Volume 5, Nos. 1 - 4, December 2004

PGIS News

Quarterly Update of the work and progress of the Postgraduate Institute of Science (PGIS), University of Peradeniya, SRI LANKA (also available at www.pgis.lk)

INTERNATIONAL STATISTICAL CONFERENCE

Hon. Prof. Tissa Vitharana, Minister of Science & Technology addressing the Inaugural Session of the conference held at the PGIS on December 28, 2004. (Seated L to R): Prof. V. Kumar (Dean, Faculty of Science, University of Peradeniya), Prof. Lakshman Dissanayake (Director, PGIS), Prof. Kapila Goonasekera (Vice-Chancellor, University of Peradeniya), Prof. Basil de Silva (International Organizing Committee) and Dr. K. Liyanage (Chairman, PGIS Board of Study in Statistics & Computer Science).

The International Statistical Conference organized by the Board of Study in Statistics and Computer Science of the PGIS, and the Department of Statistics and Computer Science of the Faculty of Science, University of Peradeniya, was held from 28th to 30th December 2004 at the PGIS. Sixty foreign participants representing *Australia (15), USA (12), India (12), Canada (8), UK (5), Singapore (2), Malaysia (2), Switzerland (1), Finland (1), South Africa (1), & Germany (1)*, and fifty six local participants representing universities and other institutes attended the conference. As more than 50 foreign participants had already arrived in the island by 26th December 2004, the organizers decided to go ahead with the conference despite the aftermath of the tsunami disaster.

The International Organizing Committee consisted of Professors Basil de Silva (Australia), Nitis Mukopadyay (USA), S Ganesalingam (New Zealand) and Tim Swartz (Canada) and the Local Organizing Committee was co-chaired by Prof. Lakshman Dissanayake (PGIS), and Dr. Pushpa Wijekoon (Faculty of Science, University of Peradeniya) and represented by members from other Sri Lankan Universities.

Hon. Prof. Tissa Vitharana, Minister of Science & Technology was the Chief Guest at the Inauguration Ceremony held on 28th December 2004 at the PGIS. The main objective of this conference was to provide an opportunity for academics and postgraduate students to present their research findings, to get exposed to new developments in statistics research, and for local participants to interact with their peers from developed and developing countries.

Group Photograph

The proceedings of the conference were published jointly by the PGIS and the RMIT University, Melbourne, Australia, with Professors Basil de Silva (Australia) and Nitis Mukopadyay (USA) as the editors.

The organizers gratefully acknowledge the sponsorship by ICTP, Trieste, Italy and the generous concessions provided for foreign guests by the Central Cultural Fund, the Ceylon Tourist Board, Department of Wildlife Conservation and the Royal Botanic Gardens.

Prof. Lakshman Dissanayake
Director, PGIS &
Co-chairman, Local Organizing Committee

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PGIS *News*

We shall be pleased to receive your comments, suggestions and contributions with a view to improving the quality of this newsletter. Correspondence and requests for copies of **PGIS *News*** should be addressed to Dr. N C Bandara – Editor:

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Educating the Public on Natural and Man-made Hazards

Earth releases enormous amounts of stored energy during earthquakes and volcanic eruptions leading to severe destruction. Compared to these, landslides are gravity driven and cause relatively little damage to life and property. Sri Lankan public are familiar with landslides and floods, but earthquakes and tsunamis are a new experience to them, and the scale of destruction caused by the tsunami on 26th December 2004 was unimaginable.

Unlike during other natural hazards, geo-scientists have been criticized in the printed and electronic media for not forecasting this earthquake and the tsunami. Since it is believed that Sri Lanka is safe from earthquake-related phenomena, (a) had any geo-scientist ever forecasted such event even a week before, very likely it would have been treated as a hoax, (b) a geo-scientist neither would have ever envisaged a destruction of this magnitude in Sri Lanka due to an earthquake-related event.

The argument in the media that the earthquake and the tsunami could have been predicted simply adds to the lack of awareness of the general public on geological hazards, as it tempts the public to think along the lines of other forecasts such as the weather, with which they are familiar. Thus, the public presume that forecasting an earthquake or a tsunami is as simple as making a weather forecast. In the manner meteorologists study a weather system (e.g. cyclone) to make a weather forecast, geo-scientists monitor the activity of a volcano and forecast an eruption. In both instances the scientists concerned have definitely identified the root cause of a possible hazard, the cyclone and the volcano, respectively. However, the geo-scientists are aware that the root of an earthquake (its focus and epicentre), its time of occurrence, and magnitude are among the most unpredictable, despite having identified the zones of occurrence of earthquakes around the world. Tsunamis are generated mainly by earthquakes beneath sea-floor and would be predictable if an earthquake causing a vertical displacement of the sea-floor could be predicted. Thus, tsunamis are even more unpredictable than earthquakes. But centres like the Pacific Ocean Tsunami Warning Centre in Hawaii can identify a tsunami in the middle of the ocean, after it has been generated by an earthquake, and warn the coastal communities before it reaches the shore. However, no such warning systems have yet been set up in other parts of the world, including Indian and Atlantic Oceans.

The national tragedy on December 26th has highlighted the need to acquire public warning systems to face any such future calamities. But if the public is not prepared and educated to respond to a warning, even the most sophisticated systems may not deliver the expectations. Almost all natural, accidental and man-made hazards may be identified if the first signals can be sensed and given serious thought. That gives sufficient time to alert everybody and take necessary precautions to avoid casualties. Sometimes, vigilant and knowledgeable public may raise the alarm of a danger before the warning systems sound. Thus, it is vital to educate the public on the causes, early signals, and dangers of all kinds of natural, accidental, and man-made hazards. That will give the leading cutting edge to protect the public from any future danger and build confidence in them to face any situation.

The kind and the scale of a hazard and those that would be affected may depend on the circumstances. It could be an earthquake, a tsunami, a landslide, a flood, a natural or man-made fire, a poisonous gas leak, thunder and lightning, micro-organism related health hazard etc. Educating the public on these hazards would be the responsibility of geo-scientists, academics in our universities, higher educational institutions, and relevant government agencies. The mechanisms to be adopted to educate the communities may range from hazard awareness educational TV programmes, public seminars to programmes designed for school children, preparing hand-outs and booklets to educate the public, hazard preparatory drills, maintaining a Hazard Monitoring and Mitigating Centre (that would also co-ordinate between different institutions dealing with such events), and train personnel at postgraduate level to man Hazard Educating Centres around the country. The Board of Study in Earth Sciences of the PGIS is happy to participate with other institutions in these programmes. It is also time to consider the introduction of new M.Sc. programmes in Natural Hazard Education in order to train personnel in these disciplines at postgraduate level. The government may be encouraged to setup provincial or divisional Hazard Educating Centers in order to educate the public as well as to coordinate actions during any hazardous event.

Mr. L R K Perera
Chairman,
PGIS Board of Study in Earth Sciences

M.Sc. PROGRAMMES COMMENCED

(January – December 2004)

M.Sc. Programme	Board of Study	Coordinators	No. of Students
Applied Statistics	*Statistics & Computer Science*	*Dr. P. Wijekoon (Dept. of Statistics & Computer Science), University of Peradeniya*	*16*
Industrial Mathematics	*Mathematics*	*Dr. A.A.I. Perera (Dept. of Mathematics), University of Peradeniya*	*10*
Science Education (with specialities in Biology, Chemistry, Mathematics & Physics)	*Science Education*	*Dr. S Karunaratne (Science Ed.Unit), Dr. R Rajakaruna (Dept. of Zoology), Prof. J S H Q Perera (Science Ed.Unit & Dept. of Chemistry), Dr. U N B Dissanyake (Dept. of Mathematics) & Prof. K Premaratne (Dept. of Physics), University of Peradeniya*	*40*
Analytical Chemistry	*Chemical Sciences*	*Dr. A. Bandara, Dept. of Chemistry, University of Peradeniya*	*24*
Clinical Biochemistry	*Biochemistry & Mol. Biology*	*Prof. P.A.J. Perera (Dept. of Biochemistry), Dr.S.B.P. Athauda (Dept. of Biochemistry) & Dr. P.H.P. Fernando (Dept. of Biochemistry), University of Peradeniya*	*13*
Environmental Science	*Environmental Science*	*Prof. M. de Silva (Dept. of Zoology), University of Peradeniya & Dr. G W A R. Fernando (Dept. of Physics), Open University of Sri Lanka, Nawala, Nugegoda*	*17*
Experimental Biotechnology	*Biochemistry & Mol. Biology*	*Dr. D.Yakandawala (Dept. of Botany) & Prof. P. H. Amerasinghe (Dept. of Zoology), University of Peradeniya, & Dr. K. Fernando (PGRC), Gannoruwa*	*5*
Industrial Chemistry	*Chemical Sciences*	*Dr. A. Wickramasinghe (Dept. of Chemistry) & Dr. P Karunaratne (Dept. of Chemical Engineering), University of Peradeniya*	*10*
Physics of Materials	*Physics*	*Prof. B.S.B. Karunaratne (Dept. of Physics), University of Peradeniya*	*18*
Postharvest Technology of Fruits & Vegetables	*Plant Sciences*	*Dr. M. Daundasekara (Dept. of Botany) & Dr. C. Abayasekara (Dept. of Botany), University of Peradeniya*	*8*
GIS & Remote Sensing*	*Earth Sciences*	*Dr. J. Gunatillake (Dept. of Geology), University of Peradeniya*	*50*
Postgraduate Diploma in IT for Education*	*Statistics & Computer Science*	*Dr. K.M. Liyanage (IT Center) & Dr. S.R. Kodituwakku (Dept. of Statistics & Computer Science), University of Peradeniya*	*78*

**** New programmes started in 2004***

PUBLIC LECTURES AND SEMINARS PRESENTED AT THE PGIS (January – December 2004)

Title of the Seminar	*Presenter's Name & Affiliation*	*Date*
Estimating Allele Frequencies in Polyploids	***Dr. Nihal de Silva*** *Scientist, Hort Research (Postharvest and Food Science), Auckland, New Zealand*	*January 9*
Which Trees Should be Felled and Which Should be Retained?	***Dr. Michelle Pinar*** *Dept. of Agriculture & Forestry, School of Biological Sciences, University of Aberdeen, U.K.*	*January 28*
Computer Assisted Learning (CAL) in Tertiary Education	***Prof. Abhai Mansingh*** *Dept. of Physics, University of New Delhi, India*	*January 31*
Improving Drought Resistance in Rice Using Quantitative Genetics: Progress and Prospects	***Dr. Adam Price*** *Lecturer in Molecular Plant Genetics, School of Biological Science, University of Aberdeen, U.K.*	*February 3*
Throughfall in Rainforest Soils	***Dr. Ian Baillie*** *Cranfield University, U.K.* *(Currently a Charles Bullard Research Fellow at Harvard University, U.S.A.)*	*March 24*
Oceanography around Sri Lanka	***Prof. Debashasis Sengupttha*** *Centre for Atmospheric and Oceanographic Studies, Indian Institute of Science, Bangalore*	*May 21*
Ecological Drivers of Mast Fruiting in Dipterocarps: Opportunities for Research at Sinharaja	***Dr. David Burslem*** *Senior Lecturer in Tropical Ecology, School of Biological Sciences at Aberdeen University, U.K.*	*June 24*
Prosopis Juliflora Invasion: Lessons From Brazil that Could be Learnt in Sri Lanka	***Dr. Phillip Hulme*** *Head of Ecosystem Dynamics Division, School of Biological Sciences, Aberdeen University, U.K.*	*June 24*
Dynamic Light Scattering the Method and it's Applications in Research on Polymers & Colloids	***Prof. Petr Stepanek*** *Head, Department of Supramolecular Polymer Systems & Director of Graduate Studies, Institute of Macromlecular Chemistry, Prague, C-Zech Republic*	*June 28*
Teflon Coated Ligands	***Prof. Rasika Dias*** *Dept. of Chemistry, University of Texas at Arlington, U.S.A.*	*20th July*
Petroleum Exploration in Sri Lanka	***Mr. Titus Jayawardena*** *Director General of Petroleum Resources, Sri Lanka*	*27th July*
DNA and Crime Detection	***Prof. S. K. Ballal*** *Senior Professor of Biology, Tennessee Technological University, U.S.A.* *(Visiting Fulbright Senior Scholar, Department of Molecular Biology & Biotechnology, University of Peradeniya)*	*4th August*
Lighting in Buildings: Past, Present and Future	***Dr. I. M. Dharmadasa*** *Reader, Applied Physics Division, Sheffield Hallam University,*	*24th August*

	Sheffield, U.K.	
Upper Kotmale Project: Issues and Challenges	***Mr. Shavindranath Fernando*** *Project Director, Upper Kotmale Hydropower Project, Ceylon Electricity Board*	*8th October*
Environmental Education in Finland, Europe and Sri Lanka	***Dr. Risto Hamari*** *Helsinki University, Finland* *(Visiting Consultant on Environmental Education, ADB Project, National Institute of Education , Sri Lanka)*	*19th October*
50 Years of Solar Cells	***Prof. Dr. Hans-Joachim Queisser*** *Former Director, Max-Planck Institute for Fundamental Research, Stuttgart, Germany*	*22nd November*

FOREIGN VISITORS (January – December 2004)

In addition to the scientists listed in pages 5 & 6, the following foreign scientists also visited the PGIS.

- ***Prof. K. R. Sreenivasan****, Abdus Salam Honorary Professor & Director, International Centre for Theoretical Physics, Trieste, Italy*
- ***Prof. D. Sengupta****, Centre for Atmospheric & Oceanic Sciences, Indian Institute of Science, Bangalore 560012, India*
- ***Dr. Jian – Hua (Joshua) Qian****, International Research Institute for Climate Prediction, The Earth Institute at Columbia University, Lamont-Doherty Earth Observatory, 61 Route 9W, Palisades, NY 10964, U.S.A.*
- ***Mr. Sanjeev Jayasinghe,*** *AIT, Thailand*
- ***Ms. M. A. Nadeera Rangika****, Program Associate, Presidents Office, AIT, Thailand*
- ***Ms. Ann Lopez-Fontanilla****, Outreach Officer, School of Civil Engineering, AIT, Thailand*
- ***Dr. Lal Samarakoon,*** *AIT, Thailand*
- ***Dr. Ajai K. Srivastava****, Physicist, Dept. of Radiology, University College of Medical Sciences & GTB Hospital, Delhi 110095, India*
- ***Dr. Rupert C. Perera****, Senior Research Fellow, Lawrence Berkley Laboratory, CA, U.S.A.*

FIRST GROUP OF FOREIGN STUDENTS AT THE PGIS

The following foreign students were enrolled as occasional students of the PGIS during 2004:

Name/Country	***Board of Study***	***Local Supervisor/Affiliation***
Mr. Joseph Grove, *U.K.*	*Plant Sciences*	*Prof. I A U N Gunatilleke* *Dept. of Botany, Univ. of Peradeniya*
Ms. Corrine Fisher, *U.K.*	*Plant Sciences*	*Dr. H M Gunatilleke* *Dept. of Agriculture Economics, Univ. of Peradeniya*
Ms. Li Jing, *P. R. China*	*Zoological Sciences*	*Prof. K H G M de Silva* *Dept. of Zoology, Univ. of Peradeniya*
Mr. K D J Johansson,	*Earth Sciences*	*Dr. H A Dharmagunawardane*

WORKSHOPS (WS), SHORT COURSES (SC) AND CONFERENCES (CF) (January – December 2004)

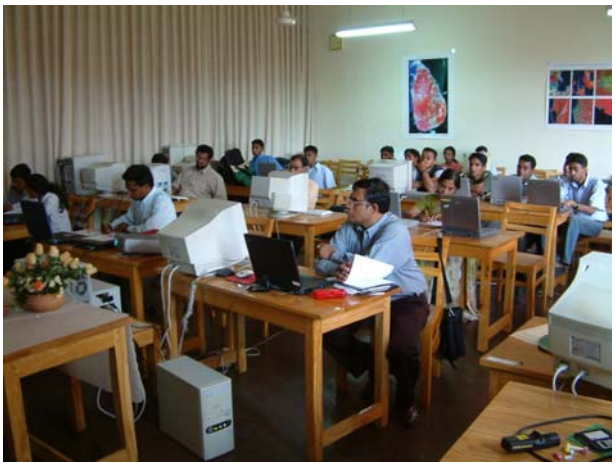
Event	Coordinator/s (Board of Study)	Period	No. of Participants
GIS and its Applications (SC)	Dr. J Gunathilake (Earth Sciences)	January 8 - 16	10
Scientific Writing (WS)	Dr. N C Bandara (PGIS)	March 26	91
National Workshop on Lightning Protection Systems (WS)	Mr. K R Abhayasinghe (Physics)	March 27	14
Eutrophication of Kandy Lake (WS)	Prof. P K de Silva Prof. E I L Silva (Zoological Sciences & Environmental Science)	May 21	32
Postharvest Handling & Disease Control of Fruits (WS)	Prof. N K B Adikaram Dr. C. L Abayasekara (Plant Sciences)	June 7 - 8	22
Applied Biology for GCE A/L Teacher Trainers (WS)	Dr. S Karunaratne (Science Education) Prof. J P Edirisinghe (Zoological Sciences) Dr. G A D Perera (Plant Sciences)	June 8 - 13	40
Data Analysis Clinic in Ecology Studies (WS)	Dr. G A D Perera Prof. I A U N Gunatilleke (Plant Sciences)	June 21	14
Peradeniya University Research Sessions (PURSE) 2004	The PGIS joined the Faculty of Science at the Peradeniya University Research Sessions (PURSE) - 2004 where research papers based on research carried out by PGIS students were presented.	November 10	161
Plant Systematics (Higher Plants)	Dr. Deepthi Yakandawala	Dec 1 - 3	47

(WS)	*(Plant Sciences)*		
Electronics (WS)	*Mr. Mahesh Edirisinghe* *(Dept. of Physics, Univ. of Colombo)*	*Dec. 2 – 3*	*63*
Chemical Resources for New Industries (SC)	*Prof. N S Kumar* *Prof. R M G Rajapaksha* *(Chemical Sciences)*	*Dec. 17 - 19*	*22*
International Statistical Conference (CF)	*International Organizing Committee:* *Prof. Basil de Silva (Australia)* *Prof. Nitis Mukopadyay (USA)* *Prof. S Ganesalingam (New Zealand)* *Prof. Tim Swartz (Canada)*	*Dec. 28 – 30*	*116* *60 - Foreign &* *56 - Local*
	Local Organizing Committee: *Prof. Lakshman Dissanayake (Co-chairperson)* *Dr. Pushpa Wijekoon (Co-chairperson)* *Dr. Saluka Kodithuwakku (Secretary)* *Dr. Champika Bandara Prof. R A Dayananda,* *Dr. Kanthi Perera, Dr. S Samita,* *Dr. M R Sooriyaarachchi &Dr. Sarath Thewarapperuma*		

REPORTS FROM THE COORDINATORS OF WORKSHOPS & SHORT COURSES

SHORT COURSE ON GIS AND ITS APPLICATIONS

A 7-day short course on '**GIS and its applications**' was conducted at the PGIS, by the Board of Study in Earth Sciences in collaboration with the Department of Geology from January 8 - 16, 2004. Geographic Information Systems (GIS) and related applications are being widely used for various projects in Sri Lanka by a considerable number of government and private sector organizations. GIS has emerged as a frontier scientific discipline covering most areas in earth sciences, biology, agriculture, and engineering for numerous applications such as land use planning, disaster management, natural resources management, forestry, wild life, transportation and supply net work, transmission, telecommunication network, etc.



Participants of the short course on 'GIS and its Applications' attending a session.

In order to respond to a request from the Kala Oya Basin (KOB) Organization, Central Engineering Consultancy Bureau (CECB), and the Natural Resources Management Services (NRMS) of Mahaweli Authority of Sri Lanka (MASL), the Board of Study in Earth Sciences of the PGIS organized this short course especially to cater to a group of engineers and scientists who were to start using GIS as a management tool in their day-to-day project activities.

The workshop had the main objective of training the participants in using GIS by introducing the following: *the basic concepts of GIS, Principals of GIS analysis, introduction to available software and hardware for GIS, application of Remote*

Sensing in GIS, modeling and analysis of geospatial data, Global Positioning Systems (GPS) and applications, various applications of GIS with special reference to water shed management and several case studies. Resource persons for this workshop were drawn from Departments of Geology, Geography, Agricultural Engineering and Civil Engineering of the University of Peradeniya and the Mahaweli Authority and National Building Research Organization (NBRO). Judging from the feedback received from the participants, the workshop has given them a novel experience in applications of GIS particularly as a decision making tool in watershed management.

Organization of this workshop would not have been possible without the interest and the cooperation of several individuals and organizations. I would like to extend my sincere thanks to Eng. KRN Bandara, River Basin Manager - KOB and his staff, Eng. Nihal Rupasinghe, Chairman - NRMS and Additional General Manager - CECB, the resource persons who agreed to conduct the course with a very short notice. I am also thankful to the Director Professor Lakshman Dissanayake and the Board of Study in Earth Sciences for encouraging and promoting this activity.

Coordinator: Dr. Jagath Gunathilake

WORKSHOP ON SCIENTIFIC WRITING

One-day workshop on Scientific Writing was held on Friday, 26th March 2004 at the PGIS auditorium. Workshop participants (91) were PGIS students registered for M.Sc., M.Phil. & Ph.D. degree programmes: *M.Sc. in Analytical Chemistry (11); M.Sc. in Environmental Science (12); M.Sc. in Experimental Biotechnology (9); M.Sc. in Industrial Mathematics (5); M.Sc. in Physics of Materials (9); M.Sc. in Science Education (35); M.Phil./Ph.D. programmes (7); Occasional Students (3).*

The workshop consisted of lectures/discussions on various aspects of postgraduate thesis/project report writing. The topics covered at the workshop were: *Structure and layout of a thesis/project report; Ethics; Title & Abstract; Computer Aided Literature Survey; Introduction & Bibliography; Experimental/Materials and Methods; Results, Interpretation & Conclusion; Problems in Thesis Writing.* Professors B. M. R. Bandara, K. Dahanayake, M. A. K. L. Dissanayake, J. Edirisinghe, C. V. S. Gunatillake, O. A. Ileperuma & R. M. G. Rajapakse (Faculty of Science), Prof. R. Sivakanesan (Faculty of Medicine), and Dr. P. M. K. Alahakoon (Faculty of Agriculture), University of Peradeniya served as resource persons.

Coordinator: Dr. N C Bandara

NATIONAL WORKSHOP ON LIGHTNING PROTECTION SYSTEMS (LPS)

Dr. Chandana Jayaratne, explaining the action of a lightning conductor, during the workshop.

A one-day workshop on Lightning Protection Systems (LPS) was organized by the PGIS Board of Study in Physics and was held at the PGIS on Saturday 27th March 2004. The workshop was partially sponsored by CEL Lanka Ltd.

Prof. M A K L Dissanayake, Director of the PGIS, Prof. V Kumar, Dean, Faculty of Science, Prof. B S B Karunaratna, Chairman of the PGIS Board of Study in Physics graced the inaugural session of the workshop. There were 14 participants from both state and private sector orgainzaions.

Resource persons of the workshop were Dr. Chandana Jayaratne (Department of Physics, University of Colombo), Eng. H K Illeperuma (Chief Engineer/High Tension Maintenance, Ceylon Electricity Board), Eng. L S B Karunaratne (Head of Section/Power and Air-conditioning, Sri Lanka Telecom) & Eng. Nuwan Kumarasinghe (Electronic Engineer, Department of Meteorolgy). All the lectures were followed up by a brief discussion and contributions from some of the participants. A number of practiced problems in installation of Lightning Protection Systems (LPS) were discussed during the panel discussion. A representative from the CEL Lanka Ltd. delivered a lecture on modern electronic instruments and systems which can be installed for protection from lightning.

Participants commented the workshop as a very useful one since they could gain a clear understanding of the techniques related to LPS. They also had an opportunity to see physically most of the instruments used in LPS.

Coordinator: Mr. K R Abhayasingha, Department of Meteorology, Colombo

WORKSHOP ON EUTROPHICATION OF KANDY LAKE

Eutrophication, the process of nutrient enrichment in freshwaters, is becoming a serious problem in the reservoirs of Sri Lanka. This is reflected by the sudden increase of certain algae, which appears as a bloom. In 1999, such an algal bloom appeared for the first time in Kandy lake clearly indicating that the lake is becoming a victim of nutrient enrichment. Human activities, especially in and around the lake watershed, are mostly responsible for the enrichment of waters. Therefore, it is extremely important and relevant to carryout continuous monitoring of the chemistry of lake waters and effective management of the catchment area. It was also felt that important recommendations should be made to the relevant authorities in this respect.

In order to address these issues, a workshop was organized jointly by the Boards of Study in Environmental Science and Zoological Sciences of the Postgraduate Institute of Science (PGIS) in collaboration with the Institute of Fundamental Studies (IFS), Kandy and was held at the PGIS auditorium on 21st May 2004. The Bank of Ceylon, Kandy, provided partial sponsorship.

The main objectives of the workshop were: i) *To invite the researchers, who are actively involved in research on eutrophication of Kandy lake to a common forum to present their research* ii) *To discuss and recommend the remedial measures that are important in restoring Kandy lake with the relevant personnel from the Department of Land & Irrigation, Kandy Municipality, Kandy Water Board, etc.*

The following resource persons contributed to the workshop: Prof. E I L Silva (IFS, Kandy); Prof. S Piyasiri (Department of Zoology, University of Sri Jayawardanapura); Prof. O A Ileperuma, (Department of Chemistry), Prof. K H G M de Silva (Department of Zoology), Prof. P K de Silva (Department of Zoology) & Dr. S Yatigammana (Department of Zoology) of the University of Peradeniya; Mrs. S Godaliyadda (Department of Land & Irrigation, Kandy); Dr. M F F Sharaff (IFS, Kandy). They presented their research on eutrophication and related subjects on Kandy Lake during two technical sessions on the following topics: Chemistry of Kandy Lake and Eutrophication; Biological indicators of eutrophication in Kandy Lake; Algal toxins in freshwaters; Bacterial consortium in Kandy Lake; Management of eutrophication in Kandy Lake.

The lectures were followed by a practical session on '*Plankton and their enumeration*' held in the main laboratory of the Department of Zoology. Live plankton samples were provided and the participants were given the opportunity to work generally with algae and particularly with those that are mainly responsible for the algal bloom (e.g. *Microcystis*). A practical guide prepared on the common freshwater algae of Sri Lanka was used for this purpose. Furthermore, the participants were taught how to enumerate plankton organisms.

There was a lively discussion at the end of the workshop and the participants had the opportunity to present any problems pertaining to nutrient enrichment in Kandy Lake as well as in other reservoirs of Sri Lanka. The following recommendations were made incorporating the comments made by the participants at the discussion.

- *Establishment of a Central Sewerage Plant in Kandy city (location to be decided by the relevant authorities).*
- *Establishment of more wetlands with macrophytes in the lake periphery.*
- *Proper maintenance of the silt traps, which are already in operation.*
- *Advising on the improvement of waste disposal systems of hotels, schools, guest houses etc. around the lake.*

It was decided to submit a report incorporating the above recommendations to the authorities concerned by the Chairman of Board of Study in Environmental Science through the Director of the PGIS.

Coordinators: Prof. P K de Silva
Prof. E I L Silva

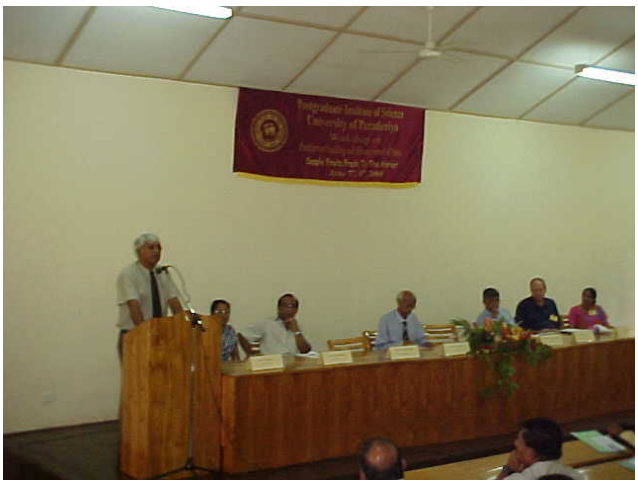
WORKSHOP ON POSTHARVEST HANDLING & DISEASE CONTROL OF FRUITS

"SUPPLY FRUITS FRESH TO THE MARKET"

This workshop was organized by the PGIS Board of Study in Plant Sciences & the Department of Botany, with the collaboration of the Queensland Department of Primary Industries (QDPI), Australia. The main objective of the workshop, which was held during June 7 – 8, 2004 at the PGIS, was to impart knowledge and expertise on fruit handling and disease management to personnel involved in both local and export fruit markets.

The main speaker at the workshop was, Mr. Tony Cook from QDPI, an expert in Postharvest Technology, having experience in sharing his expertise with other developing countries. Contributions from local experts and experienced personnel, from the ITI, the Department of Agriculture, and Universities of Peradeniya, Kalaniya and Rajarata, were noteworthy.

There were 30 participants at the workshop, from private sector industries (12), the Department of Agriculture (05), Technical Institutes (03) and the Universities (10). The wide range of speakers and participants added to the success of the workshop. The technical sessions commenced with an overview of the fruit industry and postharvest technology in Sri Lanka and Australia. This enabled the participants to realize the level at which we in Sri Lanka, need to improve current practices in postharvest technology, in order to achieve significant improvements in the industry. Different stages of the postharvest chain were dealt with, beginning at harvest and leading on to handling, disease management, packing, cooling, transport, storage, ethylene and fruit ripening etc. Special reference was given to banana, mango and pineapple, which are fruits that are currently being exported and have potential for improvement, both for the local and export markets.



Prof. Kapila Goonasekera, Vice-Chancellor of the University of Peradeniya addressing the audience at the Workshop Inaugural Session held at the PGIS Auditorium (Seated L to R): Dr. N C Bandara, Prof. N K B Adikaram, Prof. O A Ileperuma, Prof. V Kumar, Mr. Tony Cook & Dr. C L Abayasekara.

The workshop was made practical oriented and interesting with the addition of laboratory sessions each afternoon. The participants were able to have a hands-on experience of the problems encountered, methods of disease control and exposure to new technology, via this exercise which was commended by many.

The workshop provided opportunities for participants of similar interest to meet and share knowledge and establish links between each other. We hope that the links established will strengthen, and together, we can lend a hand to develop the postharvest industry in Sri Lanka. The response from the participants to the evaluation of the workshop was very positive, and most of them expressed that the content of the workshop was of great use to them. Financial assistance given by the Science and Technology Personnel Development Project, Ministry of Science and Technology is acknowledged.

Co-coordinators: Prof. N K B Adikaram
Dr. (Mrs.) C L Abayasekara

WORKSHOP ON APPLIED BIOLOGY FOR G.C.E. A/L TEACHER TRAINERS

Prof. Jayanthi Edirisinghe addressing the audience during the Inaugural Session of the Workshop (Seated L to R): Dr. S Karunaratne, Mrs. C Athapattu, Prof. K H G M de Silva, Prof. K Goonasekera, Prof. O A Ileperuma, Prof. V Kumar, Prof. N K B Adikaram and Dr. G A D Perera.

The workshop on Applied Biology was conducted by the Board of Study in Science Education in collaboration with the Boards of Study in Plant Sciences and Zoological Sciences of the PGIS and the National Institute of Education for teacher trainers of GCE A/L Biology. The workshop was sponsored by the Secondary Education Modernization Project (SEMP) of the Ministry of Education. The objectives of the workshop were to develop skills in teaching this unit on Applied Biology by making teacher trainers confident by enhancing their knowledge and providing first hand experience in practical work. The participants (40) were biology teacher trainers selected from the five provinces: Central, Uva, Sabaragamuwa, North Western and North Eastern. Unit - 8 of G.C.E. A/L Biology has seven sub units. Workshop sessions were conducted to give additional information and skills covering all these sub units. A Supplementary Teachers' Guide was prepared by the resource persons and given to participants to help in their teaching and in

conducting teacher training sessions. In addition, power point presentations made by the resource persons were also given to participants in compact diskettes (CD). All participants were of the opinion that it was very appropriate to cover unit – 8 at the workshop and they have gained further information/knowledge and skills by participating in the workshop. The workshop enabled them to realize the importance of setting up practical activities for students giving first hand experience to students and also the importance of giving them assessments and assignments. They have also stated that the knowledge and skills gained at the workshop helped them in presenting subject matter in various ways to make students and teachers interested in learning and to help them to understand concepts. The participants requested to conduct more workshop of this nature in future for other units and for other GCE A/L subjects, so that it will help teachers to realize their weaknesses and to buildup confidence in teaching.

Coordinators: *Dr. S Karunaratne*
Prof. J Edirisinghe
Dr. G A D Perera

WORKSHOP ON ECOLOGICAL DATA ANALYSIS

This workshop was aimed at improving the knowledge & skills of postgraduate students on experimental designing, statistical data analysis and solving problems of data analysis of postgraduate students. The principal resource persons of the workshop were Dr. David Burselem and Dr. Phillip Hulme from School of Biological Sciences at Aberdeen University, U.K. The morning session included lectures by Dr. David Burselem covering the topics: parametric and non parametric data sets, simple statistical tests & categorical data analysis. This session was praised by all the participants as it was simple but quite informative.

Dr. David Burselem at a discussion with workshop participants during the practical session at the PGIS computer unit.

The afternoon session was devoted to teach statistical data analysis using computers and to solve the statistical problems brought by students (Data Analysis Clinic). Students were also trained to use the EXCEL programme for simple analyses. Dr. David Burselem & Dr. Philip Hume were the resource persons for the afternoon session. Many students suggested to have such workshops every year and to organize another workshop on Multivariate Data Analysis.

Coordinators: *Dr. G A D Perera*
Prof. I A U N Gunatilleke

WORKSHOP ON PLANT SYSTEMATICS (H IGHER PLANTS)

Participants at work during a practical session of the Workshop.

A workshop on Plant Systematics was conducted by the Board of Study in Plant Sciences in collaboration with the Department of Botany, University of Peradeniya, the National Herbarium, National Botanic Gardens, Peradeniya and the Ministry of Environment and Natural Recourses during December 1 – 3, 2004. Plant Systematics plays a very important role in all disciplines involving plant based research by providing the proper identification of plants. The proper identification and nomenclature will open the door for communication with the rest of the scientific world. Further, with the

its conservation, it is urged to pay attention on training personnel on Plant systematics. Further, the proper handling of nomenclatural literature will enable us to trace a whole lot of important information.

With the development of novel techniques such as molecular biological tools and analytical techniques such as Cladistics, there has been a vast development in the field of Plant systematics in the past few years. The present Angiosperm Classification has been revised (APG II, 2004) in the light of the new data. Several families have been united and their placements have been changed. Such information will be very important to all those who are involved with plant based studies. Therefore, this workshop was intended to disseminate basics of Plant systematics emphasizing on extracting characters for identification using taxonomic keys, collection and preservation of plant specimens, identification of plant specimens using the herbarium, plant nomenclature and available taxonomic literature and the latest Angiosperm classification based on molecular studies (APG II).

The workshop was attended by academic staff of Gampaha Ayurveda Institute; School of Agriculture, & Hardy Advance Technical Institute, officers of Forest and Agriculture Departments & Central Environment Authority, Research officers of Tea, Coconut, Ayurvedic Institute and Industrial Technology Institute, officers from the Sri Lanka customs and IUCN and several postgraduate students.

According to the participants' survey carried out at the end of the workshop, most of the participants expressed the view that a continuation of this type of workshops or a follow up on the present workshop would be beneficial.

Coordinator: Dr. Deepthi Yakandawala

WORKSHOP ON ELECTRONICS

A Technical Workshop on Electronics organized by the Board of Study in Physics, Postgraduate Institute of Science, University of Peradeniya and the Department of Physics, University of Colombo was held on 02nd & 03rd December 2004 at the Department of Physics, University of Colombo. There were seven (07) technical lectures and fifteen (15) laboratory sessions with experimental demonstrations. All the lectures and laboratory work were conducted and supervised by competent professionals familiar with the latest developments in the field of electronics and instrumentation.

The workshop was intended to benefit Technical Officers & similar persons working in the area of electronics and instrumentation and postgraduate students who work with modern equipment in research and development laboratories, testing and calibration laboratories, universities etc. The main objective of this workshop was to provide modern theoretical and practical aspects of electronics and to improve participant's skills relevant to their field.

Participants attending a laboratory session on electronics.

There were 63 participants for this workshop, out of which 53 were from universities. According to the participants' responses given at the end of the workshop, it was a very successful event and most of them were able to improve their knowledge, skills and training in electronics required for their work. Most of the participants requested to have this workshop as an annual event and also asked to extend its duration giving more time for laboratory work in order to get more hands-on experience.

Prof. R L C Wijesundara (Acting Vice-Chancellor and Dean, Faculty of Science), Dr. Sumedha Jaynetti (Head, Department of Physics), University of Colombo and Prof. B S B Karunaratne (Chairman of the PGIS Board of Study in Physics) graced the inauguration of the workshop on 2nd December 2004. Prof. Lakshman Dissanayake (Director of the PGIS), Prof. Wijesundara and Prof. Karunaratne participated in the closing session on 3rd December 2004 and distributed the certificates to participants.

Coordinator: Mr. Mahesh Edirisinghe, Department of Physics, University of Colombo

SHORT COURSE ON CHEMICAL RESOURCES FOR NEW INDUSTRIES

The outcome of research activities carried out at Universities does not receive much publicity and there is a general lack of awareness, among local entrepreneurs, industrialists and funding agencies, of the valuable practical contributions that can be made by the scientific community regarding the application of new ideas for exploiting the valuable resources of Sri Lanka. The Board of Study in Chemical Sciences, PGIS, organized a "Short Course on Chemical Resources for New Industries" to address this need. The Course was held during December 17 – 19, 2004, at the Postgraduate Institute of Science, University of Peradeniya. Twenty one participants attended the programme. The participants were from Universities, Research Institutes, Industrial concerns, Government Institutions and Private sector organizations. The Industrial Development Authority, Central Province as well as the National Development Bank from Kandy, were also represented. Resource Persons were drawn mainly from the University of Peradeniya, while Resource Persons from the University of Sri Jayawardenapura, National Botanical Gardens and HORDI, Gannoruwa, also contributed.

Participants attending a session.

A wide range of topics was discussed during the programme. The occurrence, quality and under utilization of different types of Sri Lankan natural resources, was the underlying theme in many of the presentations. Value addition to products and innovative ideas for developing new products was also discussed. Prof. Dahanayake provided an overview of mineral resources, while Prof. D T B Tennakoon discussed new ideas for non-traditional clay based industries, based on physical and chemical properties of clay. Prof. R P Gunawardane stressed the importance for the establishment of a phosphate fertilizer manufacturing unit based on Eppawala apatite. Dr. Rohan Fernando dealt with Gem minerals and the need for effective utilization of gem minerals. Ideas for the use of local mineral resources for fabricating high-tech chemical materials was explained by Prof. B S B Karunaratne. Prof. O A Ileperuma discussed the importance of using waste as a raw material and explained that opportunities are available to young science graduates to establish new industries based on waste. Prof. B M R Bandara explained the nature and importance of Nature's Pharmaceuticals. Dr. S Wijesundara, Director, National Botanic Gardens, dealt with the expanding world market for Herbal Products and indicated the importance of applying the outcome of University research to improve future prospects of the Herbal Industry in Sri Lanka. Dr. K A N P Bandara, HORDI, Gannoruwa, explained the importance of producing low cost formulations, based on phytochemicals, for crop protection. The use of rice hull, as a source of silica and furfural was dealt with by Prof. A M Abeysekera. Furfural could be used for the synthesis of fine chemicals. Presentations were also made by Prof. P Touzain, Dr. P W S K Bandaranayake, Prof. H M D N Priyantha, Dr. U Wijayantha, Prof. M A K L Dissanyake, Prof. H M N Bandara, Prof. R M G Rajapakse, Dr. B F A Basnayake, Mr. N W B Balasooriya and Prof. N S Kumar. A half-day field visit to Matale was organized by Dr. A Pitawala and Dr. R Chandrajith, (Department of Geology), for the participants during the second day of the programme. Mica, Quartz, Feldspar and other mineral deposits were explored during the trip.

The Course concluded with a lively Panel discussion during which both Participants and Resource Persons contributed to the discussion. The Panel of Resource Persons felt that there was a lack of interface between academia and Industry, and that research and development was not regarded as important for Industrial development in Sri Lanka. The participants who attended the program were requested to help to maintain contacts made with the University during the present programme. Placement of undergraduate trainees in various industrial concerns was also discussed, because the Universities were ready to offer expertise to help solve some of the technical problems faced by various industries. It was also pointed out that the Sri Lankan Banking system did not provide much support for entrepreneurs. The presence of an officer from the National Development Bank, Kandy, and a representative form the Industrial Development Authority, Kandy, was an encouragement for the organizers of the programme.

Coordinators: Prof. N S Kumar
Prof. R M G Rajapaksha

DEGREES AWARDED (January – December 2004)

Ph.D. & M.Phil. Research Degrees

	Name of Awardee	*Title of the Research Project*

Ph.D. – Chemical Sciences

1	W. S. Karunaratne	Effect of tea metabolites on development and behaviour of selected insects and the transformation of steroids by *Monacrosporium ambrosium*
2	S. Kathirgamanathar	Chemistry of five lichens of Sri Lanka and sequestration of lichen compounds by a lycaenid butterfly *Talicada nyseus*

Ph.D. – Plant Sciences

1	H. S. Jayasinghe Arachchi	Rhizobial-fungal-phenolic interactions in N_2 fixing symbiosis

Ph.D. – Zoological Sciences

1	P. R. M. P. Dilrukshi	Aspects of the ecology and morphotaxonomy of cattle ticks (Acari: Ixodidae) in Sri Lanka
2	W. A. I. P. Karunaratne	Taxonomy and natural history of bees in selected areas of Sri Lanka

M.Phil. – Chemical Sciences

1	A. Mahendralingam	Development of solar cells based on dye-sensitized titanium dioxide with solid-state electrolyte
2	M. D. L. P. Gunathillake	Alkaloids of *Erythroxylum zeylanicum* O. E. Schulz (Erythroxylaceae)
3	K. T. P. M. P. Rajapaksha nee de Silva	Structural studies of the capsular polysaccharide from *Streptococcus pneumoniae* type 25F and studies on green tea constituents
4	U. I. Rodrigo	Electrochemical, gas chromatographic and spectroscopic methods for investigation of the fate of some commonly used pesticides in Sri Lanka
5	H. S. Premasiri	Development of polyaniline conducting polymer systems for sensor applications

M.Phil. – Computer Science

1	A. Jahufer	Analyzing the ridge regression techniques introduced for solving the problems of multicollinearity

M.Phil. – Physics

1	R. S. P. Bokalawela	Study of thermal and electrical properties of some polymer electrolytes based on PEO and PAN and some Intermediate Temperature Solid Oxide Fuel Cell (ITSOFC) materials based on Gadolinia doped Ceria

M.Phil. – Plant Sciences

1	W. K. R. N. Gunasinghe	Developing a bio-control method against *Botryodiplodia theobromae* & *Colletotricum musae* causing crown rot of 'Embul' banana

M.Sc. Degrees (*by course work with a research project of 3 –6 months duration*)

	Name of Awardee	*Title of the Research Project*

M.Sc. – Analytical Chemistry

1	N. P. Dharmasena	Development of low cost method for the monitoring of ambient air quality
2	H. P. P. S. Somasiri	Hydrogen peroxide in milk; its estimation and possible effects on the quality of milk
3	U. Kanagarathnam	A study of the solasodine content in different species of S*olanum* in Sri Lanka
4	M. Koneswaran	Development of an opto-chemical sensor for the detection of metal ions in aqueous solution
5	T. Peiris	Studies of plant extracts as natural anti-oxidants
6	R. Thangarajah	The study of change in atmospheric Lead (Pb) levels in Colombo with the phasing out of leaded petrol in Sri Lanka
7	N. Gunawardana	The analysis of sludge, soil, and plants for Lead contamination and investigation of suitable methods for the removal of Lead
8	J. Jeyatheepan	Assessing salinity level of soils in area near the Batticaloa lagoon
9	Y. M. W. S. Bandara	Development of an electrochemical sensor for Copper (II) analysis
10	W. M. S. C. Wanasinghe	Removal of Arsenate and Arsenite by Fullers Earth
11	W. M. P. B. K. Warnasooriya	Analysis and recovery of Iodine from brine in solar salt manufacturing
12	P. N. L. Thilakaratne	Removal of 2-chlorophenol in water using montmorillonite clay and montmorillonite-polyaniline nanocomposites
13	A. M. R. J. N. K. Abayaratne	Development of a sensor to detect Lead (II) in water using ammonium salt of diethanoldithiocarbamate
14	D. P. P. Weerasinghe	Analysis of Cadmium in drinking water in Padavi Siripura area and modification of diphenylthiocarbazone

M.Sc. – Applied Statistics

1	P. Kovintharajah	The influence of performances at the grade 5 scholarship examination on the follow-on education: A case study in the Batticaloa district
2	M. I. Fathah	An analysis of the perception of Eastern and South Eastern University students on the ongoing peace process

M.Sc. – Biodiversity Conservation Management

1	K. M. D. M. Dissanayake	Distribution, ecology and taxonomy of apple snails of the genus *Pomacea* in the wet zone of Sri Lanka
2	M. G. C. Sooriyabandara	Assessment of recreational value of Minneriya national park: possibilities of sharing benefits with stakeholder community
3	A. Sandanayake	The role of cattle, grey langur and elephant in seed dispersal of the invasive alien plant *Prosopis juliflora* (Mesquite)
4	W. A. Lalith Kumara	An assessment on the status of natural resources exploitation by the buffer zone communities of VRR sanctuary
5	G. A. T. Prasad	Estimation of population density and herd composition of elephants in Minneriya National Park, Sri Lanka

M.Sc. – Clinical Biochemistry

1	S. W. Kalpage	Assessment of the iron status of patients with chronic renal failure
2	W. N. Perera	Assessment of glycaemic control in a sample of diabetic patients with cataract and retinopathy
3	B. M. G. Ranjith	A preliminary study of enzymatic changes in a cohort of patients presenting with fever and hepatorenal syndrome
4	A. Senadheera	Variation in cholesterol concentration in EDTA plasma and serum prepared after early and delayed removal of formed elements
5	N. S. Amarasinghe	Serum Calcium and oxidation-reduction status of erythrocytes in diabetic and non-diabetic cataracts
6	G. M. L. A. Peris	Relationship between serum carbamazepine concentration and epilepsy control

M.Sc. – Computer Science

1	B. W. P. B. Eriyagama	Development of image processing and analyzing workbench for an electronic document authenticator
2	J. C. Kodikaraarachchi	Optical character recognition using image processing and artificial neural network techniques
3	H. M. A. Bandara	A study of security weaknesses of IEEE 802.11b and a solution to improve its security
4	S. U. B. Eratne	Digital image compression with wavelet transforms
5	C. K. Gamage	Counting coconut mites using digital image processing

6	G. M. M. M. A. Senaviratne	Development of a software infrastructure for a fuzzy logic based decision support system for critical care
7	R. A. T. M. S. Ranaweera	Global system for mobile communications short message service based automated credit information system
8	T. Arudchelvam	Chilly colour analysis using digital image processing
9	M. M. M. Imithiyas	Fruit volume estimation by digital image processing

M.Sc. – Engineering Geology and Hydrogeology

1	K. M. Prematilaka	Enrichment of Iron in the Gannoruwa well field: Causes and pathways
2	N. B. Samarakoon	A hydrogeological assessment of the Precambrian basement in the area around Vavuniya town, as revealed from existing tube well and dug well data
3	S. M. A. B. Samaratunga	Hydrogeology at a boundary between sedimentary and hard rock aquifer units: A case study from Palavi in the Puttalum district
4	C. N. Thilakarathne	Relationship between geological structure and geophysical characteristics of hard rocks with groundwater potential: A case study from Nochchiyagama, Anuradhapura district
5	H. U. S. Wickramaratne	Use of groundwater for coastal water supply schemes, minimizing the salinity problem: A case study at Kattankudy in Batticaloa District, Sri Lanka
6	G. A. T. Prashantha	Geological and geotechnical interpretation of some quaternary formations of Colombo
7	A. M. A. I. K. Adikari	Utilization of flushing yield to determine hydraulic parameters of hard rock aquifers
8	A. M. R. Bandara	Improvement of secondary permeability in hard rocks using hydro-fracturing techniques: A case study from hard rock terrain of Sri Lanka
9	R. M. S. M. Rajapakse	Groundwater development in Nuwara Eliya area: Hydrogeological drawbacks and remedial measures
10	W. A. D. I. D. Wanigasekara	Hydrogeological assessments of the hard rocks aquifers in proposed Biyagama export processing zone
11	M. N. C. Samarawickrama	Geotechnical back analysis as an economical method of slope stabilization: A case study at Thalathu Oya metal quarry
12	K. L. S. Gamage	Deep groundwater hydrology in the Bogala graphite mine
13	U. K. N. P. Dharmasena	Introduction of factor of safety concept in landslide hazard zonation mapping: A case study from Ratnapura municipal council area

M.Sc. – Environmental Science

1	W. M. A. S. R. Wijekoon	An investigation of chlorpyrifos in groundwater under onion cultivation in Kalpitiya peninsula
2	G. Subramaniam	Some studies on the environmental impact and waste treatment methods practiced by rice mills in Vavuniya district
3	J. P. Jayasingha	Sedimentation problem in the Rantambe reservoir

4	J. Theivathavapalan	Biomonitoring of tropospheric ozone pollution in Kandy district area
5	S. P. Indrasena	Electrolytic treatment of oil-based effluent
6	B. S. C. Gamage	A code of practice for the shrimp farmers in Sri Lanka
7	Y. M. K. R. Seneviratne	Geoenvironmental and engineering geological study of cut slope failures in Kandy area
8	A. M. N. Wijekoon	The removal of phosphate in water by adsorption on laterite
9	E. Surendranathan	Nutrient and heavy metal removal capacity of *Pistia stratiotes* L. from a freshwater wetland at Kelaniya

M.Sc. – Fish and Wildlife Management

1	W. M. C. S. Wijesundara	The diversity and aspects of the ecology of birds in Nuwara Eliya and adjacent areas of Sri Lanka
2	I. H. S. K. de Silva	The diversity and distribution of the herpetofauna in the Hakgala range, Sri Lanka

M.Sc. – Gemmology

1	S. B. Basnayake	Guidelines for setting standards for the nomenclature, description, grading and appraisal of Sri Lankan gems
2	G. Jayasena	Gem mineral distribution in the area around Uggalkaltota off Balangoda
3	W. L. D. R. A. Kumaratilake	Polyasterism in gemstones with emphasis on star Sapphire
4	R. L. D. S. Ranasinghe	Value enhancement of red spinel
5	T. S. Dharmaratne	In-situ Corundum occurrences in Kegalle district, Sri Lanka

M.Sc. – Industrial Chemistry

1	D. S. C. Perera	Optimization of activated sludge process for a brewery waste water treatment under local conditions: plant process control and management by a quality system
2	C. M. S. Pathiraja	Study of print intensity variation of cigarettes
3	K. Jeyaruban	Removal of dye colour from aqueous solution by adsorption on mineral surfaces
4	F. I. Rixzan	Quality of generic and branded drugs in Sri Lanka
5	T. K. Sahid Ossan	Survey on occupational health and safety management systems applications in Sri Lankan industries
6	U. M. Fazeel	Removal of Iron from rubber factory effluent using dried salvinia plant material

M.Sc. – Industrial Mathematics

1	R. M. T. Ratnayake	Dynamics of market models with inventory

M.Sc. – Physics of Materials

1.	L. H. Karalliyadde	Transport properties of polymer electrolytes based on poly(ethyleneoxide) complexed with Magnesium salts
2.	S. Udakara	Transport properties of polymer electrolytes based on poly(acrylonitrile) and poly(ethyleneoxide) complexed with Copper salts

M.Sc. – Postharvest Technology of Fruits and Vegetables

1	B. V. Rathnabharathie	Development of frozen "Pollos" (*Artocarpus heterophyllus*) for the export market
2	S. Liyanage	Effect of freckle disease on ripening rate of different cultivars of banana
3	H. M. Gammanpila	Effect of Nitrogen and Potassium levels of fruit peel tissue on anthracnose development and postharvest storage quality of 'Embul' Bananas
4.	B. M. R. P. Bandaranayake	Canker Disease of *Psidium guajava* L. caused by *Pestalotiopsis psidii* and host defensive responses
5.	P. G. R. H. Kumari	Product development of drumstick (*Moringa oleifera*) using pod scrapings and seeds
6.	S. M. Mallawaarachchi	Effect of *Bacillus macerans* on the growth of fungi on copra during storage, with special attention to aflatoxin levels in a medium scale processing unit
7.	A. M. Nijamudeen	The effect of 1-methylcyclopropene on the ripening of tomatoes (*Lycopersicon esculentum* Mill cv. Caraibo) during postharvest storage
8.	S. J. Abusalihu	Effects of 1-methylcyclopropene (1-MCP) on postharvest quality of chilli (*Capsicum annuum* L. var. MI-2)
9.	S. G. S. Attanayake	A study of the causal organisms and the effect of latex on stem end rot development, respiration and ethylene production in 'Karuthacolomban' mangoes
10.	O. K. D. D. Chandima	Respiration and ethylene production in relation to anthracnose development in two local mango cultivars
11.	H. A. C. G. K. Jayarathne	A study of physicochemical and quality aspects of frozen chowchow (*Sechium edule*)
12.	L. P. Kularathne	Effectiveness of some essential oils alone or in combination with sodium bicarbonate in the control of banana crown rot (*Musa acuminata* AAB)

M.Sc. – Science Education

1	S. Manoharan	A comparative study of the knowledge on biodiversity in town schools and village schools in Kandy
2	S. Warnakulasuriya	The effect of wind speed and wind direction on the ventilation through ridge vent and net covered side vents in single-span venlo-type greenhouses
3	R. M. P. Bandara	"BIOSTAT", a computer programme for Bio-statistics module for the G.C.E. A/L Biology
4	K. Senthilkumaran	Difficulties in learning Agriculture Science as a subject in G.C.E. A/L class
5	S. D. P. Bandara	Designing a teaching methodology for the G.C.E. A/L Biology curriculum based on a section evaluated as disliked by students
6	A. L. S. A. Sathar	Comparison of performance at solving conventional and conceptual problems in Physics of G.C.E. A/L students
7	H. Jayasinghe	A study of the G.C.E. A/L Combined Mathematics syllabus
8	K. M. Karunawathie	Strategies and related difficulties in solving algebraic inequalities at collegiate level
9	I. S. K. Dematawewa	A new approach to enhance scientific reasoning ability in 'Properties of Matter' unit of G.C.E. A/L Physics syllabus
10	S. Suthakaran	Use of force concept inventory to assess the conceptual knowledge of secondary level students in force and wave concepts
11	T. M. S. S. K. Yatigammana	Application of Active Teaching Learning Approaches in Science (ATLAS) for the unit on 'Man and Environment' in G.C.E. A/L chemistry syllabus
12	D. S. N. Wijegunarathne	A web based study package designed for statistics and probability unit of G.C.E. A/L Combined Mathematics syllabus in Sri Lanka

Postgraduate Diplomas (*by course work only*)

Diploma – Environmental Science

1 N. B. Herath

Diploma – Industrial Mathematics

1 S. M. Godage

2 K. N. Kasturiarachchi

3 P. A. P. L. Upasena

Diploma – Physics of Materials

1 V. Amalashvaran

ABSTRACTS OF Ph.D./M.Phil. THESES

Ph.D. (*Chemical Sciences*)

Effect of tea metabolites on development and behaviour of selected insects and the transformation of steroids by *Monacrosporium ambrosium*

***W. S. Karunaratne**, PGIS & Department of Chemistry, University of Peradeniya*

Part I is a ten generation study on the effect of secondary metabolites, on the shot hole-borer beetle, *Xyleborus fornicatus* (Coleoptera: Scolytidae) of tea, *Camellia sinensis* L. The uninhibited growth of the beetle in a sterol free medium indicated the invalidity of the hypothesis, which claimed that the resistance of tea clones is due to high saponin content reducing availability of tea sterols to the beetle. Progeny production was almost completely inhibited in media containing 100 ppm caffeine but the effect was reversible if exposure was for less than 48 hours. No significant differences were observed from control which tea saponins were introduced.

In behavioural studies in an olfactometer, females showed a density dependent attraction turning into a strong repulsion against increasing numbers of females. Males were attracted to non-mated females but not to mated individuals. GC analysis of tea bark showed its main constituents to be β-pinene, terpenolene, haxanol, linalool oxide, linalool, geraniol, methyl salicylate and eugenol. Olfactometer studies showed the beetle to be significantly attracted towards ethanol and mixtures of ethanol with ∞-pinene, eugenol and hexanol.

When both non-infested and infested tea stems were offered to beetles, a higher number entered the non-infested stems of both clones in the first hour while entry to infested TRI2025 stems was significantly delayed by 2 - 3 hours and to infested TRI2023 stems by over 24 hours, indicating an induced resistance on infestation. Caffeine is known to be the main antifungal compound in the tea plant. A quantitative analysis using HPLC showed that caffeine content varied depending on the part of the plant and the infestive stage. Non-infested TRI2025 stem contain more caffeine than non-infested TRI2023 stem, while bark contained more than stem and inter-nodal bark more than nodal bark. The caffeine content of both clones was significantly higher in infested plants with the increase being greater in TRI2025 than in TRI2023.

Part II describes olfactometry studies on the social behaviour and host discrimination of the cowpea aphid, *Aphis craccivora* Koch (Homoptera: Aphididae). The occurrence of density dependent pheromones and odour responses to its host plant *Vigna unguiculata* were studied. Apterae responded with positive anemotaxis to air passed over both apterae and alatae in groups of less than ten individuals, but negatively to air that passed over groups greater than twenty. Alatae responded similarly to groups of apterae but were repelled by alatae. Both were able to distinguish between other hosts and their original host, cowpea. When attacked by aphids, plants responded with a temporary increase in attraction that reached a maximum in 48 hours.

In part III, the insecticidal activity of *Vernonia anthelmintica* (Family: Asteraceae) seeds is described. The dichloromethane extract showed activity against *Aedes aegypti* second instar larvae. In the residual film bioassay the extract was active against *Callosobruchus maculatus* adult. Activity guided fractionation gave a crystalline substance identified as a mixture of angelicin and psoralen whose toxicity to *A. aegypti* was highest in the presence of sunlight. In the absence of sunlight, 100% growth inhibition was observed. With *C. maculatus* the substance showed 40% moribundancy in 24 hours in the residual film bioassay and 90% reduction of ovulation and 0% adult emergence in seed treatment bioassays. When separated neither were as active as the original mixture and when combined, none of the combinations showed the activity of the isolated mixture.

Part IV of the thesis describes the biotransformation of steroids by *Monacrosporium ambrosium*, the fungus associated with the shot hole borer beetle *X. formicatus*. 5∞-Androstan-17β-ol, 5∞-androstan-17-one, 5∞-androstan-3-one and 5∞-androstan-3β-ol were prepared from 17β-hydroxy-5∞-androstan-3-one and incubated with the fungus. Results suggest that *M. ambrosium* is not specific in its microbial reactions effecting hydroxylations, oxidations and reductions often leading to mixtures of products. Of the transformations observed, the 11∞-hydroxylation of 3-oxygenated steroids appears to have some potential.

Supervisor: Prof. V. Kumar (University of Peradeniya & PGIS)

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Ph.D. (*Chemical Sciences)*

Chemistry of five lichens of Sri Lanka and sequestration of lichen compounds by a lycaenid butterfly *Talicada nyseus*

S. Kathirgamanathar, *PGIS & Department of Chemistry, University of Peradeniya*

The thesis is in two parts. Part I deals with the chemistry of five lichens: *Pyxine consocians*, *Usnea* sp., *Heterodermia leucomelos*, *Lepraria atrotomentosa* and *Leproloma sipmanianum* from Sri Lanka. *Pyxine consocians*, *Usnea* sp., *Heterodermia leucomelos* are common macro lichens from the montane zone while *Lepraria atrotomentosa* (new species) and *Leproloma sipmanianum* (new record) are two lepriariod lichens. It describes the isolation and identification of a large number of compounds from five lichens and also discusses the results of the mosquito larvicidal assay against the second instar larvae of *Aedes aegypti*. Of the 16 or so natural products isolated from the extracts and sometimes the powder of the lichens, three were new compounds.

The compounds, namely cabraleadiol monoacetate **55**, 4-*O*-methylcryptochlorophaeic acid **45** and lichexanthone **57** (from *Pyxine consocians*), methyl ether of stictic acid **61** (from *Usnea* sp.) and 3,6-dimethyl-2-hydroxy-4-methoxybenzoic acid **64** (from *Heterodermina leucomelos* and *Leproloma sipmanianum*) showed moderate activity against the second instar larvae of *Aedes aegypti*.

Part II of the thesis deals with the sequestration of the compounds isolated from the lichen *Leproloma sipmanianum* by a lycaenid butterfly *Talicada nyseus* and also describes the investigations regarding the stage of entry of lichen compounds into the life cycle of the butterfly and also its life history studies on *Bryophyllum calycinum* (host plant) and *B. laciniata* (a related species).

Supervisor: Prof. V. Karunaratne (University of Peradeniya & PGIS)

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## *Ph.D.* **(***Plant Sciences)*

### Rhizobial-fungal-phenolic interactions in $N_2$ fixing symbiosis

***H. S. Jayasinghe Arachchi,*** *PGIS & Institute of Fundamental Studies, Kandy*

Phenolic compounds are a major group of natural chemicals present in large quantities in the soil with variable structures and concentrations. Soil fungi constitute a major fraction of soil microbial biomass, influencing other microbes. Rhizobia interact with these natural chemicals and fungi which may affect the biological nitrogen fixation. Rhizobial growth and $N_2$ fixing symbiosis in the presence of soil phenolic compounds and fungi were examined in this study. This could help to understand the behavior of microbes in the soil.

Effects of different concentrations of four phenolic acids (protocatechiuc, *p*–coumaric, ferulic and vanillic) on population size of four rhizobial strains (*Bradyrhizobium elkanii* SEMIA 5019, *B. japonicum* TAL 102, TAL 620 and *Azorhizobium caulinodans* ORS 571) were studied. Further, the effects of phenolic acid affected *rhizobia* on $N_2$ fixing symbiosis of soybean also investigated.

The effects of phenolic acids were concentration and structure dependant, and strain specific. The population size of TAL 102 increased when the culture medium was supplied with different phenolic acids as the sole carbon source. In many cases the presence of manitol in the medium masked the differential effects of phenolic acids on the population size. All four phenolic acids suppressed the population of TAL 620. Strain ORS 571 showed low population sizes at low concentrations followed by a growth recovery at high phenolic concentrations. All concentrations of ferulic acid increased the growth of SEMIA 5019 significantly. In different combinations, rhizobial growth and $N_2$ fixing symbiosis were negatively or positively affected by phenolic acids. Utilization of phenolic acids by rhizobia led to their biochemical changes, resulting in alteration in their symbiotic ability.

Based on the molecular weight, the possibility to fractionate different polyphenolic compounds present in different soils and plant materials without prior purification using one dimensional polyacrylamide gel electrophoresis was explored. Different polyphenolic compounds, extracted using 70% acetone were separated on 24% polyacrylamide gels (43% acrylamide and 3% bis-acrylamide). But, low molecular weight phenolics were not separated on the gel and retained at the bottom of the gel. This method provides a rapid fractionation of polyphenolic compounds according to their molecular weight. Further studies are however needed to fully establish the method.
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Mycelial colonization of common soil fungi (*Aspergillus miger*, *Penicillium* spp. and *Mucor* spp.) by the rhizobial strains, resulting in the formation of bifilms was also studied. Further, the effects of fungal exudates and their secondary metabolites on the growth of rhizobia were evaluated. Bradyrhizobia gradually colonized the mycelia for 18 days, after which the biofilm structures collapsed with the release of rhizobial cell clusters to the medium. In general, there was no mycotoxin effects of the fungal exudates on the bradyrhizobial strains used, instead the strains utilized the exudates as a source of nutrition. This study indicates that the present microbial associations with the biofilm formation have important implications in the survival of rhizobia under adverse soil conditions devoid of vegetation. Moreover, it could have developed and as yet unidentified nitrogen fixing systems that could have contributed to the nitrogen economy of soils.

The effects of different concentrations of tannic acid on the rhizobial growth and on the soybean-rhizobial symbiosis were studied. Further, the effect of different concentration of tannic acid on the fungal growth and fungal-rhizobial biofilms were examined. Population size decreased significantly in all the rhizobial cultures treated with different concentrations of tannic acid. Degradation products of tannic acid produced by the fungi were used as carbon and nutrient sources by the rhizobia.

Exudates of different fungi tested positively or negatively affected on the growth of different strains of the rhizobia. Rhizobial colonization on mycelia enhanced with the length of incubation time of the tannic acid treated co-cultures. Plant growth, nodulation and N accumulation of soybean were reduced when the rhizobial strains were affected by tannic acid. Further studies are needed to unravel at molecular level, these alterations and their relatedness to N_2 fixing symbiosis and rhizobial persistence in the soils.

Supervisors: Dr. Gamini Seneviratne (IFS, Kandy &PGIS)
Dr. (Mrs.) H. M. S. P. Madawala Weerasinghe (University of Peradeniya & PGIS)

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## *Ph.D.* (*Zoological Sciences)*

### Aspects of the ecology and morphotaxonomy of cattle ticks (Acari: Ixodidae) in Sri Lanka

***P. R. M. P. Dilrukshi***, *PGIS &Department of Zoology, University of Peradeniya*

A two-year study was done on the ecology and morphotaxonomy of cattle ticks in different agro-climatic areas of Sri Lanka, encompassing localities at low elevation dry and wet zones, and mid country and montane wet zone. A total of 164, 483 ticks were collected from 1,240 head of sampled cattle. The most abundant species was *Boophilus* sp. (Curtice, 1891), followed by *Haemaphysalis bispinosa* (Neumann, 1897). *Rhipicephalus haemaphysaloides* (Supino, 1897), *Haemaphysalis intermedia* (Warburton and Nuttal, 1909), *Hyalomma brevipunctata* (Sharif, 1928), *Hyalomma marginatum isaaci* (Sharif, 1928), *Amblyomma integrum* (Karsch, 1879) and *Haemaphysalis spinigera* (Neumann, 1897). *H. brevipunctata* was recorded for the first time on neat cattle in Sri Lanka. Keys for identification of adult and immature stages of cattle ticks were produced. Multivariate analysis of metric and descriptive character sets showed overlapping geographic variability in *Boophilus* sp. and *R. haemaphysaloides*, whereas *H. bispinosa* segregated into three disjunct populations indicative of the possibility of three distinct species. A protein profile study of *Boophilus* sp. and *R. haemaphysaloides* adult stages showed similar geographic variability as seen in the morphometric analysis. The overall tick load on the host was significantly negatively correlated with elevation, with greatest abundance at low elevation dry and wet zone localities.

Population peaks of varying periodicities and amplitudes were observed in the different species at different localities. Stepwise multiple regression analysis of tick abundance against 10 climatological variables indicated that daily temperature may have an important impact on seasonal abundance trends, appearing as a significant covariate for *Boophilus* sp., *H. intermedia* and *R. haemaphysaloides*. Individual tick species aggregated preferentially on different body regions of the host, and significant positive and negative inter-species associations were seen on different body regions. Cattle tethering strategies, acaricide use and the presence of other peridomestic animals all had impacts on cattle tick loads. Nymphs of *Amblyomma intergrum* were primarily responsible for a human otoacariasis outbreak within a low county wet zone area, which resulted in infestations of more women than men, and more children (1-10 years age), and adults (>21 years age than the intermediate age group (11-20 years).

**Supervisors**: Prof. F. P. Amerasinghe (University of Peradeniya & PGIS)
Dr. (Mrs.) P. H. Amerasinghe (University of Peradeniya & PGIS)

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Ph.D. (*Zoological Sciences)*

Taxonomy and natural history of bees in selected areas of Sri Lanka

W. A. I. P. Karunaratne, *PGIS & Department of Zoology, University of Peradeniya*

Previous taxonomic work on bees of Sri Lanka had been conducted entirely by overseas scientists commencing in 1897 and leading to the Smithsonian surveys (1975 – 1986). These studies have documented 137 bee species in 27 genera. Information on their natural history is completely lacking and only a few specimens have been deposited in Sri Lanka. In the present study (a) bees collected from several districts, agro ecological regions and habitats were identified, (b) their floral relationships and nesting habits were recorded, (c) the subfamily Nomiinae was reviewed, and (d) bees diversity was determined in selected sites.

A total of 137 bee species in 35 genera and 3 families were recorded from the study. These included 20 previously unrecorded species and 5 genera and a species new to science resulting in a total bee fauna of 157 species in 35 genera for Sri Lanka. Based on the location of the 29 collection sites, the Low Country Dry Zone, middle peneplain, and the agricultural habitats harboured the highest number of species. Flora hosts consisted of 167 species in 115 genera and 44 families. Weeds were the most preferred hosts (129 spp.) followed by crops and trees. Flowers of 6 naturalized plant species attracted an unusual number (>20 species) of bees. According to pollen relationship, 130 bee species are generalists and 7 species are pollen specialists. Twelve species of bees are buzz pollinators of crops whose pollen is concealed in anthers. Pollen from 69 floral hosts in 27 plant families when microscopically examined and grouped into 12 pollen classes.

Several stem nesting (16 spp.), ground nesting (13 spp.) and hive building (4 spp.) bees were recorded. Certain species were recorded only from their nests. Review of the subfamily Nomiinae resulted in 22 species in 11 genera. Sampling in the different locations/habitats of the Knuckles Forest Reserve gave the highest Shannon Diversity Index for agriculture habitat in the Semi Evergreen Climatic Zone. Descriptions, identification keys, locality details and floral hosts are given for the 137 bee species recorded.

Supervisors: Prof. J. P. Edirisinghe (University of Peradeniya & PGIS)
Prof. C. V. S. Gunatilleke (University of Peradeniya & PGIS)

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## *M.Phil.* (*Chemical Sciences)*

### Development of solar cells based on dye-sensitized titanium dioxide with solid-state electrolyte

***A. Mahendralingam,*** *PGIS &Department of Chemistry, University of Peradeniya*

Nano structural dye-sensitized solar cells based on titanium dioxide traditionally use a liquid electrolyte such as acetonitrile, which causes many difficulties. In this study, quasisolid state dye-sensitized Photoelectrochemical cells of the type, FTO/$TiO_2$/dye/(15%) Polyacrylonitrile, (35%) ethylene carbonate, (50%) propylene carbonate, tetrapropylammonium iodide, iodine/Pt/FTO have been fabricated and characterized using current-voltage measurements. The short-circuit current ($I_{sc}$) obtained at 1000 $Wm^{-2}$ was 6 mA and efficiencies obtained for solid electrolyte solar cells with and without 4-tertiary butyl pyridine are 2.9 and 1.6% respectively. A mechanism involving "trapping" of the liquid electrolyte on the Polyacrylonitrile (PAN) structure is proposed for the efficiency of this solid electrolyte.

For comparative purpose *cis*-di(thiocyanate)bis(4,4'-dicarboxy-2,2'-bipridyl)ruthenium(II) ($RuL_2(NCS)_2$)) was investig-ated. Bis(4,4'-dimethoxy-2,2'-bipyridyl)-4,4'-dicarboxy-2,2'-bipyridylruthenium(II) ($RuL'_2L$) dye was also prepared as a possible sensitizer. The short-circuit current, open-circuit voltage and efficiencies of the latter dye were very low compared to $RuL_2(NCS)_2$). From action spectra, the maximum incident photon conversion efficiencies of 5 and 0.5% were obtained at 530 nm for $RuL_2(NCS)_2$ and 470 nm for $RuL'_2L$ respectively.

Charge recombination between dye-sensitized nanocrystalline $TiO_2$ electrodes and $I_3^-/I^-$ couple in nonaqueous and quasi-solid electrolyte is described. The sensitizer was $RuL_2(NCS)_2$. Treating the dye-coated $TiO_2$ electrodes with 4-tertiarybutylpyridine and 8-hydroxyquinoline improve significantly both the open-circuit voltage $V_\infty$ (from 650 to 750 mV) and the efficiency (from 4 to 6%) at 1000 $Wm^{-2}$ with respect to untreated electrode. The use of 8-hydroxyquinoline for this purpose has been successfully demonstrated.
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Double dye systems using $RuL_2(NCS)_2$ and methyl violet thiocyanate simultaneously absorbed on titanium dioxide film give enhanced photocurrents and quantum efficiencies. The results show that this is not a simple additive effect. This can be explained by the interaction of the two dyes via chemical interactions where charge recombination is suppressed due to charge separation.

Supervisor: Prof. O. A. Ileperuma (University of Peradeniya & PGIS)

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## *M.Phil.* (*Chemical Sciences)*

### Alkaloids of *Erythroxylum zeylanicum* O. E. Schulz (Erythroxylaceae)

***M. D. L. P. Gunatillake**, PGIS &Department of Chemistry, University of Peradeniya*

This thesis describes a study of alkaloids in *E. zeylanicum* of the family Erythroxylaceae. Only five species of the family Erythroxylaceae are found in Sri Lanka including *E. zeylanicum* which is the only endemic *Erythroxylum* species. The leaf of this plant is used in traditional medicine as a very effective anthelmintic agent for round worms. There are no reports of photochemical work on Sri Lankan *Erythroxylum* except for *E. monogynum.*

The roots (with bark) of *E. zeylanicum* contained four alkaloids including two new alkaloids, namely 1R,3R,5S,6R-6-acetoxy-3-(3',4',5'-trimethoxybenzoyloxy)tropane, cis-3β-(cinnamoyloxy)tropane, 3α-(3',4',5'-trimethoxybenzoyloxy) tropane and trans-3β-(cinnamoyloxy)tropane. 1R,3R,5S,6R-6-acetoxy-3-(3',4',5'-trimethoxybenzoyloxy)tropane and cis-3β-(cinnamoyloxy)tropane were new and subsequently named as Erythrozeylanine A and Erythrozeylanine B. 3α-(3',4',5'-trimethoxybenzoyloxy)tropane, and trans-3β-(cinnamoyloxy)tropane were previously isolated from *E. monogynum* and *E. hypericifolium* respectively.

*E. zeylanicum* twigs and leaves contained two alkaloids including a new natural product namely cis-6β-acetoxy-3α-(cinnamoyloxy)tropane and trans-6β-acetoxy-3α-(cinnamoyloxy)tropane. The new alkaloid cis-6β-acetoxy-3α-(cinnamoyloxy)tropane was named as Erythrozeylanine C. The structures of the new alkaloids were established using spectroscopic and quantum chemical CD calculations. This is the first record of using CD calculations for the establishment of stereochemistry in structure elucidation of tropane alkaloids.

**Supervisor**: Dr. A. Wickramasinghe (University of Peradeniya & PGIS)

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M.Phil. (*Chemical Sciences)*

Structural studies of the capsular polysaccharide from *Streptococcus pneumoniae* type 25F and studies on green tea constituents

***K. T. P. M. P. Rajapaksha nee De Silva,** PGIS & Institute of Fundamental Studies, Kandy*

The thesis consists of two parts, Part I and Part II. Part I deals with the structural studies of the capsular polysaccharide isolated from *Streptococcus pneumoniae* type 25F.

The composition and the mode of linkage of the glycosyl constituents present in the polysaccharide, and in a degraded polysaccharide obtained after treatment with 48% aqueous hydrogen fluoride, were determined using sugar and methylation analysis. Nuclear Magnetic Resonance (NMR) Spectroscopy of the degraded polysaccharide was employed to establish the presence of the following structural units in the repeating unit of the polysaccharide.

→4)α-Gal*p*NAc(1 →	→4)α-Gal*p*NAc(1 →	→3)-α-Glc*p*NAc(1 →
→3)-α-GlcpNAc(1 →c	→3)-β-GalpA(1 →	β-Galf(1 →

The sequence of the sugar residues in the repeating unit, however, could not be established using these methods. Attempts to cleave the polysaccharide using Smith degradation and triflic acid hydrolysis were not successful.

Part II of the thesis describes the extraction and separation of tea constituents in fresh tender tea shoots, using High Speed Countercurrent Chromatography (HSCCC). The ethyl acetate extracts from the tea clones TRI 2023, TRI 2025, TRI 2043, TRI 3079 and TRI 4006 were used for HSCCC separation, and the fractions obtained were analyzed by High Performance Liquid Chromatography (HPLC). Catechins present were identified by comparing the HPLC retention times with those of standard reference samples. It was found that the catechins epigallocatechin gallate (EGCG), epicatechin gallate (ECG), epigallocatechin (EGC), epicatechin (EG), two other catechins FLA1 and FLA2, and theobromine, were extracted with high purity after a single HSCCC run. The structure of the two catechins FLA1 and FLA2 were elucidated using NMR and Electron Impact Mass Spectroscopy (EI-MS) data. FLA1 was found to be catechin gallate (CG) and FLA2 was identified as epigallocatechin-3-5-di-*O*-gallate.

The antioxidant activity (AOA) of the catechins and some catcehin extracts was compared with that of the antioxidants α-tocopherol (vitamin E) and Butylated Hydroxyanisole (BHA). The β-carotene bleaching method and the DPPH radical scavenging method were used for this determination. The AOA of EGCG, CG, epigallocatechin-3-5-di-*O*-gallate and catechin extracts containing a high proportion of EGCG was found to be comparable to that of Vitamin E and BHA. The high AOA of epigallocatechin-3-5-di-*O*-gallate has not been reported previously.

Supervisors: Prof. N. S. Kumar (University of Peradeniya & PGIS)
Dr. U. L. B. Jayasinghe (IFS & PGIS)

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## *M.Phil.* (*Chemical Sciences)*

### Electrochemical, gas chromatographic and spectroscopic methods for investigation of the fate of some commonly used pesticides in Sri Lanka

***U. I. Rodrigo,*** *PGIS &Department of Chemistry, University of Peradeniya*

Pollution of our environment due to heavy use of pesticides is of significant concern. Therefore, electrochemical, gas chromatographic and spectroscopic methods were used to investigate the fate of some commonly used pesticides in Sri Lanka. Among these analytical methods, electrochemical methods are generally inexpensive and easy to perform although some skills are necessary. Consequently, electro analytical methods have been attractive in recent years for quantitative and qualitative analysis, and for mechanistic studies due to their unique advantages over traditional methods.

Propanil is a common and widely applicable herbicide that is extensively used in Sri Lanka on rice and potatoes. Gas chromatography and colorimetry are able to quantitatively determine its presence at $10^{-3}$ mol $dm^{-3}$ concentration levels in soil, plant and water. Residual analysis of propanil, in the form of its principal degraded product, 3,4-dichloroaniline, has been successfully conducted using gas chromatography with the electron capture detector.

Propanil is fairly stable in mixed water/ethanol medium between pH = 4 and pH = 7 for a period of ten weeks. However, in strong acidic medium (pH = 1), it undergoes slow degradation of pseudo first order with an apparent rate constant of $9.2 \times 10^{-8}$ $s^{-1}$ while in strong basic medium (pH = 13), its degradation is very fast. Adsorption of propanil onto glassy carbon surfaces is pH dependent, and is irreversible in basic medium. Fresh solutions of 3,4-dichloroaniline mimic the behavior of propanil after degradation.

Comparison of the electrochemical behavior of propanil and that of fresh solutions of 3,4-dichloroaniline, prepared at different time periods, and the variation of the voltammetric features of these two analytes at different pHs suggest that the principal degraded product of propanil is 3,4-dichloroaniline. Although this degradation process is very rapid at pH = 13, it would probably undergo slow degradation under environmental conditions. Appearance of new peaks in gas chromatographic and spectroscopic analysis confirmed the degradation of propanil in the environmental and laboratory prepared samples.

Copper oxychloride is a commonly used protective fungicide, used to control anthracnose and Cercospora leaf spot on vegetables, chillies, tobacco and cloves: coffee rust: late blight and early blight on tomato and potatoes: blister blights on tea. It is available with the trade name of Recop, Helmoxy, Cobox, Cuprative and Fernacot. Electroanalytical methods provide an alternative approach for the determination of copper oxychloride in environmental samples. As they are often sensitive and selective with relatively lower cost of instrumentation.

Cyclic voltammetric studies of the cobox fungicide (main constituent is copper oxychloride) showed two oxidation and two reduction peaks at +0.29 V, +0.02 V, -0.12 V and -0.38 V, respectively at bare glassy carbon (GC) electrodes. These scan rate dependence of the peak current of the Cu(II)/Cu(I) couple suggests that the transfer of Cu(II) species toward the electrode surfaces is mainly due to diffusion. Further, amperometric experiments indicate that optimum potential of operation is -0.15 V vs. SCE. Amperometric calibration curves constructed at this potential produced a linear dynamic range from $5.0 \times 10^{-5}$ mol $dm^{-3}$ to $1.0 \times 10^{-4}$ mol $dm^{-3}$.

Phosphate derivatives constitute an important class of pesticides. Among those, acephate, chlorpyrifos and glyphosate are the most common pesticides in Sri Lanka. Although organophosphates are subjected to transformation in soil, with a half life of over two months, persistence of its degraded products could be found even after three months. As a result, such degradation products may be distributed in the natural water and other natural resources. Therefore, the detection and characterization of such compounds are of environmental interest. As these pesticides are not active at bare electrodes, a typical situation for many commonly used pesticides, chemical modification of bare surfaces was conducted. Chemically modified electrodes often find applications where a substance of interest is not active at bare surfaces. Electrochemical techniques gives a characteristic voltammogram for a 5.0 μmol $dm^{-3}$ glyphosate solution and an amperogram for a 0.175 mol $dm^{-3}$ stock solution, indicating that the method serves as a versatile tool for the detection of this compound at low concentrations.

During this research, attempts were also made to identify and characterize organophosphate pesticides in soil by using FT-IR and chromatographic techniques.
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FT-IR spectra show significant variations in the bands in the OH-bending region, and in the OH-stretching region along with the Si-OH and Al-OH stretching modes, while the features appear in the chromatograms resemble the spectroscopic evidence except in the case of copper oxychloride. Thus GC-FTIR techniques can be further developed for the identification and prediction of the degradation patterns of pesticides in soil in combination with other techniques.

Supervisors: Prof. H. M. D. N. Priyantha (University of Peradeniya & PGIS)
Dr. (Mrs.) A. Navaratne (University of Peradeniya & PGIS)
Dr. D. Jayawickrama (University of Illinois, Urbana-Champaign, USA)

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## *M.Phil.* (*Chemical Sciences)*

### Development of polyaniline conducting polymer systems for sensor applications

***H. D. S. Premasiri,*** *PGIS &Department of Chemistry, University of Peradeniya*

Polyaniline (PANI), a conducting polymer can exist in six different structural forms. The six forms are interconvertible and they have their own characteristic properties. In this study the polymer was developed for use as an electrocatalytic substance and as a gas sensor.

The electrochemistry of L-Ascorbic acid in 0.1 mol $dm^{-3}$ of $NaCl_{(aq)}$ in the potential range -0.4 V to +1.0 V at pH 2 shows that one oxidation peak centered at + 0.55 V and 0.38 V with respect to SCE on Glassy Carbon and Pt electrodes in contrast the Polyaniline modified electrode shows a oxidation peak centered at 0.33 V. Thus the PANI modification on Pt and Glassy carbon bare electrodes has resulted in 0.22 V and 0.15 V negative shifts for the Ascorbic acid oxidation compared to glassy carbon and Pt bare electrodes. The latter system follows the Langmuir adsorption isotherm and the monolayer coverage of ascorbic acid on PANI surface facilitates the oxidation reaction at a lower potential. The fact that relatively low potential is sufficient to oxidize ascorbic acid on PANI indicates the suitability of a PANI modified electrode as an electrochemical catalyst to sense ascorbic acid in biological samples.

The qualitative changes of different forms of PANI when exposed to various gases such as $NH_3$, HCl vapor, $H_2S$, and $Cl_2$ were studied. The adsorption of the above gases were accompanied by colour and conductivity changes in the PANI.

Exposure of emeraldine salt form of PANI deposited on glass plates to $NH_3$ gas results in decreasing of conductivity as increase of the concentration of $NH_3$ gas and the colour changes from green to blue. When the emeraldine base forms of PANI on glass plates are exposed to HCl vapor, conductivity is increased in a systematic way with the concentration of HCl vapor with no visible colour change. The exposure of pernigraniline base form of PANI to various doses of $H_2S$ gas results in an initial decrease followed by an increase of the resistance. The colour changes from violet, blue, green and finally to yellowish green. When emeraldine salt form of the polymer is exposed to an oxidizing gas such as $Cl_2$ the polymer gets oxidized resulting in the reduction of its conductivity with the colour changing from green to violet.

The conductivity and colour changes of the polymer film with the concentration of gas indicate the applicability of the polymer as a gas sensor for quantitative and qualitative determination of acidic, basic and redox gases.

**Supervisors**: Prof. R. M. G. Rajapakse (University of Peradeniya & PGIS)
Prof. H. M. N. Bandara (University of Peradeniya & PGIS)

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M.Phil. (*Computer Science)*

Analyzing the ridge regression techniques introduced for solving the problems of multicollinearity

A. Jahufer, *PGIS &Department of Statistics & Computer Science, University of Peradeniya*

Regression analysis is one of the most widely used statistical techniques for analyzing multifactor data. Its broad appeal results from the conceptually simple process of using an equation to express the relationship between a set of variables. Regression analysis is also interesting theoretically because of the elegant underlying mathematics. Successful use of regression analysis requires an appreciation of both the theory and the practical problems that often arise when the technique is employed with real world data.

In the model fitting process the most frequently applied and most popular estimation procedure is the Ordinary Least Square Estimation (OLSE). The significant advantage of OLSE is that it provides minimum variance unbiased linear estimates for the parameters in the linear regression model.

In many situations both experimental and non-experimental, the independent variables tend to be correlated among themselves. Then inter correlation or multicollinearity among the independent variables is said to exist. A variety of interrelated problems are created when multicollinearity exists. Specially, in the model building process, multicollinearity among the independent variables causes high variance (if OLSE is used) even though the estimator is still the minimum variance unbiased estimator in the class of linear unbiased estimators.

The main objective of this study is to show that the unbiased estimation does not mean good estimation when the regressors are correlated among themselves or multicollinearity exists. Instead, it is tried to motivate the use of biased estimation allowing small bias and having a low variance, which together can give a low mean square error.

In literature several biased estimation procedures were introduced for solving the problem of multicollinearity. Among them the biased regression technique namely, Ridge Regression Estimation, was first introduced by Hoerl (1964), and further developed by Hoerl and Kennard (1970a, b). Restricted Ridge Regression Estimation introduced by Sarkar (1992), Modified Ridge Regression Estimation introduced by Swindel (1976), Liu Estimation introduced by Liu Kejian (1993) and Restricted Liu Estimation introduced by S. Kaciranlar, G. P. H. Styan and H. J. Werner (1999) were frequently used biased estimation methods. These methods were rapidly developed in the recent years.

In this research five independent and a dependent standard normal pseudo random variables were used to generate multicollinear data using Monte Carlo Simulation. For the analysis 100 observations for each variable were generated, and fitted the models using unbiased and biased estimators. The stochastic properties of these estimators were analyzed, and the superiority conditions of one estimator over another were investigated.

Supervisor: Dr. (Mrs.) P. Wijekoon (University of Peradeniya & PGIS)

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## *M.Phil.* (*Physics)*

### Study of thermal and electrical properties of some polymer electrolytes based on PEO and PAN and some Intermediate Temperature Solid Oxide Fuel Cell (ITSOFC) materials based on Gadolinia doped Ceria

***R. S. P. Bokalawela,*** *PGIS &Department of Physics, University of Peradeniya*

Solid polymer electrolytes based on poly(ethylene oxide), PEO, and poly(acrylonitrile), PAN, have received much attention in the recent past due to the possibility of using them in novel technological commercial applications, such as primary and secondary batteries, electrochemical sensors, electrochemical displays, solar cells, fuel cells and chemical and biological stimulators. This thesis focuses on several important properties such as ionic conductivity, dielectric relaxation, transport numbers, melting temperatures, glass transition temperatures, cell parameters and dynamic structural properties of some PEO based polymer electrolytes, PEO based composite polymer electrolytes, PAN based gel polymer electrolytes and important electrical properties of some intermediate temperature solid oxide fuel cell electrolytes based on Gadolinia doped Ceria ($Ce_{0.9}Gd_{0.1}O_{1.95}$). It is important to investigate these properties in order to optimize the performance of electrochemical devices, which require a mutual compatibility of the electrochemical reactions and equilibrium during the charge transport process.

In one of the projects, $Mg(ClO_4)_2$ has been used as the complexing salt in PEO and $Al_2O_3$ ceramic particles and Montmorillonite (MMT) clay particles have been used as the fillers to prepare composite polymer electrolytes $PEO_9Mg(ClO_4)_2$ + filler. For PAN based gel electrolytes, $Mg(ClO_4)_2$ and $Pr_4NH_4^+I^-$ salts were complexed in host PAN by heating with ethylene-carbonate (EC) and propylene-carbonate (PC) plasticizers respectively. In the case of synthesis and characterization of intermediate temperature solid oxide fuel cell electrolytes based on $Ce_{0.9}Gd_{0.1}O_{1.95}$ (GCO), commercially available GCO and laboratory synthesized GCO by sol-gel method were used respectively. Major studies were carried out on ionic conductivity, dielectric relaxations and fuel cell parameters of the fuel cell $Pt/H_2$ (99.9999%ppm) (fuel)/GCO/Air (oxidant)/Pt.

For the systems $PEO_9Mg(ClO_4)_2$ + x wt.% MMT, x = 10 wt.% MMT shows the maximum ionic conductivity of $4.36 \times 10^{-6}$ S $cm^{-1}$ at room temperature and melting and glass transition temperatures are 55.97 $^0$C and -33.39 $^0$C respectively. From the study of this system, we conclude that the presence of montmorillonite particles enhances the ionic conductivity substantially, and the degree of enhancement depends on the content of MMT in the system.

In the case of $PEO_xMg(ClO_4)_2$ polymer electrolytes, where x = 3, 5, 6, 7, 9, 11, 13 the composition $PEO_6Mg(ClO_4)_2$ shows the highest ionic conductivity of $1.98 \times 10^{-5}$ S $cm^{-1}$ at room temperature (27 $^0$C). The melting and glass transition temperatures are 63.99 $^0$C and -11.75 $^0$C respectively. Incorporation of $Al_2O_3$ into $PEO_6Mg(ClO_4)_2$ shows the highest ionic conductivity of $5.14 \times 10^{-5}$ S $cm^{-1}$ at room temperature (27 $^0$C) for the composition with 10 wt. % $Al_2O_3$ (acidic), where acidic alumina shows slightly higher value compared to basic alumina. The eutectic melting temperature and the glass transition temperature for this system are 60.68 $^0$C and -35.43 $^0$C, respectively.

The ionic transport number of this composite electrolyte is $t_i = 0.99$ suggesting that the electrical conductance is predominately ionic in the nature. The increase in conductivity due to $Al_2O_3$ is likely to be due to the Lewis acid-base type interactions of ionic species with surface O and H groups on alumina grains.

For the system, PAN : EC : PC : $Pr_4N^+I^-$ the optimum composition with 18 wt.% PAN : 36 wt.% EC : 36 wt.% PC : 10 wt.% $Pr_4N^+I^-$ has shown the highest ionic conductivity of $1.35 \times 10^{-3}$ S $cm^{-1}$ at room temperature (27 $^0$C). The cell Mg / PAN: EC : PC : $Pr_4N^+I^-$ / (C, $I_2$) shows an initial open circuit voltage of 1.6 V, and was able to deliver 10 μA current at 1 V for more than 1000 hrs. The drop in open circuit voltage due to self discharge appears to be negligibly small during a test period of 22 days.
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For the PAN : EC : PC : $Mg(ClO_4)_2$ system, characterization of electrical and thermal properties and Mg / PAN : EC : PC : $Mg(ClO_4)_2$ / M (M = different cathodes) primary cell performances were investigated. The DSC traces of the electrolyte show the typical amorphous nature of the PAN based gel electrolytes. The highest ionic conductivity of this system is 1.18×10^{-2} S cm^{-1} at room temperature (27 ^{0}C) for the optimum composition of 18 wt.% PAN : 36 wt.% EC : 36 wt.% PC : 10 wt.% $Mg(ClO_4)_2$. The activation energy of this system is ~ 3.8 J mol^{-1}. Using the above optimum composition the primary cells, Mg / PAN: EC: PC: $Mg(ClO_4)_2$ / M were fabricated, where M indicates different cathodes based on LiV_3O_8, V_6O_{13}, V_2O_5 and $LiMn_2O_4$.

Out of the materials studied for Intermediate Temperature Solid Oxide Fuel Cells, the $Gd_{0.1}Ce_{0.9}O_{1.95}$ electrolyte shows the ionic conductivity of the order of 10^{-2} S cm^{-1} at intermediate temperature range from 500 ^{0}C to 700 ^{0}C. The derivative of the real part of the permittivity shows the dielectric relaxation of GCO. The analysis of this dielectric relaxation gives rise to polarization at grain boundaries as well as bulk effects. Addition of a small amount (0-5) wt.% of metal oxides to GCO shows an impedance to enhance the ionic conductivity, but the XRD spectra shows that it does not change the fluorite crystal structure of the GCO.

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## *M.Phil.* (*Plant Sciences)*

### Developing a bio-control method against *Botryodiplodia theobromae* & *Colletotrichum musae* causing crown rot of 'Embul' banana

***W. K. R. N. Gunasinghe,*** *PGIS &Department of Botany, University of Peradeniya*

Two common pathogens associated with crown rot in the Asian region, *Colletotrichum musae* and *Botryodiplodia theobromae* (*Lasiodiplodia theobromae*), on 'Embul' (*Musa*, AAB), bananas were assessed for their relative ability to cause disease. Experiments were conducted by inoculating banana hands or fingers with either of these pathogens or in combination. All crowns or stems developed disease at varying degrees of severity and inoculation of pathogens onto healthy crowns or stems always increased severity. However, the combined effect of both pathogens was always less than their individual effects. *B. theobromae* inoculated hands showed significantly (P=0.05) higher crown rot lesion development rates. The highest values for lesion development were on fingers inoculated with *B. theobromae*. Generally, when both pathogens were inoculated together, the frequencies of recovery of each pathogen from hands or fingers, were significantly lower (Dunn's test, P=25%) than when inoculated individually. The results suggest that *B. theobromae* is relatively more robust, and there does not appear to be a synergistic effect between *Colletotrichum musae* and *Botryodiplodia theobromae*.

Two bacteria (*Flavobacterium sp*. [W5481 (a)] and *Pantoea agglomerans* (W5482)) on the above mentioned pathogens were tested on 'Embul' (*Musa*, AAB) bananas, to determine their effectiveness as an alternative, to use as fungicides and to determine their mode of antagonism. Both live cells and culture filtrates were tested by germination assays, agar well diffusion, and TLC bioassays. Effects on banana tissues were tested either using banana peel disks (bioassay) or banana hands. Conidial germination of pathogens was significantly (P=0.05) reduced in formulations with live cells and cell free culture media significantly (P=0.05) reduced in formulations with live cells and cell free culture media (CFCM), although CFCM of *P. agglomerans* were not effective on *C. musae*. On agar well diffusion assays too, CFCM of *Flavobacterium* sp. was effective, and that of *P. agglomerans* was not. TLC-bioassays showed that extent of inhibition, and $R_f$ values of active areas of methanolic extracts of spent media, varied according to the growth medium used for preparation of CFCM and according to the test fungus. Autoclaving the CFCM partially reduced its activity on mycelial growth, but not on conidial germination.

The rot development on peel disks was significantly (P=0.05) suppressed by the treatments with live cells but not with CFCM. None of the biocontrol applications were as effective as the fungicide, thiabendazole. On banana hands, viable cell preparations of each antagonist reduced crown rot significantly (P=0.05). Antibiotics of *Flavobacterium* sp. appeared to be more potent directly on the pathogens. In spite of the differences in antibiotic production by the antagonists, live cells of each antagonist separately suppressed crown rot to the same extent.

Experiments were conducted to determine nutrient competition between antagonist and pathogens, at the site of inoculation by adding the extra nutrients. There was no indication that these treatments enhanced the efficacy of the antagonists. However, although there was no significant difference in disease incidence, the additional hydration of the infection site by adding nutrient solution or sterile distilled water appeared to favor the pathogen establishment on banana tissue.

Of the two pathogens, *B. theobromae* appeared to be more liable to control by both antagonists. Finally the results obtained from crown rot suppression data showed that there is a chance to develop an environmental friendly, effective control method for crown rot development using these antagonistic bacteria, *Pantoea agglomerans* and *Flavobacterium* sp.

**Supervisors**: Prof. N. S. Kumar (University of Peradeniya & PGIS)
Mrs. A. M. Karunaratne (University of Peradeniya & PGIS)

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FORTHCOMING EVENTS

- *Public Lecture on 'Developing young people's scientific literacy & capability' by Prof. Bill Harrison* ……. *(February 22, 2005)*
- *4th & 5th Workshops on Active Teaching & Learning Approaches in Science (ATLAS)* ……. *(March 21 - 24, 2005)*
- *Workshop on Scientific Writing* ……. *(March 29, 2005)*
- *M.Sc. programmes to be commenced during April/May 2005:*
  - *Applied Geochemistry (New Programme)*
  - *Applied Statistics*
  - *Computer Science*
  - *Industrial Mathematics*
  - *Plant Sciences*
  - *Science Education*
- *Seminar on Challenges and Opportunities for Young Researchers* ……. *(May 12, 2005)*
- *Awareness Workshop on Genetically Modified Organisms/Food (GMO & GMF) & Bio-safety* ……. *(May 2005)*
- *Short Course on Conservation and Management of Reservoirs in Sri Lanka* ……. *(June 6 - 9, 2005)*
- *Short Course on Advanced Biochemistry - Part I* ……. *(From May/June 2005)*
- *Short Course on Bioinformatics - Part I* ……. *(From June/July 2005)*
- *Workshop on Lightning, Thunder & Cyclones (in collaboration with Dept. of Meteorology)* ……. *(June 2005)*
- *Workshop on Basic Electronics* ……. *(July/August 2005)*
- *National Symposium on Mosquito Control* ……. *(September 2005)*

M.SC. PROGRAMMES OFFERED BY THE PGIS

- *Analytical Chemistry*
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- *Environmental Science*
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