. We came to know that Serpentine method was also another biocontol method against pathogen. Scientists took us to the field and showed the infected crops grown there. We could see phytophthora infection on pepper, leaf spot diseases on ginger caused by *Phyllosticta zingiberi* etc. in the experimental field. We could see and study the symptoms associated with the diseases. We could also see the mass cultivation of IISR varieties of Pepper and had an awesome experience in the mist chamber. We had the opportunity to interact with Dr.Nirmal Babu, the Director of IISR. He explained about the new works carried out at IISR and motivated us with enlightening thoughts. We finished the laboratory visit and experimental fields visit by evening.

VISIT TO A FEW PLANTATIONS AND LOCAL VEGETABLE CROP FIELDS

We visited a few tea and arecanut plantations at Wayanad on 9th October 2019 and a few coconut, tapioca, rubber and banana, plantations at Malaparamba on 18th December 2019, to study the diseases affecting these crops and to collect some infected plant specimens. We could see grey leaf spot symptoms on a large number of coconut trees and symptoms of blister blight on tea leaves. We could see a few fallen off tender fruits of arecanut in the arecanut plantations. A few banana plants affected with bunchy top disease was also seen in the banana plantations. Tapioca mosaic disease was very prevalent in Malaparamba area. We couldn't see any pathological symptoms in the rubber plantation.

We also visited some vegetable crop fields in Florican hill, to collect a few pathological specimens. Vegetable crops like Amaranthus, ladies finger, different types of chillies, pumpkins, cucumbers, bitter gourd, ash gourd, bottle gourd, elephant foot yam, Colocasia, different varieties of beans like flat bean, clove bean, cow pea etc. were cultivated. Infections of *Albugo* were plenty on Amaranthus. We could see spots caused by *Cercospora* infection on leaves of ladies finger plant. Anthracnose disease was observed on a few fruits of cow pea.

DISEASES OF VEGETABLE CROPS

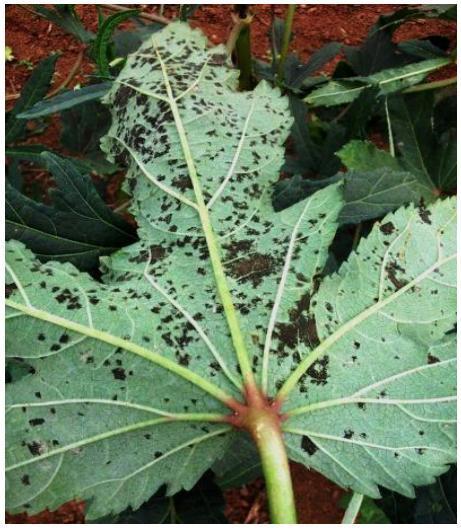
Albugo on *Amaranthus*

Leaf spot on clove bean

Leaf blight on *Cucurbita*

Vein clearing on *Capsicum*

Anthracnose of cowpea



Cercospora infection on ladies finger

Bacterial wilt in tomato

DISEASES OF SPICES

Leaf spot on ginger (IISR)

Bacterial wilt of ginger (Malaparamba)

Soft rot of ginger (Wayanad)

Quick wilt of pepperr (Wayanad)

Little leaf of pepper (Wayanad)

Phytophthora infection on pepper (Wayanad)

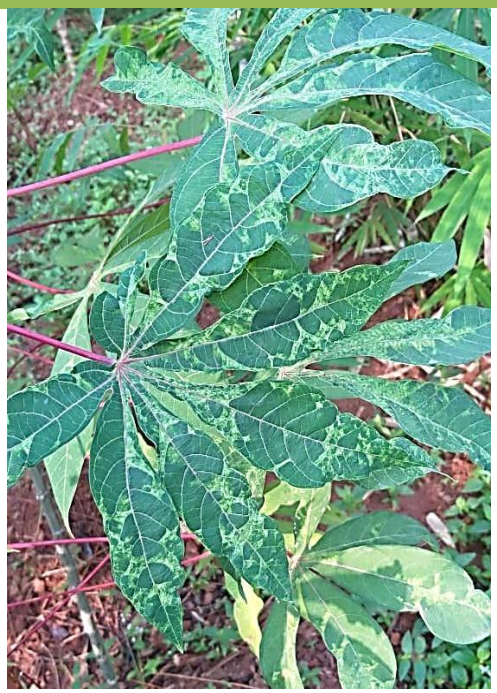
DISEASES OF PLANTATION CROPS

Blister blight of Tea (Wayanad)

Bunchy top of Banana (Wayanad)

Mahali disease of arecanut (Wayanad)

DISEASES OF TUBER CROPS & CEREALS



Leaf mosaic of Tapioca (Malaparamba)

Blast of paddy (Wayanad)

A STUDY ON DIVERSITY OF DICOT FLORA OF KANJIRAKUNNU HILLS, MALAPPURAM DISTRICT, KERALA

Dissertation submitted to the University of Calicut in partial fulfilment for the award of

MASTER OF SCIENCE IN BOTANY

ASLA VP

PWATMBT004

DEPARTMENT OF BOTANY
PROVIDENCE WOMEN'S COLLEGE
KOZHIKODE – 673OO9 KERALA

A STUDY ON DIVERSITY OF DICOT FLORA OFKANJIRAKUNNU HILLS, MALAPPURAM DISTRICT, KERALA

Dissertation submitted in partial fulfilment of the requirements for the Degree of

MASTER OF SCIENCE
IN
BOTANY

by

ASLA VP

PWATMBT004

DEPARTMENT OF BOTANY
PROVIDENCE WOMEN'S COLLEGE
KOZHIKODE – 673OO9 KERALA

MARCH 2021

DEPARTMENT OF BOTANY

PROVIDENCE WOMEN'S COLLEGE,

FLORICAN HILL, MALAPARAMBA, KOZHIKODE 9

CERTIFIATE

Certified that this dissertation entitled **'A study on diversity of dicot flora of Kanjirakunnu Hills, Malappuram district, Kerala'** was carried out by **Mrs. Asla VP**, Reg. No **PWATMBT004** under my supervision and guidance during the year 2020-21.

Dr. Deena Meria Jose
(Supervising teacher)

DEPARTMENT OF BOTANY
KOZHIKODE-9
Providence Women's College

Head
Department of Botany
Providence Women's College
Kozhikode-673009, Kerala

DECLARATION

I hereby declare that the project entitled **'A study on diversity of dicot flora of Kanjirakunnu Hills, Malappuram district, Kerala'** submitted by me in partial fulfilment of the requirements of the award of the degree of Master of Science in Botany has not been submitted by me for the award of any other degree or diploma.

Asla VP

ACKNOWLEDGEMENTS

First and foremost, I thank God almighty for endowing me with his immense blessings which helped me cover the hurdles, paving way for successful completion of the study.

I extend my sincere thanks to Dr.(Sr) Ashmitha, Principal Providence Women's College for providing all possible help towards the completion of the study, especially during the pandemic period.

I am grateful to my guide Dr. Deena Meria Jose, Head, Department of Botany for her continuous support, guidance and care during the study.

I extend my sincere thanks to Dr.Minoo Divakaran, Sr.Pilty Peter, Dr. Jattisha PI, Dr. Sinisha AK, Dr. Janeesha AP and Mrs. Dipija AP, faculty members of the Department of Botany for the encouragement and support during the work.

I also express my sincere thanks to Mrs. Vasumathi and Mrs. Simba Sherin, lab assistants for the help rendered during the different stages of the project.

I remember with gratitude, the sacrifice and prayers of my parents which supported and strengthened me always.

I also thank all my dear friends for their timely help and encouragement.

CONTENTS

ABSTRACT

Studies on diversity of dicot flora and the structure and components of the community was conducted at Kanjirakunnu hills, Malappuram District. The floristic survey revealed the occurrence of 55 species belonging to 23 families. The study was conducted during September to March which covered mostly the winter and summer seasons. Maximum number of species (7 species) were obtained from the family Scrophulariaceae. Family Rubiaceae was represented by 5 species, Families Asteraceae, Convolvulaceae and Lamiaceae were represented by 4 species each. Families Fabaceae, Apocynaceae and Euphorbiaceae were represented by 3 species each. Sapindaceae and Gentianaceae were represented by 2 members each. In this study, the maximum density was recorded by the species *Polygala elongata* .The second most density was recorded for *Justicia procumbence.* The frequency was highest for *Justicia procumbence, Spermacoce articularis, Osbeckia muralis, Polygala elongata. Spermacoce articularis was* the most abundant species in the study area (10). Second most abundance was for *Justicia procumbence.* The dominance of species is calculated based on Species Importance Value Index (IVI) Considering the IVI values, the dominant species in the study area was *Spermacoce articularis* (43.35).

INTRODUCTION

Biodiversity is the degree of variation of life of given species, ecosystem, biome, or planet. It represents the variety and abundance of life expressed at the genetic, population, species and ecosystem levels, terrestrial and marine, cultivated and natural. India is known for its rich biological diversity. The country is also recognized as one of the eight Vavilovian Centers of Origin and Diversity of Crop plants. The Western Ghats is one of the biodiversity hotspot in India and exists as major component contributing the biodiversity for Kerala state (Anto, M. and Jasy, T., 2015)

'Floristic diversity' can be defined as the diversity of indigenous plants present in a specific area during a particular time period. The rich and diversified flora of India provides a variable storehouse of herbage. The floral diversity is also important to influencing social economic and ecological niche of the country (Sharma, R.B and Sharma, S.C 2012). India is known to have a vast diversity of flora due to various reasons; topological conditions, immense difference in climatic conditions and wide range of habitat favouring the life of different plants. About 4,65,688 species of plants have been known till today on the earth; among them 49,441 species are present in India including the bacteria, algae, lichen virus and fungi (Stephen A., Renuka Suresh, Livingstone C, 2015). India is one of the 17 megadiversity countries of the world having 11.4% of the total known plant species of the whole world and 28% plant species are endemic . There is about 37.7% of Angiosperms, 0.15% of Gymnosperms, 5.27% of Bryophyta, 2.66% of Pteridophytes, 2.07% of Viruses, 15.24% of Algae, 31.05% of Fungi and 5.03% of Lichens of the total species found in India (Rao, 1997). A scientific plant exploration in India started with a British (Burkill, 1965) culminating in the seven volume, monumental work that is the Flora of British India written by Joseph Dalton Hooker. India is one of the world's mega diversity countries. It ranked ninth in the world in terms of higher plant species richness. At the ecosystem level, India also well endowed, with ten distinct bio geographic zones.

India has approximately more than 1300 species of trees, about 4000 species of shrubs and about 1000 species of herbs. Two areas in India have been identify as mega biodiversity hotspot areas that are Western Ghat Forests and Eastern Himalayan forests, although India as a whole has been marked aa Mega diversity (Chaudhari, A.B and Sarkar, D.D, 2003). In the Kerala state, harbors 5094 taxa under 1537 genera and 221 families of flowering plants. The flowering plants of Kerala

include 858 exotics that have been introducing as agriculture forestry as well as accidently entered species of which around 200 species are become naturalized in the state. Angiosperms have well diversified in species number, range of habitat & morphology. Recent studies have shown that there are 250000 species of flowering plants in some 440 families (Thome, 1992b). Floristic diversity refers to the variety and variability of plants in a given region. It refers to the number of taxa in a given region or group (Raghavendra Rao, 2017). Flora is a systematic arrangement of the species of a defined geographical area. Floristic catalogues are the source of botanical details for a particular field and it serves as a useful point for numerous detailed learning (Keith, 1988). The listing of species is easy and comparatively less time consuming (Saima *et al*., 2009) and it provides important public outreach and fundamental informations to use in addressing the biodiversity crisis (Funk *et al*., 2007).

The study deals with the assessment of Floristic diversity of Kanjirakkunnu hills situated in peringavu, near Ramanaattukara, Malappuram district, which is a rocky area with rich diversity of flora belonging to different groups.

OBJECTIVES OF THE STUDY

- To conduct a detailed study of an Angiosperm Floristic Diversity of Kanjirakkunnu hills, Peringavu, Malappuram.
- To repare a detailed description, illustration and photographs of plants.
- To find out the distribution, taxonomic and morphological features of plants at Kanjirakkunnu hills.
- Collection of plants from the study area and to record the habitat peculiarity.
- Preparation of herbarium of the collected plants.
- Examine ecosystem structure and composition patterns in terms of density, frequency and abundance of each species
- Determine the relative density, relative frequency, relative dominance for determining the IVI of major species

REVIEW OF LITERATURE

Taxonomy, one of the oldest fields of science, defined as "theoretical study of classification, including its bases, procedures, principles and rules". The word, "taxonomic' was first proposed by Prof. A.P.de Candolle in 1813. A systematic study of plants in India started from the middle 18th century; in 1565, Garcia de Orta published *Os Colquios* in Goa, which contains a detailed account of some important Indian medicinal plants. Even before the publication of Linnaeus's *Species Plantarurn* (1753), several important books on Indian plants were published, mainly from medicinal point of view, in 1678-1693, the physician Itty Achudan who provided the malayalam plant names and their medicinal properties to Hendrick van Rheede for his book *Hortus Indicus Malabaricus* is comprise 12 volumes mentioned the plants of the Malabar region. J. D Hooker (1872-1897) published the Flora of British India.

A seven volume publications dealt with the phanerogams of the British India. He has described 15,900 species of the flowering plants. The Britishers made major contributions to the floristic studies in India. Robert Wight's (1830-1853) contributed to 28 publications. Among them, *Illustrations of Indian Botany* (1840) and *Icones Plantarum Indiae Orientalis* (1838-1853), Amott and Wight in which several new taxa were described such as the *Prodromus Florae Indiae Peninsularis* (1834). This was followed by the works of Richard Boddome *Flora Sylvatica of South India* (1969-1874) and *Icones Plantarurm Indiae Orientalis* (1868- 1874). *Genera Plantarum* by Bentham and Hooker, 1862-1883 and *De Naturalichen Pflanzenfamilien* by Engler and Prantl, 1887-1915 are the only books considered as world flora. *Genera Plantarum* deals only with seed plants. He describes 200 families and 7569 genera of 7 volumes. *De Naturalichen Pflanzenfamilien* includes entire plant kingdom (Jain & Singh, 1981).

In the second half of the 19th century, several local floras were publishing. That are *Agra* by Munro, W in 1844, *Andhra* by W. Elliot in 1859, *Bengal flora* written by Long, J in 1857 & 1858, *Bombay* by J. Graham, 1839, *Calcutta* by J. W. Masters, 1840, *Kashmir* J.F. Royle, 1833, *Lucknow* by T. Anderson, 1859, *Mount Abu* by Macadam, 1890 and *Punjab* by J. L. Stewart, 1869 (Jain & Singh). Mostly the Botanical Survey of India did the 20th century an intensive exploration all over the country. That are the regional floras like *Flora of the Presidency of Bombay* by Cooke in 1901-1908, *Flora of Presidency of Madras* (Gamble and Fischer, 1915-1936), *Bengal Plants* by D. Prain, 1903, *The Botany of Bihar and Orissa* by H.H Haines in 1921-1925, *Flora of Assam* U.

Kanjilal *et al*., 1934-1940 are the best flora (Jain & Singh). *The Forest Trees of Travancore* by Bourdillion (1908) is deal with 582 indigenous trees. The important works on flora of southem peninsular India are *The Flowering plants of Travancore* (Rama Rao. 1914). *Flora of Anamalai hills Coimbatore District*, Madras Presidency (Fischer, 1921) and *Flora of South Indian Hill Stations* (Fyson, 1932). *The Flora of Tamil Nadu, India* (Nair and Henry, 1989) and *The Flora of Karnataka* (Sharma et al., 1984) were publishing as a part of the aforementioned project. Few volumes of Flora of India have been published by Sharma *et al*., 1993a, 1993 b, 1993c; Hajra *et al*., 1995.

In Kerala, floristic publications are *Flora of Calicut* (Manilal and Sivarajan, 1982) constitutes 983 species of angiosperms in 366 genera and 132 families: *Flora of Cannanore* (Ramachandran and Nair, 1988) mentions 1132 species of flowering plants in 658 genera and *Flora of Silent Valley* (Manilal, 1988) 966 flowering plants in 559 genera was described. *Flora of palghat* (Vajravelu, 1990) accounts for 1355 species belonging to 737 genera and 196 families: *Flora of Kerala: Grasses* (Sreekumar & Nair, 1991); *Flora of Thiruvananthapuram District* (Mohanan and Henry, 1994), recorded 1336 species of vascular plants in 251 genera spread over 195 families. *Flowering plants of Thrissur Forests* (Sasidharan and Sivarajan, 1996), dealt with 1225 species of flowering plants belonging to 703 genera under 129 families and *Flora of Pathanamthitta* (Anil Kumar et al., 2005), shows 1249 species under 658 genera belonging to 148 families. *Flora of Nilambur* (Western Ghats, Kerala) (Sivarajan, V.V and Philip Mathew, 1997) included 1132 species in 665 genera. *Flora of Agasthyamala* (Mohanan & Sivadasan, 2002); *Flora of Alappuzha District* (C.N Sunil & Sivadasan, 2009); *Floristic Study of Wayanad District Giving Special Emphasis to rare & threatened Plants. PhD theses.* (Ratheesh Narayanan, 2009) are other examples of flora. Floristic studies of several districts of the state have been completed, in most cases as part of Ph.D. research programs, that of *Quilon district* (Mohanan, 1984), *Malappuram district* (Babu, 1990), *Kottayam district* (Antony, 1989) and *Pathanamthitta district* (Anil Kumar, 1993). *The Aquatic and Wetland Flora of Northern Kerala* has been studied by Joseph (1991) and *The Sedge Flora of Kerala* by Rejini (1991).

Some of the important publications pertaining to *the Flora of Kerala are Biodiversity documentation for Kerala: Flowering plants* (Sasidharan, 2004); *Flowering plants of Kerala: A Handbook* (Nayar *et al*., 2006); *DVD of Flowering Plants of Kerala* (Sasidharan, 2012). *Flowering*

plants of Kerala, status and statistics, analyse the flowering plants of Kerala. The state harbors 4694 species under1418 genera &188 families. Of these 85 endemic to the Western Ghats , 237 species are endemic to Kerala (Nayer, T.S *et al*.,2008).

Taxonomy is the "queen and servant" of other branches of biology because of the plant identification very need of all other branches like Pharmacology, Ethnobotany, Tissue culture, natomy, etc. Taxonomic studies can provide efficient information about the nomenclature, distribution, ecology and utility of plant species. Taxonomy is the science of identification, naming and classifying plants. It is provide a method of identification and communication using the scientific names. This is a Latin and binomial name. Plants grouped into taxonomical hierarchy that is mainly family, genus and species. Carlous Linnaeus, the 'Father of Modern Taxonomy', developed and published the first comprehensive and consistent classification system for both plants and animals (Jain & Singh, 1981). Initially, taxonomy based on the morphological and anatomical features. In the 20th century, adapt a synthetic approaches based on the data and information provided by other branches of biology. Those are the cytology, biochemistry, molecular biology, and genetics and so on. In modern taxonomy, phenetic methods are used. It based on the criteria of overall morphological, anatomical, physiological or biochemical similarities or differences, with all characters equally weighted and without regard to phylogenetic history. So several new branches emerged in taxonomy among them are cytotaxonomy, chemotaxonomy, molecular taxonomy, and numerical taxonomy etc. Cytotaxonomy is the cytological study of chromosome has made significant contributions in taxonomy. Chemotaxonomy based on the biochemical aspects of plants in formulating taxonomic systems. At molecular level of taxonomy, data from the amino acid and nucleotide sequence of genes, which may be similar or different organisms, are classified. Numerical taxonomy is an attempt to remove some of the subjectivity. It use a large number of characteristics of all have equal value. Artificial classification as a classification using easily observed phenotypic characters and not necessarily indicating phylogenetic relationship. Phylogenetic systematics is a method of classification based on evolutionary relationships between the species (Subrahmanyam, 2005). So the field of taxonomy is changing day to day, based on the molecular and biochemical studies of plants. Therefore, many system of classification emerged in recently. APG I, II & III (Angiosperm Phylogeny Group) System (1998-2009), classification basedon the biochemistry, and evolutionary relationship. The angiosperm Phylogeny classification of flowering plants (APG IV) was proposed

by Byang, James W; Chase, Mark; Christenhusz, Maarten and Stevens, Peter (2016). This system based on the molecular analysis of plants.

Flora studies or floristic studies including species lists, life-form spectra, geographical distribution, and identification of threatened species, are useful for evaluating ecological issues such as biodiversity, growth capacity, conservation and regulation (Kargar-Chigani *et al*. 2016). A Flora is an inventory of the plants of a definite area. This inventory is usually authenticated by citations of herbarium specimens and of location or stations where each element is known to have occurred. It is customary to arrange the plants treated in a flora according to a recognized system of classification. Floristic studies are taxonomic studies of a flora or of a major segment of a flora, of a given area. They may range in extent from a compiled checklist of vascular plants of a small politically bounded area to through taxonomic or biosystematics analysis of the components of the vascular flora of a continent. Flora is the simplest list of plants occurring within a given region and they are the living organisms lacking power of locomotion which resides its whole life in any circumstances at a single spot (Ramachandran *et al*., 1988). Ramachandran and V J Nair (1988) prepared Flora of Kannur and they recorded 1,132 species from 3,670 km sq. area in Kannur district. Flora has been a part of human life from earlier times. Phytosociological analysis insights the basic information of plant species like frequency, abundance, density, basal cover, relative frequency, relative density, relative dominance, IVI and RIVI. The ultimate goal of phytosociology is characterization for vegetation types based on analysing floristic composition. The local plants act as the wealth of plant species (Qureshi *et al.,* 2014).

MATERIALS AND METHODS

STUDY AREA

The study area, Kanjirakkunnu hills is located on Cherukavu panjayath in Kondotti thaluk in Malappuram district. It is a village situated around 4.5 km from Ramanaattukara, Kozhikkode district. The region falls within the biogeographic zone of the Western Ghats. The area lies at the latitude of 11.192830° N and a longitude of 75.899287°E. There is an average annual temperature of 33°C. Climate is tropical in nature. The peaks get immersed in fog during mansoon and winter season. It is hot and sunny during the other seasons.

The name Kanjirakunnu derived from the tree Kanjiram *(Strychnos nux vomica),* which is widely distributed in this region. The area has heterogeneous vegetation along elevation gradient. The ground vegetation is dense in soil filled areas and a grassland appearance in peaks. The base of the mountain are clothed with scrub vegetation, while with increasing elevation occur dry deciduous, mixed deciduous and evergreen forest. It contains many medicinal plants, endangered and threatened species of plants. The rocks surface found bryophytes, pteridophytes, lichens and fungi and various habits are including this area such as trees, shrubs, herbs, and climbers. . Many Parasitoc and epiphytic plant species are also found there.

Study area: Kanjirakunnu, Malappuram District, Kerala

METHODOLOGY

Floristic Survey

The study area, Kanjirakkunnu hills of Cherukavu village in Malappuram district has a rich biodiversity, with very less human interference.

Collection trips were conducted to this area during September 2020-March 2021, covering winter and summer seasons. dicotyledonous plants were collected and photographs were taken. Most of the specimens were collected in generative stage like flowering and fruiting stages or both. But where generative stages could not be observed during this period of study, vegetative specimens were also collected as far as possible. Field observations like collection number, collection date, altitude, local name, family, habit and brief descriptions were noted in the field note. The specimens were collected, pressed and labelled for herbarium preparation.

The specimens identified with the help of various Floras like Flora of the Presidency of Madras, other relevant literature, and online access were also referred. For preparation of keys to the family, genus and species was based on Bentham and Hooker System of Classification. Artificial keys were provided for families, genera and species. Keys were strictly dichotomous, indented. Alphabetical order is followed in the treatment of genera within the families, and species within the genera. The nomenclatures of plants according to the International Code of Botanical Nomenclature (ICBN) was adopted.

Community Analysis

Community analysis was done by quadrant method with minimum quadrant size of 1×1 meter by species area curved method. Twenty quadrants were randomly taken for analysis. The minimum quadrant taken for the analysis is ten (Greig-Smith, 1974). It aims to analyze the vegetative environment of a given region.

Quadrat used for the study

RESULTS AND DISCUSSION

Floristic survey

A total of 55 species belonging to 23 families were collected and identified (Table 1, Figs 1-55).

Table 1: List of specimens collected

Sl no	Species name	Family
1	*Uvaria narum*, Wall.	Annonaceae
2	*Ionidium suffruticosum*, Ging F. & Thoms.	Menispermaceae
3	*Ionidium suffruticosum*, Ging.	Violaceae
4	*Polygala elongata*, Klein	Polygalaceae
5	*Polycarpaea corymbosa*, Lam	Caryophyllaceae
6	*Sida acuta*, Burrn.	Malvaceae
7	*Naregamia alata*, W. & A.	Meliaceae
8	*Cardiospermum halicacabum*, Liim;	Sapindaceae
9	*Allophylus serratus*, Radlk. A. Cobbe	Sapindaceae
10	*Indigofera trifoliata*, Linn	Fabaceae
11	*Cassia mimosoides*, Linn	Fabaceae
12	*Abrus precatorius*, Linn	Fabaceae
13	*Mimosa pudica*, Linn	Fabaceae
14	*Melastoma malabathricum*, Linn.	Melastomataceae
15	*Oldenlandia auriculata* (L) K.Schum.	Rubiaceae
16	*Oldenlandia herbacea*, Roxb. O. Heynii, Hook. f.	Rubiaceae
17	*Borreria hispida*, K. Sch.	Rubiaceae
18	*Ixora coccinea* Linn.	Rubiaceae
19	*Chasalia curviflora*, Thw.	Rubiaceae
20	*Vernonia cinera*, Less.	Asteraceae
21	*Elephantopus scaber*, Linn.	Asteraceae
22	*Synedrella nodiflora*, Gaertn.	Asteraceae
23	*Tridax procumbens,* Linn.	Asteraceae
24	*Holabrilena antidysenterica*, Wall.	Apocynaceae
25	*Ichnocarpus frutescens*, R. Br.	Apocynaceae

26	*Hemidesmus indicus*, R. Br.	Apocynaceae
27	*Strychnos nux vomica*, Linn	Loganiacea
28	*Exacum bicolor*, Roxb	Gentianaceae
29	*Canscora diffusa*, R. Br.	Gentianaceae
30	*Ipomoea obscura*, Ker-Gawl.	Convolvulaceae
31	*Evolvulus alsinoides*, Linn.	Convolvulaceae
32	*Evolvulus nummularius* (L.) L.	Convolvulaceae
33	*Merremia tridentata*, Hallier f.	Convolvulaceae
34	*Cuscuta reflexa* , Roxb.	Scrophulariaceae
35	*Lindenbergla urticaefolla*, Link and Otto	Scrophulariaceae
36	*Torenia bicolor*, Dalz.	Scrophulariaceae
37	*Buchnera hispida*, Ham.	Scrophulariaceae
38	*Striga lutea*, Lour	Scrophulariaceae
39	*Sopubia delphinifolla*, G. Don	Scrophulariaceae
40	*Centranthera indica*, Gamble n. comb.	Scrophulariaceae
41	*Rungia parviflora*, Nees	Acanthaceae
42	*Justicia procumbens*, Linn.	Acanthaceae
43	*Lantana camara*, Linn.	Verbenaceae
44	*Clerodendron infortunatum* Linn.	Verbenaceae
45	*Clerodendron serratum* Spreng	Verbenaceae
46	*Ocimum sanctum*, Linn.	Lamiaceae
47	*Hyptis suaveolens* Poit.	Lamiaceae
48	*Dysophylla quadrifolia* Benth	Lamiaceae
49	*Leucas aspera* R. Br.	Lamiaceae
50	*Cassytha filiformis* Linn.	Lauraceae
51	*Santalum album* Linn	Santalaceae
52	*Antidesma menasu* Miq.	Euphorbiaceae
53	*Breynia patens* Rolfe	Euphorbiaceae
54	*Tragia involucrata* , Linn.	Euphorbiaceae
55	*Sebastiania chamaelea* Muell. Arg.	Euphorbiaceae

The floristic survey gave information about approximate floral wealth of study area is Kanjirakkunnu hills of Cherukavu village in Malappuram district and its role in conservation. It have a rich biodiversity rocky area with very less human interference. Collection trip were conducted to this area during September 2020 - March 2021. The present study was conducted during the winter and summer season to record the available taxa. Plants were collected from ground to peak, photograped and identified. Usually specimens were collected in generative stage as flowering and fruiting or both. But where generative stages could not be observed during this period of study, vegetative specimens were also collected as possible. Field observations like collection number, collection date, altitude, local name, family, habit and brief descriptions were noted in the field note. The specimens were collected, pressed and labelled for herbarium preparation.

The specimens identified with the help of various floras like Flora of the Presidency of Madras, other relevant literature, and online access were also referred. The key preparation of the family, genus and species as follows the Bentham and Hooker System of Classification. Artificial keys were provided for families, genera and species. Keys are strictly dichotomous, indented. Alphabetical order is followed in the treatment of genera within the families, and species within the genera. The nomenclatures of plant were gives according to the International Code of Botanical Nomenclature (ICBN). The identification was further confirmed by the help of taxonomic experts.

Maximum number of species (7 species) were obtained from the family Scrophulariaceae. Family Rubiaceae was represented by 5 species, Families Asteraceae, Convolvulaceae and Lamiaceae were represented by 4 species each. Families Fabaceae, Apocynaceae and Euphorbiaceae were represented by 3 species each. Sapindaceae and Gentianaceae were represented by 2 members each.

Community Analysis

The data from the analysis consist of list of species in an area for the study and their abundance which gave information about which species are present in a certain area. The numerical value were used to find out frequency, density, relative frequency, relative density, relative basal area, value index by using standard formula (Curtis and McIntosh, 1950).

Abundance, frequency and density and were calculated using the following formula:

a) **Abundance:** It is the study of the number of individuals of different species in the community per unit area. By quadrant method, samplings are made at random at several places and the number of individuals of each species was summed up for all the quadrants divided by the total number of quadrants in which the species occurred. It is represented by the equation:

$$\text{Abundance} = \frac{Total\ number\ of\ individuals\ of\ the\ species\ in\ all\ quadrats}{Number\ of\ quadrate\ of\ occurrence\ of\ species}$$

b) **Frequency:** This term refers to the degree of dispersion of individual species in an area and usually expressed in terms of percentage of occurrence. It was studied by sampling the study areas at several places at random and recorded the name of the species that occurred in each sampling units. It is calculated by the equation:

$$\text{Frequency} = \frac{Number\ of\ quadrats\ in\ which\ the\ species\ present}{Total\ number\ of\ quadrats\ studied} \times 100 \quad (\%)$$

c) **Density**: Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. Density is given by the equation:

$$\text{Density} = \frac{Total\ number\ of\ individuals\ of\ the\ species\ in\ all\ quadrats}{Total\ number\ of\ quadrats\ studied}$$

Relative frequency, relative density and relative dominance were calculated using the following formulae;

Relative Frequency = Number of occurrence of the species * 100

Number of occurrence of all species

Relative density = Number of individuals of the species * 100

Number of individuals of all species

Relative dominance = Total basal area of the species * 100

Total basal area of all species

IVI = RD + RF + RDo

RIVI = IVI/3

Systematic Treatment

Key to the Angiosperms

1. Leaves reticulately veined; flowers 4-5 merous ……..……....Dicotyledonac

1. Leaves parallel veined; flowers trimerous…….. Monocotyledonae

Key to the Dicotyledonae

1. Flowers usually with only one whorl of Petals or none
   inner whorl of perianth is undifferentiated…….. Monochlamydeae

1. Inner whorl of perianth differentiated to sepal & petal

   2. Petals free……..... Polypetalae

   2. Petals united…….....Gamopetalae

Key to the families of Polypetalae

1. Flowers with prominent disc; calyx free from ovary

   2. Leaves glandular…… Rutaceae

   2. Leaves aglandular……..….Meliaceae

1. Flowers with receptacle modified to torus or calyx adnate with ovary

   3. Flower hypogynous

      4. Unisexual, climbers……..…….Menispermaceae

      4. Bisexual, trees or shrub ……Malvaceae

   3. Flowers perigynous/ epigynous

      5. Petal/sepal united to form perianth……..……Aizoaceae

      5. Petal/sepal differentiated from perianth

         6. Fruit legumes……..……...Fabaceae

         6. Fruit berry/ drupe/ pepo

            7. Leaves many lobed; climbers……Cucurbitaceae

            7. Leaves single lobed; erect herb/shrub……..…..Myrtaceae

Key to the families of Gamopetalae

1. Ovary inferior

2. Calyx modified into pappus..... .Asteraceae

2. Calyx normal with sepal……...Rubiaceae

1. Ovary superior

3 . Milky laticiferous shoots .....Apocynaceae

3 . Milky latex free from shoots

4. Ovules many per carpel

5. Anthers united to pairs……..Gesneriaceae

5. Anthers free……..Acanthaceae

4. Ovule 1-2 per carpel

6.Style gynobasic; ovary 4 lobed……..... ..Lamiaceae

6. Style terminal; ovary 2/4 lobed……..... .Verbanaceae

Key to the families of Monochlamydeae

1. Unisexual or polygamous flowers

2.Leaves obscure; Carpel 3.....Euphorbiaceae

2. Leaves prominent; Carpel 2.....Moraceae

1. Bisexual flowers…….. Santalaceae

Key to Monocotyledonae

1. Fruit caryopsis……... Poaceae

1. Fruit achene……. ..Cyperaceae

Taxonomic Descriptions

ANNONACEAE

1. ***Uvaria narum* Wall.**

Scandent or straggling shrubs, usually stellately pubescent. Inflorescence terminal or leaf opposed or rarely axillary. Flowers: solitary, cymose, umbellate or fascicled, yellow, purple or brown. Sepals 3, valvate, often connate below. Petals 6, orbicular, oval or oblong, imbricate in 2 rows, sometimes connate at the base. Stamens indefinite; top of connective ovoid-oblong, truncate subfoliaceous, concealing the anthers. Torus depressed, pubescent or tomentose. Ovaries indefinite, linear-oblong; style short, thick; ovules many, 2-seriate, rarely few. Or 1-seriate. Fruit of many dry or baccate, few- or many-seeded carpels. Leaves, twigs, calyx and petals stellate-tomentose.

MENISPERMACEAE

2. ***Cyclea peltata* Hook. F. & Thoms.**

Climbing shrubs. Leaves usually peltate. Flowers in axillary panicles : : Sepals 4-8,calyx globose or broadly campanulate, connate into a 4-5-lobed calyx; petals 4-8, more or less connate into a 4-5-lobed corolla ; anthers 6-8, connate round the rim of the disk-like top of the staminal column, bursting horizontally: $ Calyx globose or campanulate, lobed ; corolla globular; ovary 1, style short, 3-5-lobed, lobes radiating. Drupe ovoid; style-scar sub-basal; endocarp horseshoe-shaped, 2-locellate, dorsally tubercled, sides convex. Seed curved; cotyledons slender, semi-terete, appressed.

VIOLACEAE

3. ***Ionidium suffruticosum* Ging.**

Herbs. Leaves alternate, rarely opposite. Flowers solitary, axillary, red. Sepals 5, subequal, not produced below their insertion. Petals 5, the lower one on a long claw, saccate or spurred at the base. Anthers connate or free, 2 or 4 of them gibbous or spurred at the back. Ovary ovoid ; style clavate, incurved; stigma oblique. Capsule 3-valved, subglobose, few seeded. Seeds globose; testa crustaceous, conspicuously finely striate; valves of capsule about 2 in. long.

POLYGALACEAE

4. ***Polygala elongata*** **Klein**

Herbs or rarely shrubs. Leaves alternate. Sepals usually persistent, the 2 inner larger, sometimes petaloid. Petals 3, united below with the staminal sheath, the lower boat-shaped and usually crested at the tip. Stamens 8; filaments united below into a split sheath ; anthers opening by pores. Ovary 2-celled; ovules 1 in each cell, pendulous. Capsule 2-celled and -seeded, loculicidal, seeds with a waxy 3-fid or cup-shaped and 3-toothed caruncle, often expanded above into 1-3 short or long narrow membranous wings or into broad appendages covering the seed; albumen rarely absent.

CARYOPHYLLACEAE

5. ***Polycarpaea corymbosa*** **Lam**

Herbs, shortly tomentose ,usually erect. Leaves flat with leaf-fascicles in the axils; stipules much fimbriate, 15 in long; internodes with scattered hairs subulate, linear or spathulate ; stipules scarious. Flowers numerous, in lax or contracted cymes. Sepals 5, often white, scarious throughout or, rarely, at the margins only. Petals 5, entire toothed or erose. Stamens 5, free or coherent with the petals. Ovary 1-celled; style slender, 3 or 3-toothed; ovules numerous. Capsule 3-valved. Seeds obovoid or compressed. Embryo curved, rarely straight.

MALVACEAE

6. ***Sida acuta*** **Burrn.**

Herbs or undershrubs, pubescent with simple or stellate hairs. Leaves toothed; stipules linear. Flower pedicels axillary, solitary or clustered, disarticulating in fruit at a joint below the calyx : bracteoles 0. Sepals 5, connate below. Corolla small, yellow or white. Staminal tube divided into numerous filaments at the top. Ovary 5-12-celled ; ovules pendulous, 1 in each cell ; styles as many as the carpels ; stigmas terminal. Fruit depressed globose, enclosed in the calyx ; carpels separating from each other and from the axis.Seeds smooth. Fibre-yielding

MELIACEAE

7. *Naregamia alata* W. & A.

A small branching undershrub. Leaves alternate, 3-foliolate, petiole winged. Flowers solitary or 2 together, axillary. Calyx 5-lobed, imbricate. Petals 5, free, elongate, linear-spathulate. Disk annular. Staminal tube long, slender, cylindric below, inflated near the top and sometimes cleft in two parts, obscurely 10-crenate at the mouth; anthers 10, appendaged at the apex. Ovary 3-celled; style filiform; stigma capitate; ovules 2 in each cell, collateral, pendulous. Fruit an ovoid-globose capsule, loculicidally 3-valved, the valves separating from the 3-winged axis, the cells 2-seeded. Seeds pendulous, curved, truncate at both ends, muricate, with a short double membrane along the side next the axis; albumen fleshy; cotyledons flat, foliaceous.

SAPINDACEAE

8. *Cardiospermum halicacabum* Liim;

Climbing tendril-bearing herbs with wiry stems and branches. Leaves alternate, biternate ; leaflets coarsely dentate. Flowers irregular, polygamo-dioecious, in axillary racemes or corymbs,

the lowest pair of pedicels transformed into spiral tendrils. Sepals 4, concave, the outer pair small, the inner large. Petals 4, in 2 pairs, the two upper near the stamens with a supra-basal scale, the two lower remote from the stamens with a crested inflexed appendage. Disk unilateral, of 2 glands opposite to the lower petals. Stamens 8, excentric ; filaments unequal, free or connate below. Ovary 3-celled ; style short, 3-fid, the segments bearing inner stigmatic surfaces ; ovule 1 in each cell. Fruit a membranous, inflated, trigonous capsule, loculicidally 3-valved the valves reticulate. Seeds globose, usually with a conspicuous hilum at the base; testa crustaceous;cotyledons large, transversely conduplicate. Capsules depressed, pyriform, winged at the angles ; leaves nearly glabrous, leaflets acuminate at apex ; flowers small ; seeds black with a large, white, heart-shaped hilum

9. *Allophylus serratus* Radlk. A. Cobbe

Shrubs or small trees. Leaves alternate, 1- or 3-foliolate ; leaflets entire or serrate ; stipules 0. Flowers small, irregular, polygamodioecious, pedicelled, in fascicles in simple or branched axillary thyrses. Sepals 4 in opposite pairs, cucullate, imbricate, the outer pair smaller than the inner. Petals 4, small or almost obsolete, generally decimate, naked inside or with a reflexed

shaggy scale above the claw. Disk unilateral, usually with 4 glands opposite the petals. Stamens 8, inserted on the receptacle inside the disk, in $ flowers surrounding the ovary. Ovary usually 2 lobed and 2-celled, in < flowers merely a pistil- lode ; styles 2, free or connate below, stigmatose on the inner face above ; ovule 1 in each cell. Fruit indehiscent, 1-2-lobed ; lobes subglobose.

FABACEAE

Flowers zygomorphic; stamens definite, corolla papilionaceous; petals imbricate, the uppermost (standard) the outermost, the 4 others in 2 opposite pairs; stamens usually combined……. Papilionioideae.

Corolla not papilionaceous; petals imbricate, the uppermost the innermost, the rest similar to each other; stamens usually free……..……Caesalpinioideae

Flowers regular; stamens definite or indefinite; petals valvate, usually united above the base…….Mimosoideae.

PAPILIONACEAE

10. *Indigofera trifoliata* Linn

Herbs, undershrubs or shrubs, with appressed laterally attached hairs, sometimes mixed with basifixed hairs, frequently silvery-canescent. Leaves simple, trifoliolate or imparipinnate, the side leaflets usually opposite, but sometimes alternate, entire; stipules usually small, shortly adnate to the petiole; stipuls setaceous or 0. Flowers generally very small, usually reddish or purple, in axillary racemes or spikes, rarely solitary, rarely panicled, each flower pedicelled in the axil of a caducous bract; bracteoles 0. Calyx minute, campanulate, teeth subequal or the lowest longest. Corolla more or less caducous; standard ovate or orbicular, sessile or slightly clawed; wings oblong, slightly adherent to the keel; keel petals erect, obtuse, with a downward spur on each side near the base. Stamens diadelphous, the vexillary stamen free, the others with connate filaments; anthers uniform, apiculate. Ovary sessile or subsessile, 1-2- or many-ovulate; style glabrous ; stigma capitate, sometimes pedicellate. Pod usually linear-cylindric, rarely oblong or globose, straight or curved, sometimes angled, sometimes muricate, often torulose, septate within between the seeds. Seeds globose or cylindric and truncate; strophiole 0.

11. *Cassia mimosoides* Linn

Herbs. Leaves abruptly pinnate, the rhachis often furnished with glands between the leaflets or on the petiole below them; stipules various; stipels 0. Flowers usually yellow, often large and showy, in axillary racemes, terminal panicles or supra-axillary fascicles of 1 or more: bracts and bracteoles present, various. Calyx-tube very short ; lobes 5, imbricate. Pelals 5, imbricate, subequal or the lower the largest. Stamens normally 10 but rarely all perfect and equal, 2-5 neually the uppermost, being sometimes wanting or reduced to staminodes; anthers of the 3 lowest stamens often the longest, all dehiscing by terminal pores or by a short slit. Ovary sessile or stalked, many-ovuled; atyle incurved; stigma terminal, naually truncate, sometimes ciliolate. Pod variable, dehiscent or indehiscent, terete or flat, ilsiually septate between the seeds. Seeds transvelse, rarely longitudinal, usually compressed, albuminous.

12. *Abrus precatorius* Linn

Climbing shrubs. Leaves abruptly pinnate with many pairs of leaflets, the rachis ending in a bristle; stipules subscarious, deciduous; stipules minute. Flowers in fascicles in dense thickened racemes on axillary peduncles or short branches; bracts small, deciduous; bracteoles under the calyx 2, deciduous. Calyx-tube small, campanulate, truncate, the teeth very short. Corolla much exserted; standard broadly ovate, narrowed into a short claw, slightly adherent to the staminal tube; wings narrow, oblong-falcate; keel curved. Stamens 9, in a sheath, the vexillary one absent, anthers uniform. Ovary subsessile, many ovuled; style short, incurved, not bearded; stigma capitate. Pod oblong or linear, more or less compressed, thinly septate between the seeds, early dehiscent. Seeds globose or, hilum near the top.

13. *Mimosa pudica* Linn.

Herbs or shrubs, usually prickly. Leaves bipinnate; leaflets small, more or less sensitive, caducous, the rhachis usually prickly; stipules small; stipels small, often 2 to each pinna. Flowers small, polygamous, in globose heads on axillary, solitary or fascicled peduncles, the upper peduncles often forming a terminal raceme; bracts small, deciduous; bracteole 1, minute. Calyx very small, campanulate, shortly 4-toothed. Petuls 4, Connate below, valvate. Stamens as many as the petals, exserted; filaments filiform; anthers small. Ovary stipitate, many-ovuled; style filiform ; stigma

minute, terminal. Pod flat, membranous, of several 1-seeded joints that separate when ripe from each other and from the persistent sutures. Seeds ovoid or orbicular, flattened, albuminous

MELASTOMATACEAE

14. *Melastoma malabathricum* Linn.

Shrubs, usually erect and bristly. Leaves opposite, entire, petioled, elliptic or lanceolate, 3-7-ribbed. Flowers terminal, solitary or in clusters or panicles, large, purple or sometimes rose or white, usually 5-merous; bracts conspicuous. Calyx-tube ovoid or campanulate, covered with strigose or paleaceous hairs; lobes ovate or lanceolate, alternating with subulate appendages. Petals as many as calyx-lobes, broadly obovate, large. Stamens 10, alternately long, opposite calyx-lobes, with purple anthers and the connective produced at the base to end in two lobes and shorter opposite petals with yellow anthers and connectire not produced but with 2 tubercles in front. Ovary ovoid, more or less adnate to the calyx-tube; ovules numerous ; style simple. Fruit an irregularly dehiscent or soft berry-like capsule. Seeds minute, numerous, curved, minutely punctate.

RUBIACEAE

***15. Oldenlandia auriculata* (L)K.Schum.**

Shrubs undershrubs or herbs, usually dichotomously branched. Leaves opposite, rarely ternately whorled; stipules interpetiolar, free or connate with the petioles, often pectinately or pinnatifidly fringed. Flowers white or pink, sometimes blue, in axillary or terminal, often paniculate, cymes, rarely solitary. Calyx-teeth 4, rarely 5, persistent. Corolla rotate campanulate or funnel shaped ; lobes 4, rarely 5, valvate, Stamens 4 or 5, in the throat of the corolla-tube, included or exserted. Ovary 2-celled ; ovules numerous, on placentas attached to the septum; style filiform ; stigmas 2, linear. Fruit a capsulę, membranous or chartaceous, dehiscing septicidally, the cells splitting ventrally, or loculicidally in the upper part, or sometimes indehiscent. Seeds usually many, in cavities on the rounded placentas, smooth or angular; testa usually reticulate or pitted : albumen fleshy. Capsule indehiscent or late dehiscent or the crown only dehiscing loculicidally.

16. *Oldenlandia herbacea* Roxb. O. Heynii, Hook. f.

Shrubs undershrubs or herbs, usually dichotomously branched. Leaves opposite, whorled: stipules interpctiolar. free or connate with the petioles. Often pectinately or pinnatifidly fringed. Flowers white or pink, sometimes blue. in axillary or terminal, often paniculate. Cymes rarely solitary. Calyx-teeth 4, rarely 5, persistent. Corolla rotate campanulate or funnel-shaped; lobes 4, rarely 5, valvate. Stamens 4 or 5, in the throat of the corolla-tube, included 'or exerted. Ovary 2-celled, ovules numerous, on placentas attached to the septum; style filiform: stigmas 2, linear. Fruit a capsule, membranous, dehiscing septicidally, the cells splitting ventrally, or loculicidally In the upper part, or sometimes indehiscent. Seeds usually cavities on the rounded placentas, smooth or angular: testa usually reticulate or pitted, albumen fleshy.

17. Borreria hispida K. Sch.

Annual or perennial herbs. Leaves opposite, sessile or petiolated; stipules connate with the petioles in a broad truncate tube with marginal bristles. Flowers very small, in axillary or terminal fascicles; bracteoles many, of soft filiform bristles. Calyx-tube obovoid or turbinate; lobes 2-4, often with intermediate teeth or bristles. Corolla funnel-shaped or hypocrateriform; lobes 4. valvate. Stamens 4, on the throat or tube -of the corolla; anthers linear or oblong. Ovary 2-celled; ovules solitary in each cell on septal placentas; style filiform with 2 short arms or stigma capitate. Fruit of 2 coriaceous or crustaceous. mericarps which dehisce ventrally. Seed oblong, ventrally grooved; testa thin; albumen horny or fleshy; cotyledons small, foliaceous.

18. *Ixora coccinea* Linn.

Shrubs or small trees. Leaves opposite, rarely ternate, usually thick; stipules interpetiolar. Flowers usually 4- (rarely 5-) merous, in terminal, trichotomously branched, often corymbose cymes ; bracts usually leaf-like, coriaceous; bracteoles 2. Calyx tube ovoid; limb short, 4-, rarely 5-lobed, the lobes persistent. Corolla hypocrateriform; tube long, slender; lobes 4 (rarely 5), twisted in Bud, spreading or reflexed in flower. Stamens 4 (rarely 5) on the mouth of the corolla; filaments short or 0; anthers slender, 2-fid at base, mucronate at tip. Ovary 2-celled, ovules solitary in each cell, peltately attached to the septum; style filiform; stigma fusiform, slender, 2-branched, the branches rarely connate. Fruit globose or didymous with 2 plano-convex or ventrally concave coriaceous

pyrenes. Seeds peltate, often 1 only, the others undeveloped, testa membranous; albumen horny; embryo curved, the cotyledons thin, the radicle stout and long, inferior.

19. *Chasalia curviflora* Thw.

Shrubs or small trees; branchlets crete. Leaves opposite or ternately whorled, petiolate; stipules intrapetiolar, usually bifid. Flowers in terminal cymes: bracts and bracteoles small. Calyx-tube ovoid or subglobose, lobes 5, short. Corolla-tube clongate, slender and usually curved; lobes 5, short, valvate. Stamens 5, inserted in the corolla tube; anthers long: filaments short or 0. Disk large, annular or tumid. Ovary 2-celled; ovule I in each cell, erect; style long, with 2 stigmatic lobes. Fruit dry or slightly fleshy, of 2 pyrenes, ventrally grooved, dorsally rounded. Seeds orbicular, rounded on the back, ventrally very concave; testa membranous; albumen horny; cotyledons broad; radicle terete, inferior.

ASTERACEAE

20. *Vernonia cinera* Less.

Annual or somewhat perennial herbs erect or decumbent, leaves very variable, alternate, glabrous or pubescent, ovate or lanceolate, the margins undulately toothed; Heads homogamous, terminal or axillary, solitary or in cymes or panicles, tesually corymbose. involucral bracts lobose or hemispheric: bracts many-scriate, the inner the longest. Flowers pink or lilac with white silky pappus. Receptacle naked or pitted, sometimes shortly hairy. Corollas all equal, tubular, slender: lobes 5, narrow. Anthers obtusely auricled at hase. Style-arms subulate, puberulous. Achenes 10 ribbed 3—5-angled or terete; pappus usually 2-seriate, the outer simple or paleaceous, the inner long, feathery.

21. *Elephantopus scaber* Linn.

Rigid, usually perennial herbs. Leaves alternate or radical, entire or toothed. Heads homogamous, of 2–5 flowers, collected in a head like cluster supported by 3 broadly ovate-cordate leafy bracts; bracts of the heads about 8, in 2 rows, the outer shorter, all stramineous, oblong, acute. Receptucle nakcd. Corollas equal, tubular; limb deeply cleft in 5 lobes, which often spread palmately. Anthers auricled at base. Style-arnis subulate, puberulous. Achenes 10-ribbed, truncate at apex; pappus bristles rigid, slender throughout or dilated below in a chaffy base.

22. *Synedrella nodiflora* Gaertn.

Annual, branched, pubescent or villous, herbs. Leaves opposite, petioled, toothed. Heads heterogamous, rayed, axillary and terminal; ray-flowers 1—2-seriate, &, fertile; disk-flowers, fertile. Involucre ovoid or oblong; bracts few, 1 or 2 outer foliaceous, the rest passing into the palcac. Receptacle flat, palcac flat, scarious. Corollas of flowers ligulate, the ligule short, broad, 2—-3-lobed, yellow; of flowers tubular, limb 4-lobed. Anther-bascs obtuse. Style-arms of flowers with long acute tips. Achenes of ray-flowers dorsally compressed, winged, the wings lacerate; of disk-flowers narrow, compressed or tri- quetrous, often muricate; pappus of 2 slender awns.

23. *Tridax procumbens* Linn.

Perennial herbs. Leaves opposite, inciso-dentate or pinnatisect. Heads medium-sized, hetcrogamous, raved; ray-flowers, fertile, disk- flowers, fertile. Involucre campanulate, few-seriate, outer broad, herbaceous, inner scarious. Receptacle flat or convex: palcae membranous. Corolla of flowers ligulate or 2-labiate, the outer lip large 3-lobed, the inner small 2-lobed; of flowers tubular, the limb 2-lobed. Anther bases with short acute auricles. Style-arms hairy, the tips subulate. Achenes rurbinate or oblong, silky; pappus of short or long aristate feathery bristles.

APOCYNACEAE

24. *Holabrilena antidysenterica* Wall.

Trees or shrubs. Leaves opposite, membranous, glabrous or pubescent. Flowers white, in terminal or axillary corymbose cymes. Calyx 5-lobed, usually glandular within at the base; lobes narrow. Corolla salver-shaped; tube slender, cylindric, slightly dilated opposite to the stamens; lobes oblong or obovate, overlapping to the right. Stamens near the base of the tube, included; anthers lanceolate, mucronate, the cells rounded at the base. Disk none. Ovary of 2 distinct carpels; ovules many in each carpcl; style short; stigma oblong-fusiform, the tip bifid. Fruit of 2 terete elongate follicular mericarps connected at the tip, then free. Seeds linear or oblong, concave within, tipped at the apex with a deciduous coma of long silky brown hairs; albumen scanty; cotyledons broad, complicate, radicle short, superior.

25. *Ichnocarpus frutescens* R. Br.

Climbing shrubs with slender branches. Leaves opposite. Flowers small, in lax terminal and axillary paniculate cymes. Calyx 5-lobed, glandular or not within. Corolla salver-shaped, the throat contracted or villous, lobes overlapping to the right, the upper half deflexed in bud. Stamens inserted at or below the middle of the tube; filaments very short; anthers sagittate, conniving over and adhering to the stigma; cells spurred at the base. Disk free, with 5 erect disk glands. Ovary of 2 distinct carpels; ovules many; style short, the top obconic; stigma columnar. Fruit of 2 slender, spreading or divaricate, follicular mericarps. Seeds narrowed at the tip, crowned with a deciduous silky coma; albumen scanty; cotyledons long, flat; radicle short, superior.

26. *Hemidesmus indicus* R. Br.

Twining undershrub. Leaves opposite or in whorls of 4. Flowers small, greenish-purple, in axillary opposite crowded subsessile cymes. Calyx - 5 partite, lobes acuminate, with 5 minute scales at their bases. Corolla rotate, deeply 5-fid, with valvate fleshy lobes; corona-scales 5, thick. on the corolla-lobes and alternate with them. Stamens Inserted at the base of the corolla-tube: filaments distinct or subconnate at the base; anthers small, cohering -at the apex, ending in inflexed appendages; pollen-masses cohering in pairs in each cell, granular. the caudicles of the pollen-carriers bearing cucullate or spreading appendages. Ovary of 2 many-ovuled carpels; styles distinct, style-apex 5-lobed, flat on top. Fruit of 2 slender divaricate terete follicular mericarps. Seeds oblong, flattened, ridged ventrally, ending in a long white silky coma; cotyledons oblong; radicle cylindrical.

LOGANIACEA

27. *Strychnos nux vomica* Linn

Trees or climbing shrubs with usually short clavate circinate, tendris, in some of the axils, the adjacent _lea being then often suppressec Leaves opposite, usually coriaceous, with 3--5 or more ribs staritng fron or a little above the ha se; main nerves transverse joining the midrib and uppermside ribs, less conspicuous. Floucrs white or yellowish, ill terminal or axillary cymes; bracts and bracteoles small. Calyx 5- or 4-1obed. Corona salver-shaped; lobes 5 or 4, valvate. Stamens 5 or 4 adnate to the corolla-tube; filaments short; anthers ovate or oblong, cells parallel. Ovary 2.-celled, or I-celled above; ovules many in each cell; style short; stigma capitate or

obscurely 2-lohed. Fruit a berry, globose, indehiscent, with ahardened pericarp. Seeds many, or 1-2, embedded in a fleshy pulp; globose or compressed,,the hilum ventral; embryo short, the cotyledons foliaceous ; radicle terete, short.

GENTIANACEAE

28. *Exacum bicolor* Roxb

Herbs sometimes subshrubby and much branched. Leaves opposite, entire, usually 3- or more-ribbed, Flowers in terminal and axillary usually leafy dichasioid cymes. Calyx deeply 4—5-lobed, the lobes keeled winged or flat on the back. Corolla rotate,lobes generally white in the lower, bright blue in the upper half. The size of the leaves is variable according to locality and soil. Corolla tube short, globose; lobes 4-5, overlapping to the right in bud. Stamens 4-5, inserted on the throat of the corolla; filaments short, anthers usually oblong, dehiscing by terminal pores at length extended downwards. Ovary 2-celled; ovules many in each cell on large fleshy placentas adnate to the septum; style long; stigma small, subcapitate. Fruit a globose septicidally 2-valved capsule. Seeds many, minute, subcuboid, the testa granular.

29. *Canscora diffusa* R. Br.

Annual dichotomously branched herbs. Leaves opposite, sessile, petiolate or perfoliate Stems 4-angled, leaves, lower elliptic petioled, upper ovate-lanceolate, passing gradually into ovate acute, sometimes nearly linear, sessile, membranous bract at the bifurcations of the inflorescence; pedicels fliform, usually under 5 is long; calyx-teeth setaceous. Flowers pink in lax terminal dichasioid cymes, or axillary or spicate; bracts leafy or subulate, sometimes perfoliate. Calyx tubular, 4-toothed; tube terete and striate, keeled or winged. Corolla-tube cylindric, usually very thin and membranous; lobes 4, more or less unequal, imbricapte and overlapping in bud. Stamens 4, inserted on the corolla-tube, 1 or 2 with longer filaments and larger fertile anthers, 3 or 2 with shorter filaments which are usually sterile. Ovary 1-celled, placentas slightly intruded; ovules many; style filiform; stigma deeply 2-lobed. Fruit a cylindric membranous capsule, septicidally 2-valved. Seeds very small, angular, brown, reticulate.

CONVOLVULACEAE

30. *Ipomoea obscura* Ker-Gawl.

Twining, slender climber. Leaves alternate, broadly ovate, acuminate, deeply cordate, entire or lobed or divided. Flowers axillary, solitary or in cymes; bracts various. Calyx of 5 equal or unequal, ovate or linear, acute, apiculate, the 2 outer shorter and slightly wrinkled, often enlarged in fruit. Corolla campanulate or funnel shaped, the limb plicate, very slightly lobed. Stamens 5, usually included; filaments filiform or dilated below, often unequal; anthers straight or contorted; pollen-grains spinulose. Ovary 2- (rarely 4) celled; ovules 4, rarely 6; style filiform; stigma capitate, 2-globosc. Fruit a 4---6-valved capsule, rarely indehiscent. Seeds usually 4 or 6, glabrous velvety or woolly; cotyledons crumpled, bilobed.

31. *Evolvulus alsinoides* Linn.

A perennial herb with a woody root-stock and many spreading prostrate wiry branches. Leaves small, entire, often distichous, usually silky pubescent. Flowers light blue, small, solitary or in few-flowered pedunculate cymes. Calyx of 5 sub equal sepals, not enlarging in fruit. Corolla rotate or funnel-shaped ; limb plicate, sub entire. Stamens 5, included or exerted; filaments filiform; anthers ovate or oblong. Ovary 2- rarely l-celled; ovules 4 ; styles 2, distinct from the base, each cleft into 2 linear or subclavate branches, stigmatic on the inner face. Fruit a 4 -2 valved capsule. Seeds 4 or 2, rarely solitary, glabrous; cotyledons twice folded.

32. *Evolvulus nummularius* (L.) L.

Slender prostrate perennial herbs. Leaves 5-15 x 4-10 mm, broadly ovate to orbicular, base subcordate, apex obtuse to emarginate, glabrous or sparsely hairy below; petiole to 5 mm long. Flowers 1-2, in leaf-axils; pedicels slender 2-5 mm long. Calyx lobes 5, free, 2-3.5 mm long, ovate-lanceolate, acute, ciliate on margins. Corolla white, 6-8 mm across, rotate. Stamens sub-exserted. Capsule 3-4 mm across, globose. Seeds brown to black.

33. *Merremia tridentate* Hallier f. (*Ipomaea tridentata,* Roth)

A perennial herb with thick rootstock giving off many elongate prostrate slender branches. Leaves alternate, entire or lobed. Flowers axillary, solitary or in cymes, pale yellow, and usually with long peduncles. Calyx of 5 sub equal sepals, various in shape. Corolla campanulate or funnel-shaped,

usually white or yellow, the vertical bands defined by violet lines; limb plicate, the margin slightly lobed. Stamens 5, unequal, included or exserted; filaments filiform, often villous at the base; anthers usually twisted; pollen with longitudinal folds, not spinulose. Ovary 2—4-celled; ovules 4; style filiform; stigma 2-globose. Fruit a 4-valved capsule: 1–4-celled, the style sometimes separating with a small operculum. Seeds 4, dull, glabrous or rarely puberulous or with long hairs, cotyledons crumpled. Capsules globose.

34. Cuscuta reflexa Roxb.

Leafless twining parasitic herbs, yellow. Flowers small, white coloured, sessile or shortly pedicelled, in lateral fascicles; bracts small or 0. Calyx of 5 (or 4) subequal sepals, free or connate at the, base. Corolla ovoid globose or campanulate, usually with a ring or lobed scales near the base or below the stamens, lobes 5 (or 4) short, imbricate. stamens as manv as the corolla lobes, inserted on or below the throat of the corolla, filaments linear, anthers oblong, ovary more or less completely 2-celled ; ovules 4; styles 1 or 2; ,stigmas 2. Fruit a globose or ovoid, dry, irregularly breaking up; seeds 4-2. Seeds glabrous, albumen fleshy; embryo slender, spiral, the cotyledons obscure.

SCROPHULARIACEAE

35. *Lindenbergla urticaefolla* Link and Otto

Annual or perennial herbs; branches erect or straggling. Leaves opposite or the upper alternate toothed. Flowers usually yellow, axillary or passing into terminal spikes or racemes: bracts leafy, bracteoles O. Calyx widely campanulate. 5-lobed. Corolla 2-lipped; tube cylindric; upper lip outermost, short, 2-lobed; lower larger, 3-lobed, the palate With 2 folds.Stamens 4, didynamous, included; anthers with separate stalked cells. Ovary with many ovules; style filiform, clavate upwards; stigma capitate. Fruit a loculicidal capsule, the 2 valves separating from the placentiferous dissepiment. Seeds very many, minute.

36. *Torenia bicolor* Dalz.

Herbs, glabrous or pubescent, usually trailing and rooting. Leaves opposite, entire crenate or serrate. Flowers axillary or in terminal or pseudo-axillary umbels or racemes; bractcoles 0, Calyx usually 2- lipped, oblique at the mouth. 3--5-lobed, the back of the lobes or of some of them winged

or keeled. Corolla 2·lipped; tube cylindric. some· what curved, dilated upwards; the upper outer lip erect, concave, notched or bifid, the lower larger. 3·lobed, spreading. Stamens 4. didynamous, the 2 upper included, the two lower arched to meet under the upper lip, often with appendages about the middle; anthers connate in pairs. Ovary with many ovules; style slender; stigma 2-lamellate. Fruit a linear or oblong septicidal capsule, the valves separating from the placentiferous dissepiment which is often winged. Seeds many, rugose or cancellate.

37. *Buchnera hispida* Ham.

Annual rigid herbs, black when dry. Leaves; lower opposite, broad; upper alternate, narrow. Flowers sessile, axillary or in bracteate spikes, bracteoles 2. Calyx tubular, 5-lobed, 10-ribbed, the lobes short Corolla-tube slender; lobes 5, flat, subequal, spreading, the upper inmost in bud. Stamens 4, didynamous, included; anthers 1-celled, vertical. dorsifixed, the connective sometimes mucronate. Ovary with many ovules; style thickened or clavate above; stigma entire or notched. Fruit an oblong loculicidal capsule; valves entire, coriaceous, separating from the placentas. Seeds very many, angled, oblong.

38. *Striga lutea* Lour.

Herbs, usually scabrid, discoloured or black when dry, generally parasitic. Leaves: the lower opposite, the upper alternate, linear, entire, rarely toothed, sometimes reduced to scales. Flowers axillary or the upper in bracteate spikes: bracteoles usually 2. Calyx tubular, the tube with 5, 10 or 15 ribs; lobes 5. Corolla-tube slender, abruptly in curved at or above the middle ; limb spreading, the upper lip inner in bud, usually short, notched or 2-fid, the lower 3-lobed. Stamens 4, didynamous, included; anthers l-celled, vertical, dorsifixed, the connective sometimes mucronate. Ovary many-ovuled; style slender, thickened upwards; stigma entire. Fruit an oblong obovoid or sub globose capsule, loculicidal, the valves, entire septiferous, separating from the placentas. Seeds very many, ovoid or oblong, usually reticulate. Calyx 5-ribbed, the ribs running to the apex of each lobe

39. *Sopubia delphinifolla* G. Don

Erect perennial herbs. Leaves opposite, or the upper alternate, narrow, linear trifid or pinnatisect. Flowers in spikes or racemes with leafy bracts; bracteoles 2. Calyx campanulate, 5~lobed. Corolla-tube funnel-shaped, dilated at the throat; lobes 5, spreading, the. 2 upper inmost in bud. Stamens

4, didynamous, the anthers meeting in pairs; one anther-cell fertile, longitudinally dehiscing, the other small and imperfect. Ovary many-ovuled; style slender; stigma thickened and tongue-shaped, obtuse or capitate at apex. Fruit an ovoid or oblong loculicidal capsule, the valves entire or bifid, separating from the dissepiment which bears large placentas. Seeds numerous, oblong or cuneate, often truncate; testa lax, striate or reticulate.

40. *Centranthera indica* Gamble n. comb.

Scabrid herbs, probably more or less parasitic. Leaves opposite or the upper alternate, entire or toothed. Flowers axillary or in bracteate spikes or racemes; bracteoles 2. Calyx spathaceous, split on one side, compressed. entire or shortly 3-5-lobed. Corolla-tube long, tubular or funnel-shaped, incurved and dilated above; limb oblique; lobes subequal, spreading, the 2 upper inside in bud. Stamens 4, didynamous, included; anthers meeting in pairs, cells transverse, spurred or mucronate at base; one cell often imperfect. Ovary with many ovules; style simple, dilated above; stigma tongue-shaped, acute. Fruit an ovoid or suhglobose loculicidal capsule; valves entire, the placentas in the middle. Seeds very many, conical or cuneate; testa lax, reticulate.

ACANTHACEAE

41. *Rungia parviflora* Nees

Erect or diffuse herbs. Leaves entire, usually and prominently lineolate. Flowers in dense terminal or axillary one-sided spikes; bracts in 2 or 4 rows, 2 of the rows usually without flowers, sometimes similar to but often different from the flowering bracts which usually have scarious hyaline margins; bracteoles narrower than the flowering bracts. Calyx 5-partite, lobes linear-lanceolate. Corolla small, blue or white; limb 2-lipped, the upper lip acure or emarginate, the lower longer 3-1obed. Stamens 2; anthers 2-celled, the cells usually superposed, the lower cell often with a white basal appendage. Ovary 2-celled; ovules 2 in each cell; style filiform; stigma minutely bifid. Fruit an ovoid or oblong capsule, the placentas and retinacula elastically separating from the base after dehiscence. Seeds 4, compressed, orbicular, minutely tuberculate or concentrically ridged.

42. *Justicia procumbens* Linn.

Herbs, undershrub or shrubs. Leaves entire, usually lincolate with often very many raphides. Flowers pale purple, sessile or subsessile, in spikes or panicles, rarely solitary; bracts various,

bracteoles usually narrow, sometimes 0. Calyx 5. Or 4-partite, the lobes narrow. Corolla-tube as long as or shorter than the limb; limb 2-lipped, the upper lip 2-lobed or sub-entire, the lower 3-lobed, the lobes imbricate in bud. Stamens 2; filaments often dilated; anthers 2-celled, the cells round or oblong usually more or less separate, the lower always with a white basal appendage, Ovary 2-celled; ovules 2 in each cell; style fusiform; stigma shortly 2-fid. Fruit an ovoid or obovoid capsule, pubescent at tip solid at base or not, often papery. Seeds 4, ovoid or suborbicular, more or less compressed, tuberculate rugose or echinate, not hygroscopically hairy.

VERBENACEAE

43. *Lantana camara* Linn.

Erect or subscandent, often rambling, often strong-smelling, pubescent or scabrous shrubs; branches 4-angled, sometimes prickly. Leaves simple, opposite or ternate, crenate, often rugose. Flowers in pedunculate capitate ovoid or cylindric spikes; bracts conspicuous, persistent, bracteoles 0. Calyx small, membranous, truncate or obscurely toothed. Corolla-tube cylindric, slender; limb salver-shaped ; lobes 4 or 5, spreading. Stamens 4, didynamous, included in the corolla-tube and inserted at its middle; anthers oblong, the cells parallel. Ovary 2- celled; ovules 1 in each cell; style short; stigma oblique, subcapitate, Fruit a drupe with more or less fleshy mesocarp; endocarp hard, separating into 2 celled, l-seeded pyrenes. Seeds exalbuminous ; testa reticulate.

44. *Clerodendron infortunatum* Linn.

Shrubs, sometimes straggling, or climbing. Leaves opposite, ovate or almost orbicular, acuminate, cordate or obtuse at base, entire denticulate or serrate, villous or tomentose, rarely verticillate, simple, entire or toothed or lobed. Flowers small or large, 'in axillary cymes or terminal panicles, often leafy below; bracts conspicuous or small; bracteoles 0 or very small. Calyx campanulate, rarely tubular, truncate 5-lobed or almost 5-partite, lobes lanceolate, acute, persistent often accrescent, often coloured in fruit. Corolla salver-shaped or funnel-shaped,pinkish white;; tube usually long and slender, limb more or less oblique with 5 spreading lobes. Stamens 4, didynamous, long, exserted; filaments filiform, involute in bud; anthers ovate or oblong, the cells parallel. Ovary imperfectly 4-celled, l-ovuled; style filiform; stigma shortly bifid. Fruit a globose drupe, succulent or rarely dry, 4-grooved, separating into 4 pyrenes of which 1—3 sometimes

suppressed; endocarp bony or crustaceous. Seeds oblong or pyriform, albumen 0;cotyledons fleshy.

45. *Clerodendron serratum* Spreng

Trees and shrubs. Leaves opposite, rarely verticillate, simple, coarsely serrate. Flowers small or large. in axillary cymes or terminal panicles, often leafy below; bracts conspicuous or small; bracteoles 0 or very small. Calyx companulate, rarely tubular, truncate 5-1obed or almost 5-partite, persistent often accrescent, often coloured in fruit. Corona salver-shaped or funnel-shaped; pretty blue coloured tube usually long and slender, limb more or less oblique with 5 spreading lobes. Stamens 4. didynamous, long-exerted; filaments filiform, involute in bud; anthers ovate or oblong, the cells parallel. Ovary imperfectly 4-cdled. 1-ovuled; style filiform; stigma shortly bifid. Fruit a globose drupe, succulent or rarely dry. 4-grooved, separating into 4 pyrenes of which 1-3 sometimes suppressed; endocarp bony or crustaceous. Seeds oblong or pyriform, albumen 0; cotyledons fleshy.

LAMIACEAE

46. *Ocimum sanctum* Linn.

An erect much-branched softly pubescent undershrub with red or purple small flowers. Leaves opposite or whorled, usually toothed, petioled; floral leaves small, bract-like, usually caducous. Flowers small, in whorls of 6—10 on the axis of elongate spikes or racemes which are sometimes panicled; pedicels with recurved tips ; bracts small, caducous. Calyx ovoid or campanulate, deflexed in fruit and then usually enlarged and hardened, 2-lipped ; upper lip broad, flat, decurrent, lower lip with 4 mucronate teeth, the 2 middle ones usually the longest. Corolla 2-lipped ; tube short, not annulate within ; upper lip subequally 4-lobed, lower lip hardly longer than the upper, declinate, entire. Stamens 4, didynamous, declinate, exserted ; filaments free or the lower connate below, the upper often with a tooth or hairy below; anthers 1-celled, later on flattened out. Disk entire or 3-4-lobed. Ovary 4-partite: style slender, bifid at apex. Fruit of 4 dry, smooth or subrugose, nutlets, often mucilaginous when wetted.

47. *Hyptis suaveolens* Poit.

Herbs or shrubs. Stem tetragonal hispid. Leaves cordate, denticulate, opposite. Flowers small or medium sized blue colouredvvariously arranged, often capitate. Calyx ovoid campanulate or tubular, subequally 5-lobed, often accrescent. Corolla-tube cylindric; lobes 5, the lower lobe or lip deflexed and saccate, the others erect and spreading, flat. Stamens 4, didynamous, declinate; filaments free; anther-cells confluent. Disk entire or glandular. Ovary 4-partite; style with a subentire or shortly bifid stigma. Fruit of 4 dry ovoid or oblong nutlets, smooth or rugulose ; basal scar small.

48. *Dysophylla quadrifolia* Benth

Herbs. Leaves opposite or whorled. Flowers minute, in dense long spikes or racemes of many whorled cymes; bracts and bracteoles many, usually small. Calyx ovoid or campanulate, equally 5-lobed, the throat naked within. Corolla very small, equally 4-lobed, the tube exserted or included. Stamens 4, exserted. straight or subdeclinate; filaments long, bearded; anther-cells confluent. Disk cqual , subenrire. Ovary 4-partitc; style slender, 2-fid, the stigmatic lobes subulate. Fruit of 4 ovoid or oblong, smooth or rough, dry nutlets, the basal scar small.

49. *Leucas aspera* R. Br.

Herbs, undershrubs or shrubs, nearly always pubescent or villous; branches usually 4-gonous. Leaves opposite or whorled; floral leaves usually similar. Flowers usually white, in axillary few or many flowered whorls, rarely quite terminal; bracts usually many, linear or lanceolate, frequently enclosing the base of the whorls. Calyx tubular, 10-ribbed, the mouth straight or oblique, cqually or unequally 6-10- toothed, often with a ring of hairs within the teeth, fruiting calyx often elongated. Corolla 2-lipped; tube included, annulate or naked within; upper lip erect concave externally, often densely and white or tawny-villous, lower lip spreading, 3-lobed, the midlobe very large. Stamens 4, didynamous, the lower pair the longer; filaments ascending under the upper lip; anthers connivent, the cells divaricate, at length confluent. Disk entire or lobed, equal or glandular in front. Ovary 4-partite; style subulate at the apex, the upper lobe obsolete. Fruit of 4 ovoid triquetrous obtuse dry nutlets, the basal scar small.

LAURACEAE

50. *Cassytha filiformis* Linn.

Filiform twinnig parasites, adhering to their host by suckers. Leaves consisting of minute scales. Flowers small.-hermaphrodite. spicate capitate or racemose; bra creoles 3. Perianth-tube short and globose or turbinate and as long as the lobes; lobes 6, the 3 outer smaller. Perfect stamens 9 or 6, 2-celled; those of the 1st row opposite the outer perianth-lobes introrse, those of the 2nd row opposite the inner, also introrse, sometimes reduced to staminodes; those of the 3rd row opposite the 1 st row extrorse, the filaments with a pair of glands at the base; within these and opposite the 2nd row, 3 sessile or stipitate staminodes. Ovary globose, free in flower but included in the perianth-tube, which closely covers it in fruit; style short; stigma small or capitate. Fruit a drupe enclosed in the enlarged inflated perianth-tube, crowned by the remains of the lobes and stamens; pericarp of 2 layers, the outer thin, the inner thic;k and hard. Seed conform to the drupe; testa thin; cotyledons fleshy, at length confluent.

SANTALACEAE

51. *Santalum album* Linn

Trees or shrubs usually semiparasitic on the roots of other kinds; branches usually slender, glabrous. Leaves opposite or rarely alternate, glabrous. Flowers hermaphrodite, axillary or in terminal 3-chotomous paniculate cymes; bracts minute. Perianth tube campanulate or ovoid, adnate to the base of the ovary; lobes 4, rarely 5, valvate, with a tuft of hairs on the face. Stamens 4 or 5, adnate to the bases of the perianth. lobes, alternating with the fleshy scales of the disks ;filaments short; anthers ovate, the cells distinct, parallel. Disk of the scales between the stamens. Ovary at first free, later semi-inferior; ovules 2-3, pendulous from below the top of a long acuminate central column; style elongate; stigma 2-3-lobed. Fruit a subglohose drupe,annulate on the top ofthe deciduous perianth. endocarp rugose. Seed sub· globose; albumen copious; embryo tcrete, slender; radicle longer than the cotyledons.

EUPHORBIACEAE

52. *Antidesma menasu* Miq.

Small trees or shrubs. Leaves alternate, entire; stipules narrow. Flowers dioecious, very small, in slender, axillary or terminal, simple or branched spikes or racemes. Calyx-lobes 3-5. rarely more. Petals 0. Stamens 2-5, inserted on or within the disk; filaments exsert; connective broad, lunate,the anther-cells ending its wings, dehiscence transverse. Disk annular or cushion-like. Ovary 1-celled; ovules 2 in each cell; stigmas 2-4, usually short; pistillode in male clavate or globose. Fruit a small more or less compressed drupe.

53. *Breynia patens* Rolfe

Shrubs or small trees. Leaves small, alternate, entire, petioled, often distichous. Flowers monoecious, minute, axillary. Calyx in male flower turbinate or hemispheric. truncate, lobes 5-6, with the rounded glands of the tube behind them; in female campanulate or rotate, 6·1obed, sometimes accrescent in fruit. Petals 0. Disk 0. Stamens 3, the filaments connate in a column, the cells linear parallel, distinct. Ovary globose or truncate or depressed at top, 3-celled; either styles 3 sessile or connate in a short column. or stigmas 3 sunk in the apex of the ovary. Fruit globose or depressed, more or less succulent, indehiscent or with a 6-valved pericarp enclosing cocci. Seeds with membranous testa; albumen fleshy; cotyledons broad; radicle long.

54. *Tragia involucrata* , Linn.

Perennial herbs, usually climbing, hispid with stinging hairs. Leaves alternate, simple or palmately 3-lobed, serrate, 3-5 -ribbed at the base; stipules prominent at first, early deciduous. Flowers monoecious in terminal or leaf-opposed androgynous racemes, the male flower uppermost, the female below and few. Calyx in maleglobose or obovoid, valvately 3-5-partite;

in female of 6 imbricate, usually pinnatifid, lobes, enlarged, hardened, and spreading stellately in fruit. Petals O. Disk O. Stamens 1-3, rarely more, usually 3; filaments free or connate; anthers with contiguous parallel cells. Ovary 3-celled; ovule I in each cell; styles united in a column, spreading above. Fruit a capsule of 3 2-valved cocci; endocarp crustaceous. Seeds globose; testa crustaceaus; albumen fleshy; cotyledons broad, flat.

55. *Sebastiania chamaelea* Muell. Arg.

Herbs or shrubs. Leaves alternate. Flowers minute, monoecious, in slender racemes, the male flower 1-3 to each bract, the female solitary or at the base of the raceme. Calyx of male minute, membranous, unequally 5-1obed or -partite, of female 3-1obed or -partite. Petals 0. Disk 0. Stamens 2-4; filaments short, free or nearly so; amher-cells distinct. contiguous, parallel. ovary 3-celled ; ovule 1 in each cell; styles free or connate at base, entire. Fruit a capsule of 3 cocci separating from a columella, seeds oblong.

Community Analysis

Density

In this study, the maximum density was recorded by the species *Polygala elongata* .The second most density was recorded for *Justicia procumbence*. (Tables 2-3)

Frequency

The frequency was highest for *Justicia procumbence, Spermacoce articularis, Osbeckia muralis, Polygala elongata*. (Tables 2-3).

Abundance

Spermacoce articularis was the most abundant species in the study area (10). Second most abundance was for *Justicia procumbence* (8.2). This was followed by *Indigofera trifoliata* (5.83), *Polygala elongata* (5.51) and *Evolvulus alsinoides* (4.22 and Osbeckia *muralis* (4.75) (Tables 2-3).

Importance Value Index (IVI)

The dominance of species is calculated based on Species Importance Value Index (IVI) Considering the IVI values, the dominant species in the study area was *Spermacoce articularis* (43.35). This was followed by *Justicia procumbence* (36.87), *Polygala elongata* (24.79), *Osbeckia muralis* (24.45) *and Evolvulus alsinoides* (20.39).

SUMMARY

Kanjirakunnu hills, is studied mainly on two aspects, its vascular flora as well as the structure and components of the community. The floristic survey revealed the occurrence of 55 species belonging to 23 families. The study was conducted during September to March which covered mostly the winter and summer seasons. Maximum number of species (7 species) were obtained from the family Scrophulariaceae. Family Rubiaceae was represented by 5 species, Families Asteraceae, Convolvulaceae and Lamiaceae were represented by 4 species each. Families Fabaceae, Apocynaceae and Euphorbiaceae were represented by 3 species each. Sapindaceae and Gentianaceae were represented by 2 members each. In this study, the maximum density was recorded by the species *Polygala elongata* .The second most density was recorded for *Justicia procumbence.* The frequency was highest for *Justicia procumbence, Spermacoce articularis, Osbeckia muralis, Polygala elongate. Spermacoce articularis was* the most abundant species in the study area (10). Second most abundance was for *Justicia procumbence.* The dominance of species is calculated based on Species Importance Value Index (IVI) Considering the IVI values, the dominant species in the study area was *Spermacoce articularis* (43.35). This was followed by *Justicia procumbence* (36.87), *Polygala elongata* (24.79), *Osbeckia muralis* (24.45) *and Evolvulus alsinoides* (20.39).

CONCLUSION

Knjirankunnu is mostly an undisturbed laterite hill with abundant dicot plant diversity. The predominant species in the area are grassland flora with a few trees. Not only grasslands have a local importance for the maintenance of biodiversity and food production, but they also affect ecological processes at landscape like pollination, water regulation and climate regulation. Grasslands are recognized globally for their high biodiversity and their social and cultural values. Kanjirakunnu is a typical grassland with rich dicot floral diversity, which plays a crucial role in maintain the microclimate of the local area. Biodiversity of this special ecosystem has to be con served from human interference.

REFERENCES

Anil Kumar N, *et al*., 2005. *Flora of Pathanamthitta Western Ghats, Kerala*. Daya Publishing House Delhi.

Anto, M. and Jasy, T. 2015. *Floristic diversity of angiosperms in the proposed site of Aranmula International Airport.* International Journal of Current Research, 18(2): 26008-26013.

Antony V T. 1989. *Systematic study of Flora on the Kottayam District Kerala. Bharathiar University.*

Babu A. 1990. *Flora of Malappuram district: Excluding Nilambur Forest division.* PhD thesis, Calicut University.

Burkill J.H. 1965. *Chapters on the history of Botany in India.* Botanical Survey of India, Culcutta.

Chaudhari, A.B & Sakar, D.. 2003. *Mega diversity Conservation Flora, Fauna and Medicinal plants of Indians hotspots.* Data Publishing House.

Curtis & Mclntosh. 1950. *The Interrelations of Certain Analytic and Synthetic Phytosociological Characters*. Ecology Volume 31, Issue 3 p. 434-455. Article.

Curtis, J.T. & R.P. McIntosh (1950). Ecology, The interrelations of certain analytic and synthetic phytosociological characters. Ecology, 31: 434-455.

Dutta, 2000. *Partnerships in urban development: a review of Ahmedabad's experience.*

Fischer. 1932. *A Survey of the Flora of the Anaimalai Hills in the Coimbatore District, Madras Presidency*. Records of a Botanical Survey of India. Vol.9 (1.)

Funk *et al.,* 2007. *Checklist of the plants of the Guiana Shield (Venezuela: Amazonas, Bolivar, Delta Amacuro; Guyana, Surinam, French Guiana)*.National *Museum of Natural History.*

Fyson. 1932. *The Flora of the South Indian Hill Stations: Ootacamund, Coonoor, Kotagiri, Kodsikanal, Yercaud, and the Country Round.* Superintendent, Government Press.

Keith. 1988. *Ecology and Conservation of Lynx in the United States.*

Kumar *et al*., 2006. *Plant and soil diversities in a sub tropical forest of the Garhwal Himalaya*. Ghana Journal of Forestry, 19-20:1-19.

Manilal, K.S & Sivarajan VV.1982. *Flora of Calicut.* Bishen Singh, Mahendra Pal Singh, Dehra Dun.

Manilal. K.S 1988. *Flora of Silent Valley.* Bishen Singh Mahendra Pal Singh Dehra Dun.

Mohanan & Henry. 1994. *Flora of Thiruvananthapuram.* Botanical Survey of India Culcutta.

Mohanan & Sivadasan. M 2002. *Flora of Agasthyamala.* Bishen Singh Mahendra Pal Singh, Dehra Dun.

Mohanan. 1984. *Studies on the Flora of Quilon District, Kerala.* PhD thesis. Madras University,Madras.

Nayar, T.S *et al.,* 2008. *Flowering Plants of Kerala: Status & Statistics.* Rheedea 18 (2): 96.

Noble & Dirizo. 1997. *Forests as Human Dominated Ecosystem.* Science Article Vol- 277.

Peter. 2016. *An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG IV.* Botanical Journal of the Linnean Society 181 (1), 1-20.

Philips *et al*.,2003. *Efficient plot based floristic assessment of tropical forest.* Journal of Tropical Ecology.

Qureshi, *et al*., 2014. *Flora of Lal Suhanra National Park, Bahawalpur, Punjab, Pakistan.* Pak. J. Bot 46 (4), 1331-1341.

Raghavendra Rao. 2017. *Floristic diversity in Western Ghats: Documenttion, Conservation & Bioprospects. A Priority Agenda for Action.* Journal Sahyadri Envis. Environmental Information System.

Rama Rao. 1914. *Flowering Plants of Travancore Kerala, India.* Government Press Travencore.

Ramachandran & Nair. 1988. *Flora of Cannanora.* Botanical Survey of India, Culcutta.

Rao R R. 1997. *Diversity of Indian Flora.* Indian national science academy. B63. no.3 pp 127-138.

Ratheesh Narayanan. 2009. *Floristic Studies of Wayanad District Giving Special Emphasise to rare and threatened Plants.* PhD thesis.

Saima *et al. 2009. Floristic compositions along an 18-km long transect in ayubia National Park district Abbottabad, Pakistan.* Pak. J. Bot 41 (5), 2115-2127.

Sasidharan & Sivarajan. 1996. *Flowering Plants of Thrissur Forests (Western Ghats, Kerala, India)*. Scientific publishers, Jodhpur.

Sharma B D. 1984. *Flora of Karnataka: analysis.* Howrah: Botanical Survey of India.

Sharma, R.B & Sharma, S.C. 2012. *Floral biodiversity of moderate to steep slope land in Semi-arid area Aravali hills, Avikanagar.* Published in Biodiversity & Taxonomy. 299-304.

Sivarajan, V.V. &Philip Mathew. 1997. *Flora of Nilambur, Western Ghats, Kerala.* Bishen Singh Mahendra Pal Singh Dehra Dun.

Sreekumar & Nair. 1991. *Flora of Kerala grasses.* Botanical Survey of India, Culcutta.

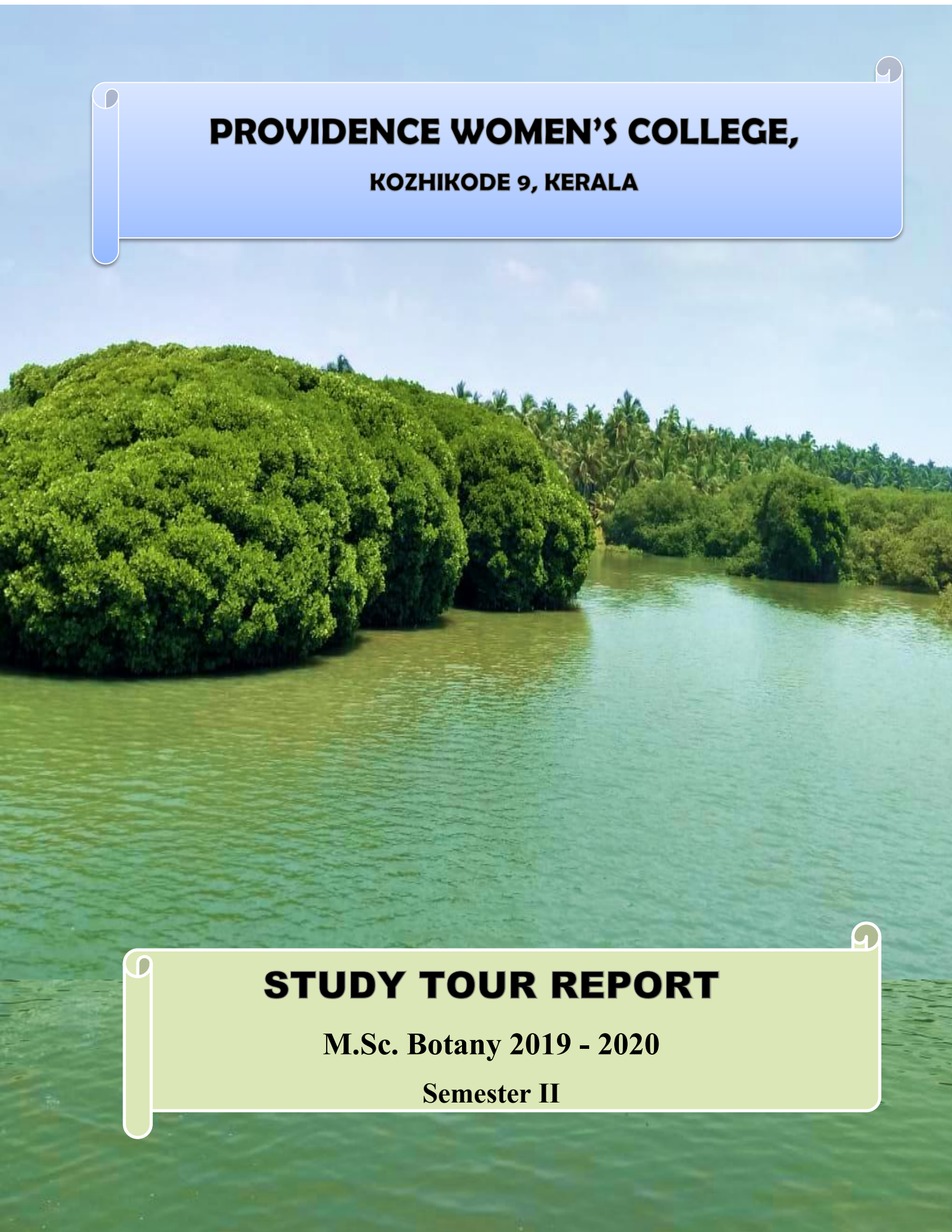
Stephan *et al.*,2015. *Indian biodiversity:past, present and future.* International Journal of Environment and Natural Sciences, Vol.7, 13-28 ISSN -2349-3763.

Subrahmanyam. 2005. *Modern Plant Taxonomy.* Vikas Publishing house Pvt. Ltd.

Sunil C.N & Sivadasan. 2009. *Flora of Alapuzha District, Kerala, India.* Bishen Singh Mahendra Pal Singh, Dehra Dun.

Thorne, 1992b. *An updated classification of the flowering plants*. Alison 13: 365.

Vajravelu. 1990. *Flora of Palghat District.* Botanical Survey of India, Culcutta.



PROVIDENCE WOMEN'S COLLEGE,

KOZHIKODE 9, KERALA

STUDY TOUR REPORT

M.Sc. Botany 2019 - 2020

Semester II

REPORT OF VISIT TO
ECOLOGICALLY SIGNIFICANT AREAS

KADALUNDI VALLIKKUNNU COMMUNITY RESERVE
& KADALUNDI BIRD SANCTUARY

DEPARTMENT OF BOTNY

PROVIDENCE WOMEN'S COLLEGE, KOZHIKODE 9, KERALA

CERTIFICATE

Certified that this is an authentic report of the field trips / study tours conducted by Ms.……..……..…….. (Reg No. **PWATMBT**……...) of II Semester M.Sc. Botany, Providence Women's College, during 2019 - 20, as part of the curriculum of Second Semester of the M.Sc. Botany Programme of the University of Calicut.

Examiners:

1

2

Kadalundi-Vallikkunnu Community Reserve

Community reserves in India are terms denoting protected areas of India which typically act as buffer zones to or connectors and migration corridors between established national parks, wildlife sanctuaries and reserved and protected forests of India. Such areas are designated as Conservation Areas if they are uninhabited and completely owned by the Government of India but used for subsistence by communities and Community Areas, if part of the lands is privately owned. Administration of such reserves would be through local people and local agencies like the gram panchayat, as in the case of communal forests. **Community Reserves** are the first instances of private land being accorded protection under the Indian legislature. It opens up the possibility of communally owned for-profit wildlife resorts, and also causes privately held areas under non-profit organizations like land trusts to be given protection. Total number of community reserves in India is 45.

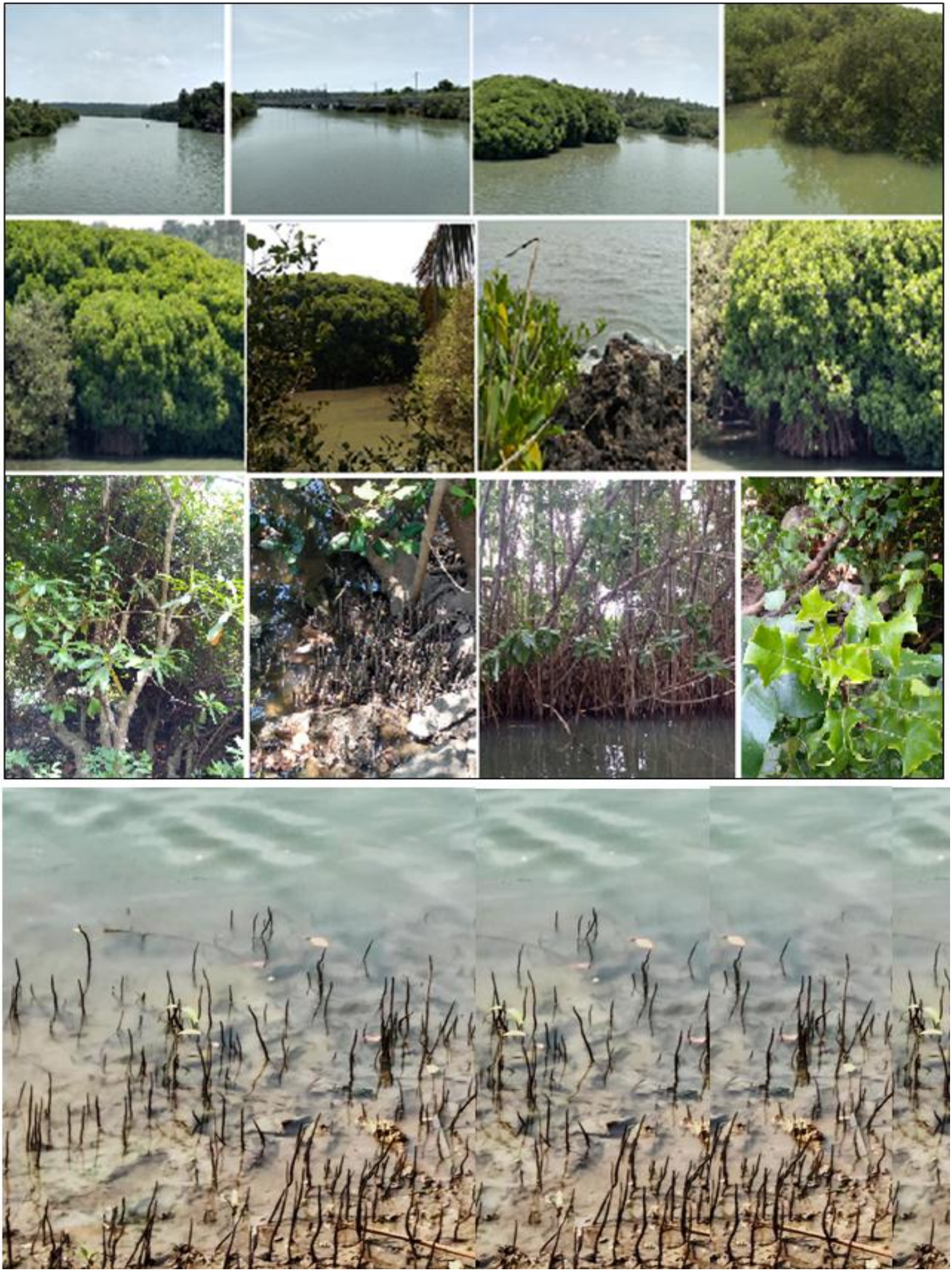
Kadalundi Vallikunnu Community Reserve, declared in 2007 is the only one community reserve in Kerala. It has a total area of 1.5sq.km. It spreads over the districts of Kozhikkode and Malappuram. The Kadalundi-Vallikkunnu Community Reserve is the first initiative of the State Forest Department to undertake nature conservation with people's participation. The Kadalundi estuary is located at the mouth of the river Kadalundi that drains into the Arabian Sea on the west coast of Kerala. Apart from scattered patches of mangroves, the estuary is bordered by human habitation and coconut groves.

As part of our curriculum we visited Kadalundi on 26th July 2019. The visit was as a part of the observation of world mangrove day, organized by the Social Forestry Extension Wing, Kerala Forest and Wildlife Department. We started at 7.30 am from college and reached there by 9.00 am. We were welcomed by Mr.Suresh (Range Officer , Janakikkadu). During the inaugural session, he gave us an outline about distribution, morphology and general characters of Mangroves. Mangroves are xerophytic plants covering 17 Sq.km of the Kerala coast. Mangroves are ecologically very significant as they act as wind belt, prevent salinity of water from entering the land, prevent soil erosion, giving breeding place for fishes and prawns, reduce the effect of Tsunami, used as medicine, providing habitat for many birds etc. Indian Mangroves had its origin from Gulf of Oman. Conservation of Mangroves has become a necessity as they widely cleared for firewood, timber, rice cultivation, developmental purposes etc. Both gap planting and barren land plantings of Mangroves are monitored by the Forest Department these days.

After the introductory session, we had a trucking through the Mangroves spread across Balathuruth, CP thuruth and Cheruthuruth. We were guided by Mr. Suresh (Social Forestry Extension Officer), Mr. Chandrashekhar (Watcher-Kadalundi Community Reserve), Mr. Rajan and Mr. Sunil. The flora of Kadalundi Community Reserve was predominated by mangroves. During our trucking we could closely observe many Mangroves indicators like, *Pongamia pinnata*, *Aliricida sepium*. Our guides helped us to identify many Mangrove species and gave us valuable information about different aspects of Mangroves, mode of planting Mangroves and the variety of birds seen in Mangroves.

We could study the special type of ecology prevailing in the marshy habitat. Special adaptive features of the mangroves like respiratory roots, viviparous fruits etc. were quite curios to observe. Mangroves are plants adapted to muddy shifting saline condition. The characteristics mangrove species found were *Rhizophora mucronata* and *Avicennia officianalis*, sufficiently large trees like *A. marina*, *Excoecaria agallocha* Trees of medium stature like *Aegiceras cornicelatam, Kandelia candal* and *Cerbara manghasare* and gregarious spinescent shrubs like *Acanthus ilicifolius* and mangrove associated plants like *Clerondrum inermeis* , and *Pongamia pinnata* etc. were found in these areas. *Sonneratia alba* was the first Mangrove we identified and it had a green star shaped fruit. Going deep into the Mangroves we could see many species like, *Kandelia kandal*, *Rhizophora* apiciulata and *Rhizophora mucoronata*. We could see 3 zone of Mangroves; they are *Avicennia zone*, *Sonneratia zone* and *Rhizophora zone*. *Rhizophora* species are greener and they have stilt root which can withstand long period of tides. The *Sonneratia zone* of the area was highly reduced. While exploring Mangroves we could identify and collect many bryophytes and pteridophytes like *Pallavicinia*, *Lygodium*, *Angiopteris*, *Glychienia* etc.

After lunch we had a short visit to the Kadalundi estuary with Mr. Chandrashekhar. The site was really beautiful. We got back to the college by 5.45pm. Nature camp was a great experience for all of us and it gave us a lot of knowledge and memories



.Kadalundi Bird Sanctuary

The Kadalundi Birds' Sanctuary lies in the Malappuram district of the state of Kerala in India. It spreads over a cluster of island where the Kadalundipuhza River flows into the Arabian Sea. The sanctuary hill is around 200m above the sea level. It is 19km from Calicut city center. Kadalundi Bird Sanctuary is one of the most beautiful bird sanctuaries of Kerala. The Kadalundi Bird Sanctuary gets its name from the Kadalundi River which flows into the Arabian Sea. The river originates from the Western Ghats and flows through the Silent Valley, Malappuram and Kozhikode. The place has been named on this beautiful river. Over a hundred species of native birds have been recorded in the sanctuary; including about 60species of migratory birds which visit seasonally. These include turns, gulls, herons, sandpiper & cormorants. Notable species are whimpers' and Brahming kites. The sanctuary is well known for a wide variety of fish, mussels & crabs. Around 8 ha of mudflats, exposed during low tides, offers potential foraging ground for several hundreds of wintering and resident water birds, particularly waders. It also provides significant socio-economic and livelihood services for the people around (fishing, oyster farming andsand mining). A total of 110 species of water birds including 53 migrants have been recorded. The estuary is one of the few habitats on the west coast where a small population of Lesser Sand Plover (*Charadrius mongolus*), Whimbrel (*Numenius phaeopus*) and Common Redshank (*Tringa totanus*) are observed to over-winter. A good regional population of Brown-headed Gulls (*Larus brunnicephalus*), Black-headed Gulls (*Larus ridibundus*) and the critically endangered Spoon-billed Sandpiper (*Eurynorhynchus pygmacus*). Considering its importance in terms of diversity of wetland birds and heavy anthropogenic pressures, the estuary has been officially declared as the Kadalundi Vallikunnu community reserve.

DEPARTMENT OF ZOOLOGY

PROVIDENCE WOMEN'S COLLEGE, CALICUT-9

A Comprehensive document containing information on the focus in the neighbourhood- its systematic position, scientific name and common name, habit and habitat, morphology etc. inducing a sense of responsibility and awareness to Conserve Nature and to strengthen the diverse of the region.

I hereby certify that this is a bonafide record of the field work done by the Candidate HALKA HARISH (Ad.No 37073) of I DC Zoology in the year 2020-21.

Sangeetha

Signed by:

Head of the Department

DR. NISHI ANN
ASST. PROFESSOR & HEAD
DEPARTMENT OF ZOOLOGY
PROVIDENCE WOMEN'S COLLEGE
CALICUT- 673 009

Sangeetha

Teacher-in-charge

Dr. SANGEETHA G KAIMAL
Asst. Professor & Research Guide
Department of Zoology
Providence Women's College
Calicut - 673 009

DEPARTMENT OF ZOOLOGY

PROVIDENCE WOMEN'S COLLEGE, CALICUT-9

A Comprehensive document containing information on the focus in the neighbourhood- its systematic position, scientific name and common name, habit and habitat, morphology etc. inducing a sense of responsibility and awareness to Conserve Nature and to strengthen the diverse of the region.

I hereby certify that this is a bonafide record of the field work done by the Candidate VANDANA P. (Ad. No. 36999) of I DC Zoology in the year 2020-21.

Signed by:

Head of the Department

DR. NISHI ANN
ASST. PROFESSOR & HEAD
DEPARTMENT OF ZOOLOGY
PROVIDENCE WOMEN'S COLLEGE
CALICUT- 673 009

Teacher-in-charge

Dr. E. Julie
Assistant Professor
Department of Zoology
Providence Women's College
Calicut - 673 009

LOCAL BIODIVERSITY REGISTER

A comprehensive document containing information on the fauna in the neighborhood- its systematic position scientific name, and common name, habit, and habitat, morphology, etc; inducing a sense of responsibility and awareness to conserve nature and to strengthen the diverse fauna of the region.

I hereby certify that this is a bonafide record of the work done by the Candidate.....FATHIMA HIBA.....with the Register number.....PWATSZ0029.....during the years 2019 to 2021.

Teacher-in-charge.

Dr. E. Julie
Assistant Professor
Department of Zoology
Providence Women's College
Calicut - 673 009

Head of the department

Dr. Nishi Ann
Head & Assistant Professor
Department Of Zoology
Providence Womens College
Carmel Hill, Calicut - 673 009

Examiners:

DEPARTMENT OF ZOOLOGY
CALICUT - 673009
PROVIDENCE WOMENS COLLEGE

LOCAL BIODIVERSITY REGISTER

A comprehensive document containing information on the fauna in the neighborhood- its systematic position scientific name, and common name, habit, and habitat, morphology, etc; inducing a sense of responsibility and awareness to conserve nature and to strengthen the diverse fauna of the region.

I hereby certify that this is a bonafide record of the work done by the Candidate.....FATHIMA HIBA.....with the Register number.....PWATSZ0029.....during the years 2019 to 2021.

Teacher-in-charge.

Dr. E. Julie
Assistant Professor
Department of Zoology
Providence Women's College
Calicut - 673 009

Head of the department

Dr. Nishi Ann
Head & Assistant Professor
Department Of Zoology
Providence Womens College
Carmel Hill, Calicut - 673 009

Examiners:

DEPARTMENT OF ZOOLOGY
CALICUT - 673009
PROVIDENCE WOMENS COLLEGE

CARAUSIUS MOROSUS

STICK INSECT

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	INSECTA
ORDER	:	PHASMATODEA

HABIT & HABITAT

Stick insects live in tropical and sub-tropical areas of the world. It's a common found in India. They are vegetarians and eat the leaves of plants, shrubs and trees.

MORPHOLOGICAL CHARACTERS

They have a cylindrical shaped body and reaches adult length of up to 8 cm. Overall the body colour is a yellowish-green to brown and the forelegs have red patches at their base.

MALE & FEMALE

Males are rare. Culture stocks are parthenogenetic females that can reproduce without mating.

Females are elongated and about 80–100 mm in length, ranging from a light green to a darkish brown in colour. The front legs have red patches at the base of forelegs, and similar but yellow patches on the mid legs.

ADAPTATIONS

When disturbed, the major defence method is feigning death, the body becoming rigid, and the legs held along the line of body. They may also be found swaying to mimic the movement of foliage in wind.

TRIGONIULUS CORALLINUS
COMMON ASIAN MILLIPEDE

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	DIPLOPODA
ORDER	:	SPIROBOLIDA

HABIT & HABITAT

It is widely distributed in India, Western Ghats, China and much of Indonesia. It inhabits moist areas, rotten wood and compost.

MORPHOLOGICAL CHARACTERS

They have a cylindrical body. They are highly segmented. Each segment has a 2 pairs of legs. The head contains a pair of sensory organs. They are dark red in colour.

ADAPTATIONS

Primary defense mechanism is to curl into a tight coil protecting their delicate legs inside an armored body exterior. Many species emit poisonous liquid secretions.

NEOCURTILLA HEXADACTYLA

NORTHERN MOLE CRICKET

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	INSECTA
ORDER	:	ORTHOPTERA

HABIT & HABITAT

It is common in Kerala, South India and it ranges from South to North America. They are seen in wet, sandy or muddy soil and also in agricultural fields.

MORPHOLOGICAL CHARACTERS

Basal projection of fore-femur lobe like, hind tibia with eight spines at apex, four on inside and four on outside. They have a length of 19 - 33 mm.

NEORTHACRIS ACUTICEPS
MULBERRY GRASSHOPPER

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	INSECTA
ORDER	:	ORTHOPTERA

HABIT & HABITAT

It is found in South India, Peninsular India and in parts of South Asia. They are seen on grasses and on gardens.

MORPHOLOGICAL CHARACTERS

Body is bright green. A black band arising from base of eye extending over pronotum till mid of metasome, bordered on lower side by white streak on thorax, pronotum has a red line beneath the black band and above black band on metathorax. Ventral side is yellowish green.

OXYOPES BIRMANICUS
BROWN LYNX SPIDER

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	ARACHNIDA
ORDER	:	ARANEAE

HABIT & HABITATS

Its found in India, Western Ghats, China to Indonesia. They are commonly seen in grasses and shrubby vegetation during day time. They are solitary active hunters. They do not build web.

MORPHOLOGICAL CHARACTERS

Cephalothorax is slightly elongated and brown to yellow in colour. Ocular region brownish yellow in colour with two longitudinal black lines running from anterior median eyes towards mandibles. Abdomen pale brown in colour, elongated and posteriorly tapering end.

It is covered with hairs. Dorsal surface of abdomen with distinctive pattern. Legs are long and covered with distinct spines, underside of femora has two black lines.

MALE & FEMALE

Female is 7-9 mm and male is 6-7 mm long.

BEHAVIOUR

They are agile hunters and can be seen running and jumping after prey. When approached, they dart quickly to the reverse side of leaf.

ONOMARCHUS

KATYDID

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	INSECTA
ORDER	:	ORTHOPTERA

HABIT & HABITAT

They are found mainly in the tropical forests of Asia. They are common in India, Western Ghats, Kerala and other parts of Asia.

MORPHOLOGICAL CHARACTERS

It is green in colour. It resembles that of a leaf. It has long antennae and legs.

ADAPTATIONS

They are noted for their remarkable camouflage. They closely resembles leaf.

ORYCTES RHINOCEROS
ASIATIC RHINOCEROS BEETLE

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	INSECTA
ORDER	:	COLEOPTERA

HABIT & HABITAT

It is commonly found in Kerala, TamilNadu, parts of Asia and Hawaii. Adults eat the leaves of coconut and burrow into the crown, stunting plant development.

MORPHOLOGICAL CHARACTER.

Adult beetles range from 1.2 to 2.5 in length and are dark brown or black in colour. The ventral surface has reddish-brown hairs. They posses a small horn used for leverage when moving within tightly packed leaves or within cavities they create in the crown of palms.

MALE & FEMALE

Ventral surface of female has a fuzzy grouping of reddish-brown hairs at the tip of abdomen. The horn length is longer on average for males.

BEHAVIOUR

These beetles causes damage to leaves of coconut. They are a major pest of coconut palm. They feeds on the healthy leaf and causes stunted growth to the plant.

OXYOPES SALTICUS

STRIPED LYNX SPIDER

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	ARACHNIDA
ORDER	:	ARANEAE

HABIT & HABITATS

They are found over South India, Western Ghats and other parts of World. Its habitat tends to be grasses and leafy vegetation, grassy, weedy fields and row crops.

MORPHOLOGICAL CHARACTERS

Adult have some colour variation between orange, cream and brown. On the abdomen stripes are present. There is a diamond cardiac mark and macrosetae covering legs. There is a broad clypeus. Spiny legs present.

MALE & FEMALE

Adult females typically have stripes on both

the carapace and abdomen. Adult females range in size from 5-6 mm and adult males range in size 4-5 mm.

AGRICULTURAL IMPORTANCE

They are predator of economically important agricultural pests. It is particularly common in cotton, soyabean, grain and sorghum. Its a major predator of bollworm and tobacco budworm.

MALADERA JAPONICA

VELVETY CHAFER

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : COLEOPTERA

HABIT & HABITAT

It is seen in Japan, India, Western Ghats and other parts of Asia. They are active in summer and can be seen at night or found around porch light.

MORPHOLOGICAL CHARACTERS

It has a body length of 7.0-10.0 mm. Body shape is oblong-oval. It is convex shaped when viewed laterally. It's colour is dark brown. Male and female look similar.

SUCCINEA PUTRIS

AMBER SNAIL

KINGDOM : ANIMALIA

PHYLUM : MOLLUSCA

CLASS : GASTROPODA

ORDER : STYLOMMATOPHORA

HABIT & HABITAT

They are seen in India, Western Ghats, tropical forests and Russia. These are seen on plants and in damp places.

MORPHOLOGICAL CHARACTERS

They are relatively flat with shallow sutures. The body whorl is massive. The spire is small. It's colour is amber yellow. The visible soft parts are yellow with a reddish hue, which becomes lighter downwards to the sides.

RHYNCHOPHORUS FERRUGINEUS

RED PALM WEEVIL

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : COLEOPTERA

HABIT AND HABITAT

It is widely distributed in Southern Asia and Melanesia. Eggs of this are laid in the trunk of the palms, and the larval stages feed on the soft plant tissue within the trunk of palms, which leads to the formation of tunnels inside the palm.

MORPHOLOGICAL CHARACTERS

The body of the beetle is about 35 mm long, red-brown with a few black spots, and its slender snout or rostrum is 1mm long. The head and the rostrum comprise about one-third of the total length

MALE AND FEMALE

There is sexual dimorphism is present in rhynchophorus. The females are longer than males for abdomen length and width, total head size, and the length from tip of rostrum to antennal insertion. In general the longer length of the female is associated with reproductive features.

PARASITIC ADAPTATION

It is a highly destructive and persistent pest of coconut palms. It infests the crown either by boring through the soft parts or by entering through the holes and cuts already present. Its ecology is characterized by the adults' ability to aggregate on palms. The aggregation process has the functions of protection, feeding and reproduction for the individuals. Semiochemicals and visual cues strongly influence this behaviour at intraspecific and interspecific levels.

RAPHIDOPALPA FOVEICOLLIS

RED PUMPKIN BEETLE

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : INSECTA

ORDER : COLEOPTERA

HABIT AND HABITAT.

It is a pest in pumkin. They feed on leaves and buds, and flowers and can defoliate the plants; the grub before boer into the roots and damage the stems and fruits that lie on the soil. It found in India and neighbouring countries.

MORPHOLOGICAL CHARACTERS

The adult measures 5–8 mm in length and about 3.5 mm in breadth. The colour of elytra varies from pale orange-yellow to bright orange-red to medium brown, and the abdomen is black with

comb soft while hues.

MALE AND FEMALE

Both male and female looks similar.

ECOLOGICAL ADAPTATION

The beetles hibernate over winter.

MONOBIA QUADRIDENS

FOUR-TOOTHED MASON WASP

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : INSECTA

ORDER : HYMENOPTERA.

HABIT AND HABITAT

It is a primarily neotropical genus of medium sized to large potter wasps occuring from the united states to Argentina. It is bivoltine, having two generations in a year, while in most wasp spps, it only lasts a minute or two. It nests in a variety of cavities including tunnels abandoned by carpenter bees, old mud dauber nests and hollow plant stems.

MORPHOLOGICAL CHARACTERS

It grows to a wingspan of 18 mm.

They have a dark or black coloured body with a white coloured band on it.
It is entirely black except for broad ivory-coloured band on the first tagta

MALE AND FEMALE

Females are larger than males.

ECOLOGICAL ADAPTATIONS.

They are two generations per year, with one generation over wintering as pupae.

ORTHETRUM CHRYSIS

SPINE TUFTED SKIMMER

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : ODONATA

HABIT AND HABITAT

The Spine tufted skimmer or brown-backed red marsh hawk is a species of dragon fly in the family Libellulidae. It is widespread in many Asian countries. Common in marshes.

MORPHOLOGICAL CHARACTERS

It is a medium sized dragon fly with dark thorax and blood-red abdomen. It is very similar to Orthetrum pruinosum in shape and size; but can be distinguished by the colour of the abdomen.
Wingspan is about 31–38 mm. And the wing is almost transparent.

MALE AND FEMALE

Male is larger than female in size.

BEHAVIOUR

commonly found perched around marshes, ponds, paddy fields and stagnant parts of rivers and streams.

EUREMA HECABE

COMMON GRASS YELLOW

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : LEPIDOPTERA.

HABIT AND HABITAT

It is a small pierid butterfly species found in Asia, Africa and Australia. They are found flying close to the ground and are found in open grass and scrub habitats

MORPHOLOGICAL CHARACTERS

They have a wingspan of 35 to 45 mm
They are small in size. They have bright yellow wings, with blackish brown bordering on the upper side and the under side of the wings are pale yellow with brown speckles. They have narrow black band on the hindwing. They have different colouration in their wings depending on the season.

MALE AND FEMALE

Males have a brand lying along the cubital vein on the forewing underside. The female is larger than male and is pale yellow, with broader black but different markings on the upperside of both wings.

ECOLOGICAL ADAPTATIONS

Exhibit seasonal polyphenism.

SUASTUS GREMIUS

INDIAN PALM BOB

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : LEPIDOPTERA.

HABIT AND HABITAT

It is the Indian palm bob or palm bob, is a butterfly belonging to the family hesperiidae. It is found in Indomalayal realm.

MORPHOLOGICAL CHARACTERS

Alea of both wings brownish ochreous. Underside grey tinged with pinkish. Hindwing clear pinkish-grey without any suffusion, but sparsely covered with whitish scales, a black spot near the upper end of the cell; and there is an oblique row in the median and inturn-median interspaces, all tinged with whitish.

MALE AND FEMALE

Female usually paler than the male, markings similar, the spots on the forewings are all larger, the two upper discal spots square, the middle spot excavated on its outer side, two conjoined large spots at the cell end.

The female is generally (but not always) somewhat larger than the male.

SIGNIFICANCE

Act as pollinating agent

RATHINDA AMOR

MONKEY PUZZLE

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : INSECTA

ORDER : LEPIDOPTERA

HABIT AND HABITAT.

It is found in Sri Lanka and India.
It prefers the undergrowth but can be seen along forest paths and clearings. It can also be seen in gardens with one or more of its host plants.
The butterfly has a weak flight and keeps low landing frequently on bushes to bask in the sun.

MORPHOLOGICAL CHARACTERS.

They have a wingspan of about 22 - 30 mm.
It is a small butterfly with contrasting upper and lower side

Underside is white to dark yellowish brown. Forewings has irregular dark basal markings with a curved white discal line. The apical two fifths are a rich dark brown colour. The hind wing has a silvery margin with many irregular black lines and spots within. Upper side is dark brown and has a white spot end all. It has nineteen white spots forming a short band on the forewing. It has three tails, being white different sizes in lengths it shows a slight dimorphism, dry season butterfly being larger and more whitish of the two.

MALE AND FEMALE

The both sexes are the same. colour and pattern.

SIGNIFICANCE

Act as pollinating agents.

ACRAEA TERPSICORE

TAWNY COSTER

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : INSECTA

ORDER : LEPIDOPTERA

HABIT AND HABITAT

It can be seen in abundance wherever its larval food plant is found. The adult tends to avoid dense undergrowth and shady areas, instead keeping to open spaces in all types of vegetation. It is found in India, Sri Lanka, Maldives, Myanmar, Thailand, Cambodia, Vietnam, Singapore and recently Australia.

MORPHOLOGICAL CHARACTERS

It is a medium sized butterfly with wingspan of an adult ranging from 48mm to 54mm. The upperside is dull orange with narrow, black outer borders and black

outer borders and black wing spot. The black thorax and black hindwing borders are spotted white. The underside is pale with markings more prominent

MALE AND FEMALE

The male is dup orange while the female is tawny yellow. It shows sexual dimorphism. It includes in size, coloration or body structure

SIGNIFICANCE

While pollinating they hunt for small insects and are good pollinators

JUNONIA IPHITA

CHOCOLATE PANSY

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : LEPIDOPTERA

HABIT AND HABITAT

Junonia iphita, the chocolate pansy or chocolate soldier, is a butterfly found in Asia. It is a nymphalid butterfly. It can be spotted in all parts of the island of Srilanka. Individual maintains a territory and are usually found in close to the ground level and often bask in the sun.

MORPHOLOGICAL CHARACTERS

The wingspan is about 5-6 cm.
Hindwing with a slender blackish loop near apex of ulterior area; a broad inwardly diffuse, outwardly well defined short discal fascia in continuation of the one on the forewing;

a series of postdiscal somewhat ochraceous ocelli with black pupils minutely ringed white
The wavy lines on the underside of the wings vary from wet-to dry-season forms.

MALE AND FEMALE

The female can be told apart from the male by white markings on the oblique line on the underside of the hindwing.

SIGNIFICANCE

As Pollinators and bio-indicators of studies

ZIZULA HYLAX

TINY GRASS BLUE

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : LEPIDOPTERA

HABIT AND HABITAT

It is a species of blue butterfly found in several areas throughout tropical and subtropical Africa, Asia, and Oceania including India, Japan, Philippines, Singapore, north and east coasts of Australia and also in Southern Australia. Its habitats is short grasses with small leguminous and acanthaceous plant.

MORPOLOGICAL CHARACTERS

They have a wingspan of 16 – 21 mm. They have black antennae, the shafts tinged with white. Head, thorax and abdomen are dark brown, with a little violet pubescence on the head and thorax.

beneath, pulpi, thorax and abdomen greyish white.

MALE AND FEMALE

Female is larger than male. In male ground colour pale grey, with a suffusion of small brown black spots. Female is similar to male.

Male upper side dull violet blue, which changes to a beautiful tint of violet in certain light, while female's glossy brown, without any violet-tint

SIGNIFICANCE

As insect pollinators play a huge role in plant reproduction. Useful as indicators species in biodiversity studies.

MELANITIS ZITENIUS

GREAT EVENING BROWN

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : INSECTA
ORDER : LEPIDOPTERA

HABIT AND HABITAT

It is a species of butterfly found flying at dusk. The flight of this species is erractic. They are found in South and Southeast Asia.

MORPHOLOGICAL CHARACTERS

Pale brown colour. The ground colour on the whole somewhat warmer brown, a very broad patch of ochraceous yellow, above and beyond the subapical black spots, light coloured spots.

MALE AND FEMALE

Black spots larger in the females than males.

BEHAVIOUR

Adult behaviour the butterflies are normally found singly, when disturbed from their resting places in the forest undergrowth.

CRAMBIDIA PALLIDA

PALE LICHEN MOTH

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : INSECTA

ORDER : LEPIDOPTERA

HABIT AND HABITAT.

It is found in Nova Scotia to Florida, west to Texas and north to North Dakota and Manitoba. The habitat consists of forests and woodland.

MORPHOLOGICAL CHARACTERS.

The wingspan is about 19–25 mm. The fore wings are light to medium yellowish–brown or greyish with slightly pale veins. The hindwings are pale and unmarked. Adults are on wing from May to September. There are two generations per year.

The larvae feed on lichens preferring lichens that grow on the bark.

MALE AND FEMALE

Both male and female are similar.

BEHAVIOUR.

The larvae feed on lichens preferring lichens that grow on the bark. Hence the name pale lichen moth.

ERETMOCERA IMPACTELLA

IMPACTELLA MOTH

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	INSECTA
ORDER	:	LEPIDOPTERA

HABIT AND HABITAT

It is found in small plants and shrubs. It is known from Oman, United Arab Emirates, India, Sri Lanka, Taiwan and Thailand and Pakistan.

MORPHOLOGICAL CHARACTERS

It is a small sized moth with head and thorax. Thorax is cupreous, collar tegulae yellow. Metathorax and first abdominal segment together forms a yellow ring as do abdominal segment 4–6, abdomen with second, third and terminal segments cupreous, legs without tufts of scales.

MALE AND FEMALE

Males are larger than female.

ECOLOGICAL ADAPTATION

They show the adaptation called camouflage. It can blend into their surroundings during rest for the survival from predators.

HETEROPODA VENATORIA

HUNTSMAN SPIDER

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : ARACHNIDA

ORDER : ARANEAE

HABIT AND HABITAT

It is found in Australia, Newzealand, Southeast Asia, The Mediterranean, Florida, and Hawaii and possibly in other tropical and semi-tropical regions. They frequent sugar cane fields, avocado and banana groves and forests, hiding in tree holes and under bark.

MORPHOLOGICAL CHARACTERS

It is a large brown spider with a flattened body structure and very little body pubes. Adult specimens have body length of 2.2 – 2.8 cm and have a lifespan

of 7–12 cm.

MALE AND FEMALE

Adults females have a larger body size especially the abdomen, than males.

BEHAVIOUR

If threatened, a huntsman spider will 'play dead', to avoid danger. A female huntsman places her egg sac under bark or a rock, then stands guard over it.

ARGIOPE TRIFASCIATA

BANDED GARDEN SPIDER

KINGDOM : ANIMALIA

PHYLUM : ARTHROPODA

CLASS : ARACHNIDA

ORDER : ARANEAE

HABIT AND HABITAT

It is a species of spider native of North and South America, but now found around the world. It can be found in certain areas of Europe. It found in the areas of tall grasses and shrubby vegetation

MORPHOLOGICAL CHARACTERS

It is a large spider, with a generally ovoid form and bright markings. The back of spider is covered with silvery setae. Numerous dark lines crosses the body and yellow banding may be present as well as.

MALE AND FEMALE

Females are about the size 13-14.5 mm while males are substantially smaller, with a body length of only about 1/3 that of the female.
Adult males have prominently enlarged pedipalps projecting from the side of the head and is used in sperm transfer.

BEHAVIOUR

It is a day active hunter and can usually be observed resting in the centre of the web, although they may drop readily when disturbed. Unlike many orbweaver spiders, they do not make a retreat along the edge of the web.

ARGIOPE PULCHELLA

GARDEN CROSS SPIDER

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : ARACHNIDA
ORDER : ARANEAE

HABIT AND HABITAT

Argiope pulchella is species of an orb-weaver spider family It is found commonly in gardens, woodlands, grasslands, and crop fields. Upon disturbance the spider vibrates the web or move to the other side of the web. Prefer dense, moist environment. Builds perfect orb webs and rest at the centre of the web in upside down position. It found in India, china and Indonesia.

MORPHOLOGICAL CHARACTERS.

Cephalothorax covered with thick layer of pubescence.

chelicerae small and weak. 8 eyes present, posterior median eyes encircled by black rings and lateral eyes located on tubercles. Easily identified with the presence of cruciate (x shaped) stabilimentum in the web. Alternate white, yellow, black or red coloured parallel bands with spots present on abdomen. The abdomen is broad but ends with sharp tapering distally. legs long, strong, alternately brown and yellow coloured and covered with hairs and spines.

MALE AND FEMALE.

The female is larger than male, being 8 - 10 mm while male is 4 - 6 mm. The male has more crab appearance; having a dark brown cephalothorax and lacking the stripes found in the female.

ECOLOGICAL ADAPTATIONS.

The web of it is distinct. The web has a dense area of silk towards the centre of the web that form a zigzag pattern called the stabilimentum. The purpose of the stabilimentum is debated. It may be used as a camouflage, to warn birds of the web's presence or to attract prey.

PEUCETIA VIRIDANS

GREEN LYNX SPIDER

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	ARACHNIDA
ORDER	:	ARANEAE

HABIT AND HABITAT

It is a bright green lynx spider usually found on green plants. It is the largest North American species in the family Oxyopidae. This spider is common in Jamaica.

MORPHOLOGICAL CHARACTERS

They are variable in size about 4–16 mm in length. They have very long, thin legs are a pale green to yellow, with the aforementioned black spines and are covered with numerous black spots, particularly noticed on the femora. The greenish abdomen is like a pencil ending in a point with several white and red chevron-shaped markings.

MALE AND FEMALE

The female of this is about 12 to 22 mm in length with long, spiny spiny legs and an oblong-to oval abdomen. The male is much smaller and slender, reaching only half-inch.

ECOLOGICAL ADAPTATIONS.

The gum lynx hunts prey on vegetation and flowers and catch can adjust its body colour to match the background. Females in this species also construct a silk retreat in which they suspend the egg sac. Females then guard the eggs and young spiders in this retreat.

PHINTELLA VITTATA

BANDED PHINTELLA

KINGDOM : ANIMALIA
PHYLUM : ARTHROPODA
CLASS : ARACHNIDA
ORDER : ARANEAE

HABIT AND HABITAT

They are commonly seen on small bushes and small medium sized plants. Under sunshine they appear to shine due to their iridiscent body surface.

MORPHOLOGICAL CHARACTERS

Cephalo thorax small, almost spherical with two broad black lines on bluish-white iridiscent body. Eight eyes present, ocular region covered with iridescent setae. Chelicerae slender with longer, slender and curved fangs. Abdomen almost rounded having alternate black bands on bluish white iridiscent body. A semicircular black spot is present near the spinnerets.

legs are slender and small.

MALE AND FEMALE

The female spider is slightly larger than the male and measures about 4 mm to 5 mm in size. The size of male spiders varies from 3 mm to 4 mm.

ECOLOGICAL ADAPTATIONS

The female spiders are able to detect ultraviolet light from UVB Band (315 – 280 nm) and have specialized surface on their bodies to reflect it. The reflection of UVB radiation by males during courtship has been shown to enhance their ability to attract females.

PLEXIPPUS PAYKOLLI

PANTROPICAL JUMPING SPIDER

KINGDOM	:	ANIMALIA
PHYLUM	:	ARTHROPODA
CLASS	:	ARACHNIDA
ORDER	:	ARANEAE

HABIT AND HABITAT

It is usually found living on and around man-made structures, in particular on buildings. Although it has also been recorded from tidal grooves and cotton fields. It may be found near light sources catching insects attracted by the light. Found in Asia & Africa.

MORPHOLOGICAL CHARACTERS

It has a carapace. It is covered with short greyish hairs with sometimes dramatic accents of red.
Cephalothorax slightly elongated, pale beige coloured with a white mid-dorsal white line.

MALE AND FEMALE

The cephalothorax of female is pale yellowish brown coloured with a light dorsal band in the cephalic area. Abdomen oval with a narrowing tip, pale beige colour in male and pale yellowish brown colour in female. Abdomen of male has a white longitudinal band with dark brown bands on either side and white lines on the lateral margins.

BEHAVIOUR

It builds dense, structurally complex nests, which detain potential prey and sometimes assist the spider in prey capture.

CAMARICUS MAUGEI

CRAB SPIDER

KINGDOM : ANIMALIA

PHYLUM : CHORDATA

CLASS : ARACHNIDA

ORDER : ARANEAE

HABIT AND HABITAT

Camaricus maugei is a crab spider found in India to Vietnam, Indonesia. They live on flowers, plants and tree bark.

MORPHOLOGICAL CHARACTERS

It small sized spider. Light brown coloured body. They do not make any webs and hide themselves under flower or leaves of plants for the preys holding the 1st pairs of legs wide apart.

They have yellow spots on the black dorsal side.

MALE AND FEMALE

The males and females do not look alike.
The females pedipalps looks like little legs.
The end of male's pedipalp look like boxing gloves.

ECOLOGICAL ADAPTATION

Crab spiders use their long legs to run away from predators. They have camouflage for protection.

SCHOOL OF CHEMICAL SCIENCES

MAHATMA GANDHI UNIVERSITY

Priyadarshini Hills, Kottayam-686560
Kerala, India

Phone: 0481 -2731036

17.03.2021

I hereby certify that we had an online lab visit for 39 Undergraduate students (B. Sc Chemistry) of Providence Women's College, Calicut as a part of their B. Sc Curriculum of Calicut University, on 22nd January 2021 at 10.30 am with lab sessions on instrumentation of FT-IR Spectrometer and UV-Vis Spectrophotometer.

Professor & Director

Professor and Director
School of Chemical Sciences
Mahatma Gandhi University
Priyadarsini Hills P.O.
Kottayam, Kerala 686 560

PROVIDENCE WOMEN'S COLLEGE

CALICUT

DEPARTMENT OF CHEMISTRY

IV REPORT

Online Laboratory Visit

School of Chemical Sciences, MG University

NAME : ASWATHY PAUL

REG No : PWASSCH026

CLASS : III BSC. CHEMISTRY

EXAMINER

Dr. Rema. VT

HEAD OF DEPARTMENT

Sr. Asha Thomas

DEPT. OF CHEMISTRY
PROVIDENCE WOMEN'S COLLEGE
CALICUT

INTRODUCTION

Industrial visit is the occasion in which we are watching and analysing the practical applications of our subject. In every year, final year students go for study tour as part of their curriculum. But in this year as we are facing such a pandemic - covid 19, we the department of chemistry, Providence women's college conducted online industrial visit on 21-01-2021 and 29-01-2021 in collaboration with School of chemical Science, Mahatma Gandhi University. On 21-01-2021 Dr. Devaky, Director of School of chemical science along with Namitha Nandanan, Scientific assistant and Fency, Research scholar explained about Infrared Spectrometer and ultraviolet-visible Spectrometer. On the next day, 29-01-2021 Dr. Sunilkumar P.N, Mahatma Gandhi University explained about Nuclear magnetic Resonance Spectroscopy and conducted demonstration with Sample.

Spectroscopy and Spectrometer :

Spectroscopy is defined as the branch of science which is associated with the interaction of radiations of different wavelengths with matter. There are different types of spectroscopy, Based on the type of radiation interacting it is classified. A molecule possess quantised translational, Rotational, vibrational and electronic energy levels. Spectroscopy is the general study of interaction of matter with Electromagnetic waves but and using spectrophotometer we can quantify the measurement, Light Spectra reflection and transmission as a function of wavelength - Spectrophotometer is an instrument that measure the amount of light absorbed by a sample.

Ultra violet - Visible Spectrometer :

If ultraviolet-visible radiation is incident on a matter it result in the transition from one electronic level to another. The study regarding this is called electronic spectroscopy or ultra-violet spectroscopy.

Ultraviolet-visible spectrophotometry is a technique used to measure light absorbance across the ultraviolet and visible ranges of the electromagnetic spectrum. we know that the absorbance of radiation in UV-visible range cause atomic excitation i.e, when the atom excites on to another higher transition state it must absorb a sufficient radiation and each molecule has a specific energy to undergo these transition. UV-visible spectrophotometer is using this Principle to characterise the sample.

Namitha Nandhanan, Scientific assistant demonstrated their UV-visible spectrometer - UV 2600 using silver nanoparticle in distilled water as sample. The sample is taken in one cuvette. The sample should be diluted also. In the beginning blank and the reference is introduced to spectrometer and give Preliminary adjustments in the Software window. i.e, about choosing the base line. Then take the blank out of the spectrometer and introduce the sample in the sample holder and a peak is obtained in the Software window. This is the UV-visible characteristic of that sample. By analysing the spectrum

obtained we can study and understand about the sample introduced. The most important feature of UV-2600 is the ability to perform wavelength measurements up to 1400 nm and it allows the analysis of organic, inorganic, biological samples, optical materials and photovoltaics.

Infrared Spectrometer :

Infrared spectroscopy or vibrational spectroscopy. is the study of interaction of infrared radiation with matter causes the transition in vibrational energy levels. If a molecule gives a characteristic infrared spectrum, it is said to be infrared active - IR active. The molecules with permanent dipole moment are IR active. Infrared spectrometer is a useful techniques for structural and functional group analysis and it has been used widely to identify unknown substances. This technique is utilizing the ability of atoms to absorb infrared frequencies that match their transitions to higher vibrational level and generates an absorption spectra specific to particular compounds

The demonstration was carried out in ATR - Attenuated total reflection model IR spectrometer. It is a sampling technique used in conjuction with infrared spectroscopy which enables samples to be examined directly in the solid or liquid state without further preparation. They carried out the chacteristic of Urea and thiourea sample. ATR uses the property of total internal reflection. In ATR model a crystal which is made of an optical material with a higher refractive index is required. In the case of liquid sample, pouring a shallow amount over the surface of the crystal is sufficient. In case of solid sample, samples are firmly clamped to ensure good contact, it is ensured by adjusting the upper knob. Generally Zinc, Silicon, Germanium, Diamond are the ATR crystals used. Here diamond is used because it has excellent mechanical properties An ATR accessory operates by measuring the changes that occur in an internally reflected Infrared beam. when the beam comes to contact with the sample the beam is directed onto an optically dense crystal with a high refractive index at a certain angle. This internal reflectance

creates an evanescent wave that extends beyond the surface of the crystal into the sample held in contact with the crystal. In regions of the IR spectrum where the sample absorbs energy, the evanescent wave will be attenuated. The attenuated beam returns to the crystal, then exists the opposite end of the crystal and is directed to the detector in the IR spectrometer. The detector records the attenuated IR beam as an interferogram signal, which can be used to generated an IR spectrum using software comparing to other accessories. ATR have many advantages it only require minimal sample preparation, fast and easy clean up can be done we can analyse the sample in their natural states, it is excellent for thick or strongly absorbing samples.

NMR Spectrometer :

Nuclear Magnetic Resonance spectroscopy. Here Spectrum arises from the transition between the nuclear spin energy levels of the molecules when an external magnetic is applied on it. The radiation in the range of radio frequency provide the energy related to this transition. This technique use the ability

of atomic nuclei to behave like a small magnet and align themselves with an external magnetic field. When irradiated with a radio frequency signal the nuclei in a molecule can change from being alligned with the magnetic field to being opposed to it. The energy frequency at which this occurs can be measured and is displayed as an NMR Spectrum. The most common nuclei observed using this technique are ^{1}H and ^{13}C.

NMR technique may be used to detect the presence of particular nuclei in a compound and since for a given nuclear species the strength of the NMR signal is directly proportional to the no. of resonating nuclei to estimate them quantitatively. The two characteristics of nmr make it more powerful and useful they are chemical shift and coupling constant. Chemical shift is the difference in the absorption position of a particular proton due to variation in its chemical environment from that of an isolated proton for that we are keeping a reference compound - TMS, Tetramethyl silane in which all the proton have the same chemical environment. The indirect

interaction between the spins of the neighbouring magnetic nuclei that is transmitted through intervening bonding electrons is called spin-spin coupling. The magnitude of separation between the peaks in a multiplet arising from spin-spin coupling is called spin spin coupling constant.

Dr. Sanilkumar PN explained about all this and demonstrated NMR spectrum of a sample. There Bruker Advance III 400 NMR Spectrometer is used. To get the nuclei in a molecule to get align in the same direction, a very strong magnetic field is generated using a super conducting electromagnet. Sample taken in a sample take is inserted to the top of magnet and radio frequency field is generated. when NMR signals are Produced it is detected with sensitive radio detector and NMR Spectrum is obtained.

CONCLUSION

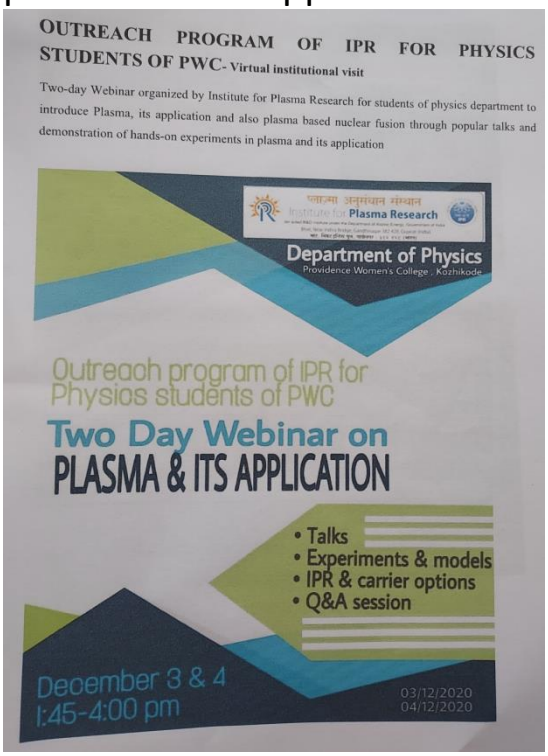
From this online industrial visit we get an idea about characterising the samples using UV-visible, IR, NMR spectroscopy. School of chemical science and their faculties help us to understand about the wide range of application of spectroscopy. Spectroscopy can be applied in many fields - pharmaceuticals, astronomy, forensic, Research and development, food and Beverages, Environmental analysis, mineralogy, Gemeology etc.. because using UV-visible we can detect the metals in various samples their quantification is also possible. Then using IR, we can determine the organic structures, functional groups, we can measure bond strength, degree of unsaturation. Then using NMR we can determine the structure of organic compounds and it is applied in MRI - Magnetic resonance imaging. By realising and understanding all this our mind is enlightened to explore the heights and depths of chemistry.

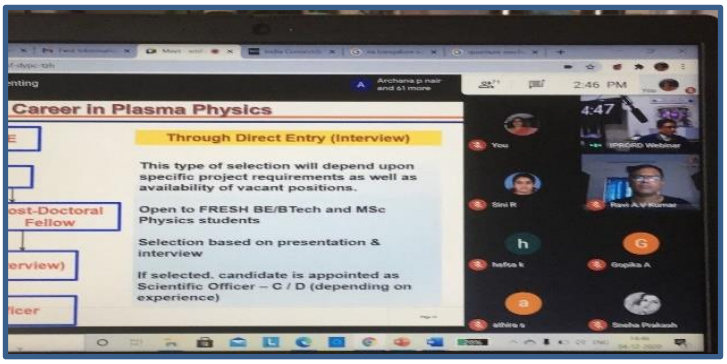
Industrial Visit

Industrial visit has its own importance in a career of a student who is pursuing a professional degree. It is considered as a part of college curriculum. Objectives of industrial visit are to provide students an insight regarding internal working of companies.27students accompanied by 2 teachers had made a visit to Cybaze company, Cyberpark. They also had a chance to join for the seminar conducted by them.

OUTREACH PROGRAM OF IPR FOR PHYSICS STUDENTS OF PWC- Virtual institutional visit

Two-day Webinar organized by Institute for Plasma Research for students of physics department to introduce Plasma, its application and also plasma based nuclear fusion through popular talks and demonstration of hands-on experiments in plasma and its application.





CERTIFICATE

This Is to Certify that the project titled "CUSTOMER REALATIONSHIP MANAGEMENT SYSTEM IN MALABAR GOLD AND DIAMONDS, KANPUR" submitted to University of Calicut in partial fulfillment of the requirement for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms.SREEMOL.K and the Project has not formed the basis for the award of any degree, diploma ,fellowship or other similar title or recognition before.

Viva Voice Examination held On: 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "IMPACT OF COVID-19 ON THE CONSUMPTION PATTERN OF RURAL CUSTOMERS WITH SSPECIAL REFERENCE TO KODENCHERRY GRAMA- PANCHAYAT (CALICUT)" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. SONA SEBASTIAN and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/04/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. BRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "A STUDY ON BRAND LOYALTY AT INDUS MOTORS, VATAKARA" submitted to the University of Calicut in partial fulfillment for the award of Bachelor's Degree in Commerce, is record of bona fide research work done by SETHULAKSHMI M. The project has not been formed on the basis for the award of any degree, diploma, fellowship or similar title or recognition before.

Viva voice examination held on---------- 28/07/2021 ----------

---

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project title **"CUSTOMER PERCEPTION TOWARDS ROYAL ENFILED WITH SPECIAL REFERENCE TO CALICUT DISTRICT."** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. ROSHNA P.K** and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled '**Savings and Investment Behaviour of College Teachers With Special Reference to Kozhikode District** 'submitted to the University of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in Commerce , is a record of bonafide research work done by Ms. Maneesha Mathew and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva Voice Examination held on 28/7/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "MICRO BUSINESS AND GOVERNMENT FINANCIAL SUPPORT with special reference to Kozhikode district " Submitted to the University of Calicut in partial fulfillment for the award of Bachelor's of commerce, is a record of bonafide research work done By Ms. MALAVIKA.K . The project has not been formed the basis for the award of any degree , diploma , fellowship or other similar title or recognition before.

Viva voice examination held on 28/07/2021

Internal examiner

NINIKALA K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

external examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "CO-OPERATIVE BANK AND RURAL CREDIT FOR INCLUSIVE GROWTH: A STUDY OF PERUVAYAL CO-OPERATIVE BANK" submitted to the university of Calicut in partial fulfillment of the requirements for the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. Jiss Joseph and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "employees issues due to covid-19 pandemic with special reference to ECOMATE company" submitted to the university of Calicut in partial fulfillment of the requirements for the award of bachelor degree in commerce, is a record of bona fide research work done by Ms. KRISHNAPRIYA MP and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project entitled "**A STUDY ON CONSUMER APPROACH TOWARDS PLASTIC MONEY** "submitted to the university of Calicut in partial fulfilment of the requirements for the award of Bachelor degree in commerce , is a record of bonafide work done by Ms.Jesniya.T, under my guidance and supervision and the project has not formed the basis for the award of any degree , diploma, fellowship or other similar title or recognition before.

Viva voce examination held on 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that **Ms.APARNA.A.P.** is the student of the Department of Commerce, Providence Women's College, Calicut and this project report entitled **" SAVING AND INVESTMENT HABITS OF WORKING WOMEN WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT "** has been submitted by her for the partial fulfillment of requirement for the award of the Degree of Bachelor of Commerce, (CUCBCSS-UG), University of Calicut, and the project have not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on 28/07/2021

Internal Examiner
NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673

External Examiner
Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "EFFECTIVENESS OF E-GOVERNANCE IN AKSHAYA E-KENDRA WITH SPECIAL REFERENCE TO THALAYAD BRANCH(CALICUT)" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor's Degree in Commerce, is a record of bonafide research work done by Ms. Iris Maria George and the project has not been formed on the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 23/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "CONSUMER ATTITUDE TOWARDS MOBILE BANKING WITH SPECIAL REFERANCE TO KOZHIKODE DISTRICT" submitted to the University of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. HASNA .K and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar titile or recognition before.

Viva voice examination held on : 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "**ATTITUDE OF STUDENTS TOWARDS ENTREPRENEURSHIP WITH SPECIAL REFERENCE TO VATAKARA**" submitted to the University of Calicut in partial fulfilment of the requirement of the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. ANUSERR AK and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination on: 28/07/2021

Internal Examiner:

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "PROBLEMS FACED BY RETAILERS IN SM STREET, CALICUT" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. FARHA SIRAJ and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "Consumer preference towards Food Products Brand with Special Reference to Eastern Condiments Pvt. Ltd" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. [illegible] Francis, and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voce Examination held on ______ [illegible] ______

Internal Examiner

External Examiner

CERTIFICATE

This is to certify that the project titled"INFLUENCE OF ADVERTISING ON CONSUMER BUYINGBEHAVIOUR TOWARDS COSMETIC PRODUCTS" Submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **MS. DRISSYA PRABHA R S**, and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "Investment pattern among senior citizens with special reference to Kodom village Kasargod district" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of original work done by Ms. Chinnu Prakash under the guidance and supervision of Ms. Mirabel Josephine Paul Assistant Professor, Department of Commerce, Providence Women's College Calicut. She have successfully completed 21 days project and it has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 23/07/2021

Internal examiner:

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify the project title **"ROLE OF ADVERTISEMENT IN CONSUMER PREFERENCE TO BABY PRODUCT"** Submitted to the university of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in commerc , is a record of bonafide research work done by **Ms. BIJIMOL C K** the project has not formed the basis for the award of any Degree ,Diploma ,Fellowship or other similar title or recognition before .

Viva voice examination held on : 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"VIEWERS PERCEPTION TOWARDS MALAYALAM NEWS CHANNELS WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. ASWATHI K and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **CUSTOMER AWARENESS TOWARDS HOME LOAN POLICIES WITH SPECIAL REFERENCE TO WAYANAD DISTRICT CO-OPERRATIVE BANK, PULPALLY BRANCH"** submitted to the University of Calicut in partial fulfillment of the requirements of the award of Bachelor Degree in Commerce, is a record of bonfire research work done by **Ms. Aswani** and the project have not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"A STUDY ON THE AWARENESS AND USAGES OF DIGITAL WALLET AMONG YOUTH WITH SPECIAL REFERENCE TO WAYANAD DISTRICT"** submitted to the University Of Calicut in partial fulfillment of the requirements for the award of Bachelor's Degree in Commerce, is a record of bonafide research work done by **Ms. Archana T S.** The project has not been formed on the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal Examiner:

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "CONSUMER ATTITUDE TOWARDS ONLINE SHOPPING" submitted to the University of Calicut in partial fulfilment of the requirements for the award of Bachelor's Degree in Commerce, is a record of Bonafede research work done by Ms. ANNA MERINE and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 23/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"Customer satisfaction towards banking services of Kallanode service Co-operative bank"** submitted to the university of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in Commerce , is a record of bonafide research work done by Ms. Anju Sebastian and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva Voce Examination held on 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"ATTITUDE OF CUSTOMERS TOWARDS POST OFFICE INVESTMENT SCHEMES IN KOZHIKODE CORPORATION"** submitted to the University of Calicut in partial fulfillment of the requirements of the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. ANJANA P** and the project have not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to clarify that the project titled **"A STUDY ON EMPLOYEE SATISFACTION IN KSEB IN MEENANGADI BRANCH - WAYANAD"** submitted to the university of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in commerce, is a record of bonafide research work done by **Ms. Anjana M K,** under the guidance and supervision and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal Examiner

Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "A STUDY ON THE MARKETING STRATEGIES OF KERALA MALANAD KARSHAKA PRODUCE CO-OPERATIVE MARKETING SOCIETY LTD THIRUVAMBADY, WITH SPECIAL REFERENCE TO HEARTONICA" submitted to the University of Calicut in partial fulfillment for the award of Bachelor's Degree in Commerce, is record of bonafide research work done by Ms. Anita Jose. The project has not been formed on the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project "JOB SATIFACTION OF EMPLOYEES AT MARUTI SUZUKI INDUS MOTORS KOYILANDY" submitted to the University of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. AMISHA PN and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner:

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"EFFECTIVENESS OF SOCIAL MEDIA IN SMEs WITH SPECIAL REFERANCE TO KANNUR DISTRICT"** submitted to the University of Calicut in partial fulfillment of the requirement of the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. ALPHONSA THOMAS** and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"EMPLOYEE RETENTION STRATEGY WITH SPECIAL REFERENCE TO TVS IYENGAR SONS PVT LTD"** submitted to the university of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. Aleena M.V, under the guidance and supervision and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva vice Examination held no 28/07/2021

.....

Internal Examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

.....

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"STUDY ON SERVICE QUALITY WITH SPECIAL REFERENCE TO INDUS MOTOR, CALICUT"** submitted to the University of Calicut in partial fulfillment of the requirement of the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. AKHILA K** and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination on: 28/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "EMPLOYEE PERCEPTION ABOUT MERGING OF BANKS WITH SPECIAL REFERENCE TO SBI" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. AISWARYA.M.DAS and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 28/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"IMPACTS OF FLOODS ON FARMERS WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. AISWARYA C and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled 'Prospects and challenges of real estate markets' submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. Adula Harif .v, under my guidance and supervision and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva Voce Examination held on 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certifying that this project report entitled **" A STUDY ON QUALITY OF WORK LIFE OF EMPLOYEES WITH SPECIAL REFERENCE TO PMK CONSTRUCTION "** was prepared by Miss. ADHEENA N. K. (PWASBCM028) under my guidance and supervision in partial fulfillment of the requirements for the award of the degree of Bachelor of commerce (B.Com) with finance by the University of Calicut during the academic year 2018 -2021.

Submitted to examination held on: 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that this project report entitled **"CUSTOMER SATISAFACTION OF ROYAL ENFIELD WITH SPECIAL REFERENCE TO THRISSUR DISTRICT"** submitted to the university of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree of Commerce, is a record of bonafide research work done Ms. Vyshnavidevi. K. S and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voce examination held on 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project "ATTITUDE OF INVESTORS TOWARDS STOCK MARKET WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT" submitted to the University of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. SREELAKSHMI R and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner:

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"COMPARATIVE STUDY ON SERVICE QUALITY PROVIDED BY SBI & ICICI BANK IN KOZHIKODE BRANCH"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. Sneha Mp and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project entitled"**A STUDY ON INVESTMENT PATTERNS IN MUTUAL FUNDS WITH SPECIAL REFERENCE TO INVESTORS IN CALICUT DISTRICT**" submitted to the university of Calicut in partial fulfilment of the requirements for the award of Bachelor degree in commerce , is a record of bonafide work done by, SiyaGopinath. M.Kunder my guidance and supervision and the project has not formed the basis for the award of any degree , diploma, fellowship or other similar title or recognition before.

Viva voce examination held on 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "Customer Buying Behaviour Towards Two Wheelers with special reference to ACE Motors, Calicut" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degre in Commerce, is a record of bona fide research work done by Ms.SHRADDHA.S.PAI and the project has not formed the basis for the award of any degree, diploma,fellowship or other similar title or recognition before.

Viva Voice Examination held on: 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"ATTITUDE OF CUSTOMERS TOWARDS MULTILEVEL MARKETING WITH SPECIAL REFERENCE TO WAYANAD DISTRICT"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. SHARONA ROY** and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled ' **Role of Kudumbashree in financial inclusion special with reference to Kunnamangalam grama panchayath'** submitted to the university of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in commerce , is a record of bonafide research work is done by bonafide Ms. Sandra. P. M, under my guidance and supervision and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voce Examination held on. 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"THE ROLE AND EFFECTIVENESS OF ONLINE CLASSES AMONG COLLEGE STUDENTS"** submitted to the University of Calicut in partial fulfillment of the requirement of the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. RINSHA V V** and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal Examiner

N[illegible] K
Asst.
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "COMPARATIVE STUDY OF THE PERFORMANCE OF AIRTEL AND JIO TELECOMMUNICATION SERVICES AMONG STUDENTS WITH SPECIAL REFERENCE TO CALICUT" submitted to the University of Calicut in partial fulfillment of the requirements for the award of bachelor's degree in commerce, is a record of bona fide research work done by Ms. RIFANA MUMTHAZ T and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut-673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"INTERNET MARKETING VS TRADITIONAL MARKETING: A COMPARATIVE STUDY OF COSMETICS WITH SPECIAL REFERENCE TO CALICUT CORPORATION"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. RABIA FARZINE** and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled 'The impact of COVID-19 on travel and tourism sector in Kozhikode district' submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a recod of bonafide research work done by Ms. Megha. I.K and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva Voice Examination held on 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "A STUDY ON STRESS MANAGEMENT OF EMPLOYEES AT ZOOM COMMUNICATIONS, CALICUT" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor's Degree in Commerce, is a record of bonafide research work done by Ms. JUMANA C and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"WOMEN EMPOWERMENT THROUGH KUDUMBASAREE UNITS"** Submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **MS.HARSHIDA C K**, and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project "ATTITUDE OF INVESTORS TOWARDS STOCK MARKET WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT" submitted to the University of Calicut in partial fulfilment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. CHANDANA TT and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "**EFFECTIVENESS OF YOUTUBE ADVERTISING: A Study of Viewers Analysis**" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. AYNAH USMAN KOYA**, under my guidance and supervision and the project has not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "IMPACT OF COVID-19 ON EMPLOYEMENT WITH SPECIAL REFERENCE TO SERVICE SECTOR IN KERALA" submitted to the University of Calicut in partial fulfillment of the requirements for the award of bachelor's degree in commerce, is a record of bonafide research work done by Ms.ARYA.HARIDAS and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

A study on CUSTOMER SATISFACTION FOR FASTRACK WATCHES

PROJECT REPORT

SUBMITTED BY

SINIJA K

BCom Finance

UNDER THE SUPERVISION OF

Ms NIVEDHYA PRAMOD

DEPARTMENT OF COMMERCE

PROVIDENCE WOMENS COLLEGE

KOZHIKODEM

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

Dr. K. Sravana
External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

GOODS AND SERVICE TAX: AN AWARENESS OF COMMON OPEOPLE WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT

Project report submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor of Degree in Commerce

By

AKHILA CHANDRAN

Register no. PWASBCM009

Under the guidance of

Ms. Ninikala.k

Assistant Professor and Head

Department of commerce

Providence Womens college, Calicut

March 2021

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "**A STUDY ON WORK LIFE BALANCE OF WOMEN WITH SPECIAL REFERENCE TO KOZHILODE DISTRICT**" Submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **MS. ROSELIT BABU**, and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal Examiner

NINIKALA. K
Asst Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "WELFARE FACILITIES OF EMPLOYEES IN HEALTH SECTOR WITH SPECIAL REFERENCE TO KOZHIKODE DISTRICT" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bona fide research work done by Ms. ANJANA V and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal Examiner:

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"THE FACTORS AFFECTING CUSTOMERS INVESTMENT DECISION TOWARDS LIFE INSURANCE POLICIES WITH REFERENCE TO LIC, KOZHIKODE"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. Aiswarya P. K and the project has not formed for the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva Voce examination held on 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "ANALYSIS OF THE WORKING CAPITAL MANAGEMENT OF HCL TECHNOLOGIES" submitted to the University of Calicut in partial fulfilment of the requirements for the award of the Bachelor's Degree in Commerce, is a record of bonafide research work done by Ms. AYISHA ANIS and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voce examination held on: 27/7/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "A COMPARATIVE ANALYSIS OF BRAND PREFERENCE TOWARDS PREMIUM PHONES (IPHONE) AND ANDROID PHONES AMONG STUDENTS" submitted to the University of Calicut in partial fulfilment for the award of Bachelor's Degree in Commerce, is record of bonafide research work done by Ms AYSHA KM, and the project has not been formed the basis for the award of any degree, diploma, fellowship or other similar title recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner
NINIKALA. K
Asst. Professor
Dept.of Commerce
Providence Women's College
Calicut - 673 009

External examiner
Dr. K. SRAVANI
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **'RETAILERS PERCEPTION TOWARDS GST'** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by Ms. Glenna Babu John and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva Voce Examination held on 27/07/2021

Internal Examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner

DR. R. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled **"EFFECTIVENESS OF PROMOTIONAL TOOLS ADOPTED BY NESTLE WITH SPECIAL REFERENCE TO CALICUT CITY"** submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of bonafide research work done by **Ms. ILLHAM BICHU E V** and the project have not formed the basis for the award of any degree for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "**A STUDY ON EFFECTIVENESS OF RECRUITMENT AND SELECTION BASED ON VIRON SYSTEMS KALLAI CALICUT"** Submitted to the University of Calicut in partial fulfilment of the requirements for the award of the Bachelor's Degree in Commerce, is a record of Bona-fide research work done by Ms. SILNA HASHIM and the project has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal Examiner
NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External Examiner
Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

CERTIFICATE

This is to certify that the project titled "Financial empowerment of women through employment with special reference to Olavanna panchayat" submitted to the University of Calicut in partial fulfillment of the requirements for the award of Bachelor Degree in Commerce, is a record of original work done by Ms. Ajanya.p under the guidance and supervision of Ms.Ninikala.K, Assistant Professor and Head, Department of Commerce, Providence Women's College Calicut. She have successfully completed 21 days project and it has not formed the basis for the award of any degree, diploma, fellowship or other similar title or recognition before.

Viva voice examination held on: 27/07/2021

Internal examiner:

NINIKALA. K
Asst. Professor
Dept of Commerce
Providence Women's College
Calicut - 673 009

External examiner:

Dr. K. SRAVANA
Assistant Professor & Research Guide
P.G. Department of Commerce
Govt. Arts & Science College
Kozhikode-18

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that the project titled " **A STUDY ON CUSTOMER PREFERENCES AND BRAND LOYALTY TOWARDS SELECTED FMCG PRODUCTS OF HINDUSTAN UNILEVER LIMITED** " is a bonafide piece of work done by AMBILY BENNY(PWATMCM001) in partial fulfilment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on ...16/8/2021.....

SHASWATI.T

Internal examiner

P. Subha.C

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"A STUDY ON EMPLOYEE RETENTION STRATEGIES OF T.V SUNDRAM IYENGAR & SONS (P) LTD, CALICUT."**is a bonafide piece of work done by ANAGHA.E (PWATMCM002) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on ..16/8/2021.....

SHASWATI.T

Internal examiner

2. Subha.C

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that " **IMPACT OF MERGER ON FINANCIAL PERFORMANCE OF PUBLIC SECTOR BANKS, WITH SPECIAL REFERENCE TO SBI AND IT'S ASSOCIATES**"is a bonafide piece of work done by NAME (REG NO.) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/8/2021

SHASWATI. T

Internal examiner

Dr. Vineeshkumar M.

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"PRE AND POST COVID SCENARIO OF INTERNET BANKING WITH SPECIAL REFERANCE TO CALICUT CITY"**is a bonafide piece of work done by ARUNYA.C (REG NO.PWATMCM004) in partial fulfillment as required for the degree of master of commerce (M.Com) as per the University of Calicut.

Viva voce examination held on ....16/08/2021.....

SHASWATI. T
.....
Internal examiner

1- Dr Vinaritha TM
.....
2. Subha. C
External examiner

DEPARTMENT OF COMMERCE

PROVIDENCE WOMEN'S COLLEGE

CALICUT-673009

CERTIFICATE

This is to certify that this project work titled that **"INVESTORS OUTLOOK ON TAX SAVING SCHEME OF AXIS AND UTI MUTUAL FUND"** is a bonafide piece of work done by ASWATHY V (**PWATMCM005**) in partial fulfillment as required for the degree of master of commerce **(M. Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

SHASWATI. T.

Bhaswati

.....

Internal examiner

1. Vinasha Vinod

.....

2 Subtec

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"INVESTMENT PREFERENCES AND DETERMINANTS OF LIFE INSURANCE BUYING BEHAVIOUR"** is a bonafide piece of work done by ATHULYA SUNNY (PWATMCM006) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

SHASWATI. T

Internal examiner

1. Vinassha

2. Sub Lt. C

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"IMPACT OF SENSORY BRANDING OF NESTLE MAGGI ON CONSUMER"** is a bonafide piece of work done by CHINJU JAIN (PWATMCM07) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on ....16/08/2021.....

SHASWATI. T

Internal examiner

Dr. Vinutha T.M.

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"A STUDY ON GOLD COMMODITY TRADING AMONG INVESTORS IN CALICUT DISTRICT"** is a bonafide piece of work done by GAYATHRI RAMESH (PWATMCM008) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

I. SHASWATI. T
.....
Internal examiner

Dr Vineetha. TM
.....
P. Subha. C
External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **" JOB SATISFACTION OF EMPLOYEES WITH SPECIAL REFERENCES TO ASHIQUE EXPORT PVT.LTD"** is a bonafide piece of work done by KEERTHI.T (PWATMCM009) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on ...16/08/2021.....

1. Bhaswath. T

Internal examiner

1. Vinassha

2. Subha. C

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"IMPACT OF COVID-19 ON BRAND PREFERENCES OF HYGIENE PRODUCTS WITH SPECIAL REFERENCE TO KOZHIKODE CITY"** is a bonafide piece of work done by KRISHNASREE M (PWATMCM010) in partial fulfilment as required for the degree of master of commerce (MCom) as per the University of Calicut.

Viva-voce examination held on 16/08/2021

1. SHASWATI. T

Internal examiner

1. Vinarsha

2. Subhee

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"STUDENTS PERCEPTION TOWARDS EDUCATION LOAN"** is a bonafide piece of work done by MEHVISH FATHIMA (PWATMCM011) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

1. SHASWATI. T

Internal examiner

Dr. Vinodha. C

2. Subha. C

External examiner

DEPARTMENT OF COMMERCE

PROVIDENCE WOMEN'S COLLEGE

CALICUT-673009

CERTIFICATE

This is to certify that this project work titled that **"TAX PLANNING AND INVESTMENT BEHAVIOUR AMONG SALARIED EMPLOYEES WITH SPECIAL REFERENCE TO KERALA"** is a bonafide piece of work done by NIMISHA TOMY (PWATMCM012) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut

Viva voce examination held on 16/08/2021

I. SHASWATI. T

Internal examiner

Dr Vimala T.M

D. Subha. C

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"A STUDY ON INVESTORS PERCEPTION ON GOLD PRICE FLUCTUATION AND ITS PRICING FACTORS"** is a bonafide piece of work done by NIMMY PHILOMINA D'CRUZ (PWATMCM013) in partial fulfilment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

1. SHASWATI. T — Internal examiner

Dr Vinutha.T.M, 2. Subha.C — External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"COMPARITIVE ANALYSIS OF SALARIED GOVERNMENT AND PRIVATE EMPLOYEES INVESTMENT PATTERN, SPECIAL REFERENCE OF CALICUT DISTRICT, KERALA"**is a bonafide piece of work done by NIMNA.K (PWATMCM014) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

1. SHASWATI.T

Internal examiner

1. Vinarsha
2. Subha.C.

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"CUSTOMER ATTITUDE TOWARDS ONLINE SHOPPING WITH SPECAIL REFERENECE TO THAMARASSERY CITY"**is a bonafide piece of work done by RAHIBA T (PWATMCM015) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

1. SHASWATI. T

Internal examiner

2. Subha. C.

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"CUSTOMER PERCEPTION ON E-BANKING SERVICES WITH SPECIAL REFERENCE TO CALICUT CITY"** is a bonafide piece of work done by **REEMA ZAINA(PWATMCM016)** in partial fulfilment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/8/2021

1. SHASWATI. T

Internal examiner

1. Dr. Vineeshkumar

2. Subha. C.

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled **"PERCEPTION ON POST OFFICE SAVING SCHEME AMONG WOMEN OF CALICUT DISTRICT"** is a bonafide piece of work done by RESHMA C (PWATMCM017) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on ....16/08/2021.....

1. SHASWATI. T

.....

Internal examiner

.....

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"EFFECTIVENESS OF COMPENSATION MANAGEMENT ON THE EMPLOYEES WITH SPECIAL REFERENCE TO STAR TILE WORKS LTD KALLAI"** is a bonafide piece of work done by SNEHA NARAYANAN.PK (**PWATMCM018**) in partial fulfillment as required for the degree of master of commerce **(M.Com)** as per the University of Calicut.

Viva voce examination held on 16/08/2021

1. SHASWATI. T

Internal examiner

1. Vinarsha

2. Subha c

External examiner

Department of Commerce

Providence Women's College

Calicut-673009

CERTIFICATE

This is to certify that this project work titled that **"STUDY ON EFFECTIVENESS OF E-CRM IN BANKING SECTOR WITH SPECIAL REFERENCE TO STATE BANK OF INDIA"** is a bonafide piece of work done by THERESA CATHERIN JOSE (REG NO.: PWATMCM019) in partial fulfillment as required for the degree of master of commerce (M.Com) as per the University of Calicut.

Viva voce examination held on 16/08/2021

1. SHASWATI. T

Internal examiner

1. Dr. [illegible]
2. Subha. C.

External examiner

DEPARTMENT OF ZOOLOGY

PROVIDENCE WOMEN'S COLLEGE, CALICUT 09.

DR. NISHI ANN

Head of the Department

Phone: Office: +91 49522372487

Mob : +91 9946484810

Carmel Hills, Malaparamba, P.O

Calicut- 673 009, Kerala, INDIA

Date: 30 Mar 21

CERTIFICATE

This is to certify that the project titled **'SYNTHESIS OF SILVER NANOPARTICLES FROMMANGO FRUIT'** is an authentic record of the work carried out by the following students under my supervision and guidance in partial fulfillment of the requirements of the Degree of Bachelor Science in Zoology during the year 2020-2021 and that no part thereof has been presented before any other project.

SL.NO	NAME	REGISTER NUMBER
1	AKSHAYA S	PWASSZO001
2	ARUNIMA SREENIVASAN	PWASSZO017
3	ARYA E K	PWASSZO018
4	BHAVYASREE S	PWASSZO021
5	FATHIMA NISANA V P	PWASSZO022
6	FIDHA RAFEEQ C	PWASSZO023
7	LADEEDA	PWASSZO028
8	NIRANJANA U	PWASSZO029
9	RUSHDA A C	PWASSZO031
10	SARANYA T V	PWASSZO032
11	SHARIKA A P	PWASSZO033

Examiners:

1.

2.

Dr. Nishi Ann

Dr. Nishi Ann
Head & Assistant Professor
Department Of Zoology
Providence Womens College
Carmel Hill, Calicut - 673 009

DEPARTMENT OF ZOOLOGY

PROVIDENCE WOMEN'S COLLEGE, CALICUT-09

Dr. E. JULIE
Assistant Professor

Phone:Office :+914952372487
Mob :+916282446398
Carmel Hill, Malaparamba P. O
Calicut-673009, Kerala, INDIA

Date 30 Mar 21

CERTIFICATE

This is to certify that the project titled **'ANALYSIS OF PHYTOCHEMICALS AND ANTIOXIDANT ENZYMES OF OF FRESH AND GALL INFECTED LEAVES OF LITSEA CORIACEA EXTRACT (LAURACEAE)'** is an authentic record of the work carried out by the following students under my supervision and guidance in partial fulfilment of the requirements of the Degree of Bachelor of science in zoology during the year 2020-21 and that no part thereof has been presented before for any other project.

SI.NO	NAME	REGISTER NUMBER
1.	AMRITHA LAXMI C	PWASSZO014
2.	AMALA GEORGE K	PWASSZO013
3.	ANAGHA K C	PWASSZO015
4.	ANGEL D' SOUZA	PWASSZO016
5.	ATHIRA K	PWASSZO019
6.	HIBA FATHIMA V	PWASSZO05
7.	JULIA MARY THOMAS	PWASSZO025
8.	KEERTHANA. V	PWASSZO026
9.	KRISHNAPRIYA K	PWASSZO027
10.	NITHA K.M	PWASSZO030
11.	VARSHA RAJU	PWASSZO035

Examiners

1.

Dr. E. JULIE
Asst. Professor
Department of Zoology
Providence Women's College.

2.

DEPARTMENT OF ZOOLOGY

PROVIDENCE WOMEN'S COLLEGE, CALICUT.

Dr. SANGEETHA G KAIMAL
Assistant Professor

Phone: Office: +91 4952372487
Mob: +91 9447476859
Carmel Hill, Malaparamba P.O.
Calicut - 673 009, Kerala, INDIA.

Date: 05-03-2021

CERTIFICATE

This is to certify that the project titled "**EFFICACY OF GINGER LEAF EXTRACT ON THE DIGESTIVE ENZYMES OF *SITOPHILUS ORYZAE***" is an authentic record of the work carried out by the following students under my supervision and guidance in partial fulfilment of the requirements of the Degree of Bachelor of Science in Zoology during the year 2020-21 and that no part thereof has been presented before for any other project.

SL.NO	NAME	REGISTER NUMBER
1.	ALEENA SAJEEVAN .K	PWASSZO002
2.	ARYA T.P	PWASSZO003
3.	FATHIMA NASRIN A.K	PWASSZO004
4.	KEERTHANA S	PWASSZO006
5.	LAKSHMI KRISHNAKUMAR	PWASSZO007
6.	LAKSHMI VINOD	PWASSZO008
7.	NIVYA K.G	PWASSZO009
8.	SREEVIDYA. M	PWASSZO011
9.	ALEENA. A	PWASSZO012
10.	JIKKI M ROY	PWASSZO024
11.	SHIVYA SANTHOSH	PWASSZO034

Examiners:

1.
2.

Sangeetha
Dr. SANGEETHA G. KAIMAL

MANAGEMENT FEST

Students were encouraged to participate in management fest conducted by different colleges which will enhance their managerial skills . students will get practical knowledge of many of the management skills that they learned from their classroom. This year 5 of our students participated the management fest which was organized by SNES institute of management studies and research kunnamangalam. Best manager, treasure hunt, b quiz, business plan were the games organized by them . vasanthika ,our ii year student won second prize in best manager contest

Students participated were

1. Rudha m p
2. Keerthana m p
3. Neha anand
4. Vasanthika
5. Ansitta sunny

2.3.1. *Student centric methods*

Entrepreneurship Development club	https://instagram.com/proviventure?utm_medium=copy_link	Instagram page to sell the products