



# Research Project Completed During 2016-2020





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## Damping off disease of big onions in Sri Lanka and its biological control using *Trichoderma* spp.

RG/2011/AG/03

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E- *A. cepa* L. nursery beds prepared with different treatments for the field trial



Nurseries affected with damping off disease

### INTRODUCTION

*Allium cepa* L. is an important cash crop and prone to a number of diseases. The most common soil-borne seedling disease seen at the nursery stage is damping off disease caused by soil borne fungal spp. *Fusarium*, *Pythium* and *Rhizoctonia* either singly or in combination. Fungicide application for the control of the pathogens causes deleterious effects on the environment whereas biological control would be devoid the above limitation whilst being safe and sustainable. *Trichoderma* spp. have been identified as highly effective biological control agents of many soils borne phytopathogenic fungi. Therefore, the project was aimed at isolating effective *Trichoderma* spp from local soils with a view to prepare an inoculum for the control of damping off diseases in onions.

### PROJECT ACHIEVEMENTS/OUTPUTS

*Trichoderma* inocula prepared were applied using two methods *i.e.* soil application prior to planting of seeds and priming of onion seeds before planting. Both methods of introducing the *Trichoderma* inocula reduced incidence and severity of damping off disease significantly ( $P \leq 0.05$ ) in pot and field experiments indicating that the *Trichoderma* inocula prepared in the present study can be used effectively against damping off disease of onion in the field. This is the first record of an effective locally produced *Trichoderma* inoculum for the control of onion diseases in Sri Lanka.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

The field trial was continued during *yala* season to evaluate the efficacy of *Trichoderma* spp. in managing basal rot disease of *A. cepa* L. In addition to testing the efficacy of *Trichoderma* spp. in controlling damping off and basal rot diseases, the effect of *Trichoderma* spp. on vegetative parameters of *A. cepa* L. was also assessed.



Transplanting in mud bed

**Postgraduate degrees completed:**

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Thesis title: Control of damping off and basal rot diseases of big onion (*Allium cepa* L.) using *Trichoderma asperellum* and *Trichoderma virens*

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The results are of extreme importance as a means of using bio control agents for the management of economically important onion diseases of Sri Lanka has been developed. Our study showed that the preparation is equally effective as the fungicide treatments used during onion cultivation. Mass production of the inoculum using a low cost medium (molasses) as well as a low cost carrier medium (talc) have been developed in the present study and that will reduce the cost of disease management significantly. Most importantly, the preparation is completely harmless to the environment and poses no health hazards to the farmers as well as the consumers and serves a solution to attain a sustainable agriculture for future generation.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

The farmers should be educated on the benefits of using environmentally friendly, effective preparation with no health hazards as an alternative to chemicals.

The inoculum prepared in the research should be mass produced and sold at a minimal cost to farmers to be used under field conditions.

## Use of microorganisms to improve solubility of phosphate fertilizer

RG/2011/AG/06

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Cinnamon pot experiment

### INTRODUCTION

Eppawala Rock Phosphate (ERP) reservoir is the major phosphate mineral resource in Sri Lanka which is recommended only for perennial crops such as cinnamon and pepper, highly priced export agricultural crops. This study was aimed at the sustainable utilization of ERP applied for cinnamon and pepper with the assistance of native Phosphate Solubilizing Microorganisms (PSMs); *Aspergillus* sp., *Burkholderia* sp. and a *Glomus* sp which have the potential of solubilizing ERP in a cheap and environmental friendly manner.

### PROJECT ACHIEVEMENTS/OUTPUTS

It has been optimized the environmental parameters and culture conditions affecting efficient *in-vitro* ERP solubilization by *Aspergillus* sp., *Burkholderia* sp. and a mix culture of *Aspergillus* sp and, *Burkholderia* sp. It was evident that *Aspergillus* sp. is capable of dissolving ERP effectively. Hence it can be used to produce aP bio-fertilizer and a liquid P fertilizer which can be applied for annual crops as well.

Pot experiment proved the employment of *Aspergillus* sp. for improved P nutrition of cinnamon and pepper. It was noted that *Aspergillus* sp. has long-term persistence in soil compared with *Burkholderia* sp. Since cinnamon and pepper are perennial crops it will be more suitable to use *Aspergillus* sp. for field experiment with different P fertilizer levels.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Cinnamon field was established in Akaralla Estate (Ratnapura District) in 2017. Plant growth parameters and soil parameters were obtained in 3 month time intervals. However, there is no significant difference among the treatments in any of the parameters, so far. Pepper field established in the same Estate died after 5 months of establishment due to a drought condition. It was re-established in Hasalaka (Kandy district) 3 months ago.

The fungus was tested in pot and field trials for rice which proved that 50% of TSP application can be cut down when ERP is applied with P bio-fertilizer.



Pepper pot experiment



Cinnamon field experiment

**Postgraduate degrees completed:**

Dr P K R S Ranasingha  
PhD (2019)

Thesis title:  
Sustainable utilization of  
Rock Phosphate for  
improved phosphorus  
nutrition of rice (*Oryza  
sativa* L.), black pepper  
(*Piper nigrum* L.) and  
cinnamon (*Cinnamomum  
verum* J. Presl) by using  
microbial inocula

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

ERP is recommended only for perennial crops due to its low solubility. Annual and biennial crops require soluble phosphate fertilizers: single super phosphate and triple super phosphate, which are imported to Sri Lanka at high cost. The research identified an *Aspergillus* sp. can be used as a P bio-fertilizer for improved and sustainable P management in crops.

Reduced usage of imported chemical phosphate fertilizer can be resulted in reducing foreign Further well-being of the will be people improved due to mitigated environmental pollution.

Further, sustainable use of rock phosphate resource, which is a nonrenewable resource of the world can be achieved by using this P bio-fertilizer.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

*Aspergillus* sp. is capable of dissolving ERP effectively, the technology can be transferred to the industrial sector in order to develop a liquid P fertilizer from ERP, which can be applied to any crop.

After conducting field trials a biofertilizer need to be developed for cinnamon and pepper. The biofertilizer need to be tested by multilocational field trial before recommending to the farmers.

## Forecasting growth and yield performance of Sri Lankan grown Sesame/Thala (*Sesamum indicum* L.) and its wild relatives to water deficit conditions

RG/2011/AG/08

**Principal Investigator:**

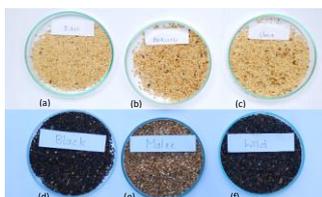
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Field experiment on drought tolerance of Sesame conducted at the Field Crops research and development Institute, Mahalluppallama



Sesame seeds of (a) Idal (b) Pokuru (c) Uma (d) black seeded (e) Malee and (f) wild varieties/ cultivars in Sri Lanka

### INTRODUCTION

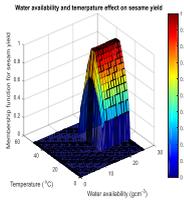
The study focused on Sesame (*Sesamum indicum* L., family Pedaliaceae), one of the most ancient crop plants grown in dry regions of Sri Lanka to (i) identify the potential to survive in simulated drought conditions and (ii) model its germination, growth and yield responses to drought using Fuzzy logic theory and Artificial Neural Network approaches.

### PROJECT ACHIEVEMENTS/OUTPUTS

Agronomic aspects of Sesame cultivation in Sri Lanka were identified, morphological variations of ecotypes were compared and drought responses of ten Sri Lankan Sesame cultivars were evaluated. Drought tolerant and/or susceptible Sesame varieties were identified. The publications resulted by the study upgraded the scientific knowledge about germination, growth and yield performances of Sri Lankan Sesame to drought stress. The study also contributed to capacity building of a permanent academic member of the University of Colombo.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Through an international collaboration, investigations were extended to understand the physiological changes of a selected Sesame cultivar in response to drought stress induced at juvenile, flowering, and seed filling stages. Accordingly, a glasshouse experiment was carried out at Queensland Crop Development Facility, Redlands, Australia on an Australian cultivar of Sesame. The study verified that sesame could tolerate moderate drought stress conditions with no effect on yield or seed quality. When exposed to extreme drought conditions during seed filling stage, Sesame was able to survive but with 39 % of yield reduction. The study also provided the evidence for the physiological basis of drought responses of Sesame plants such as the adjustment of leaf osmotic potential as a drought tolerant mechanism of plants.



Graphical representation of Membership functions for describing the combined effect of water availability and temperature on sesame yield

**Postgraduate degrees completed:**

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PhD (2017)

Thesis title:

The impact of water deficit on the growth and yield performance of sesame (*Sesamum indicum* L.): Analysis through mathematical modeling

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Sesame has morphological and physiological adaptations to tolerate drought conditions and varietal differences exhibit this capacity to various extents. Growing the best suited sesame to a particular location would ensure continuous supply of the produce. Sesame is also a great soil constructor, retains and improves moisture levels sufficient for next crop and reduces soil blow in eroded lands. Therefore, Sri Lanka inherits a great potential to expand Sesame cultivation and increase the level of production. At present it remains as an underutilized crop grown in small scale mainly in the marginal lands of the Dry zone. Increased awareness on values of Sesame crop, its global demand, country’s potential and eco-friendly cultivation practices, availability of locally improved Sesame varieties and marketing strategies would encourage famers to engage in Sesame cultivation and strengthen Sesame production in Sri Lanka.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

It will be important to qualitatively and quantitatively characterize the oil content of Sesame varieties under simulated drought conditions. Availability of drought tolerant cultivars, ability to access information and instructions related to Sesame cultivation, establishing a stable local market for the harvest, direct manipulation of the government in arranging an efficient marketing structure, development of various agro -based industries (confectionary, culinary, cosmetic, and animal feed) that use Sesame seeds and oil would directly encourage Sesame farmers. This will support subsistence for farmers, create tremendous employment opportunities and contribute to alleviate rural poverty in dry regions. Increased awareness on assorted values of Sesame among public may also expand the consumers and thus stabilize the local Sesame market. Value added food productions from Sesame can be promoted at district level by the Department of Agriculture. Switching from ‘organic by default’ farming practices to ‘certified organic farming’ may also attract the global organic Sesame market.

# Investigating the effect of cowpea (*Vigna unguiculata*) on the accumulation of visceral fat mass and oxidative status using animal experimental model

RG/2011/AG/09

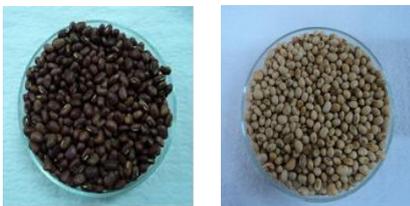
## Principal Investigator:

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## Co-Investigators:

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Picture of Waruni and MI35 cowpea seeds



Blood lipid analysis using plate reader

## INTRODUCTION

In this study, the effect of whole cowpea powder on the serum lipids, glucose, antioxidant activity, and cecal fermentation was investigated in Wistar rats. From findings it was observed that Waruni cowpea is the best of all studied cowpeas in lowering serum lipids and glucose in Wistar rats.

## PROJECT ACHIEVEMENTS

Waruni, Bombay and MI35 cowpea cultivar incorporated experimental diets significantly reduced serum LDL cholesterol in Wistar rats. From all the findings it could be speculated that Waruni cowpea is the best of all studied cowpeas in lowering serum lipids and glucose. The hypocholesterolemic and hypoglycemic effect of cowpea were supported by higher fecal weight, higher cecal weight, higher cecal *Lactobacilli* population and higher serum antioxidant activity in rats. Based on the findings consumption of cowpea could be recommended to improve the serum lipids and glucose.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

There is a high prevalence of non-communicable diseases in Sri Lanka at present. Thus, promoting cereal based diets such as cowpea may save millions of money spending on some imported cereals and as well as reduce the health cost and increase the wellbeing of the people in Sri Lanka. Further, promoting cowpea consumption may increase the economic value of the cowpea and increase the income of the poor farmers.



Analyzing microbial population in caecal content

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## **FOLLOW-UP**

Further studies will be conducted to investigate the effect of different processing method on *in vivo* lipid and glucose modulation ability of cowpeas. Findings will be disseminated to general public through newspaper articles to promote the consumption of cowpea.

## Addressing the needs of rubber (*Hevea brasiliensis*) grown in drier regions of Sri Lanka through the assessments on physiological parameters and the quality of raw rubber produced

RG/2011/AG/10

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### INTRODUCTION

Limitation of lands for rubber cultivation in wet regions has led to expand the rubber cultivation into the drier non-traditional areas where land per capita is reasonably higher. To facilitate this process by developing suitable agronomic protocols, this study was aimed to identify the responses of rubber plants to drier climates in terms of physiological parameters and the quality and quantity of raw rubber produced under S/2 d4 Low Frequency Harvesting system (LFH).

### PROJECT ACHIEVEMENTS/OUTPUTS

Considering the temporal advantages of different harvesting systems, a suitable alternative harvesting system was identified where S/2 d4 LFH could be adopted during wet period (Sep. – March) and traditional S/2 d2 during dry period (April-Aug.) of the year. Latex quality was not generally affected by LFH. With low Mooney viscosity, rubber produced by LFH system was found suitable for manufacturing less hard items. Environmental conditions were found to be improved by rubber cultivation with reduction in temperature and increase in relative humidity. Average growth rate of rubber plants was recorded as 6.75 cm/year.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

To investigate on the long-term effects, all the experimental fields in Intermediate and Dry zone are continued with necessary assessments. Another four experimental fields were established in Padiyathalawa, Hambegamuwa, Vauniya and Kandakadu with 10 rubber clones to investigate their suitability to the suboptimal climatic conditions in Intermediate and dry zone. Further, a special project has been launched to promote rubber cultivation in Eastern Province as a livelihood development programme.



Experimental field established  
at Nedunkulama, Vauniya



Sample collection for latex diagnosis



Investigating on plant physiological parameters

**For more details, contact:**

Dr V H L Rodrigo  
[laksh@slt.net.lk](mailto:laksh@slt.net.lk)

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Outputs of the proposed project will undoubtedly promote rubber cultivation in drier areas of the country. Key beneficiaries are the resource poor farmers whose livelihood at present depends on seasonal crops grown mostly under rain-fed conditions. Most of them are either at or below the poverty line. Stability of the income given by rubber is evident hence alleviation in rural poverty and contribution to economic development at regional level will undoubtedly be assured improving the well-being of the people.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

Adoption of S/2 d4 system in wet seasons and changing that to S/2 d2 in dry periods is recommended as the yield performance of S/2 d4 was better during wet periods whilst S/2 d2 performed better in dry periods. Further field demonstrations with more smallholdings are required to promote this system. Among the rubber clones tested, RRIC 121 showed high level of performance confirming its suitability for drier climate. However, further screening of clones is to be done for maintaining the clonal diversity in rubber lands.

With the knowledge gained from this study, rubber cultivation in drier climates could be further promoted in Sri Lanka. In cultivating rubber particularly in Northern Province, a special project is to be launched with the participation of the Tamil community.

## Chemistry and bio-activity of some popular edible fruits: Studies on possible application in health and agriculture

RG/2012/AG/01

**Principal Investigator:**

Prof. U L B Jayasinghe

**Co-Investigator:**

Prof. N S Kumar

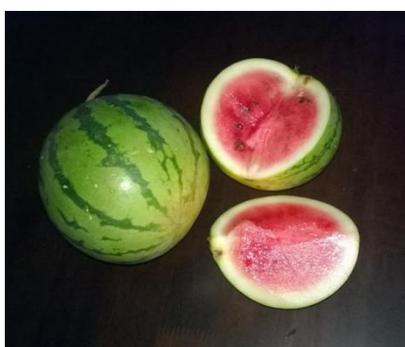
National Institute of  
Fundamental Studies,  
Kandy

### INTRODUCTION

This research project is to identification and characterization of environmentally friendly bioactive compounds from Sri Lankan fruits with special reference to their antifungal, antioxidant, phytotoxic, brine shrimp lethality and enzyme inhibitory properties to use in human health and crop protection in agriculture. Safety and toxicological issues of edible fruits are less than those of other natural products.

### PROJECT ACHIEVEMENTS/OUTPUTS

During this study we were able to identify some edible fruits extracts having some good bioactivity (antifungal, antioxidant, cytotoxicity (Brine shrimp lethality), phytotoxicity, anticandidal and  $\alpha$ -amylase inhibitory activities) which include the *Aegle marmelos*, *Anacardium occidentale*, *Averrhoa bilimbi*, *Citrus lanatus*, *Elaeocarpus serratus*, *Garcinia quesita*, *Hylocereus undatus*, *Limonia acidissima*, *Nephelium lappaceum*, *Passiflora edulis*, *Phyllanthus embilica* and *Psidium guajava*. Some fruits extracts were studied for phenolic metabolites by LC-MS studies.

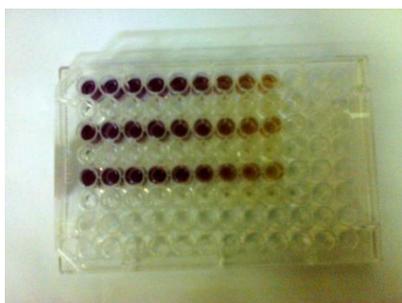


Fruits of *Citrus lanatus*

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

After completion of this project several workshops were conducted at National Institute of Fundamental Studies.

- National Workshop on Separation Techniques in Natural Product Research, 19<sup>th</sup>-23<sup>rd</sup> September, 2016.
- The 1<sup>st</sup> Sri Lankan ANRAP Regional Seminar (ANRAPSL1) on "Herbal Approaches in Combating Diabetes and Common Tropical Diseases", 17<sup>th</sup> -19<sup>th</sup> January 2018.



DPPH Bioassay in Microplate



Analysis of fruit extracts by LC-MS instrument

**Postgraduate degrees completed:**

Ms. H R W M D P K  
Niyangoda  
M.Phil (2019)

Thesis title:  
Chemistry and bioactivity  
of five popular edible  
fruits in Sri Lanka

**For more details, contact:**

Prof. U L B Jayasinghe  
[lalith.ja@nifs.ac.lk](mailto:lalith.ja@nifs.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This study showed that the potential of identification of bioactive compounds from edible fruits in Sri Lanka. Several bioactive compounds and extracts have been identified which are potential source for environmentally friendly antifungal, phytotoxic, antioxidant etc. Further research on edible fruits may lead to useful applications of these fruits extracts in human health and crop protection in agriculture. As an example, natural phytotoxic compounds identified from the present studies could be used to reduce or to replace hazardous synthetic weedicides / herbicides.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

This study was three-year project which indicated that the edible fruits are a potential source of environmentally friendly bioactive compounds. Further research on edible fruits will lead to useful applications of these fruits extracts in human health and crop protection in agriculture.

# Use of Electromagnetic Induction based proximal sensing to support site-specific Soil management of Paddy cultivation in the Intermediate Zone

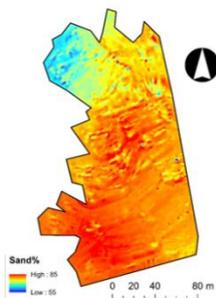
RG/2012/AG/07

**Principal Investigator:**

Dr W A U Vitharana  
Department of Soil Science  
Faculty of Agriculture  
University of Peradeniya



Proximal Soil Sensing of the variability of paddy grown soils



Spatial variability of Soil Texture mapped using proximal soil sensing

## INTRODUCTION

This project was conducted in the framework of Precision Management of Paddy Soils in Sri Lanka using latest technology. Thus, the project evaluated the potential of proximal soil sensing of apparent electrical conductivity (ECa) for detailed mapping of soil texture of paddy soils and subsequent delineation of management zones for site-specific nutrient management of Paddy.

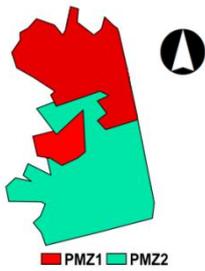
## PROJECT ACHIEVEMENTS/OUTPUTS

This Project revealed a strong spatial variability of soils in studied two paddy tracts in Sri Lanka. Further, this soil variability can be mapped accurately but cost-effective manner using proximal soil sensing technology. The soil texture-based management zones delineated using proximal soil sensing showed clear potential of site-specific management of fertilizer application for paddy.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Publication: Rathnayaka R.A.A.S., Vitharana U.W.A. and Balasooriya B.L.W.K. 2018. Detailed mapping of soil texture of a paddy growing soil using multivariate geostatistical approaches. Tropical Agricultural Research Vol. 29 (4): 300 – 312.

MPhil Thesis: Site specific nutrient management for paddy soils on the basis of potential management zones delineated through proximal soil sensing. By R.A.A.S. Rathnayaka. Postgraduate Institute of Agriculture (2019- PGIA).



Management Zones for precision management of fertilizers for paddy

***For more details, contact:***

Dr W A U Vitharana  
[uvithara@pdn.ac.lk](mailto:uvithara@pdn.ac.lk)

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This study revealed the presence of short scale spatial variability in paddy soils. The information about the short-scale soil variability is very important to optimize fertilizer management to cut-down the cost of fertilizer. Further, optimal application of fertilizers will result in higher productivity (yield) while minimizing environmental costs due to improper management of paddy soils. Further, the novel technology “proximal soil sensing” has not been tested under local conditions to map soils. Further, this study revealed a high-potential of proximal soil sensing for cost-effective and accurate mapping of soil texture in paddy lands.

## **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Research outcomes showed a considerable potential of proximal soil sensing for mapping soil texture and sub-sequent delineation of potential management zones for site-specific management of fertilizer for paddy. Further studies are need to optimize fertilizer application for paddy according to potential management zones. Further, novel technologies such as multi-spectral imaging using drone technology should be tested to optimize soil fertility management in paddy.

“Research is the Foundation of Knowledge”

# Antimicrobial, antibiofilm activity of Sri Lankan grown Galangal (*Alpinia galanga*) or Mahaaraththa against *Staphylococcus aureus* and its safety evaluations

RG/2012/AG/02

## Principal Investigator:

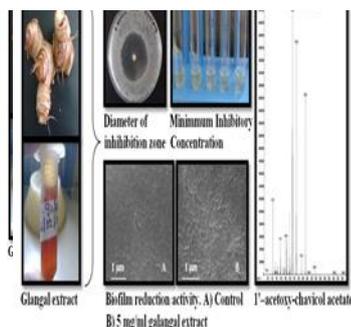
Dr N S Weerakkody  
Department of Agricultural  
and Plantation Engineering,  
The Open University of Sri  
Lanka

## Co- Investigator:

Dr G Mayuri  
Thammitiyagodage  
Animal Unit  
Medical Research Institute



Characteristic features of different plant parts of Galangal



Antimicrobial and antibiofilm activity of Galangal

## INTRODUCTION

The rhizome of Galangal (*A. galanga*)/Mahaaraththa, a plant native to southeast Asia and Southern China is widely used as a spice and a food flavorings agent and in food industry. This study investigated the antibacterial, antibiofilm activity, chemical composition and toxicity limits of Galangal for safe use in food industry.

## PROJECT ACHIEVEMENTS/OUTPUTS

Galangal extract can be used as a safe marketable natural antimicrobial product, natural food preservative or as an alternative for antibiotics or disinfectant.

The tested concentrations of Galangal extract for acute skin and eye irritation and acute oral toxicity are well above the therapeutic levels for its antimicrobial activity against *Staphylococcus aureus*. Findings of this study could be useful for establishing safe limits of galangal extract as a functional food ingredient.



Eye and skin irritation reactions of Galangal extract on CAM surface and rabbit skin

**Postgraduate degrees completed:**

P U H S Karunaratne  
M Phil (2017)

**Thesis title:**

Antimicrobial property, antioxidant activity and toxicity level of galangal (*Alpinia galanga*) grown in Sri Lanka and its potential to be used in functional foods

**For more details, contact:**

Dr Nimsha Weerakkody  
[nweer@ou.ac.lk](mailto:nweer@ou.ac.lk)

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

If Galangal rhizome extract can be used as a marketable product there will be a demand for galangal raw material. This will be an advantage for the people who can grow galangal commercially. Growing galangal as a cultivation or as mixed crop will ensure benefits for the environment as well.

Further, the introduction of novel natural antimicrobial product for the emerging consumer demand will enable to catch export market and earn foreign currency for the country economic development.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

We have tested antibiofilm activity of *A. galanga* and developed antibiofilm sprayer to be used in food industry as a sprayer on food processing surface (validation research is still ongoing). This product received Winner award - The best innovation that promote food safety at Profood/ Propack and Agbiz 2017 and 2018, BMICH Colombo.

There is a possibility to develop various products by applying Galangal as a natural preservative where we have developed a shelf life extended half boil egg using natural preservatives for 2019 Profood pro pack exhibition and received Winner award - The best innovation that promote food safety at Profood/ Propack and Agbiz 2018.

In addition, galangal extract can be used as an ingredient in marinated meet products to extend the shelf life.

# Determination the effect of silicon on natural defense system against anthracnose disease and some pre and postharvest qualities in *Capsicum annum* L. (Malumiris) and investigating the possibility of using rice hull as a low-cost silicon source

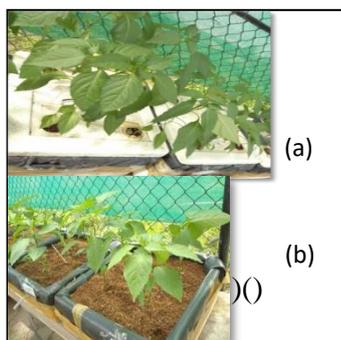
RG/2012/AG/04

## Principal Investigator:

Dr H L D Weerahewa  
Department of Botany  
Open University of Sri Lanka

## Co-Investigator:

Ms. M D J S Saparamadu  
Department of Natural Sciences  
Open University of Sri Lanka



Non circulated liquid hydroponic boxes (a) and simplified hydroponic boxes (b)



Lesion Development on fruits from simplified hydroponics system and control fruits

## INTRODUCTION

Anthracnose is one of the major diseases of capsicum (*Capsicum annum* L.) causing higher postharvest loss. Control of the diseases is currently achieved by fungicides which are hazardous on environment. Application of Silicon has long been proven effective in controlling diseases. This research was conducted to investigate the effect of silicon, as form of chemical (pottasium silicate) or as natural source (rice hull) on improving the pre and postharvest qualities of capsicum grown in soil free system of cultivation. The potassium silicate was used in the plants grown in non- circulating hydroponics system and the raw rice hull was incorporated as the inert media for growing plants in simplified hydroponics system.

The resistance against anthracnose disease was tested in capsicum fruits by challenged inoculating *Colletrotrichum* spp. The postharvest quality: fruit firmness, physico chemical properties (TSS, TA & pH) and sensory properties of capsicum from Si treated and non treated plants were also investigated. The possible mechanism underlying the silicon mediated disease resistance was investigated by measuring cuticle thickness, level of phenols and studying fungal appressoria formation.



Carrying out the sensory evaluation of capsicum fruits from Si treated and non-treated plants

**For more details, contact:**

Dr H L D Weerahewa  
[weerahewa@gmail.com](mailto:weerahewa@gmail.com)

## PROJECT ACHIEVEMENTS

Application of 75mg/L silicon is an effective method for controlling the anthracnose disease caused by *Colletotrichum capsici* or *C. gloeosporioides* in capsicum. The Root application of 75 mg/l of Si during only blooming stage would be optimum and economical against the anthracnose disease of capsicum 'Muria F1' grown in liquid hydroponic system. Rice hull leachate was effective for overall performance of the capsicum. The current nutrient solutions used for hydroponics systems of cultivation could be effectively replaced by the new nutrient formula produced by incorporating silicon. Plants grown in the simplified hydroponic system showed about 80% of anthracnose disease reduction and enhanced fruit firmness. There were no changes observed in sensory properties of silicon treated fruits. The silicon treated fruit exhibited significantly higher cuticle thickness, higher level of cell wall bound phenols and higher number of appressoria of fungi indicating resistance mechanisms of the silicon treated capsicum fruit.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The alternative method of using silicon to control the disease instead of using agrochemicals will greatly benefit the small, medium and large scale vegetable industries by, minimising the expenditure for the pesticides, improving the quality and yield of the produce and making it more economical due to the availability of low cost silicon sources such as rice hull. The people will be benefited with the fungicide free produce and reduced vegetable price due to minimizing of crop loss. Silicon application appear to be available option for disease management by reducing fungicide, insecticides and pesticide use and therefore potential environmental threats can be reduced.

## FOLLOW-UP

The nutrient solution used for this research is novel and has formulated by incorporating silicon to the media and by considering the plants requirement to growth and blooming. It is low cost and could be replaced for commercially available expensive solution systems use for growing plants in hydroponics system. The patent documents have already been submitted for the new nutrient formula produced for this purpose. The effect of Si supplement by the new nutrient formulations can be tested for other crops as well.

The effect of application of higher concentrations of Silicon as a foliar spray would be important for easy and practical application of Silicon. Further studies should be carried out on this and if it becomes successful it can be practiced for the crops grown in soil as well. Simplified hydroponics system can be specially recommended for the busy urban community living in housing schemes for their home gardening. Further investigations are needed to investigate the possible mechanism/s by which Si suppressed the anthracnose disease of capsicum.

# The overall impact of different bark consumption rates associated with additional days of latex harvesting on growth, yield and financial implication of rubber (*Hevea brasiliensis* Muell.Arg) plantations

RG/2012/AG/06

## Principal Investigator:

Dr A M W K Senevirathna  
Department of Export  
Agriculture  
Uva Wellassa University

## Co- Investigator:

Dr P Seneviratne  
Rubber Research Institute of  
Sri Lanka



Determining phloem turgor pressure in rubber trees inserting capillaries into the bark.



Measuring the phloem turgor pressure in rubber trees.

## INTRODUCTION

Adoption of improper harvesting practices aiming high rubber yields causes long term crop losses due to stresses. This situation leads to poor management of plantations resulting either uprooting before full economic lifespan or maintaining at uneconomical levels. Therefore this study was planned to determine the impact of different bark consumption rates associated with additional days of latex harvesting (over the recommendation) on growth, yield and financial implications of rubber plantation.

## PROJECT ACHIEVEMENTS/OUTPUTS

This study confirmed that bark consumption rates of higher tapping frequencies associated with excessive recovery tapping and daily tapping adversely influence on economic lifespan of rubber plantations without providing sustainable yields. Also the incidence of Tapping Panel Dryness was high with high frequency harvesting reducing healthy trees in the plantation. With this context, early detection of bark consumption rates would be useful in identifying any malpractices and thereby to take early measures to rectify the problems, and also to introduce remedies to minimize the damage due to higher rate of bark consumption.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

This is a part of an ongoing research leading towards a PhD; and therefore, the study is being continued to collect more data in different aspects of this burning issue. Some yield determining parameters, bark anatomical and economical aspects are under consideration for in depth analysis of high bark consumption and high frequency of harvesting. Considering all these aspects of the excessive bark consumption rates, remedies and recommendations will be put forward to conserve rubber plantations to achieve sustainable yields throughout.



Spectrophotometric determination of latex sucrose levels in rubber trees collecting latex to iced bath

**Postgraduate degrees completed:**

Dr T U K Silva  
PhD(Being done)

Thesis title:

The impact of bark consumption rates with additional days of latex harvesting on growth, yield and financial implication of rubber plantations

**For more details, contact:**

Dr A M W K Senevirathna  
[wasanthasen@gmail.com](mailto:wasanthasen@gmail.com)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Based on this study, a protocol will be developed to sustain the economic lifespan of the rubber tree through standardization of the bark consumption rate. Thus, the sustainable yields can be achieved throughout the commercial lifespan of the rubber plantations. Hence, contribution to the GDP will be increased while reducing the replanting cycle and the cost. The gap between COP and NSA can positively be increased by increasing the yield and reducing the % TPD affected trees.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

A protocol will be developed to sustain the economic lifespan of the rubber tree through standardization of the bark consumption rate. Based on the information gathered any alterations or modifications to the presently recommended harvesting systems will be implemented. Alternative methods will be introduced to utilize tapping panels during 24 year harvesting period.

# Growth and phosphorus (P) nutrition diversity of Sri Lankan and introduced rice varieties at variable soil P supply and adaptations to increase the P uptake and use-efficiency when grown in P impoverished soils

**RG/2014/AG/01**

**Principal Investigator:**

Dr L D B Suriyagoda  
Department of Crop Science  
Faculty of Agriculture  
University of Peradeniya

**Co-Investigators:**

Mr D N Sirisena  
Dr W L G Samarasinghe  
Department of Agriculture

Dr P C G Bandaranayake  
University of Peradeniya

Dr Matthias Wissuwa  
JIRCAS, Tsukuba, Japan



Rice cultivars grown in greenhouse condition under low and high-P conditions at 40 days of age

**Postgraduate degrees completed:**

D S Kekulandara  
PhD

**For more details, contact:**

Dr L D B Suriyagoda  
[laliths@pdn.ac.lk](mailto:laliths@pdn.ac.lk)

## INTRODUCTION

Rice cultivars bred for fertile soils may not be the best suited to nutrient limited environments. Out of many nutrients, phosphorus (P) is a key element limiting the growth of many agricultural systems. Therefore, rice cultivars suited to sustain productivity in low-P soils and their adaptive mechanisms for success need to be identified.

## PROJECT ACHIEVEMENTS/OUTPUTS

Sri Lankan rice cultivars which show promise in growth, yield, phosphorus uptake and P-use under low fertile soil conditions (mainly phosphorus) were identified. The mechanisms for higher growth and P efficiency were also identified. The presence and the importance of P nutrition related gene PISTOL-1 were studied.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Thesis writing of the student is in the final phase before submission. Another paper of this work got accepted by the Journal of Plant Nutrition.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Rice cultivars which showed promise in the growth under low-P conditions can be recommended to grow in low fertile soils. Under any restriction of P fertilizer importation and/or application, selected varieties can be used to minimize risk.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

Information/data generated are quite useful in future rice breeding programs.

# Biological control of mealybugs and white-fly populations using locally available coccinellid predators through augmentation and release

RG/2014/AG/02

## Principal Investigator:

Dr K S Hemachandra  
Department of Agricultural  
Biology  
Faculty of Agriculture  
University of Peradeniya

## Co- Investigator:

Dr U G A I Sirisena  
Department of Plant  
Sciences  
Faculty of Agriculture  
University of Ruhuna



Newly emerged and matured adult of *C. montrouzieri*



Efficacy of *C. montrouzieri* was assessed in cage experiment

## INTRODUCTION

Insect pest management in crop ecosystems is an essential crop management practice and currently relies on application of insecticides. Considering the consequences of insecticide spray on human and environment health, nonchemical methods are explored. Biological control using coccinellid predators is a potential strategy; hence, this project was focused on generating required biological and ecological data to initiate bio control programme through augmentation and release. Mealybug, whitefly and aphids were identified as the target hosts.

## PROJECT ACHIEVEMENTS/OUTPUTS

It was re-established that locally available coccinellid predators are very effective in managing sap feeding soft bodied insects. Five coccinellid species: *Cyptolaemus montrouzieri* : mealybug predator, *Axinoscymnus puttardriahi* : whitefly predator, *Nephasphis* sp. : whitefly predator, *Menochilus sexmaculata* : aphid predator, *Micraspis discolor* : aphid predator were identified as potential predators as per their Feeding behavior, search behavior and reproductive behavior. *Cyptolaemus montrouzieri* proved its efficacy in field cage studies to manage the mealybug populations on cassava.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

As *Cyptolaemus montrouzieri* was the most promising candidate, the research work is being continued as thesis research of a student attached to the Postgraduate Institute of Agriculture, University of Peradeniya. Insect cultures are being maintained in the Entomology laboratory to supply the research materials.

Research student submitted the thesis to the Postgraduate Institute of Agriculture, and waiting for the thesis defense examination. Results generated in the study programme is being discussed in undergraduate and postgraduate classes to disseminate the new information as well as in other suitable forums.



Mass culture of *C. montrouzieri*

***For more details, contact:***

Dr K S Hemachandra

[kshema@pdn.ac.lk](mailto:kshema@pdn.ac.lk)

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Upon the implementation of biological control programme, it is expected to reduce the insecticide application in crop ecosystems, benefiting the farmer community in terms of cost of control, health benefits through uncontaminated crop produce, and reduced non target effects conserving the beneficial insects in ecosystems. Fully implementation of biocontrol system is yet to be done.

## **RECOMMENDATIONS FOR FOLLOW- UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START- UP BUSINESS, IF ANY**

It is important to implement the biocontrol programme in farmer fields with the participation of the farmers to demonstrate the efficacy of the biocontrol agents and to convince them to use the system.

## Regulation of growth and flowering of Heen-bovitiya (*Osbeckia ocatndra*) to develop as a flowering ornamental plant

RG/2014/AG/03

**Principal Investigator:**

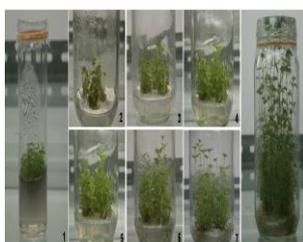
Prof J P Eeswara  
University of  
Peradeniya

**Co-Investigator:**

Dr S A Krishnaraja  
Royal Botanic Garden  
Peradeniya



Flowering Heen Bovitiya Plants



Development stages of *Osbeckia* seedlings under in-vitro condition

### INTRODUCTION

The possibility of manipulation of plant height and flowering of Heen-bovitiya (*Osbeckia octandra*) with plant nutrition, the application of plant growth regulators and the use of pruning and training techniques was investigated with the objective of introducing it as a flowering ornamental, to the floriculture industry in Sri Lanka.

### PROJECT ACHIEVEMENTS/OUTPUTS

One research paper was published  
MPhil was completed

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

***Paper Published***

D.M.I.C.B. Dassanayake\*, S.A. Krishnarajah<sup>1</sup> and J.P. Eeswara (2018) 1. Development of an Effective Propagation Protocol for *Osbeckia octandra* (L.) DC. (Heen Bovitiya) Tropical Agricultural Research Vol. 29 (2): 123 – 134 (2018)  
(Best presentation award was received for this paper)

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Heen Bovitiya is an endemic flowering plant with medicinal properties. This species uses in Ayrvedic medicine to cure hepatitis and liver disorders. Scientific experiments have proven that the leaves of Heen Bovitiya contain lot of anti-oxidants (Ruwanmali et al., 2018). If this species is popularized among general public, it will serve not only as an ornamental plant but also as a medicinal plant.



BAP treated Paclabutraxol treated

Effect of plant growth regulators on growth and development of Heen Bovitya

**Postgraduate degrees completed:**

D M C I B Dassanayake  
MPhil (2019)

Thesis title: Manipulation of growth and flowering of *Osbeckia octandra* (Heen Bovitya) to develop as a flowering ornamental plant

***For more details, contact:***

Prof. J P Eeswara  
[jpeeswara@yahoo.com](mailto:jpeeswara@yahoo.com)  
[jpe@pdn.ac.lk](mailto:jpe@pdn.ac.lk)

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

1. Popularize Heen Bovitya as an ornamental plant as well as plant for culinary purposes in home gardens.
2. Identify the nutritional and pharmaceutical value of Heen Bovitya leaves

# Screening for antioxidant activity in some leafy vegetables popular in Sri Lanka

RG/2014/AG/04

**Principal Investigator:**

Dr K D P P Gunathilake

**Co-Investigator:**

Dr O D A N Perera

Department of Food Science  
& Technology, Faculty of  
Livestock, Fisheries &  
Nutrition, Wayamba  
University of Sri Lanka



Change of phenolics, carotenoids, and antioxidant capacity following simulated gastrointestinal digestion and analysis of selected edible green leaves

K.D.P.P. Gunathilake<sup>1,2</sup>, K.R.D.S. Ranawana<sup>3</sup>, H.P.V. Rajapathige<sup>4</sup>

**ARTICLE INFO**

**Keywords:** The bioavailability of phenolics, carotenoids, vitamins, lipoxanthin and chlorophyll in edible green leafy vegetables during simulated gastrointestinal digestion has been investigated. It was found that the amount of dietary phenolics, carotenoids and vitamins which were available for further uptake is varying depending on the leafy type. Bioavailable phenolics after the gastric phase, intestinal phase and in digestible fractions were in the range of 1.13-10.16, 1.64-6.77% and 1.12-12.19 respectively when compared with the total amount. Total antioxidant capacities in the digestible fractions were significantly lower than the original. Bioavailability of dietary phenolics showed a strong positive linear relationship with the amount of phenolics in the original samples. Higher bioavailability of all three nutrients were found in both gastric and intestinal phases than in both leaves. These results highlighted that gastrointestinal digestion may substantially affect the absorption of phytochemicals and carotenoids present in leafy greens.

Research paper published in Food Chemistry 2018



Leafy vegetables studied in details

**For more details, contact:**

Dr K D P P Gunathilake

[kdppgunathilake@yahoo.com](mailto:kdppgunathilake@yahoo.com)

**INTRODUCTION**

This study examined the antioxidant properties of thirty-four edible green leafy vegetables (GLV) popular in Sri Lanka. With the screening, 6 leafy types were selected for further studies. Leaf extracts of GLV were analyzed for bioactives such as phenolics and carotenoids and were evaluated for antioxidant activities during invitro digestion and cooking.

**PROJECT ACHIEVEMENTS/OUTPUTS**

Among the leafy vegetables studied, *Sesbania grandiflora*, *Cassia auriculata*, *Murraya koenigii* Spreng, *Passiflora edulis*, *Gymnema lactiferum* and *Olax zeylanica* showed comparatively higher antioxidant properties. It can be speculated that phenolic compounds present in the extracts may exert their antioxidant activity individually as well as synergistically.

Five research papers were published in SCI indexed journals, four research papers were published in international peer review journals and four research communications in international conferences in Sri Lanka and USA.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The study showed antioxidant properties of leafy vegetables in Sri Lanka. Some leafy vegetables can be used to substantiate the scientific reasoning that free radical scavenging and ROS is indeed the mode of action of these plants in the prevention of oxidative stress. The results of this study are useful for industries in the development of “Natural antioxidants” from plant, development of functional food/ingredients/nutraceuticals etc.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

These results output make available for academics, nutritionist and policy makers in order to use or further investigation for the utilization of these GLV to overcome oxidative stress related disease prevention.

# Investigation of fruit phenology and pre-harvest foliar treatments of growth regulators on fruit quality and post harvest life of lime (*Citrus aurantifolia* Swingle)

RG/2015/AG/01

**Principal Investigator:**

Dr W A H Champa

**Co- Investigator:**

Ms. Ruwanka Ratnayake

Institute of Post-harvest  
Technology  
Anuradhapura



Field visit by NSF research review committee on 30th June, 2017

## INTRODUCTION

Lime is highly seasonal crop which has constant year round demand. However, in Sri Lanka, no systematic research has been carried out to address pre and postharvest issues of this crop. Therefore, this research aimed to study fruit phenology, maturity, manipulating fruit season to make the lime production a business venture.

## PROJECT ACHIEVEMENTS/OUTPUTS

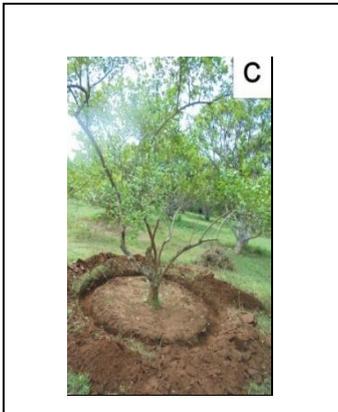
1. M.Phil degree– S D Samaradiwakara, PGIA, UOP
2. A set of standard maturity indices, sizing rings and colour charts
3. Expansion of existing acute harvest season of 3 months up to 7 months
4. Three publications in national (01) and international (02) symposia.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

1. Findings were presented at the
  - a. 30<sup>th</sup> Annual Congress of the Postgraduate *Institute of Agriculture held on 15-16 November, 2018 at Amaya Hills, Kandy. (the PG student was adjudged as the best in the poster session).*
  - b. International research symposium on postharvest technology held on 19<sup>th</sup> October, 2018 at National Institute of Postharvest Management, Anuradhapura, Sri Lanka.
2. Colour charts and sizing ring were printed in three languages (Sinhala, Tamil, and English) in order to distribute among stakeholders. Copies were submitted to the NSF library.



Adopting pruning practices before commencing the spraying



Selected lime tree for the experiment

**Postgraduate degrees completed:**

Ms. S D Samaradiwakara  
M Phil (2020)

**Thesis title:**

Investigation of fruit phenology and pre-harvest foliar treatments of growth regulators on fruit quality and post-harvest life of lime (*Citrus aurantifolia* Swingle)

**For more details, contact:**

Dr W A H Champa  
[harindra.bsu@wyb.ac.lk](mailto:harindra.bsu@wyb.ac.lk)  
[harindra74@gmail.com](mailto:harindra74@gmail.com)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The project outputs have been contributed to human resource development (01 M.Phil), livelihood development of lime growers thus poverty alleviation in rural farming community. Generation of employment due to year round availability of quality raw materials for processing/value added industry.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

It is suggested to forward findings of the experiment 1 to the Sri Lanka Standard Institution (SLSI) to set maturity and quality standards for lime and then industry will adopt those in quality control procedures.

To recommend the findings of the experiment 2 i.e. field spraying of salicylic acid and gibberellic acid, we have to contact Department of Agriculture and conduct the field trials with them.

It would be better to initiate cold storage facilities for long term storage of limes, promote its export and provide investment for establishment of processing industry on lime based products.

# Identification and quantification of previously unexplored chemical and nutritional information about coconut oil and coconut cake

RG/2015/AG/03

**Principal Investigator:**

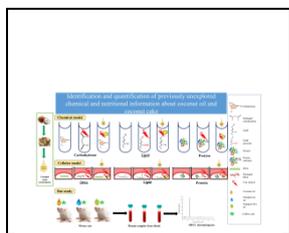
Prof. Kapila Seneviratne

**Co- Investigator:**

Prof. Nimanthi Jayathilaka

Department of Chemistry

University of Kelaniya



Antioxidant properties in chemical models and cellular model

**Postgraduate degrees completed:**

Ms. Asiri Karunasiri  
M Phil (2020)

Thesis title: Identification and quantification of previously unexplored chemical and nutritional information of coconut cake

**For more details, contact:**

Prof. Kapila Seneviratne  
[kapilas@kln.ac.lk](mailto:kapilas@kln.ac.lk)

**INTRODUCTION**

The antioxidant activity of the polyphenolic compounds extracted from coconut cake (CCPE), a byproduct of coconut oil industry, was studied. The activity of CCPE against the oxidation of the biomacromolecules was evaluated using both *in vitro* chemical methods and *in vivo* cell models.

**PROJECT ACHIEVEMENTS/OUTPUTS**

Three full papers were published. One patent was filed. Seven abstracts were published.

**UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF**

One publication was submitted. One manuscript is ready for submission. Patent comments were addressed.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Results of the project are important for the promotion of virgin coconut oil industry. Coconut oil producers in Sri Lanka all well as other countries in the world use the findings for the promotion of coconut oil. Coconut cake is a byproduct of virgin coconut oil. The project was also aimed at utilizing this byproduct.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Another grant was secured to continue with the commercialization of coconut cake extracts as food preservatives. Pilot testing of coconut cake antioxidants with commercial food samples are underway.

## Biodiversity and technological potential of micro-flora from Selected Sri Lankan dairies

RG/2016/AG/02

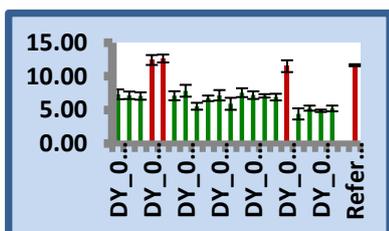
Principal Investigator:  
Dr (Ms.) Ilmi G N Hewajulige  
Industrial Technology Institute

Co-Investigators:  
Dr (Ms.) C M Nanayakkara  
University of Colombo

Dr (Ms.) W W P Rodrigo  
Ms. D U Rajawardana  
Industrial Technology Institute



*marxianus* strain isolated from the Sri Lankan dairies



Sri Lankan dairy yeast strains with the ability to produce single cell proteins from whey

### INTRODUCTION

Microbial communities of raw bovine milk represent largely unexplored reservoirs of genetic and metabolic diversity with potential beneficial use for various industrial applications. Quantifying the risks associated with dairy pathogens and organisms responsible for milk spoilage is of equal importance to safeguard the dairy economy and public health of a country.

### PROJECT ACHIEVEMENTS/OUTPUTS

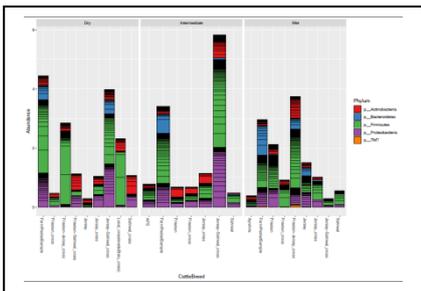
This is the first study, which investigated the microbial biodiversity of Sri Lankan dairies targeting 16S metagenomic DNA using Illumina MiSeq sequencing platform. This project laid foundation to establish the Sri Lanka's first dairy culture depository within ITI. The project generated two Journal publications, fourteen national and international communications, 16 NCBI submissions of native bacterial and yeast strains, nine awards and recognitions, one article to scientific magazines and an invited television program.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Third research paper for a refereed journal and patent writing activities are in progress. Bench work related to the Postgraduate degree is completed and thesis writing is in progress.



Farmer survey to gather information about farm hygiene, hygienic practices, animal health



Taxonomic composition (bacterial phyla) of cattle milk collected from three different climatic zones of the country (The Y axis represent the relative abundance and X axis represent the donor cattle breed)

**Postgraduate degrees completed:**

D U Rajawardana  
PhD (In progress)

**Thesis title:**

Biodiversity and technological potential of micro-flora from Selected Sri Lankan dairies

**For more details, contact:**

Dr (Ms.) Ilmi G N Hewajulige  
[ilmi@iti.lk](mailto:ilmi@iti.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Sri Lanka does not produce microbial cultures for industrial applications and the industries completely depend on imported genetically modified, freeze-dried cultures and/or undefined cultures with unpredictable performances. None of our industries is utilizing microorganisms for the production of antibiotics, enzymes, vitamins, single cell proteins, amino acids, food grade/pharmaceutical solvents etc. Strains isolated / identified from this study could be further studied and use to initiate local starter culture production.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

- Initiate the establishment of Sri Lanka’s first dairy microbial culture collection.
- Patent for the technology to produce virgin coconut oil using native lactic acid bacterial co-culture.
- Complete *in-vivo* safety assessment tests to select safer isolates for human consumption and their whole genome sequencing to use as future probiotic starters in functional food industry.
- Technology development for the production of single cell proteins using *Kluyveromyces marxianus* strains isolated from Sri Lankan dairies.

## Efficacy of soluble silicon in inducing disease resistance against post harvest fungal pathogens in banana

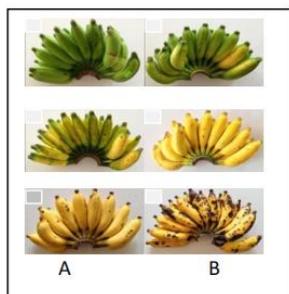
RG/2016/AG/03

### Principal Investigator:

Prof. W A M Daundasekera  
Department of Botany  
Faculty of Science  
University of Peradeniya

### Co- Investigator:

Prof. M Y U Ganehenege  
Department of Chemistry  
Faculty of Science  
University of Peradeniya



Anthraxnose development in 'Embul' bananas at 21 days of storage at room temperature;  
A = Si treated (< 5% of rot development)  
B = control treatment (> 25% of rot development)

### INTRODUCTION

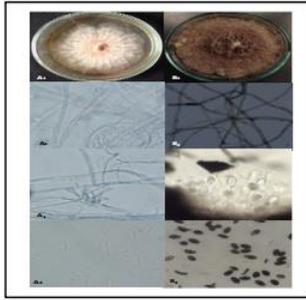
Silicon (Si) is considered as a GRAS (generally-regarded-as-safe) compound, which is capable of reducing severity of tropical fruit diseases. This ability has been attributed to Si-mediated structural and chemical changes in the host tissues. This study investigated the efficacy and mechanisms of Si in controlling postharvest fungal rots in banana.

### PROJECT ACHIEVEMENTS/OUTPUTS

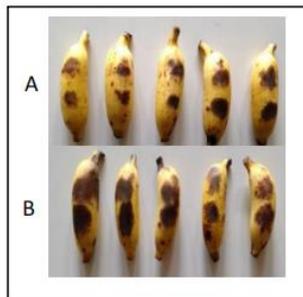
Publication of the findings in one international SCI-indexed journal and dissemination of the findings at three National Conferences.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

- The M.Phil. Thesis writing is nearly completed and expected to submit to the PGIS for examination soon.
- Another manuscript is under preparation to be submitted to a SCI indexed journal.
- The M.Phil. candidate has been absorbed to the Uva-Wellassa University as a Temporary Lecturer, based on her experience gained during this research Project.



Stemv- end rot pathogen (right) and anthracnose pathogen (left ) isolated from Embul banana



Susceptibility of Si-treated (A) and non-treated (B) Embul banana to anthracnose disease

### Postgraduate degrees

#### Completed:

N G D N Nikalgolla  
M Phil (Thesis to be submitted soon)

#### Thesis title:

Efficacy of soluble silicon in extending the keeping quality and inducing disease resistance against postharvest fungal pathogens of banana

#### **For more details, contact:**

Prof. W A M Daundasekera  
[malkanthid@pdn.ac.lk](mailto:malkanthid@pdn.ac.lk)

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Sri Lanka does not produce microbial cultures for industrial applications and the industries completely depend on imported genetically modified, freeze-dried cultures and/or undefined cultures with unpredictable performances. None of our industries is utilizing microorganisms for the production of antibiotics, enzymes, vitamins, single cell proteins, amino acids, food grade/pharmaceutical solvents etc. Strains isolated / identified from this study could be further studied and use to initiate local starter culture production.

### RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

- Initiate the establishment of Sri Lanka's first dairy microbial culture collection.
- Patent for the technology to produce virgin coconut oil using native lactic acid bacterial co-culture.
- Complete *in-vivo* safety assessment tests to select safer isolates for human consumption and their whole genome sequencing to use as future probiotic starters in functional food industry.
- Technology development for the production of single cell proteins using *Kluyveromyces marxianus* strains isolated from Sri Lankan dairies.

## Enrichment of egg yolk lipids with anti-cancer Conjugated Linoleic Acid (CLA) by feeding seed fat of bitter melon (*Momordica charantia*) to layer chickens

RG/2017/AG/03

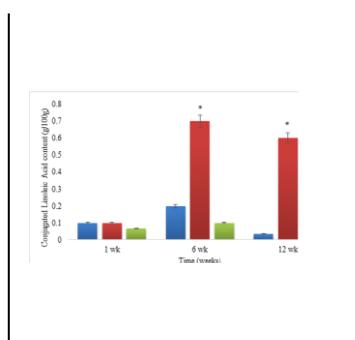
**Principal Investigator:**

Dr L J P A P Jayasooriya

**Co- Investigator:**

Dr Dilan Satharasinghe  
Prof. Anoja Wanigasekera  
Prof. R P V J Rajapakse  
Prof. S P Gunaratne

Faculty of Veterinary Medicine  
and Animal Science  
University of Peradeniya



Accumulation of CLA in egg yolk lipids at different time periods of experimental feeding. The RED color bars represent the group of birds fed with bitter

**For more details, contact:**

Dr L J P A P Jayasooriya  
[apjayasooriya@gmail.com](mailto:apjayasooriya@gmail.com)

**INTRODUCTION**

This study was designed to determine whether the alpha-eleostearic acid (ESA) from bitter melon seed fat, which is added into the poultry layer feed is converted into Conjugated Linoleic Acid (CLA) in bird's body and is deposited in egg yolk lipids as the valuable CLA (9c, 11t) which has anti-cancer properties.

**PROJECT ACHIEVEMENTS/OUTPUTS**

As it was hypothesized, the ESA was converted into CLA (9c, 11t) and was deposited in egg yolk lipids. As a result, the CLA content in egg yolk lipid was significantly increased. Thus this protocol is proved to be an effective method to enhance the natural CLA in egg yolk lipids.

**UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF**

Due to the success and the importance of the outcome of the study, the results were disseminated as two conference abstracts. Furthermore, this project was selected for the submission as a continuing research grant proposal under the high priority area. This new grant proposal is currently under the review process by NSF. Through this new proposal which was developed based on the results of this project, it is expected to test a more feasible method to enrich CLA in egg yolk lipids.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The egg is regarded as one of the most nutritious food items in the consumer market. The CLA enriched egg generated by this technology would be a super-nutritious egg and it would also acts as a prophylactic measure against cancer because the CLA (9c, 11t) has been recognized as an anti-cancer agent

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

As this novel technology has been established as a “proof of concept” it is recommended improve the technology to develop this value-added egg in to a commercial scale. A new grant scheme of the NSF has selected our project as one of the eligible concepts on high priority basis for further funding. This would certainly facilitate potential commercialization of this highly nutritious egg using a feasible method in future.

# Identification and isolation of potential anti-diabetic compounds from Sri Lankan medicinal plants

RG/2012/BS/01

## Principal Investigator:

Prof H K I Perera  
Department of Biochemistry  
Faculty of Medicine  
University of Peradeniya

## Co- Investigator:

Prof. U L B Jayasinghe  
National Institute of  
Fundamental Studies

Prof. R Sivakanesan  
University of Peradeniya

## INTRODUCTION

Diabetes mellitus causes millions of deaths each year. Humankind has a long history of using herbal remedies to treat diseases.

The objectives were to screen up to twenty medicinal plants for the in vitro inhibitory activities on  $\alpha$ -amylase,  $\alpha$ -glucosidase, lipase and protein glycation, and identify two such inhibitors.

## PROJECT ACHIEVEMENTS/OUTPUTS

Medicinal plants with strong in vitro inhibitory effects on  $\alpha$ -amylase,  $\alpha$ -glucosidase, lipase and protein glycation were identified.

Three apigenin C-glycosides with lipase inhibitory activity were purified and two of them were identified from *Trigonella foenum-graecum* seeds. Two isomers of a pentacyclic triterpenoid with amylase inhibitory effects namely, ursolic and oleanolic acid were isolated and identified from *Syzygium cumini* leaves.



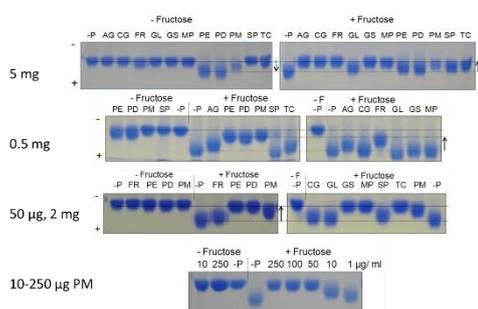
Antidiabetic plants investigated

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

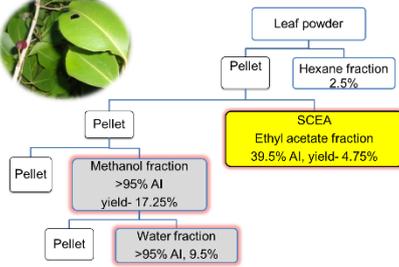
Progressed more in antiglycation effects of medicinal plants and developed another method to investigate inhibitory effects of medicinal plants on glycation induced protein cross-linking.

The research student obtained his MPhil in 2021.

The PI was promoted to the post of Professor in Biochemistry and successful completion of this grant also contributed for this.



Inhibitory effects on protein glycation of antidiabetic plants investigated



Isolation of amylase inhibitor from  
*Syzygium cumini* leaves

#### Postgraduate degrees completed:

Mr Jeyakumaran Poongunran  
M Phil (2021)

Thesis title:

Determination of antidiabetic  
potential of selected medicinal  
plants and isolation of active  
compounds from *Syzygium  
cumini* leaves.

#### **For more details, contact:**

Prof. H K I Perera

[kumudup@pdn.ac.lk](mailto:kumudup@pdn.ac.lk)

[kumudu.perera@med.pdn.ac.lk](mailto:kumudu.perera@med.pdn.ac.lk)

[kumuduperera10@gmail.com](mailto:kumuduperera10@gmail.com)

#### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Outcome is directly focusing to promote health and thereby bringing up social and economic status of humans.

Plants with potent in vitro activities were identified and could be used to alleviate chronic diabetic complications.

Findings prove that there are opportunities for employment and improving the economy of the country through agriculture and pharmaceutical industry based on these medicinal plants.

#### RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

As the indirect of the findings, one producer is progressing with a commercial product giving employment for 6 others.

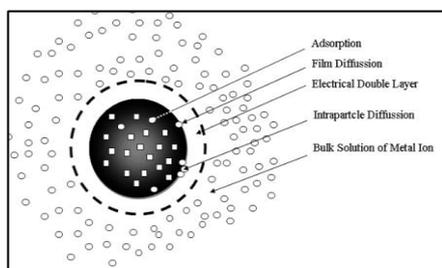
“Research is the Foundation of Knowledge”

# Kinetics and equilibrium aspects of interaction of heavy metal ions and peat in natural and modified forms

RG/2012/BS/02

## Principal Investigator:

Prof. Namal Priyantha  
Department of Chemistry  
Faculty of Science  
University of Peradeniya



Different model of adsorbent - adsorbate interaction (o) adsorbate species; (□) adsorbent sites

## INTRODUCTION

This project was on the investigation of kinetics, equilibrium and mechanistic aspects of peat – heavy metal ion interactions using raw and processed peat, under optimized conditions, for selected heavy metal ions with the intention of extending toward treatment of industrial effluents. Processing of peat would overcome certain disadvantages/drawbacks leading to stronger attraction with heavy metals.

## PROJECT ACHIEVEMENTS/OUTPUTS

It is evident that ion-exchange, and complexation of carboxylic and phenolic functional groups of humic acid present in peat are effective modes of mass transfer of Cu(II) and Cr(III) from the solution phase to the solid peat matrix, while Cr(VI) is initially reduced to Cr(III) for subsequent attraction. Further, these metal ions reach adsorption equilibrium relatively fast on peat, leading to pseudo second order kinetics with contribution to intra-particle diffusion.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Received the Technology grant of NSF for scale-up this project output until industrial application.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This project demonstrates the potential applicability of peat, available substance in Muthurajawela peat land, for treatment of industrial effluents. As mechanistic details were mainly focused in this investigation, how pollutants are removed from such substances can be understood/predicted through the findings of the project. This project will thus lead to better understanding in treatment of industrial effluents/waste water when other types of natural substances are used.

**Postgraduate degrees completed:**

M U S Wickramasooriya  
M.Phil (2016)

Thesis title:  
Kinetics and Equilibrium  
Aspects of Interaction of  
Heavy Metal Ions and Peat  
in Natural and Modified  
Forms

***For more details, contact:***

Prof. Namal Priyantha  
[namal.priyantha@yahoo.com](mailto:namal.priyantha@yahoo.com)

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

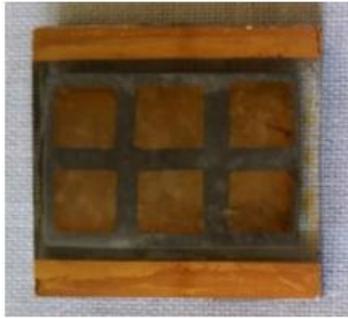
Future studies:

- Detailed investigation of interaction of humic acid and fulvic acid with metal ions under different experimental conditions.
- Investigation of interaction of other heavy metal ions with Muthurajawael peat (MP).
- Metal ion removal with different processing conditions.
- Large-scale treatment of heavy metal ion solutions with peat.

Application:

- Design of treatment plants containing processed peat for industrial effluents.





The fabricated CdS/CdTe solar cell

### **Postgraduate degrees**

#### **Completed:**

Dr W G C Kumarage  
Ph.D. (2018)

Thesis title:

Studies on modified  
CdS thin films for possible  
PV applications

#### ***For more details, contact:***

Dr B S Dassanayake  
[buddhikad@pdn.ac.lk](mailto:buddhikad@pdn.ac.lk)

### **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Solar energy harvesting and utilizing it to supply electric power to all sectors in the country will greatly reduce Sri Lanka's dependency on fossil fuels. This research will contribute towards economic development in the country as well as the well-being of the people.

As the second phase of the project, the Ministry of Science and Technology has already agreed to allocate Rs. 270 M to commercialize and educate the general public about solar energy generation of thin film solar cells.

### **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

1. The efficiency of the CdS/CdTe solar cell will be bettered through further optimization and improvisation by using different deposition techniques.
2. Arranging of seminars, workshop and conferences with collaboration of foreign delicate to educate the research community in Sri Lanka.

# Development of Energy Storing Devices using Conducting Polymers

RG/2014/BS/01

**Principal Investigator:**

Prof. K P Vidanapathirana

**Co-Investigators:**

Prof. G A K S Perera

Department of Electronics  
Faculty of Applied Sciences  
Wayamba University of Sri Lanka



Conducting polymer electrodes used to fabricate rechargeable cells & redox capacitors



Gel polymer electrolyte hot pressed between two glass

## INTRODUCTION

Li based cells and super capacitors having liquid electrolytes are dominating the market of small power requirements. These have drawbacks such as high cost, low self-life and environment issues. As an alternative, conducting polymer (CPs) based storage devices having gel polymer electrolytes were fabricated and tested.

## PROJECT ACHIEVEMENTS/OUTPUTS

Three CPs, Polypyrrole (PPy), Polyaniline (PANI) and Polyethylenedioxythiophene (PEDOT) were selected for the study. Rechargeable cells and redox capacitors were fabricated with each of those CPs using gel polymer electrolytes (GPE) as the separator. Rechargeable cells fabricated had open circuit voltages of 1.0 – 1.6 V. Highest specific discharge capacity of 393.6 Fg<sup>-1</sup> was obtained with redox capacitors having PANI electrodes and gel polymer electrolyte based on Polyvinylidene fluoride, ethylene carbonate, propylene carbonate and Zinc trifluoromethanesulfonate.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Government is keying to use of renewable sources to generate power. Solar energy is most suitable renewable source to our country and at present the government is promoting it. Power generation with solar can contribute in the day time. But to address to peak power requirement in night time there should be a storage system. Rechargeable cells and redox capacitors studied in this project can be used to design solar power storage systems. This can immensely contribute to socio-economic development of the country.



Fabricated redox capacitor  
with conducting polymer  
electrodes

**Postgraduate degrees  
Completed:**

Dr W A D S S Weerasinghe  
Ph.D. (2018)

Thesis title:

Development of energy  
storing devices using  
Conducting Polymers

***For more details, contact:***

Prof. K P Vidanapathirana  
kamalpv41965@gmail.com

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY  
DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

There should be further studies to maximize the performance of the rechargeable cells and redox capacitors. The scale of the cells and redox capacitors has to increase to the actual usage and testing should be done to bring them to the stage where they can be transforming to large scale manufacturing. This can be achieved by establishing university-industry partnership.

## Chemistry and Bioactivity of endophytic fungi from six plants used in indigenous medicine in Sri Lanka : Possible applications in health and agriculture

RG/2014/BS/02

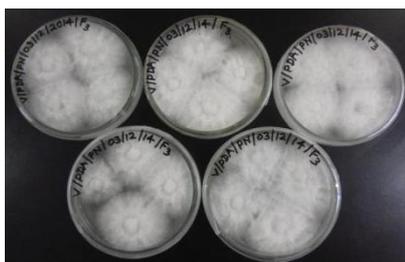
**Principal Investigator:**

Prof. U L B Jayasinghe

**Co-Investigator:**

Prof. N S Kumar

National Institute of  
Fundamental Studies  
Hantana Road  
Kandy



Endophytic fungi isolated from a plant



Endophytic grown in potato dextrose agar medium

### INTRODUCTION

The use of natural products in the management and treatment of diseases in humans and plants is culturally more acceptable and offer less risk than use of synthetic compounds. Therefore, this project was to discover suitable bioactive extracts/compounds from endophytic fungi associated with some Sri Lankan plants used in the indigenous system of medicine.

### PROJECT ACHIEVEMENTS/OUTPUTS

In this study several endophytic fungi were isolated from respective plants as *Xylaria berteri* & *Colletotrichum siamense* isolated from *Piper nigrum*; *Collectrichum capsia* & *Glomerella magna* from *Piper betel*; *Aspergillus fumigatus* from *Solanum insanum*; *Didymella macrostoma* & *Annulohyphoxylon stygium* from *Momordica charantia*. Chemistry and bioactivities these fungi were studied in detail. Sixteen secondary metabolites with diverse structural features have been isolated. The results of this study indicated the potential of secondary metabolites for various applications in health and agriculture.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

After completion of this project several workshops were conducted at National Institute of Fundamental Studies and one communication was produced.



Morphologically identification of endophytic fungi

**Postgraduate degrees completed, if any.**

Ms. M V K Munasinghe  
M Phil (2017)

Thesis title:

Chemistry and Bioactivity of secondary metabolites from endophytic fungi isolated from *Piper nigrum*, *Solanum insanum* and *Momordica charantia*.

**For more details, contact:**

Prof. U L B Jayasinghe  
[lalith.ja@nifs.ac.lk](mailto:lalith.ja@nifs.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Endophytes have attracted huge attention in the past few decades due to their ability to produce novel secondary metabolites for medical, agricultural and industrial use. It is also considered as an outstanding source of bioactive compounds due to their ability to occupy any plants at any environments. It has been estimated that there may be as many as 1 million different fungal species in our planet. Therefore, there is a very high potential to identify bioactive compounds from endophytes.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

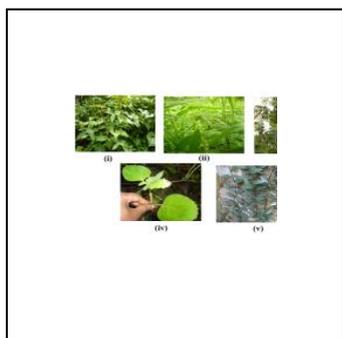
This is a three-year project and during this study we were able to identify several bioactive compounds presence in endophytic fungi from some medicinal plants of Sri Lanka. Further research on this subject will lead to useful applications of fungal extracts/secondary metabolites in health issues and agriculture and crop protection.

# A comprehensive study on the anti-inflammatory and antimicrobial secondary metabolites in selected medicinal plants

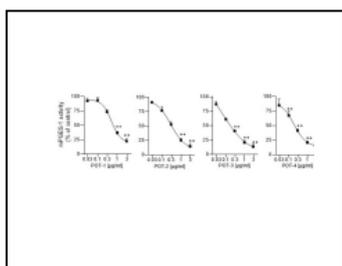
RG/2015/BS/01

## Principal Investigator:

Dr M T Napagoda  
Department of Biochemistry  
Faculty of Medicine  
University of Ruhuna



Medicinal plants employed in the study  
(i) *Hibiscus furcatus* (ii) *Leucas zeylanica*  
(iii) *Nyctanthes arbor-tristis* (iv)  
*Plectranthus zeylanicus* (v) *Pothos scandens*



Inhibition of mPGES-1 in a cell-free assay by extracts of *P. scandens* using n-hexane (POT-1), DCM (POT-2), ethyl acetate (POT-3), or methanol (POT-4)

## INTRODUCTION

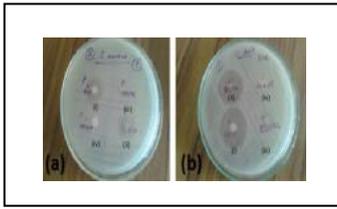
Although, a number of plant species have been employed as anti-inflammatory and antimicrobial remedies in traditional medicine, only a limited number of in-depth scientific studies are available to rationalize these traditional claims. Therefore, the anti-inflammatory and antimicrobial properties of different extracts prepared from five popular medicinal plants in Sri Lanka were evaluated in this study.

## PROJECT ACHIEVEMENTS/OUTPUTS

The project provided important insights into the biological activities of several anti-inflammatory medicinal plants in Sri Lanka and validates the traditional claims on their therapeutic potential. The detection of highly potent 5-LO and/or mPGES-1 inhibitory activities in *Plectranthus zeylanicus*, *Leucas zeylanica* and *Pothos scandens* extracts and the compounds thereof was a significant finding in the field of anti-inflammatory natural products. The findings of the project were presented as 08 abstracts in international conferences while 02 manuscripts have already been published in indexed journals.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Even after the submission of the final report, one abstract titled “*Plectranthus zeylanicus* Benth: A potent source of secondary metabolites with antimicrobial, disinfectant and anti-inflammatory activities” was presented at “Trends in Natural Product Research – Phytochemical Society of Europe- Young Scientists’ Meeting” in Budapest, Hungary in June 2019. Similarly, a manuscript titled “The Anti-Inflammatory and Antimicrobial Potential of Selected Ethnomedicinal Plants from Sri Lanka” was published in “Molecules” journal. The molecular docking experiments on the compounds isolated from *Plectranthus zeylanicus* is currently in progress.



Antibacterial activity of different extracts of *P. zeylanicus* against (a) *S. aureus* or (b) *S. saprophyticus* where (i) hexane, (ii) DCM, (iii) EtOAc, and (iv) methanol were used for extraction

**For more details, contact:**

Dr M T Napagoda

[mayurinapagoda@yahoo.com](mailto:mayurinapagoda@yahoo.com)

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The findings of the study provide new insight into the field of medicinal plant research in Sri Lanka while contributing towards the national development agenda of the country, a subarea of the National Research and Development framework (NRDF) in Sri Lanka. The outcome of the study could undoubtedly be useful for the research and development needs identified in NRDF as conducting systematic study on medicinal plants to identify their chemical composition.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

The terpenoid compounds isolated from *Plectranthus zeylanicus* will be further subjected to self-assembly studies to determine their suitability to be developed as drug delivery vehicles in the follow-up study. If this follow-up project would lead to successful findings, then necessary steps will be taken to develop herbal pharmaceuticals with a commercial value.

# Synthesis of biologically active natural product libraries of 3 $\beta$ -[( $\alpha$ -L-arabinopyranosyl)oxy]olean-12-en-28-oic acid

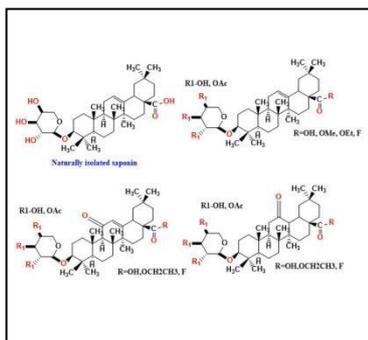
RG/2016/BS/02

## Principal Investigator:

Prof. Anura Wickramasinghe  
Department of Chemistry  
Faculty of Science  
University of Peradeniya

## Co- Investigator:

Dr Susanthi Jayasinghe  
Department of Chemistry  
Faculty of Science  
University of Peradeniya



Synthetic analogues of a triterpenoid saponin; 3 $\beta$ -[( $\alpha$ -L-arabinopyranosyl)oxy]olean-12-en-28-oic acid

## INTRODUCTION

Synthesis of natural product derived compound libraries in the search for novel anticancer drugs is still a priority goal. The reported study focused on synthesis of new structural analogues of a triterpenoid saponin; 3 $\beta$ -[( $\alpha$ -L-arabinopyranosyl)oxy]olean-12-en-28-oic acid, which exerts significant cytotoxicity against NCI-H292 cells with IC<sub>50</sub> value of 5.949  $\mu$ g/mL; in order to enhance the anti-cancer activity.

## PROJECT ACHIEVEMENTS/OUTPUTS

23 new potential anti-cancer compounds were produced by synthetic modification of natural triterpenoid saponin. Structure activity relationship of the target compound was studied. One MPhil student has been trained in the field of natural product chemistry, synthetic organic chemistry and bio-chemistry, and thereby one MPhil thesis is produced.

Four conference proceedings were published and 3 papers are in preparation. Addition of knowledge to the field of cancer studies, synthetic chemistry and natural product chemistry.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Two abstracts were published at two virtual conferences.

**Postgraduate degrees completed:**

J M Jayamini Jayasundera  
M Phil (Reading)

**Thesis title:**

Synthesis of biologically active natural product libraries of 3 $\beta$ -[( $\alpha$ -L-arabinopyranosyl)oxy]olean-12-en-28-oic acid

***For more details, contact:***

Prof. Anura Wickramasinghe  
[awick@pdn.ac.lk](mailto:awick@pdn.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Human resource development at the M.Phil. level was achieved. She could serve another institution to develop research capacity. Development of the synthetic laboratory which enables training of many post graduate and undergraduate students in the field of synthetic organic chemistry.

Sci index publications generated would enhance the research capacity of the individuals as well as the University there by increase world ranking of the university. Development of the natural product chemistry towards the Structure - Activity relationship studies of the active compounds and generation of world worthy knowledge on this regard from Sri Lanka.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

New potential anti-cancer compounds produced by synthetic modification of natural triterpenoid saponin will be avenue for further research.

# Synthesis and characterization of structure property correlation of biomass (lignin) based polyurethane foams as a replacement for petrochemical based foams use in Sri Lanka

RG/2016/BS/03

**Principal Investigator:**

Dr Thusitha Etampawala  
Instrument Centre

**Co-Investigator:**

Dr Dilru Rathnaweera  
Department of Polymer Science

Faculty of Applied Sciences  
University of Jayewardenepura

**For more details, contact:**

Dr Thusitha Etampawala  
[tetampa@sjp.ac.lk](mailto:tetampa@sjp.ac.lk)

## INTRODUCTION

The aim of this research work was to develop biomass-based polyurethane (PU) in order to replace petrochemical based existing PU foam products. Petrochemical based diols/polyols were replaced with lignin, which is a biobased polyol in the synthesis of PUs.

## PROJECT ACHIEVEMENTS/OUTPUTS

An economically feasible method to extract lignin from coconut saw dust was established. Different types of PUs were synthesized and their properties were characterized. However, their physio mechanical properties were not par with the existing PU form products in the market.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

The reasons for the poor physio mechanical properties of the synthesized PU products were identified. It was necessary to purchase different types of di or poly-isocyanates to tune the characteristics of the polyurethanes synthesized with lignin. However, none of the suppliers submitted the quotations for the required diisocyanates. Thus, project was not continued.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Our preliminary work has shown that the lignin couple with diisocyanate to form polyurethanes. If the necessary diisocyanate with rubbery middle group is available this project should definitely work.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

The research findings will be useful for future researchers in this area.

# Development of Metal Organic Frameworks as Semiconductor Materials for Dye Sensitized Solar Cells

RG/2016/BS/05

**Principal Investigator:**

Prof. C V Hettiarachchi

**Co- Investigator:**

Dr H A I R Perera

Department of Chemistry  
Faculty of Science  
University of Peradeniya

## INTRODUCTION

Growth in the energy demand in the world has encouraged scientists to explore novel techniques to harvest energy from renewable energy sources. Solar energy grabs the foremost attention as the most abundant and free available renewable energy source. Dye sensitized solar cell (DSSC) has a potential to harvest solar energy at low manufacturing cost. These devices had a slow but a steady development throughout the last two decades. Thus, it is high time to introduce a new type of solar cells based on versatile material; Metal Organic Frameworks (MOF).

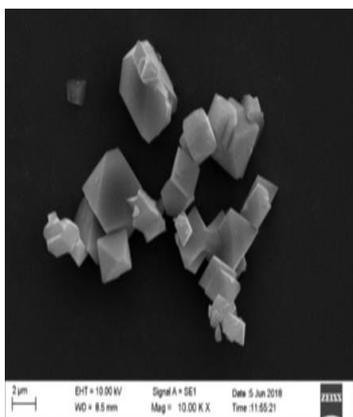
## PROJECT ACHIEVEMENTS/OUTPUTS

MOF based dye sensitized solar cells are a new group of photovoltaic having a long journey in the development. Results of this project were able to enhance and fine tuning of the semiconductor properties of few MOFs by encapsulating guest molecules and fabricating MOF-TiO<sub>2</sub> co-shell particles. Solar cells fabricated with these new materials developed as the photoanode indicated that there is a great possibility of developing them further to achieve higher efficiencies in the future as a new branch of solar cell research.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Completion of the M.Phil. thesis by the student.

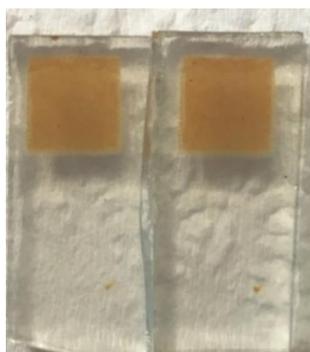
Two peer reviewed journal publications were produced.



SEM image of MOF-199 synthesized



Fabrication of thin films using  
Screen Printing methods



Thin films of MOF-74(Ni) coated  
TiO<sub>2</sub> based photoanode

**Postgraduate degrees completed:**

Ms. Suleshi Niwarthana  
Abeysingha  
M Phil (2021)

Thesis title:

Development of Metal Organic  
Frameworks as Photoanode  
Materials for Photovoltaic  
Applications

***For more details, contact:***

Prof. C V Hettiarachchi  
[champikav@pdn.ac.lk](mailto:champikav@pdn.ac.lk)  
[champikav@sci.pdn.ac.lk](mailto:champikav@sci.pdn.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The area of this research project is still in its early stages. Thus commercialization may require more extensive research. Harvesting solar energy to produce electricity is promising owing to its abundance and sustainability. Thus, development of stable devices under prolong exposure to sunshine, is vital. From this project we have demonstrated the possibility of fabricating MOF based solar cells. These studies pave the way to fabricate stable solid-state devices that are tuneable according to the requirements of the application.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Not in the near future, as this field of research is still in the early stage of the development in the international technology.

## Synthesis and characterization of ionic liquid based gel polymer electrolytes to be used for rechargeable cells and super capacitors

RG/2017/BS/02

**Principal Investigator:**

Prof. G A K S Perera

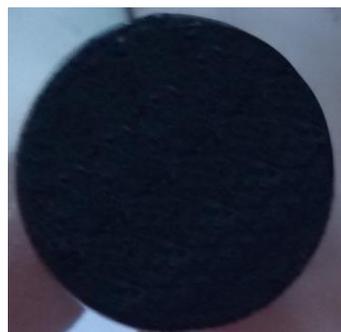
**Co- Investigator:**

Prof. K P Vidanapathirana

Department of Electronics  
Wayamba University of Sri  
Lanka



A gel polymer electrolyte prepared with solvent casting technique



A natural graphite electrode for rechargeable cells

### INTRODUCTION

Energy storage devices with appropriate electrolytes have received a great attention at present. Ionic liquid (IL) based gel polymer electrolyte (GPE)s belong to one category of interest. Several international research groups work on those GPEs. But, to our knowledge no Sri Lankan research team has yet entered to this area.

### PROJECT ACHIEVEMENTS/OUTPUTS

Incorporating ionic liquids, thin and mechanically stable gel polymer electrolytes were prepared with good ionic conductivities at ambient temperature. Rechargeable cells and super capacitors were fabricated using those GPEs and they had appreciable performance to be developed as marketable products.

One degree of Master of Philosophy was completed. Following number of publications were produced.

SCI Publications	:	06
Refereed Journal Publications	:	04
Conference Proceedings	:	06

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

A postgraduate student is carrying forward the work for developing more ionic liquid-based electrolytes to be used for rechargeable cells and super capacitors. Successful results have been obtained with a Zn based electrolyte. It was tested for use in rechargeable cells and super capacitors and observed good results. One research paper has been published in a SCI journal and two presentations were done at local conferences.



A fabricated super capacitor

**Postgraduate degrees completed:**

Mrs. K W Prasadini  
M.Phil (2020)

Thesis title:

Study on ionic liquid-based gel polymer electrolytes for energy storage devices

***For more details, contact:***

Prof. G A K S Perera

[kumudu@wyb.ac.lk](mailto:kumudu@wyb.ac.lk)

[kumudu31966@gmail.com](mailto:kumudu31966@gmail.com)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The cost of the rechargeable cells and super capacitors fabricated and tested are quite comparable with their performance. So, they are affordable to people even at low income levels. This will immensely promote use of renewable energy for the cover up of day to day power requirements. Ultimately, this relieves the gigantic power demand. Realizing the suitability of natural graphite is also supporting for value addition for a natural resource.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Performance of the laboratory scale devices can be further improved and after that, commercial level products can be fabricated. Support from suitable investors is needed for the transition from laboratory scale to market stage.

## Fundamental Studies on Y-TZP ceramics and mechanisms for enhancing the hydrothermal ageing resistance

RG/2017/BS/04

### Principal Investigator:

Dr U Sutharsini  
Department of Physics  
University of Jaffna



Densitometer bought from this grant



Material Science Lab opened by our Head of the Department

### INTRODUCTION

3 mol% yttria stabilized tetragonal zirconia polycrystalline (3Y-TZP) ceramics are excellent biomaterial for dental and bone implants. However, the slow degradation in aquas environment makes it not suitable for this application. In this work, a two-step sintering process applied to enhance the hydrothermal ageing resistance of 3Y-TZP ceramics and to determine the ageing mechanism.

### PROJECT ACHIEVEMENTS/OUTPUTS

It was found that the argon sintering enhances the hydrothermal ageing but in the expenses of mechanical properties and the ageing resistance is highly depending on the second step sintering time. Also, the research revealed that the prolonged second step sintering time increases the surface yttria content and hence the ageing. The findings of the work were published in 2 SCI indexed journals.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Future research work carried on effect of dopant on hydrothermal ageing resistance of 3Y-TZP ceramics. One SCI indexed publication and one communication were produced.



Current work presented at ICAMR 2019, Singapore

***For more details, contact:***

Dr U Sutharsini

[ubsutharsini@univ.jfn.ac.lk](mailto:ubsutharsini@univ.jfn.ac.lk)

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Zirconium composites are achieved from natural minerals, mainly zircon. Sri Lanka is well-endowed with industrial minerals including Graphite, Ilmenite, Rutile, Zircon, Quartz, Feldspar, Clay, Kaolin, Apatite, Silica Sand, Garnet sand, Mica, Calcite and Dolomite. Pulmoddai beach sand deposit is the most important mineral reserve in Sri Lanka to date. This work will improve the understanding of the materials and create an awareness on our mineral resources to the society.

## **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Two step sintering can be developed as an effective sintering method to prepare 3Y-TZP ceramics with improved ageing resistance. However, we need a furnace (worth 2.5 million) and a cold isostatic pressing system (worth 2.5 million) to continue the research.

# Construction and characterization of expression vector cassettes containing genes for wheat proteins, gliadin and glutenins-towards the development of wheat-like rice

RG/2010/BT/04

## Principal Investigator:

Prof. W S S Wijesundera  
Department of Biochemistry  
& Molecular Biology  
Faculty of Medicine  
University of Colombo

## Co-Investigators:

Dr N V Chandrasekharan  
Department of Chemistry  
Faculty of Science  
University of Colombo

## INTRODUCTION

Gluten proteins, gliadin, low molecular weight (LMW) and high molecular weight (HMW) glutenins gives elasticity and extensibility required for bread making. Therefore, the present study was aimed at developing transgenic rice lines containing gluten proteins towards improving the dough functionality that could complement wheat flour for bread making in Sri Lanka.

## PROJECT ACHIEVEMENTS

Vector cassettes containing gliadin, LMW and HMW glutenin genes under the control of rice Glutline B-1 promoter were constructed and transformed into Bg250 rice using *Agrobacterium* mediated & *in-planta* transformation. The transgenic plants of all three genes produced seeds and the expression of gliadin, LMW glutenin in the T<sub>1</sub> transgenic rice seeds were confirmed by Western Blot analysis. The methodology used in the development of these transgenic rice plants can be applied to other economically important crops.

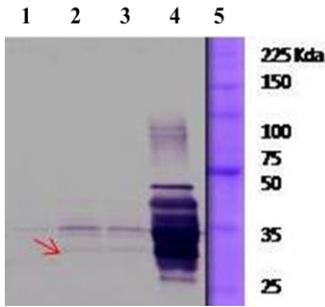
## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

According to the Central Bank statistics over 300 million dollars are spent on wheat imports every year. The transgenic “wheat like rice” lines can be used as a substitute for wheat flour in the bakery industry. Furthermore, gluten expressing gene constructs can also be introduced into kurakkan plants to improve the dough making ability of kurakkan bread. Kurakkan flour has lower glycemic index compared to wheat flour. Constructed recombinant vector cassettes could also be patented.

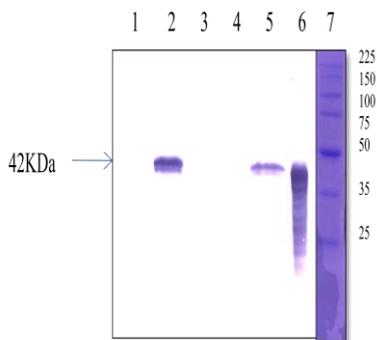
Gliadin      LMW Glutenin      HMW Glutenin



Bg250 transgenic plants containing gliadin, LMW & HMW glutenin genes of T<sub>1</sub> generation and the harvested seeds



Identification of gliadin protein in transgenic rice flour using Western Blot analysis. Lane 1- non transgenic rice flour, Lane 2,3- transgenic rice flour, lane 4- wheat flour and lane 5- broad spectrum Protein ladder (stained with Coomassie blue R-250)



Identification of LMW glutenin protein in transgenic rice flour using Western Blot analysis. Lane 1- non transgenic rice flour, lane 2,3,4,5- transgenic rice flour, lane 6- wheat flour and lane 7- broad spectrum protein ladder (stained with Coomassie blue R-250)

## FOLLOW-UP

Transgenic rice containing gluten proteins have been developed. The next step would be to express all three genes in a single rice plant. This can be achieved by identifying homozygous lines in  $T_2, T_3, T_4$  generations. The homozygous lines can be artificially crossed to generate transgenic rice line expressing all three genes and confirm the expression by Western blot analysis. Field trials can then be carried out after obtaining approval from National Competent Authority, Sri Lanka.

### Postgraduate degrees completed:

Dr Kirushanthy Panchanathan  
PhD (2017)

Thesis title:

Construction and characterization of expression vector cassettes containing genes for wheat proteins, gliadin and glutenins-towards development of wheat-like rice

### For more details, contact:

Prof W S S Wijesundera  
[sulochanawijesundera@gmail.com](mailto:sulochanawijesundera@gmail.com)  
[sulochana@bmb.cmb.ac.lk](mailto:sulochana@bmb.cmb.ac.lk)

# Development of a molecular detection system of causal agents for controlling virus and virus-like diseases of chilli (*Capsicum annum L.*) in Sri Lanka

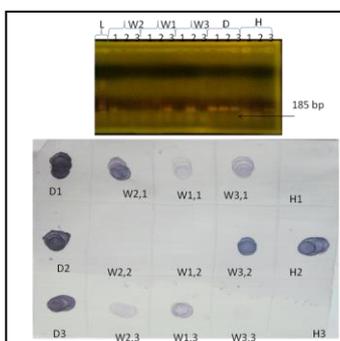
RG/2011/BT/01

## Principal Investigator:

Prof. D M De Costa  
Department of Agricultural  
Biology  
Faculty of Agriculture  
University of Peradeniya



Variety-MI-2, collected from Galkiriyagama showing symptoms of CLCC



Signal development by the DNA probe through dot-blot hybridization when PCR products given by alternative hosts were arrayed on a membrane

## INTRODUCTION

Chilli leaf curl complex (CLCC) and chilli narrow leaf disorder (CNLD) are the major virus and virus-like diseases of chilli cultivation in Sri Lanka. The study was aimed to (1). Molecular identification and characterization of causal agents of CLCC and CNLD (2). Development of a nucleic acid hybridization-based detection system for screening causal agents in plant materials/vectors and alternative hosts as a preventive measure of chilli leaf curl complex and chilli narrow leaf disorder and (3). Validation of the effectiveness of the developed detection system.

## PROJECT ACHIEVEMENTS/OUTPUT

PCR, DNA sequencing and homology search revealed that the causal viruses in CLCC-infected plants were highly homologous to chilli leaf curl virus isolate 14 and 15. Seeds of the CLCC-infected plants did not contain the virus in seed tissues. Moreover, association of RNA-type virus was not identified in CLCC-infected chilli plants.

Phytoplasma was detected in CNLD-infected chilli plants and the symptomless flush produced by the infected plants after replanting. N phytoplasma was detected in seeds and pericarps of seeds of the infected plants. Begomovirus were also not present in CNLD-infected plants. Based on DNA sequences of CLCC isolate 14 and 15, a DNA probe was designed to detect the virus in plant tissues, seeds, alternative weed hosts and insect vectors.

## UPDATED STATUS AFTER THE FINAL REPORT IS ACCEPTED BY THE NSF

Following research was conducted as a M.Phil. degree in 2017 Molecular variations of viruses infecting chilli (*Capsicum annum L.*) and tomato (*Solanum lycopersicum L.*) and insect vectors involved with virus transmission in different agroecological zones of Sri Lanka.



CNLD-infected chilli plant

***For more details, contact:***  
Prof. D M De Costa  
[devikadecosta@gmail.com](mailto:devikadecosta@gmail.com)

#### **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Research output is useful to control a major disease in chilli by accurate and efficient detection at early stage of crop establishment. Such early detection systems are useful to researchers in the fields of Plant Breeding, Plant Pathology, Entomology, Plant Quarantine and Seed Certification and also to the personnel involved with chilli cultivation even though they may not have much technical expertise. Moreover, the expected research output has many beneficial impacts on national food security, economic development, poverty alleviation, environmental sustenance, well-being of human, on the improvement of high-tech industry as well as agro-industry. All these aspects are highly essential for the development of sustainable Agriculture in Sri Lanka.

#### **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

The DNA probe developed in the study can be used for rapid and early detection of CLCV. It is possible to develop such a probe as a field identification kit or a rapid virus detection kit.

# Molecular mapping for improved salinity tolerance in rice

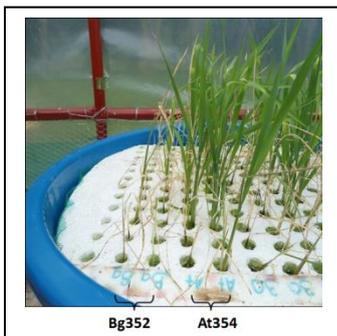
RG/2011/BT/02

## Principal Investigator:

Prof. N S Kottarachchi  
Department of  
Biotechnology  
Faculty of Agriculture &  
Plantation Management  
Wayamba University of Sri  
Lanka

## Co- Investigator:

Dr Gamini Samarasinghe  
Rice Research and  
Development Institute  
Department of Agriculture



Bg352 and At354 rice varieties grown under salinity stress condition (EC 12 dS/m) showing their divergence phenotype

## INTRODUCTION

A cross between At354, a salt tolerant parent and Bg352, a salt susceptible parent was made to produce recombinant inbred line (RIL) population, and the F5 population was used to map salinity responsive QTLs, as the first local population used for gene mapping in Sri Lanka. The results revealed few promising QTLs and the study was extended to identify the most promising QTLs using Single Nucleotide Polymorphic (SNPs) markers at International Rice Research Institute, Philippine.

## PROJECT ACHIEVEMENTS/OUTPUT

1. Promising QTL hotspots with salinity tolerance potential were identified.
2. SNP based high density Molecular maps were developed for 12 chromosomes in rice.
3. These QTLs were used as the base for finding candidate genes for salinity tolerance via a new Research grant.
4. Research findings were disseminated in 5 peer reviewed journal including one SCI publication and 10 conference proceedings.
5. Following awards were received for the project and related publications.
  - i. NSF Certificate of Commendation under Biotechnology Category 2019
  - ii. NSF awarded SUSRED Award 2018
  - iii. National Research Council -Merit Awards- 2016
6. One MPhil and One PhD degree holders were produced
7. The knowledge gained from the project was disseminated to Sri Lankan scientists via a workshop

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

In order to continue with the research findings, a grant (NRC-16-16) was obtained from the National Research Council. The new project was involved in NGS based whole genome sequencing of Bg354 and At352 rice varieties and the discovery of candidate genes in salinity tolerant QTLs.

**Postgraduate degrees completed:**

Ms Buddika Dahanayake  
M Phil (2015)

Thesis title:

Molecular Mapping of quantitative trait loci associated with salinity tolerance using a RIL population of rice

***For more details, contact:***

Prof. N S Kottearachchi  
[kottearachchins@yahoo.com](mailto:kottearachchins@yahoo.com)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This project developed human resources in the area of plant molecular breeding, by producing one M.Phil degree and one PhD degree holders. Also, this research provided research themes for four undergraduate students to strengthen their research capacity. International Rice Research Institute (IRRI), Philippine accepted this project to do a part collaboratively with a Sri Lankan student whom was offered Global Rice Science scholarship to do a PhD.

The MPhil student was able to receive a Scholarship from University of Southern Queensland, Australia to pursue her doctorate degree in a similar research field as she became an expert in the plant molecular breeding because of this project.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Few recombinant inbred lines of the mapping population used in this study were identified as promising salinity tolerant lines and they were handed over to the Rice Research and Development Institute, Batalagoda as intermediate parents to examine the field level salinity tolerance.

Using the findings of this research, a new research was proposed and a grant was obtained from the National Research Council, Sri Lanka under the title of "QTL map based candidate gene discovery for salt tolerance in rice (*Oryza sativa*)", where NGS based whole genome sequencing of At354 and Bg352 was conducted, by giving an opportunity to do another PhD degree.

# Characterization of mutations and sequence variants of Growth Hormone (*GH1*) and Growth Hormone Releasing Hormone Receptor (*GHRHR*) in a cohort of Sri Lankan children with growth hormone deficiency

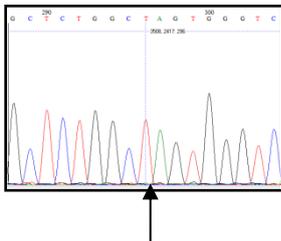
RG/2011/BT/03

**Principal Investigator:**

Prof. Kamani H Tennekoon

**Co- Investigator:**

Prof. Shamy De Silva  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology



The mutation at codon 72

Part of the electropherogram which shows homozygous mutation at codon 72 of *GHRHR* gene



The image is of twin sisters. The child on the right is affected with growth hormone deficiency.

**For more details, contact:**

Prof Kamani H Tennekoon  
[kamani@ibmbb.cmb.ac.lk](mailto:kamani@ibmbb.cmb.ac.lk)

## INTRODUCTION

Growth hormone deficiency (GHD) leads to short stature. The genetic causes of GHD have not been studied in Sri Lankan children previously. In the present study we characterized mutations and sequence variants of *GH1* and *GHRHR* (growth hormone releasing hormone receptor) genes in a cohort of children biochemically and clinically confirmed to have GHD.

## PROJECT ACHIEVEMENTS

In our cohort we observed *GH1* gene deletion in two children, reported pathogenic mutations in *GH1* gene in two children, codon 72 mutation of *GHRHR* gene in eight children and another pathogenic mutation in codon 71 of *GHRHR* gene in one child. In addition several sequence variants/polymorphisms in the *GH1* gene and *GHRHR* gene were also observed.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Establishment of genetic screening for *GH1* and *GHRHR* genes will facilitate screening of affected children and their parents. In the event the mutations detected are hereditary, genetic counseling can be offered to parents to minimize birth of the affected children.

## FOLLOW-UP

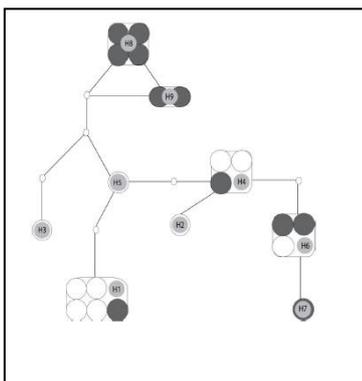
Currently screening of children with short stature for *GH1* gene deletion, mutations in the *GH1* gene and *GHRHR* codon 72 mutation are available at the IBMBB at the cost price.

## Development of DNA based techniques to differentiate *Anopheles culicifacies* species B from species E and *An. subtopics* from *An. sundaicus*

RG/2011/BT/04

### Principal Investigator:

Prof. S N Surendran  
Faculty of Science  
University of Jaffna



### Haplotype network of *COI* of the *An. culicifacies* s.l. populations.

The network is composed of sibling species B (black large circles) and E (white large circles). Large circles indicate individual sequences and the haplotype numbers are shown as H series. Small empty circles represent missing hypothetical haplotypes.

### INTRODUCTION

The *Anopheles culicifacies* sensu lato and *An. subpictus* s.l are the major and secondary vectors of malaria respectively in Sri Lanka. Both species exists as species complex comprising two sibling species each. The major objective of the project was to develop a DNA based diagnostic techniques to differentiate *An. subpictus* from *An subpictus* B (*An. sundaicus*) and sibling species B from sibling species E of the Culicifacies complex.

### PROJECT ACHIEVEMENTS/OUTPUTS

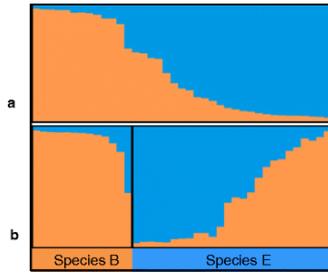
(i) An allele specific PCR- assay has been developed to distinguish sibling species A and sibling species B/*An. sundaicus* in Sri Lanka.

(ii) The molecular data urge for taxonomic reassessment of the Subpictus Complex and other closely related member of the Sundaicus Complex.

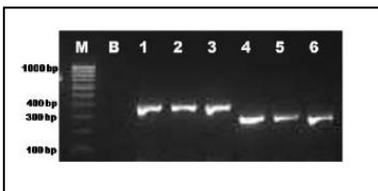
(iii) The microsatellite data show that there are two genetically distinct populations in the *An. culicifacies* complex that are not associated with Y-chromosome morphology.

(iv). All molecular data suggest that species B and E are not reproductively isolated to have fixed molecular variation to call true sibling species (morphologically more or less similar but reproductively isolated members of a species) but may show different biological traits.

The PI continues to work on *An. subpictus* and *An. sudnaicus* complex using the available resources established through the grant to study the genetic properties and insecticide resistance of mosquito samples collected from northern Sri Lanka. A manuscript has been submitted and identified by publishers as potential for publication in the reputed journal *Parasites and vectors* (Impact factor: 3.2)



Clustering of putative species B and E of the Culicifacies Complex in Sri Lanka by STRUCTURE



Identification ASPCR assay for *An. subpictus* species A from *An. sudaicus* s.l.

**Postgraduate degrees completed:**

Ms Kokila Sivabalakrishnan  
M.Phil (to be awarded)

Thesis title: Cytogenetics and population genetics of *Anopheles subpictus* complex in Northern Sri Lanka

**For more details, contact:**  
Prof. S.N. Surendran  
[noble@univ.jfn.ac.lk](mailto:noble@univ.jfn.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This project has generated crucial tools for identifying important malaria vectors in the field, which is a necessary step to formulating and subsequently implementing effective vector control measures by health authorities to reduce the socio-economic burden of the country due to malaria. Since members of a species complex show different bio-ecological traits, the developed molecular tool can be effectively used to establish bio-ecological traits mainly insecticide resistance of species A and species B of the Subpictus complex.

The results show the presence of genetic variations in the major malaria vector *An. culicifacies* that is not associated with karyotypic assignment of sibling species. Considering their role in malaria transmission a population genetic analysis along with insecticide resistance is essential to control malaria when there is a re-emergence or local transmission

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Even in the absence of local transmission it is recommended to continuously monitor the major vector populations and funding is essential to study the genetic property of the major malaria vectors *An. culicifacies* and discriminating *An. subpictus* from *An. sudaicus* s.l. Since malaria is endemic in the neighbouring Southern State of India. Further taxonomic re-assessment is essential with the wider collaboration of South-Asian countries to determine the systematic position of Sri Lankan *An. sudaicus* s.l.

## Development of *Bacillus thuringiensis* (Bt) microbial pesticide with enhanced and broad-spectrum activity to control rice and vegetable pests

RG/2011/BT/05

### Principal Investigator:

Dr Radhika Samarasekera  
Industrial Technology Institute  
Buddhaloka Mawatha  
Colombo 07

### Co- Investigator:

Dr O V D S J Weerasena  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology (IBMBB)  
University of Colombo

### INTRODUCTION

The project addressed the development of *Bacillus thuringiensis* (Bt) microbial bio-pesticides with enhanced and broad-spectrum activity for crops. In this study, 18 indigenous insecticidal Bt strains were isolated and identified and previously isolated 11 indigenous insecticidal Bt strains were also characterized. i.e. Bt kurstaki (5 strains), Bt graciosensis (8 strains), Bt poloniensis (1 strain), Bt canadensis (1 strain), Bt konkukian (5 strains), Bt israelensis (4 strains), Bt jegathesan (2 strains), Bt morisoni (1 strain), Bt aizawai (1 strain), Bt kenya (1 strain), Bt galleriae (1 strain), Bt 1.AL15.7 (1 strain) and Bt 1. BE17.3 (1 strain).

### PROJECT ACHIEVEMENTS/OUTPUT

This is the first report of isolating Bt subspecies, graciosensis, poloniensis, canadensis konkukian, jegathesan, morisoni, aizawai, kenya, galleriae, 1.AL15.7 and 1. BE17.3 from Sri Lanka. Four Bt strains were identified with improved chitinase activity among the 23 chitin degrading strains. Bt kurstaki and Bt jegathesan strains showed elevated insecticidal activity against *Plutella xylostella* (diamondback moth) and rice leaf folder hence can be used as promising biological control agents for the control of pests of crops. This study also identified Bt morisoni and Bt aizawai with good insecticidal activity against root pests.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF PROJECT ACHIEVEMENTS/OUTPUT

The project has contributed to scientific advancement through local and international journals and communications and a PhD thesis.

**Postgraduate degrees completed:**

Ms Rashini Baragama  
Arachchi  
M.Phil (to be awarded)

**Thesis title:**

Development of *Bacillus thuringiensis* (Bt) microbial pesticide with enhanced and broad-spectrum

***For more details, contact:***

Dr Radhika Samarasekera  
[radhika@iti.lk](mailto:radhika@iti.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

*Bacillus thuringiensis* microbial pesticides developed through this study have applications in agriculture to control lepidopteran and coleopteran pests attacking vegetables and rice as well as root pests of vegetables and fruits thus contributing to increase the crop productivity by minimizing pest damage. *Bacillus thuringiensis* an alternative for synthetic pesticides in agriculture and also a viable option to use in organic agriculture to produce high-value organic crops and products which have a competitive advantage and high global market price.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

*Bt microbial* pesticides have high potential as a bio pesticide and have applications in agriculture, especially in organic agriculture in Sri Lanka. Further, Bt is an alternative for synthetic pesticides. Therefore, Bt pesticides have higher commercialization potential in Sri Lanka. It is required to conduct large-scale farmer field trails for the selected Bt strains using industrial-scale production.

## Assessment of genetic diversity and tracing the origin of weedy rice population found in rice fields of Sri Lanka

RG/2011/BT/06

### Principal Investigator:

Prof. S R Weerakoon

### Co-Investigators:

Dr S Somaratne  
Department of Botany  
The Open University of Sri  
Lanka

Dr O V D S J Weerasena

IBMBB

University of Colombo



Panicle of Weedy Rice



Weedy Rice growing in rice fields in Sri Lanka

### INTRODUCTION

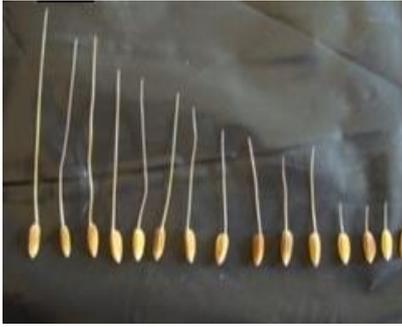
Weedy rice (*Oryza sativa* f. *spontanea*), is a recently emerged rice-weed spread through rice growing areas in the world. WR is a competitor of cultivated rice, causing considerable economic constraint due to loss of quality and quantity of yield. In Sri Lanka, there are zone-specific cultivated rice varieties and wild rice species and discontinuously distributed weedy rice populations. Thus, there is a confusing problem on the origin and distribution of WR in Sri Lanka. The study focused to characterize different populations and trace possible origins of WR.

### PROJECT ACHIEVEMENTS/OUTPUT

The agro-morphological characters such as seedling height, leaf blade width, leaf blade length, culm strength, panicle shattering, seed coat color and leaf angle emerged as salient characters in distinguishing WR populations. The pattern of morphological diversity of different weedy rice populations in climatic zones suggest vague ancestry centered on the species *O. nivara* and *O. rufipogon*. Five out of ten markers, RM280, RM14, RM167, RM205 and RM332 were appeared as potential markers in differentiating WR populations from cultivated rice varieties and wild rice species and RM280 stands out as the most important maker in identification of WR eco-types. The genetic diversity of the cultivated rice varieties, wild rice species and WR populations indicated zonal groups in which wet zone cultivated rice varieties and WR populations grouped together and associated with wild rice species, *O. rufipogon* indicating ancestral role of it and similarly, dry zone populations of cultivated rice varieties and WR are closely related to wild rice species *O. nivara* reflecting the potential ancestry of dry zone WR populations.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

A hypothetical model of the emergence and evolution of WR in Sri Lanka over time was developed. It shows that Sri Lankan WR populations have multiple origins.



Seeds of different weedy Rice Eco-types collected from rice fields in Sri Lanka

**Postgraduate degrees completed:**

K D K Karunaratna  
M.Phil (2017)

**Thesis title:**

Genetic Diversity and  
Origin of Weedy rice  
(*Oryza sativa* f. *spontanea*)  
Populations Found in Rice  
Fields in Sri Lanka

**For more details, contact:**

Prof. S R Weerakoon  
[shyamaweerakoon@gmail.com](mailto:shyamaweerakoon@gmail.com)

Wild rice had influenced emergence of first WR populations in Sri Lanka through the process of exoferality (wild rice with cultivated rice) and secondary origins of WR eco-types were resulted from the endoferality (WR eco-types with cultivated rice species). In Sri Lankan context, Bg 11-11, an old-cultivated rice variety, have been identified as a potential progenitor of WR eco-type populations. The exoferality and endoferality are the driving forces of WR evolution in Sri Lanka which produce new WR populations with time, which are adapted to the conditions in the corresponding agricultural environment.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The close similarity (physiological and morphological) between WR and cultivated rice prevents the use of selective herbicides in controlling WR during the crop growth stages. Due to this difficulty, farmers are unable to obtain a clean paddy harvest from their paddy fields. WR is a competitor of cultivated rice, causing considerable economic constraint due to loss of quality and quantity of yield, which affects the national rice production. Once fields are infested with WR, the cost of control is very high. Therefore, understanding of the evolution of WR is an important effort on the way to efficient controlling strategies. The scientific knowledge of the history of rice cultivation and the emergence of WR provides an evolutionary path taken by WR in a rice cropping system in a particular area of the world. This knowledge is crucial to prevent the emergence and spread of WR in rice fields of Sri Lanka, and to apply new management strategies for effective controlling of WR.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

- The evolution of WR is a continuous time-bound process that produced various WR eco-type populations.
- This process is required to control the formation of new WR eco-type population through using certified seeds, introducing transplanting instead of direct seeding and avoidance of the use of contaminated agricultural machinery.
- Need to focus on the quick identification of existing WR eco-type populations using molecular markers.
- Required efficient controlling of already existing WR populations.
- Need prevention of the formation of new WR eco-type populations by adapting the existing agricultural practices in the country.

## Anther culture with local *Oryza sativa* subsp. *indica* (rice) germplasm for doubled haploid production

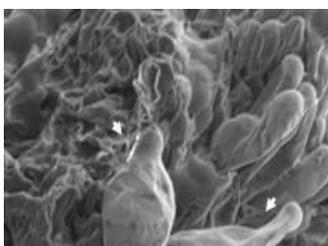
RG/2011/BT/10

**Principal Investigator:**

Prof. T D Silva  
Department of Plant  
Sciences  
Faculty of Science  
University of Colombo

**Co-Investigator:**

Ms. N P S de Silva  
Regional Rice Research  
and Development Centre  
Bombuwela



Scanning electron micrograph of regenerating compact callus (white arrows-oblong protrusions on callus surface)

### INTRODUCTION

In vitro culture of anthers leads to the development of doubled-haploid plants with complete homozygosity. Therefore, anther culture technique can be used as a rapid alternative route to conventional breeding for development of inbred lines. The study investigated various factors that affect anther culture response in selected indica rice varieties.

### PROJECT ACHIEVEMENTS/OUTPUT

1. Identification of anther-culture responsive genotypes among local rice germplasm
2. Determination of factors that promote callus induction from indica rice microspores
3. Production of haploid/di-haploid plants in rice variety At 303
4. Development of human capital through successful completion of the research and defense of thesis leading to award of a PhD degree
5. Dissemination of research findings through 05 conference proceedings, 01 book chapter and 03 peer reviewed articles in SCI-indexed journals

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Research assistant who worked on the project joined the permanent academic staff of the University of Colombo and is continuing investigations into cellular changes in cold stressed microspores of rice variety At 303. Results have revealed that cold stress prevents gametogenesis in microspores and arrest cells in the late uni-nucleate stage, the most favorable stage for sporophytic induction. Histological studies on regenerating callus tissues have shown that histo-differentiation occurred mostly from compact callus.



Anther-derived rice plants of variety At 303



Prolific callus induction in variety Hondarawalu

**Postgraduate degrees completed:**

Dr D M R G Mayakaduwa  
PhD (2019)

Thesis title:

Anther culture  
with local *Oryza sativa* L.  
*subsp. Indica* (rice)  
germplasm for doubled  
haploid production

***For more details, contact:***

Prof. T D Silva  
Department of Plant Sciences  
Faculty of Science  
University of Colombo  
[tara@pts.cmb.ac.lk](mailto:tara@pts.cmb.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Development of a standard protocol for regeneration of haploid/di-haploid plants through in vitro anther culture will substantially reduce the time taken to release new rice varieties. The project generated new knowledge that is helpful for streamlining anther culture procedure with local indica rice. Further improvements in the technique may contribute to the accelerated release of new rice varieties, which in turn will help to reduce time and resources spent on achieving breeding goals.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

For practical utility of the technique, callusing frequency in anthers and rate of plant regeneration from induced callus must be enhanced significantly. Therefore, further research is required to determine in vitro conditions and ex vitro factors that would contribute to the substantial improvement in overall success.

# Molecular characterization of bacteria involved in Bioremediation of heavy metals and elucidation of possible bioremediation mechanisms

RG/2011/BT/08

**Principal Investigator:**

Dr C D Wijayarathna

**Co- Investigator:**

Dr N V Chandrasekharan

Department of Chemistry  
Faculty of Science  
University of Colombo

## INTRODUCTION

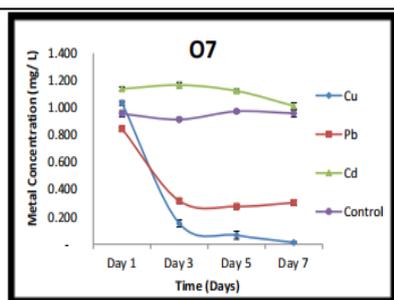
Bioremediation is an alternative approach for metal removal in addition to conventional methods, using the gained or evolved capabilities of bacteria, to detoxify industrial effluents. The genetic determinants of such bacteria for heavy metal resistance can be manipulated for the development of a novel strain to be used in bioremediation.

## PROJECT ACHIEVEMENTS/OUTPUT

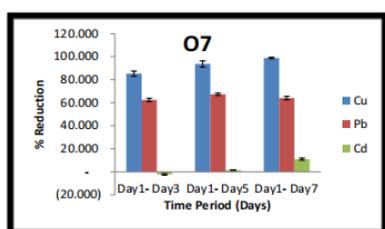
Isolated bacterial strains were identified up to species level using 16S rRNA sequence analysis. Isolates have the potential to remove Cu, Cd and Pb. Presence of *cadA*, *cadD* and *copA* genes reveals that these species employ efflux mechanisms for tolerance of metals from surroundings. Heavy metal tolerant genes of these bacterial strains (*copA*, *cadA*, *copZ*, *cadC* and *cadD*) were isolated and analysed by sequence analysis. To determine the resistant mechanisms complete genes of interest *copA*, *cadA*, *cadC* and *copZ* of bacterial strains were cloned successfully.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Primers designed for this study can be further used to screen metal resistant genes in unknown/known bacteria. The data obtained in this study will benefit further studies in metal resistance genes which are not studied in details. This study has demonstrated that the isolated bacteria have the potential to be used as biological agents in the removal of Cu, Cd and Pb and identified genes involved in metal resistance and multi metal ion up-take can be used as potential tools for heavy metal bioremediation.



Heavy metal removal ability of the isolate O7 which was positive for genes (*copA* and *copZ*) related to the Cu tolerance



Percentage Bio-reduction of  $Cd^{2+}$ ,  $Pb^{2+}$  and  $Cu^{2+}$  metal ions at a concentration of 1mg/L over a five day time period by the isolate O7



Growth of isolate D7 in the LB broth media containing Cd<sup>2+</sup>, Pb<sup>2+</sup>, and Cu<sup>2+</sup> metal ions (1 mg L<sup>-1</sup>). Isolate D7 was positive for genes (*cadD*, *copA* and *copZ*) related to the Cu and Cd/Pb tolerance.



Cell pellet of the isolate B4 after grown in a media containing Pb<sup>2+</sup> ions (1 ppm). Black/dark brown colour pellet was not visible in the control where no metal ions present.

#### **Postgraduate degrees**

##### **Completed:**

Dr W M N H Kumari

PhD (Writing in progress)

☐

Tentative thesis title:

Molecular characterization of bacteria involved in Bioremediation of heavy metals and elucidation of possible bioremediation mechanisms

##### ***For more details, contact:***

Dr C D Wijayarathna

[dilruksh@chem.cmb.ac.lk](mailto:dilruksh@chem.cmb.ac.lk)

#### **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Identified genes relevant to heavy metal tolerance which were cloned to TA cloning vector will be cloned to an expression vector to determine the activity of the genes. Further research into development of a genetically modified organism, to be used in cleaning of heavy metal presence in industrial effluents/waste water treatment, is recommended.

# Assessment of the genetic diversity among finger millet (*Eleusine coracana* (L.) Gaertn) accessions of Sri Lanka using morphological and molecular markers

RG/2011/BT/09

## Principal Investigator:

Prof. (Mrs) P N Dasanayaka  
Department of Botany  
Faculty of Applied Sciences  
University of Sri  
Jayewardenepura

## Co- Investigator:

Dr (Mrs) S A C N Perera  
Department of Agricultural  
Biology  
Faculty of Agriculture  
University of Peradeniya



Branched ear of finger millet at dough stage

## INTRODUCTION

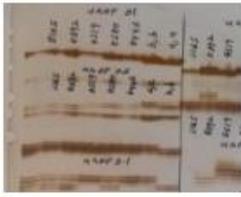
Finger millet (*Eleusine coracana* (L.) Gaertn.) is a highly nutritious and important food crop with enormous health benefits. Thus, worthy to be subjected to crop improvement programs. Germplasm collection and characterization are the important preliminary steps in crop improvement programs. A rich collection of finger millet germplasm accessions collected from Sri Lanka, India and Zimbabwe is conserved at the Plant Genetic Resource Centre (PGRC) Gannoruwa yet considered to be largely uncharacterized. This study was conducted to characterize finger millet germplasm accessions conserved at PGRC, Gannoruwa, Sri Lanka using molecular and morphological markers.

## PROJECT ACHIEVEMENTS/OUTPUT

A set of informative SSR markers were compiled using the mapped SSR markers published by Dida *et al* (2007) for finger millet which can be used for large scale studies in future. The study was successful in revealing the genetic diversity among the finger millet germplasm accessions conserved at PGRC, Gannoruwa, Sri Lanka. Accessions with the highest genetic distances were identified to be used as potential parents in hybridization. Elite germplasm accessions for cultivation and core accessions for conservation were recognized.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

DNA (SSR) marker data generated by the study was utilized in determining population structure of the germplasm and the SSR markers used for the study were evaluated for their feasibility to be used in Marker Assisted Selection (MAS). Four sub-populations and their admixtures within the conserved finger millet accessions were identified. A direct link between markers and the traits was not identified by visual interrelation. PhD thesis was submitted in November 2018, defended and the degree was awarded.



SSR alleles of different markers visualized on a Polyacrylamide gel



Finger millet plants grown inside the net house at flowering stage

#### **Postgraduate degrees**

##### **Completed:**

Dr P W Wakista  
PhD (2018)

Thesis title:

Genetic Diversity and Population Structure of *ex-situ* Conserved Finger millet [*Eleusine coracana* (L.) Gaertn] Accessions of Sri Lanka

##### **For more details, contact:**

Prof. P N Dasanayaka  
[nilanthiedas@sjp.ac.lk](mailto:nilanthiedas@sjp.ac.lk)

#### **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

When the production of Finger millet will be increased by utilizing the findings on the elite germplasm for cultivation and also in long term by introducing hybrids with desirable traits using the potential parents revealed by the study, it will pave the way for a decent income for the farmers. And there is a potential of opening doors for the export market as well which is a visible impact on the community. Important accessions to be conserved revealed by the study is of great use in plotting and fine-tuning collection programs. Preservation of such accessions ensures agricultural security as well as the richness of biodiversity indicating a positive impact on socio economic development of the country.

# Cloning and expression of cellulase and xylanase genes of *Trichoderma* in a yeast system to develop synergistic saccharification and direct fermentation of cellulosic biomass to ethanol

RG/2012/BT/02

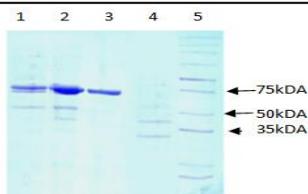
## Principal Investigator:

Prof. W S S Wijesundera  
Faculty of Science  
University of Colombo

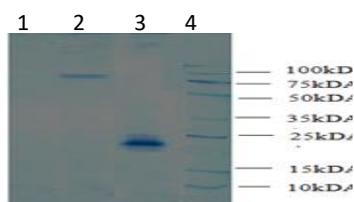
## Co-Investigators:

Dr N V Chandrasekharan  
Prof. R L C Wijesundera

Department of Biochemistry  
and Molecular biology  
Faculty of Medicine  
University of Colombo



**Figure 1:** Lanes (1), (2) and (3). Recombinant BGLI enzyme (52 kDA), CBHI (50 kDA) and BGLI enzyme (48 kDA) secreted by recombinant *S.cerevisiae*. Lane (4) The enzyme extract of native *S.cerevisiae*. Lane (5) broad range protein molecular weight marker.



**Figure 2:** Lane 1, The enzyme extract of native *p.stipitis*; Lane 2, 3. Recombinant XYLI enzyme (84 kDA) and EXNI enzyme (~24 kDA) secreted by recombinant *P.stipitis*; Lane 4 Broad range protein molecular weight marker.

## INTRODUCTION

Bioethanol, produced from a renewable energy source such as lignocellulosic biomass is an economically and environmentally suitable substitute to petroleum. Genetically modified yeast producing cellulase and hemicellulase can be effectively used for the synergistic saccharification and direct fermentation cellulose and hemicellulose fraction of plant biomass to ethanol.

## PROJECT ACHIEVEMENTS/OUTPUT

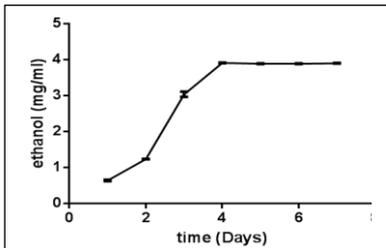
Cellulase genes;  $\beta$ -glucosidase I (BGLI), endoglucanase I (EGLI) and cellobiohydrolase I (CBHI) and xylanase genes; endoxylanases I (EXNI) and  $\beta$ -xylosidase I (XYLI) of filamentous fungi (*Trichoderma virens* and *Aspergillus niger*) were successfully isolated, cloned and expressed in *Saccharomyces cerevisiae* and *Pichia stipitis* respectively. Co-fermentation studies of all recombinants resulted maximum 14.8 grams of ethanol from 100 g of pretreated straw.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

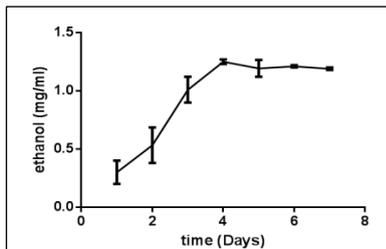
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## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

In Sri Lanka main industries such as textile, brewery, leather and animal feed are totally dependent on the import of these enzymes at a tremendous cost. Local production of these enzymes will significantly reduce or replace importation. The recombinant yeast developed in this study has the capability of utilizing low cost substrate (plant biomass) into a valuable product of ethanol which has a tremendous applicability and is of great demand in globally and locally.



**Figure 3-** Fermentation analysis of recombinant *EGLI*, *CBHI* and *BGLI* harbouring *S. cerevisiae* by the co-fermentation of YP medium containing 5% pre treated straw.



**Figure 4-** Fermentation studies of *EXNI* and *XYLI* recombinant *P. stipitis* using 5% pretreated straw.

#### Postgraduate degrees completed:

Dr G H I M Wickramasinghe  
PhD (2017)

Thesis title: Cloning and expression of cellulase and xylanase genes of filamentous fungi in yeast for synergistic saccharification and direct fermentation of cellulosic biomass to ethanol

#### For more details, contact:

Prof. W S S Wijesundera  
[sulochanawijesundera@gmail.com](mailto:sulochanawijesundera@gmail.com),  
[sulochana@bmb.cmb.ac.lk](mailto:sulochana@bmb.cmb.ac.lk)

#### RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

The findings of the project can lead to both industrial scale ethanol production and industrial scale cellulase and xylanase enzyme production. Two pilot scale projects can be initiated with appropriate modifications to optimize parameters. Then the fermentation process should be modeled and simulated to scale up with the experimental data. In bio-ethanol and enzyme production, down-stream process should be optimized considering the low energy requirement and the cost of production in the scaled-up process.

## Detection of dengue viruses in *Aedes* mosquitoes and their population genetics structure in Colombo, Sri Lanka

RG/2012/BT/03

**Principal Investigator:**

Prof. B G D N K de Silva  
Department of Zoology  
Faculty of Applied Sciences  
University of Sri  
Jayewardenepura

### INTRODUCTION

The infected *Aedes* mosquito populations are the major factor for spreading dengue and thus the target site for dengue control.

The possibility of detecting the DENV infection of wild *Ae.aegypti* mosquitoes was examined and the population genetic structure of them was analysed to figure out the population differentiation, isolation, effective population size and migration.

### PROJECT ACHIEVEMENTS/OUTPUT

Confirmed the potential use of NS1 antigen strips for detection of mosquito DENV infection for applications in vector-virological surveillance. Relationship between vector presence, infectivity and the dengue incidences highlighted the importance of vector and virological surveillance. Effective use of strategic, successive adulticide spraying was emphasized.

Population genetic study revealed high levels of gene flow. Correlation between microsatellite alleles and DENV infectivity of *Ae. aegypti*, emphasized the opportunity of identifying DNA markers for DENV infectivity in future.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

The study was extended in order to investigate more areas in virological detection of DENV in dengue mosquitoes. PhD research is still ongoing and research publications in this regard are in preparation.

**Postgraduate degrees completed:**

Ms P D Dayanda  
PhD (2020)

Thesis title:

Virological surveillance of DENV in *Aedes aegypti* mosquitoes in dengue high risk areas of Colombo district

**For more details, contact:**

Prof. B G D N K de Silva  
[nissankakolitha@gmail.com](mailto:nissankakolitha@gmail.com)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Considering the observations and the experimental results, the study revealed the importance of integrating virological surveillance of *Ae.aegypti* mosquitoes, the importance application of more strategic (indoor- outdoor), successive adulticide spraying rounds to eliminate vector and implications of unsynchronized spraying in adjacent geographical areas. Thus, the study strongly suggested incorporating virological surveillance of vectors as an interactive approach and following a more strategic, well synchronized adulticide spraying measures for minimizing dengue spread in the country.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

The study will pave the way to establish DNA markers in *Ae.aegypti* mosquitoes responsible for possible DENV infectivity by investigating the correlation between DNA markers and the DENV infectivity in *Ae. aegypti* mosquitos, Although very few microsatellite markers isolated to date in the *Ae.aegypti* genome, the experimental procedure adopted in this study would be used towards future studies with other genetic markers.

## Studies on cryopreservation of embryogenic callus from unfertilized ovaries using the encapsulation-dehydration technique and post thaw plant regeneration in coconut (*Cocos nucifera* L.)

**RG/2014/BT/01**

**Principal Investigator:**

Dr H D D Bandupriya  
Tissue Culture Division  
Coconut Research Institute

*Current address*

Department of Plant  
Sciences  
Faculty of Science  
University of Colombo

**Co-Investigators:**

Dr S A C N Perera  
Dr Vijitha Vidhanaarachchi  
Coconut Research Institute

Dr G A U Jayasekera  
University of Colombo



Encapsulated embryogenic calli undergoing sucrose pretreatment

### INTRODUCTION

The recalcitrant storage behavior and large size of the coconut seed make it impossible to use as a germplasm storage material. Thus development of alternative methods to complement the current conservation efforts is very important. Cryopreservation is the only viable option available currently for the long-term conservation of germplasm.

### PROJECT ACHIEVEMENTS/OUTPUT

A protocol which recorded 25% recovery rate for the cryopreservation of coconut using unfertilized ovary embryogenic calli was developed. The exposure of coconut calli into encapsulation-dehydration system favoured the preservation of genetic fidelity when assessed using SSR markers.

One short paper, one review article, three abstracts were published based on the results of the project.

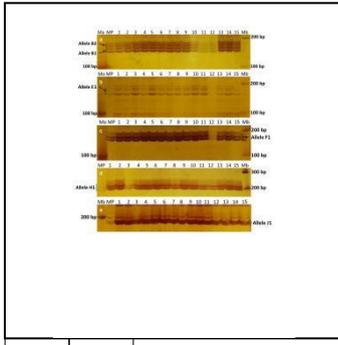
One research manuscript was submitted to Plant Biotechnology Reports Journal and manuscript is under review.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

One M.Phil thesis was generated and the student passed viva-voice examination with minor corrections on 13<sup>th</sup> July 2018.



Germinating somatic embryo subjected to cryopreservation treatment



Polyacrylamide gel shows genetic fidelity of cryopreserved somatic embryos via simple sequence repeat (SSR) markers.

**Postgraduate degrees completed:**

W W M A Iroshini  
M.Phil (2018)

**Thesis title:**

Studies on cryopreservation of embryogenic callus from unfertilized ovaries using the encapsulation-dehydration technique in coconut (*Cocos nucifera* L)

**For more details, contact:**

Dr H D D Bandupriya  
[dbandupriya@pts.cmb.ac.lk](mailto:dbandupriya@pts.cmb.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Coconut is one of the most important plantation crops in Sri Lanka. Conservation of existing coconut diversity of its germplasm is vital particularly to sustain crop production by utilising germplasm for crop improvement through conventional breeding programmes. Callus lines obtained from best palms that hold superior characters need to be preserved carefully for future use. Those are the material which will allow multiplying best clones. Initial steps on embryogenic calli cryopreservation showed encouraging results.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Further studies are recommended for increasing of the recovery rate.

# Screening, isolation and characterization of type II restriction enzymes from bacteria isolated from different regions of Sri Lanka

RG/2014/BT/02

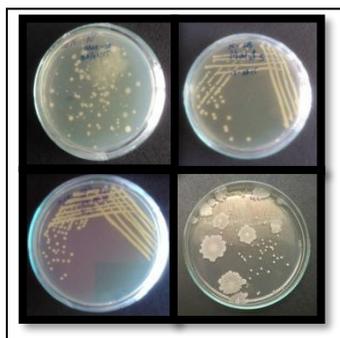
## Principal Investigator:

Prof. Chamari Hettiarachchi

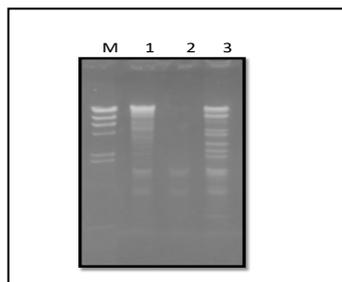
## Co- Investigator:

Dr N V Chandrasekharan

Department of Chemistry  
Faculty of Science  
University of Colombo



Isolation of bacteria from soil and water samples



Screening bacterial isolates for restriction enzymes  
Lane M,  $\lambda$ /Hind III marker; Lane 1,2 & 3, cleavage of  $\lambda$  DNA by different bacterial lysates

## INTRODUCTION

Type II Restriction enzymes (REs) cleave double stranded DNA in a sequence specific manner. These REs isolated from bacteria are fundamental tools in genetic engineering. The objective of this project was to screen and isolate REs from bacteria from soil and water samples in Sri Lanka.

## PROJECT ACHIEVEMENTS/OUTPUT

Nine isolates belonging to different genera (*Lysinibacillus*, *Acinetobacter*, *Pseudomonas* and *Brevibacillus*) were positive for the presence of restriction endonucleases. Two isolates (MatS1 and UprS18) were further analyzed. The restriction enzyme from MatS1 was partially purified and characterized. It was found to be an isoschizomer of Hind III. The genomes of both isolates were sequenced. The gene coding for the isoschizomer of Hind III was identified. Putative genes encoding restriction enzymes in the other isolate UprS18 were also identified.

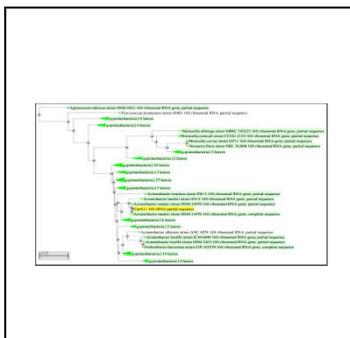
## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Cloning of the isoschizomer of Hind III is in progress.

S N J Pathirana, M Kajan, D A S Elvitigala, G H C M Hettiarachchi, C M Nanayakkara, R G S C Rajapakse and N V Chandrasekharan (2018). Identification and *in-sillico* characterization of a novel *HindIII* isoschizomer from a *Pseudomonas* spp. Proceedings of the 3<sup>rd</sup> International Conference on BioScience and Biotechnology, pg. 21

Full paper “Identification and characterization of a novel *HindIII* isoschizomer from a *Pseudomonas* spp.” Preparation of manuscript is in progress.

PhD Thesis writing is in progress



Phylogenetic analysis of a bacterial isolate (Upr11) using 16S rRNA

**Postgraduate degrees completed:**

Ms S N J Pathirana  
M Phil

Thesis title:

Screening, isolation and characterization of type II restriction enzymes from bacteria isolated from different regions of Sri Lanka

**For more details, contact:**

Prof. Chamari Hettiarachchi  
[chamarih@chem.cmb.ac.lk](mailto:chamarih@chem.cmb.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Restriction enzymes have had a tremendous impact on rDNA technology, particularly molecular cloning. Currently all restriction enzymes required in the country are imported. We have identified and isolated nine bacterial strains producing restriction enzymes. The isolated and purified enzymes/cloned recombinant enzymes have the potential to be commercialized.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

- (i) Production of recombinant restriction enzymes and corresponding methylases from the two isolates (MatS1 and UprS18) with a view to commercialization.
- (ii) Characterization of restriction enzymes from the other isolates also with a view to eventual commercialization.

## Development of a vaccine candidate with a broadly reactive neutralizing immune response against dengue

RG/2014/BT/03

**Principal Investigator:**

Prof Charitha Goonasekara

**Co-Investigator:**

Dr Prasad Premaratne

Faculty of Medicine

General Sir John Kotelawala

Defence University

### INTRODUCTION

As a solution to designing an effective vaccine for dengue, this study proposed an alternative strategy to the commonly used tetravalent-type vaccine design strategy; focusing on conserved B-cell epitopes of dengue proteins. Five such epitopes that elicit broadly cross-reactive and neutralizing antibodies during natural dengue infections were identified, which would be potential dengue vaccine candidates.

### PROJECT ACHIEVEMENTS/OUTPUT

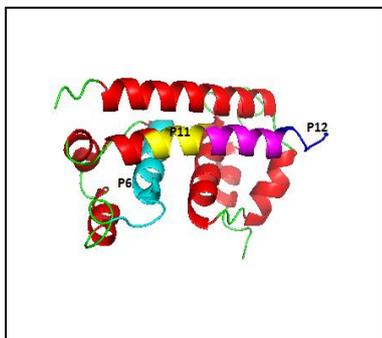
Two national patents were filed. One for dengue serotype specific peptides as a type detection diagnostic marker. The other for broadly immunogenic neutralizing dengue protein epitopes as a universal vaccine candidate.

Produced four articles in science indexed journals; 3 already published and 1 submitted.

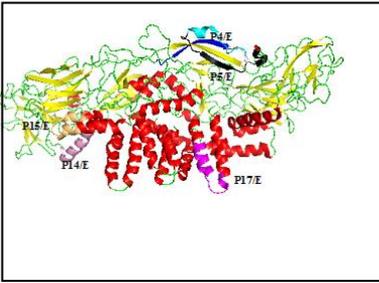
Produced seven communications; three presented in international conferences and three presented in national conferences. One of the presentations was published as a full paper in the conference proceedings.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

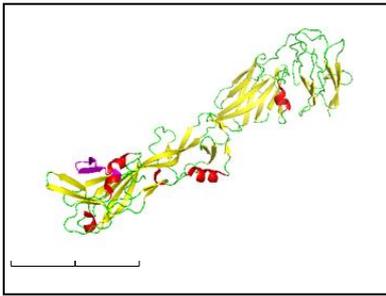
Additional experiments were conducted against the broadly immunogenic peptides, where mice immunosera generated for each peptide was tested for viral neutralization against all the four dengue serotypes. The five Envelope protein epitopes which were neutralizing against DENV4 were also neutralizing against the other three DENV serotypes. The results confirmed the broadly immunogenic and neutralizing ability of the five E protein epitopes. Additionally, one of the epitope from Pre-membrane protein was also neutralizing against some serotypes.



Map of identified antigenic epitopes on the secondary ribbon structure of Capsid dimer. (serotype specific; P6/C: cyan, and broadly immunogenic P11/C: yellow, P12/C: blue, overlapping region of P11/C and P12/C: purple)



Map of broadly immunogenic neutralizing epitopes on the secondary ribbon structure of Envelope protein. (P4/E: blue, P5/E: black P14/E: pink, P15/E: brown and P17/E: magenta).



Map of broadly immunogenic partially neutralizing P1/prM (purple) epitope on the ribbon structure of the Pre-membrane protein

**Postgraduate degrees completed:**

Dr Mahesha Nadugala  
PhD (2018)

Thesis title:

Development of a vaccine candidate with a broadly reactive neutralizing immune response

**For more details, contact:**

Prof. C L Goonasekara  
[charithalg@kdu.ac.lk](mailto:charithalg@kdu.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The project identified potential candidates for a novel vaccine for dengue, which could relieve the burden of the disease worldwide.

At the same time, it further identified several peptides to be used as an ELISA based diagnostic marker for identifying the serotype of dengue infection. ELISA being a user friendly and low cost assay, compared to PCR, this can be applied in a wider capacity, assisting the dengue disease management program in the country.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

It can be recommended that a dengue vaccine is constructed with the identified broadly immunogenic neutralizing epitopes and the follow up clinical studies are conducted in collaboration with an industrial partnership.

It is further recommended to develop the technology for commercializable rapid diagnostic kits for dengue serotype detection with the identified serotype specific peptides. All these can contribute to uplift the pharmaceutical capacity of the country, and thereby again to the socio-economic development of the country.



# Analysis of mutations and polymorphisms in exon 11 of *BRCA2* gene in Sri Lankan young breast cancer patients

RG/2014/BT/04

## Principal Investigator:

Dr W Sumadee De Silva  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology

## Co-Investigators:

Prof. Kamani H Tennekoon  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology

Dr Kanishka De Silva  
National Cancer Research  
Maharagama

Dr. D.M.A.S Dissanayake  
\*Present: Teaching Hospital  
Jaffna

## INTRODUCTION

Early onset breast cancer though rare, generally presents at an advanced stage as most aggressive subtype with poor prognosis. Based on the previous studies done, exon 11 of *BRCA2* was identified as the most mutable region screening of which can be useful for early diagnosis of young breast cancer patients.

## PROJECT ACHIEVEMENTS

We were able to identify several novel and reported highly pathogenic variants in exon 11 of *BRCA2* in young breast cancer patients proving that the screening of this region for familial young patient is really important. Based on the results, one international communication was presented and one peer reviewed full journal article was published.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Several clearly pathogenic and likely pathogenic variants in exon 11 of *BRCA2* were identified in young familial breast cancer patients. Recent studies done worldwide, suggest that patients with unilateral breast cancer carrying *BRCA1/BRCA2* mutations with a strong family history of breast cancer have a 16%-35% elevated risk of developing second primary cancer in contralateral breast.

Given the study as evidence, offering *BRCA1/BRCA2* testing at least for patients with young onset breast cancer and family history is strongly recommended.

## FOLLOW-UP

Funds were not sufficient to execute any follow-ups on the studied patients.

## For more details, contact:

Dr W Sumadee De Silva  
[sum@ibmbb.cmb.ac.lk](mailto:sum@ibmbb.cmb.ac.lk)

# Analysis of antioxidant genes expression in tapping panel dryness (TPD) affected rubber trees (*Hevea brasiliensis* Muell. Arg.) and effect of exogenous application of ascorbic acid on alleviating TPD

RG/2015/BT/01

## Principal Investigator:

Dr P K G S S Bandara  
Department of Bio-systems  
Technology  
Faculty of Technology  
Sabaragamuwa University of  
Sri Lanka

## Co-Investigators:

Prof. V A Sumanasinghe  
Department of Agricultural  
Biology  
Faculty of Agriculture  
University of Peradeniya

Dr S P Withanage  
Department of Genetics and  
Plant Breeding  
Rubber Research Institute of Sri  
Lanka



Collection of latex from a TPD affected rubber tree to isolate total RNA

## INTRODUCTION

Antioxidant gene expressions of tapping panel dryness (TPD) affected rubber trees were analyzed using qRT-PCR as the TPD seems to be caused by high oxidative stress. As there are no effective measures to treat TPD currently, the effect of exogenous application of ascorbic acid on TPD trees were also analyzed.

## PROJECT ACHIEVEMENTS/ OUTPUT

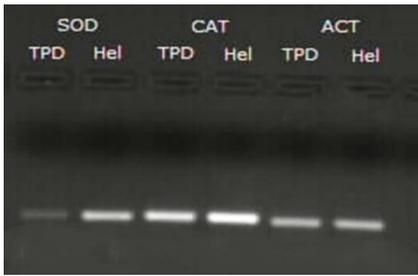
According to the qRT-PCR analysis, among the other antioxidant genes, the *MnSOD* gene was significantly down regulated in all the affected trees assuming its major role in TPD. Exogenous application of ascorbic acid on bark tissues of TPD affected rubber trees showed significant TPD recovery after the treatment compared to the control trees.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

A large-scale field trial on exogenous application of ascorbic acid on TPD affected rubber trees has been planned to conduct at the rubber lands of the Rubber Research Institute of Sri Lanka.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

TPD causes a severe loss in natural rubber production around the world including Sri Lanka. Based on the findings of the project, exogenous application of ascorbic acid on TPD affected rubber trees has been proposed to improve the productivity of the country's rubber industry using a cheap and environmentally friendly method to alleviate TPD that causes a considerable economic loss to the country's GDP.



Semi quantitative PCR analysis of antioxidant gene expressions, SOD: *HbMnSOD*; CAT: *HbCAT*; ACT: *HbACT7*; TPD: Tapping panel dryness; Hel: healthy.



Exogenous applied of ascorbic acid on bark tissues of TPD affected rubber trees.

**For more details, contact:**

Dr P K G S S Bandara  
[sarath@agri.sab.ac.lk](mailto:sarath@agri.sab.ac.lk)

#### RECOMMENDATION FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/START-UP BUSINESSES, IF ANY:

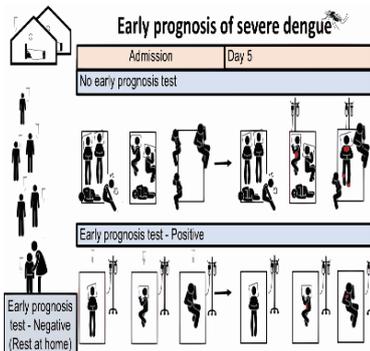
A large-scale field trial on exogenous application of ascorbic acid on TPD affected rubber trees are recommended to further analysis for its effectiveness as a treatment.

# Evaluating the expression changes of non-coding RNA in Dengue Hemorrhagic Fever

RG/2015/BT/02

## Principal Investigator:

Prof. Nimanthi Jayathilaka  
Department of Chemistry  
University of Kelaniya



DF patients and patients who later develop severe dengue present with similar clinical symptoms at the acute phase. Severe symptoms manifest after about 5 days from fever onset. An early prognostic test can distinguish those who will develop severe dengue and benefit from early medical care.

## INTRODUCTION

Dengue fever (DF) is not fatal while severe manifestations may result in death. Early prognosis can reduce dengue related deaths. Due to their function and stability in biological fluids, relative expression of selected microRNA and their putative target genes may serve as early biomarkers to distinguish DF from severe dengue.

## PROJECT ACHIEVEMENTS/OUTPUTS

One MPhil student completed her studies under this project. Two manuscripts have been published in international indexed journals. Two patent have been obtained on the use of expression level of miR-150, EZH2 and iNOS as early prognosis tools for severe dengue (SD).

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

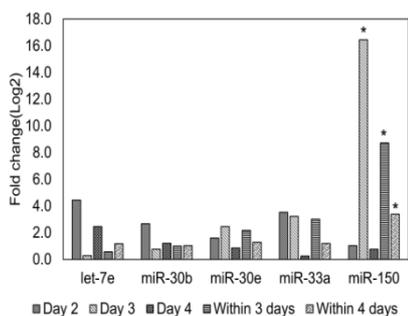
### Publications:

1. Hapugaswatta, H., Wimalasekara, R. L., Perera. S. S., Premaratna, R., Seneviratne, K. N., Jayathilaka, N. (2021). Expression of nitric oxide synthase and nitric oxide levels in peripheral blood cells and oxidized low-density lipoprotein levels in saliva as early markers of severe dengue, *Biomed Research International* doi.org/10.1155/2021/6650596
2. Hapugaswatta, H., Amarasena, P., Premaratna, R., Seneviratne, K. N., Jayathilaka, N. (2020). Differential expression of microRNA, miR150 and enhancer of zeste homolog 2 (EZH2) in peripheral blood cells as early markers of severe forms of Dengue, *Journal of Biomedical Science*. 27:25, <https://doi.org/10.1186/s12929-020-0620-z>
3. Presentation: 74th Annual Scientific Sessions, SLAAS, December 2018.
4. Presentation: International Postgraduate Research Conference, University of Kelaniya, December 2018.

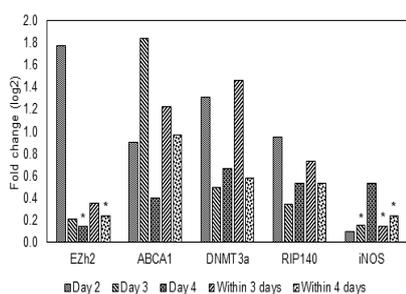
### Patents awarded:

1. 20460
2. 20459

Further studies in a larger cohort is being carried out under an OWSD grant. Studies are being conducted to develop tools to detect the early markers uncovered in this study in resource limited settings.



\*P<0.05, hsa-miR-150-5p showed significant (P<0.05) up regulation and hsa-let-7e, hsa-miR-30b-5p, hsa-miR-30e-3p, hsa-miR-33a did not show significant differential expression in PBC of SD patients compared to DF patients during the acute phase of infection.



\*P<0.05, EZH2 and iNOS showed significant (P<0.05) downregulation and ABCA1, DNMT3A, RIP140 did not show significant differential expression in PBC of SD patients compared to DF patients during the acute phase of infection.

### Postgraduate degrees completed:

Ms. H P H Hapugaswatta  
M.Phil (2018)

### Thesis title:

Evaluating the expression changes of non-coding RNA in dengue hemorrhagic fever.

### For more details, contact:

Prof. Nimanthi Jayathilaka  
[njayathi@kln.ac.lk](mailto:njayathi@kln.ac.lk)

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The early symptoms of dengue fever and severe dengue are similar. The severe symptoms only develop after approximately 5 days from fever onset. Therefore, an early differential diagnosis is needed to predict the outcome for proper patient care and public health management. An early prognostic test that can reliably predict the severe outcome of dengue infection at the acute phase could alleviate the health and socioeconomic burden by identifying patients who can benefit from hospitalization.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/START-UP BUSINESSES, IF ANY

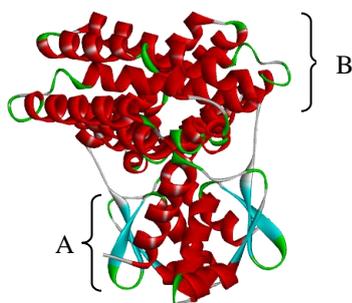
The expression changes of the microRNA and the target genes should be validated in a larger cohort of patient samples to assess their potential as biomarkers for early prognosis of disease severity. Prognostic tools can be developed for detecting these markers for early prognosis. Such a tool would be a highly marketable test not only in Sri Lanka but also in other regions most affected by this mosquito-borne viral infection.

# Investigation of GntR family transcriptional regulators of *Pseudomonas aeruginosa* PAO1 as potential drug target

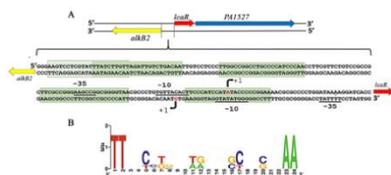
RG/2015/BT/03

## Principal Investigator:

Prof. Inoka C Perera  
Department of Zoology and  
Environment Sciences  
Faculty of Science  
University of Colombo



LcaR dimer. A) DNA binding wHTH domain, B) Effector binding domain.



Schematic drawing of intergenic region between *alkB2* and *lcaR*; green boxes indicates DNA sequences that are recognized by LcaR. Transcription initiation sites and promoter elements are indicated. B) Sequence logo of the LcaR binding motifs. Height of the corresponding symbol of each nucleotide represents the corresponding frequency of occurrence at a particular position.

## INTRODUCTION

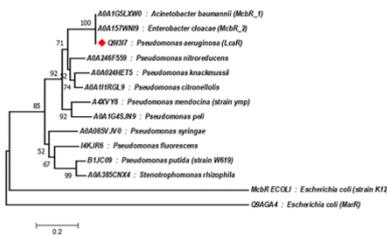
*Pseudomonas aeruginosa* encodes an enzyme cascade for the degradation of n-alkanes. Direct regulatory mechanisms of this system is not reported. Transcription factor, LcaR, that regulates *alkB2* gene was identified and characterized in the current study where understanding of such regulatory mechanism is beneficial for bio-engineering effective bio-catalysts for industrial purposes, bio-remediation and novel drug designing.

## PROJECT ACHIEVEMENTS/OUTPUT

- Three abstracts were published in three international conference proceedings
- One abstract was published in university symposium proceeding in 2019
- Japan collaborative research grant were awarded in 2017 and 2018 for this project.
- ICGEB short-term PhD fellowship was awarded in 2020 for an extended study of this project.
- One PhD student trained

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

In order to understand the complete regulatory mechanism of LcaR, ICGEB short-term PhD fellowship grant was applied for an extended study and it was awarded in 2020. Fellowship period was postponed due to the travel restrictions imposed by Covid-19 pandemic. Research publications were submitted, and the thesis will be submitted in the near future.



Phylogenetic analysis of LcaR

**Postgraduate degrees completed:**

Dr W P E H Hemamali  
PhD (2021)

Thesis title:  
LcaR is a master regulator of n-alkane degradation in *P. aeruginosa* PAO1

**For more details, contact:**

Prof. Inoka C Perera  
[icperera@sci.cmb.ac.lk](mailto:icperera@sci.cmb.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Findings of this project significantly advances the understanding of the mode of regulation of alkane degradation in *P. aeruginosa*. This would have direct implications in the fields of bio-catalysts, bio-remediation and industrial microbiology. Such advanced findings would elevate the status of Sri Lankan research and would lead to attract more funding to the system. Furthermore, this finding leads to a new drug target. Transcriptional regulators of this kind would provide new hope for the battle against antibacterial resistance.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

The regulatory mechanism that was found in this study can be used in developing synthetic circuitry for improved bio-transformation of n-alkanes into useful compounds. Furthermore, the drug industry can use this as a drug target for developing novel drugs against resistant bacteria.

# Genetic diversity and management of cabbage white mold pathogen, *Sclerotinia sclerotiorum*, and feasibility of Anaerobic Soil Disinfestations (ASD) and Bio-Fumigation (BF) based disease management for upcountry vegetable production system

RG/2015/BT/04

**Principal Investigator:**

Dr R N Attanayake

**Co- Investigators:**

Dr C S Rajapakse

Mr K P Somachandra

Department of Botany

Faculty of Science

University of Kelaniya



Infected cabbage with the head rot pathogen.

## INTRODUCTION

Cabbage head rot, caused by *Sclerotinia sclerotiorum* is an economically important disease world-wide. Disease severity was high due to improper field practices. This project focused on determination of population genetic diversity and feasibility of Anaerobic Soil Disinfestation (ASD) in disease management in Sri Lanka. High genetic diversity was detected and ASD was effective in managing the pathogen survival structures.

## PROJECT ACHIEVEMENTS/OUTPUTS

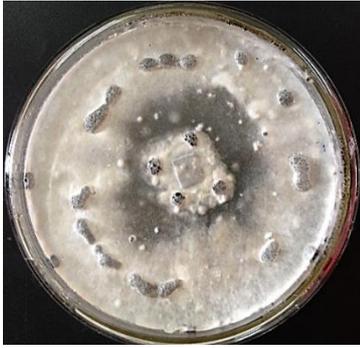
One MPhil degree

Three full peer reviewed papers, one full conference paper and two full research papers are in preparation. In addition, 6 abstracts including one in ICPP 2018 Boston conference were produced.

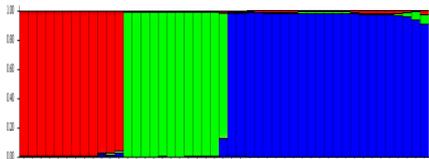
1. Mahalingam et al. 2018. *Journal of the National Science Foundation of Sri Lanka*, 46(2)
2. Mahalingam et al. 2017. *Plant Disease*, 101(1), p.249.
3. Attanayake et al. 2018. *Tropical Plant Pathology*. DOI:10.1007/s40858-018-0248-7
4. Population genetics of white mold pathogen. In preparation for journal of 3Biotech.
5. ADS based disease management of *Sclerotinia sclerotiorum*. In preparation for tropical plant pathology.
6. Guruge et al. 2016. Proceedings of the 5<sup>th</sup> YSF symposium. Pp 33-35.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Continue working on the publications and workshops in distributing the knowledge among scientific communities and farmers. Small farmer meetings will be conducted and in the process of writing the next grant on evaluating the possibilities of further implementing the ASD in the field level.



Pure culture of the pathogen identified as *Sclerotinia sclerotiorum* showing the formation of sclerotia on PDA



Population genetic structure analysis using the STRUCTURE software showing three subdivided genetic populations in Sri Lanka

### **Postgraduate degrees**

#### **Completed:**

T Mahalingam

M Phil (2018)

Thesis title:

Population diversity and C source dependent anaerobic soil disinfestation (ASD) of *Sclerotinia sclerotiorum* on cabbage

#### ***For more details, contact:***

Dr R N Attanayake

[renuka@kln.ac.lk](mailto:renuka@kln.ac.lk)

### **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Early detection of the disease is important. Due to high potential of cross resistance development farmers should be careful in choosing fungicides and field sanitation is critical. Infected heads should be destroyed. Deep plowing help burring sclerotia in deep soil it will help reducing the pathogen survival. Maintaining anaerobic conditions with easily degradable C source will further reduce the pathogen survival.

### **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Further research is needed mainly in isolating and purifying potential chemical compounds from the bio fumigants and there is a high potential in finding bio active components from the positive C sources found above. In addition, field trials of ASD with differing rates of C source should be tested. Not only what is present in each sample after treatment but what they do? should be answered. This can be done via a through meta genomics analysis, new science to the country.

# Morphological, Biochemical and Molecular Characterization of Bael Fruits and Rapid Multiplication of Bael (*Aegle marmelos* (Lin.) Correa)

RG/2015/BT/05

**Principal Investigator:**

Prof. J P Eeswara

**Co- Investigator:**

Prof. T Madhujit

Prof. P Bandaranayake

University of Peradeniya

Dr Kalyani Ketepearachchi

Department of Agriculture



Variation of the fruit morphology in five bael accessions.

The representative fruit images and their cross sections are shown side by side. A: *Beheth Beli* (BB),

B: *Paragammana* (PA);

C: *Mawanella* (MA);

D: *Rambukkana* (RA);

E: *Polonnaruwa Supun* (PS)

## INTRODUCTION

The fruit morphological diversity, genetic diversity using SSR and ISSR markers, chemotaxonomic structure, anti-oxidant and antibacterial properties of five elite bael (*Aegle marmelos* L.) mother plants, selected by the Fruit Crop Research Development Institute (FCRDI) of the Department of Agriculture Sri Lanka were assessed

## PROJECT ACHIEVEMENTS/OUTPUTS

### Human Resource Development

1. PhD –Ms. C.K. Pathirana-2019

2. Two Undergraduate Research Projects in 2018

(A.M.C. Alahakoon, D.B.R. Kaushalya)

### Dissemination of knowledge

Eight Publications in peer reviewed journals and symposia

### Infra Structure Development in University of Peradeniya

Rotary Evaporator and Mini Gel Apparatus which are used by both undergraduate and postgraduate students

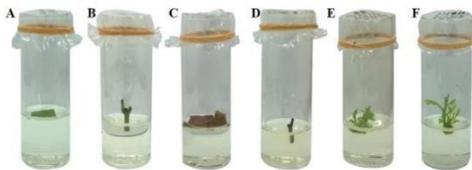
## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

### Following Publications were made after the final report

Pathirana et al., (2020) Establishment of a micropropagation protocol for Elite Accessions of Bale (*Aegle marmelos*(L)) Corr.) a Tropical Hardwood Species. *Advances in Agriculture*, <https://doi.org/10.115/2020/8840386>

Pathirana et al., (2019). Morphological Variation of Bael Fruits (*Aegle marmelos* (L.) Corrêa) among Five Accessions in Three Different Agro-Ecological Regions of Sri Lanka, *Tropical Agricultural Research* Vol. 30 (4): 23 – 33 , DOI: <http://doi.org/10.4038/tar.v30i4.8326>

Pathirana et al., (2019) Assessment of the contents of a selected macro, micro and toxic elements in ripen bael fruits and tender shoots of water spinach and sweet potato using XRF and ICP-MS methods *Ceylon Journal of Science* 48(1) 67-75 DOI:



The representative images of the explants at the initial establishment and after eight weeks. A and B: Leaf and twig, respectively, at the initial establishment, C and D: Leaf and twig (collected before April), respectively, with no development, E and F: Leaf and twig (collected after April), respectively, with development after eight weeks.



The rooting results. A: three shoots just before inserting in the rooting medium; B: shoots form roots; C: rooted plantlets removed for subculturing; D: bottom enlargement

**Postgraduate degrees completed:**

Dr C K Pathirana  
PhD (2019)

Thesis title:

Morphological Biochemical and Molecular Characterization of Fruits and Rapid Multiplication of Five selected Bael Accessions (Aegle marmelos(Lin) Correa)

**For more details, contact:**

Prof. J P Eeswara  
jpeeswara@yahoo.com

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The results of the present study showed the nutritional properties and biological activities of bale fruit. Dissemination of this knowledge among general public would enhance the demand for bale fruits increasing the cultivation giving income to people living in rural areas where bale is widely growing in Sri Lanka

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Processing of Bale Fruits and development of new products such as fruit drinks, jams, toffees, extruded products, development of baby foods for local market and export market would be really be important.

# Characterization and Expression of raw starch hydrolyzing alpha amylase gene from *Thielaviopsis ethacetica* in E coli.

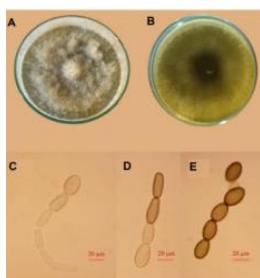
RG/2016/BT/01

## Principal Investigator:

Dr S N T De Silva  
Department of Material Nano  
Science  
Faculty of technology  
Wayamba University of Sri Lanka

## Co- Investigator:

Prof. D P S T G Attanayaka  
Department of Biotechnology  
Faculty of Agriculture and  
Plantation Management  
Wayamba University of Sri Lanka



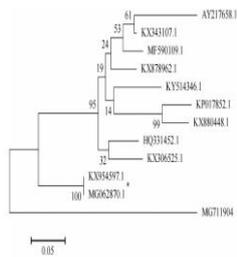
Morphological characteristics of *Thielaviopsis ethacetica* A) culture on PDA Surface B) culture on PDA lower surface C-D) chains of secondary conidia E) Chains of aleurioconidia

## INTRODUCTION

Starch hydrolysing enzymes have attracted great attention in starch related industries. They are widely used to produce numerous products which have high demand in the current world. *Thielaviopsis ethacetica* is a soil born fungi which has been identified to exhibit high enzyme activity on starch substrates and would be an ideal candidate for production of alpha amylases. Therefore, an attempt was made to clone alpha amylase gene from *Thielaviopsis ethacetica*. cDNA clones containing putative amylase gene in pH6HTN His6HaloTag® T7 expression vector system have been isolated and transformed into *E. coli* JM109 as the compatible host for protein expression.

## PROJECT ACHIEVEMENTS/OUTPUTS

1. Characterization of alpha amylase producing *Thielaviopsis ethacetica* and its raw starch hydrolyzing ability on different agricultural substrates. *Microbiol. Biotechnol. Lett.* (2019), 47(3), 412–422. <http://dx.doi.org/10.4014/mbl.1812.12002>
2. Production and Characterization of Novel  $\beta$ -galactosidase from fungus *Thielaviopsis ethacetica* (2021), 49(4), (563-571)
3. Production and Identification of raw starch hydrolases from *Thielaviopsis ethacetica*. *NextGen Genomics, Biology, Bioinformatics and Technologies (NGBT) conference*, Sep 30<sup>th</sup>- Oct 2<sup>nd</sup>, 2018, Jaipur, India. pp: 82-83. (2018).
4. Characterization of *Thielaviopsis ethacetica* and its starch hydrolyzing enzymes. *International conference on Beneficial Microbes: Microbes for benefit of mankind*. July 30<sup>th</sup>–Aug 01<sup>st</sup>, Kuching, Serawak, Malaysia. Page: 87. (2018).



Maximum likelihood phylogenetic tree generated from ITS sequences, showing phylogenetic relationship of *Thielaviopsis ethacetica*



fungal strain *Thielaviopsis ethacetica* showing clear blue in YpSs media treated with x-gal after 72 hrs incubation confirming  $\beta$ -galactosidase activity at outer edge

**Postgraduate degrees completed:**

Dr D M S Dissanayaka  
PhD (Pending)

**Thesis title:**

Characterization and Expression of raw starch hydrolyzing alpha amylase gene from *Thielaviopsis ethacetica* in *E coli*

**For more details, contact:**

Dr S N T De Silva  
[nimalides@wyb.ac.lk](mailto:nimalides@wyb.ac.lk)

**UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF**

After establishing cDNA library, it was screened for starch hydrolyzing clones. At the end of screening eight starch hydrolyzing clones were isolated. Starch degradation ability was compared to original strain and clone C7 was found to be a promising clone for further enzyme studies.

Comparison of starch degradation ability of recombinant *Escherichia coli* containing candidate genes for alpha amylase enzyme- Proceedings of 19th Agricultural Research Symposium (2020) 1-5 Abstract accepted by third CBSL conference

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Clone 7 is suitable for further enzyme purification and characterization. Further the clone can be sequenced to identify the nature of the insert which has the ability to hydrolyze starch. This will be used for structure prediction of the insert.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Clone 7 is a promising candidate for further studies. We are hoping to characterize the enzyme profile and produce starch hydrolyzing enzyme with established stabilizing conditions.

# Possible anti-carcinogenic mechanisms of novel cytotoxic compounds isolated from *Camptosperma zeylanica* on breast cancer cells: Evaluation of molecular mechanisms and validation of anti-breast cancer pathway/s

RG/2016/BT/02

**Principal Investigator:**

Prof. Kamani H Tennekoon  
Institute of Biochemistry  
Molecular Biology and  
Biotechnology  
University of Colombo

**For more details, contact:**

Prof. Kamani H Tennekoon  
[kamani@ibmbb.cmb.ac.lk](mailto:kamani@ibmbb.cmb.ac.lk)

## INTRODUCTION

*Camptosperma zeylanica* (Sinhala name-*Aridda*) is a plant endemic to Sri Lanka. Three novel compounds [camptospermenone A, camptospermenone B and camptospermenone C] were isolated from the leaves of *C. zeylanica*. Possible anti-carcinogenic mechanisms of these compounds were evaluated in breast cancer cells.

## PROJECT ACHIEVEMENTS/OUTPUTS

Three compounds isolated exerted potent cytotoxic effects in breast cancer cell lines with less cytotoxicity to normal cells. Three compounds also induced apoptosis in breast cancer cells. Gene and protein expression analysis revealed that camptospermenone A and B have a potential to target the PI3K/ AKT/mTOR signaling pathway, which is reported to be the most frequently altered signaling pathway in human cancers. Findings of this study provided a strong rationale to investigate *in-vivo* anti-cancer efficacy/toxicity of camptospermenone A and B as PI3K inhibitors.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Isolated compounds have been added to the natural compounds' library available at the IBMBB and screening of the natural compounds library in a range of cancer cell types are being conducted. Screening of these new compounds will aid to identify new anti-cancer mechanisms in distinct cancer cell lines.

#### **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

After evaluating the *in-vivo* efficacy, these natural drugs can be advanced into clinical trials of breast cancer patients and these can be made available to Sri Lankan women with breast cancer. As we attempt to develop novel compounds found in an endemic plant (*C. zeylanica*) to Sri Lanka, commercial and medicinal value of Sri Lankan medicinal plants will greatly increase.

#### **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

A patent application will be filed to claim biological effects three novel compounds and *in-vivo* efficacy/toxicity will be assessed in a suitable mouse model for breast cancer under the ongoing RPHS Grant if adequate funding becomes available. If these compounds display a favorable pre-clinical efficacy in *in-vivo* mouse models, development of a nutraceutical containing these compounds or the extract used to isolate the compounds will be considered.

# Design of Biological and Advanced Oxidation Technology (AOT) hybrid reactor system for oil wastewater treatment

RG/2012/ESA/01

## Principal Investigator:

Prof. Jayasundera Bandara  
National Institute of  
Fundamental Studies  
Kandy

## INTRODUCTION

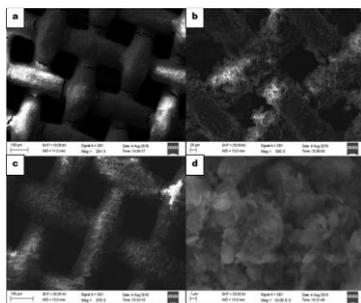
In Sri Lanka, service stations do not have proper waste water treatment plants owing to high operational cost. Hence on-site, cheap water treatment plant for the small-scale industries is imminent concerning the environmental impact and the target of the proposed research was to develop a reactor to separate free oil and grease from the waste water.

## PROJECT ACHIEVEMENTS/OUTPUTS

Several types of filters were successfully tested for oil-water separation and it was noted that oil-water can be separated effectively with the filters made of mica, TiO<sub>2</sub> nanofibers, polystyrene as well as PVDF. These filters were tested under laboratory scale for the separation of real water oil water from service station confirms the suitability of these filters for small scale industrial application. Two SCI papers were published and a local patent is under evaluation.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Secured a technology grant titled “Fabrication and scaling up of an industrial reactor for the purification of waste oil-water of the service stations” from the NSF.



SEM images of low magnification  
(a) Hydrothermally modified mica electrodeposited mesh, (b) natural mica sprayed mesh, (c) Sprayed layer on top of the electrodeposited layer, (d) 10 kx magnified image of random area of SEM image c



Laboratory scale reactor for the separation of service station waste oil: oil can be collected from the second compartments and water can be collected from the third compartment and membrane is fixed in the middle

**Postgraduate degrees completed:**

U B Gunathilaka  
M Phil (2017)

Thesis title:  
Design of Biological and Advanced Oxidation Technology (AOT) hybrid reactor system for oil wastewater treatment

**For more details, contact:**

Prof. Jayasundera Bandara  
[jayasundera@yahoo.com](mailto:jayasundera@yahoo.com)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Development of a low-cost water purification system, especially treatment of oily waste-water makes it possible to recycle the water reducing the cost of water requirement in the industry.

The increasing water pollution threatened bio-diversity as well as becoming increasingly unfit for healthy living. Destroying the biodiversity no doubt adversely affects the human. Hence this project that involves removal of organic waste from waste water has great impact on the improving of well-being of the people.

**RECOMMENDATIONS TO FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES**

The small-scale laboratory scale reactor works efficiently (~ 95% oil-water separation) for the separation of oil-water in service station waste oil. For in-situ real service station water treatment, the laboratory scale reactor has to be scaled up for industrial applications and the technical problems that might arise due to scale-up have to be re-assessed.

# Dynamic rating of power distribution

RG/2014/EA & ICT/01

**Principal Investigator:**

Prof. Janaka Ekanayake

**Co- Investigators:**

Dr Janaka

Wijayakulasooriya

Department of Electrical  
and Electronic Engineering  
University of Peradeniya

## INTRODUCTION

Sri Lanka is gradually increasing its renewable energy share. Therefore, a grid infrastructure which can seamlessly absorb renewable energy sources is a must. Even though upgrading the existing grid infrastructure is a viable option, in this research a method of utilization the existing infrastructure is proposed.

## PROJECT ACHIEVEMENTS/OUTPUTS

In this research, a system that can determine the dynamic line rating was developed using low-cost solutions. A number of different sensors were developed and they were tested in real power lines. These sensors and respective software develop to manage the data are the main output of the project. Other than that, a number of papers were published in local and international conferences and in NSF journal.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

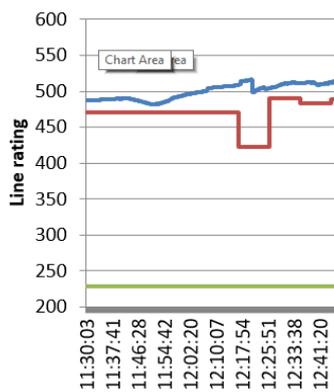
This project will have direct impact for the socio-economic development of the country by enabling the addition of more renewable energy sources to our electricity networks while postponing any line additions. The proposed system will relieve bottlenecks in the distribution networks thus allowing more renewable energy connections. They will have long term benefits by meeting national energy needs at competitive costs thus paving path to the development of commercial and industrial sector in the country.



Sensing device with Rogowski coils



Devices tested at a wind farm collector network



Static (Light green) vs Dynamic (red and blue) line ratings

**Postgraduate degrees**

**Completed:**

Dr Akila Wijeratne  
PhD (2018)

Thesis Title:

Maximizing Renewable energy integration into distribution networks through clustering approach, dynamic line rating and demand side management

**For more details, contact:**

Prof. Janaka Ekanayake  
[jbe@ee.pdn.ac.lk](mailto:jbe@ee.pdn.ac.lk)

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

The sensing devices and associated post processing software could be easily commercialized provided that CEB or similar utilities in the world could be convinced about the benefits offered by operating their lines closer to the dynamic line rating. However, the developed prototype should be enhanced and tested under various operating conditions before the commercialization of the product.

# Investigation of Mud-Concrete for in-sit cast load bearing Walls

**RG/2015/EA & ICT /02**

**Principal Investigator:**

Prof. Rangika Halwatura  
Department of Civil Engineering  
Faculty of Engineering  
University

## INTRODUCTION

In-situ cast Mud-Concrete load-bearing Walling (MCW) technology is a locally developed, durable, affordable, low cost, labour free, fast, flexible and sustainable alternative walling technology which cater to the growing demand of housing across the world. Also it receives a great attention due to its economical affordability, low embodied energy and the enhanced natural moisture buffering capacities.

## PROJECT ACHIEVEMENTS/OUTPUTS

Specifications, standards and guidelines of the self-compacting in situ cast Mud-Concrete load-bearing walling (MCW) system was developed within this research process. Thus, the achieved results and probable applications were published through journals, conferences, scientific reports and paper articles. A few workshops and presentations were conducted to popularize the technology among academics, professionals, university students and school children. The MCW technology was introduced to government mass housing projects particularly designed for low-income communities. Also we have worked with architects and engineers to promote the MCW technology among general public through their building designs.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Few conference papers were published and few journal papers were in the process of reviewing. Technology was introduced to few architects and they have successfully used the MCW technology for their building designs. In addition, the research project was extended to investigate the fabric form work and fabric MCW construction to remove material wastage and develop novel architectural elements. Further, the research was extended to examine shell structures and thin vaulting through MCW.



Mud-Concrete in-situ  
cast load bearing wall segment



Obtaining MC core samples



Corner formwork using  
to cast MC in-situ cast load  
bearing wall segment

### **Postgraduate degrees**

#### **Completed:**

**Dr F R Arooz**

PhD (2019)

#### Thesis title:

In-situ mud-concrete  
as a material for load  
bearing walls and  
sustainable building  
practices

#### **For more details, contact:**

Prof. Rangika Halwatura

[rangika@uom.lk](mailto:rangika@uom.lk)

[rangika@gmail.com](mailto:rangika@gmail.com)

Dr F R Arooz

[rizznaz@gmail.com](mailto:rizznaz@gmail.com)

### **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

MCW technology is a patented product which includes the inventions of mix design and modular form work system. In this system, methods were introduced to reduce the raw material (virgin soil) usage and to maintain the consistency of the material through exact mix design. The findings show the flexibility of MCW technology in catering to different architectural and structural requirements while creating a thermally comfortable environment. Significantly this novel soil based self-compacting in-situ cast walling system can apply for the sustainable green construction, climate sensitive architectural designs and low-cost mass housing projects while tremendously contributing to save the environment, energy and the capital expenditure of the country.

### **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Initially the technology was introduced to few Architects and contractors who interested about the technology. After that the knowledge was shared and trained the labourers according to the agreements made with the contractors.

# Non-Intrusive Load Monitoring for Flexible Demand Estimation and Management

RG/2016/EA & ICT/01

## Principal Investigator:

Dr G M R I Godaliyadda

## Co- Investigator:

Dr M P B Ekanayake

Prof. J B Ekanayake

Department of Electrical and  
Electronic Engineering  
University of Peradeniya

## INTRODUCTION

This research project proposes a novel methodology to accurately identify combinations of turned-ON appliances in a consumer premises utilizing single active power measurement collected at a low sampling rate. This enables the estimation of flexible loads that can be shifted/controlled per resident/industrial user at a given time.

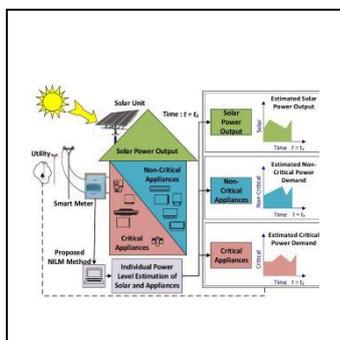
## PROJECT ACHIEVEMENTS/OUTPUTS

This research project was able to produce,

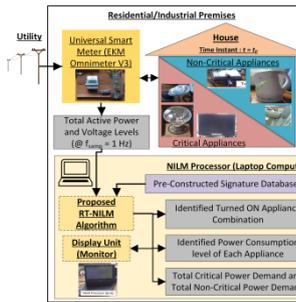
- two Journal papers in Applied Energy, Elsevier Journal (impact factor = 7.9)
- two Journal papers in the IEEE Transactions on Smart Grid,
- A Journal publication in AIMS Energy,
- 8 more IEEE international conference papers,
- President Award for Scientific Publications in 2018 for Prof. J.B. Ekanayake, Dr. G.M.R.I. Godaliyadda, Dr. M.P.B. Ekanayake and,
- A Pending patent.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

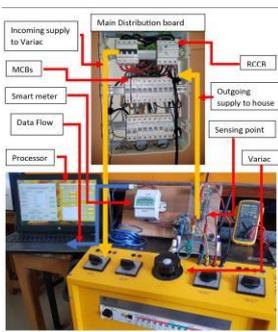
One of the papers in Applied Energy was accepted and published after the final report. Further, the same team won a NSF grant to accommodate the outcomes of this grant for investigating novel Smart Distribution Management System (S-DMS) to maximize the rooftop PV absorption capacity of last mile network.



Graphical abstract



Complete hardware architecture of the proposed RT-NILM implementation



Measurement setup

**For more details, contact:**  
 Dr G M R I Godaliyadda  
[roshangodd@ee.pdn.ac.lk](mailto:roshangodd@ee.pdn.ac.lk)

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The outcomes of this research will aid the utilities to manage the network such that demand can follow the generation while increasing the efficiency and reliability of power networks. This operational philosophy helps the addition of renewable energy sources thus reducing the dependency on imported fossil fuel. This not only prevents the reduction of our foreign currency reserves but also increases the socio-economic sustainability.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

The algorithms developed has the proven ability to function as a standalone system providing the user and the utility with the details of appliance usage in a customer premises in real-time and it also possesses the ability of further advancement into a tool of predication, demand side management, and distributed renewable generation management. As the system is at a complete state, and a patent is pending there is high possibility of developing it as a commercially viable Application.

# Optimization of the processing parameters used in the traditional sesame oil production unit (sekku) and in the screw expellers used in Sri Lanka [to enhance the quality and the consistency of the quality of sesame oil produced]

RG/2015/EA&ICT/01

**Principal Investigator:**

Prof. R Shanthini  
Department of Chemical &  
Process Engineering  
Faculty of Engineering  
University of Peradeniya

**Co- Investigator:**

Prof. K S Walgama,  
Department of Engineering  
Mathematics  
Faculty of Engineering  
University of Peradeniya



**INTRODUCTION:**

In Sri Lanka, sesame oil is produced from landrace seeds at cottage industry level using wooden sekku, and domestic, cottage and industry-scale screw expellers (DSE, CSE and ISE, respectively). Major objective of this study was to optimize processing parameters to enhance the quality of sesame oil produced. Mathematical modelling of the forces exerted on sesame seeds and the frictional heat generated during sesame oil extraction both in sekku and in expellers were also carried out.

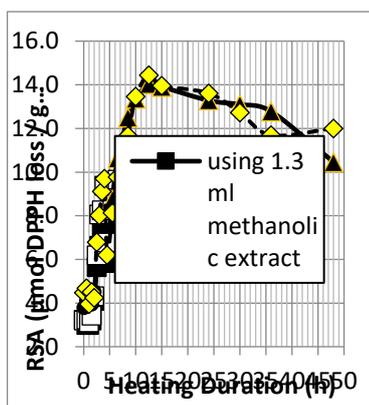
**PROJECT ACHIEVEMENTS/OUTPUTS:**

Sesame oil samples extracted from well preserved certified-quality white-seeded Uma using a DSE or a sekku complied with international oil quality standards. When using landrace seeds, use of fresh seeds or seeds packaged when fresh and stored under supervision helped to produce quality sesame oil. Free fatty acid content (FFA) of fresh sekku-made oil was higher than FFA of fresh DSE/CSE-made oil and, therefore, upon storage, FFA of sekku-made oil increased beyond permissible oil quality limit whilst FFA of DSE-made oil did not surpass the oil quality limit even after 40-month of storage at ambient conditions. Irrespective of the level of FFA, however, sesame oil was stable against oil oxidation in all cases studied, as judged by *para*-anisidine value, total polar matter and refractive index. Sekku-made oils were unique in the sense, when heated to frying temperatures (160°C or 180°C), their free radical scavenging activities (RSA) increased significantly which was proven to have been caused by the increase in free radical scavenging antioxidants in sesame oil being heated. Sesamin and sesamolin contents in oils were independent of the oil extraction equipment used, and were strongly dependent upon the seed source: more sesamin and sesamolin contents in landrace seeds-based oils than in certified seeds-based oils. Compositions of major fatty acids in oil extracted from Uma and landrace seeds using DSE or sekku were as follows: 9.0% to 9.9% palmitic acid (C16:0), 5.1% to 5.7% stearic acid (C18:0); 39.1% to 40.1% oleic acid (C18:1, *n*-9) and 43.0% to 44.7% linoleic acid (C18:2, *n*-6). Unwanted elaidic acid and linolelaidic acid were tested for and found to be not present in none of the oil samples. Aflatoxins were present in 3 out of the 48 samples tested and their concentrations did not exceed the limits placed for quality oils by national and international standards. Oil quality was independent of (i) seed moisture content varying in the range of 3.6 to 7.0% dry basis and (ii) frictional heat generated during oil extraction.



Wooden sekku, traditional oil extraction technology, in use today for sesame oil production in Sri Lanka.

Domestic-scale screw expeller (DSE) used for extraction



Variations in radical scavenging activity (RSA) of sekku-extracted sesame oil samples from landrace seeds heated at 180°C for 48 hours.

**Postgraduate degrees completed:**

Ms. Oshani C Abeysekera  
PG Dip. in Chemical and Process Engineering (2018)

Thesis title:

Yield, antioxidant quality and oxidative stability of sesame oil produced from sesame seeds of varying water content

**For more details, contact:**

Prof. R Shanthini  
[rshanthini@pdn.ac.lk](mailto:rshanthini@pdn.ac.lk)  
[admin@rshanthini.com](mailto:admin@rshanthini.com)

**UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF:**

Results of this study were disseminated among oil producers and consumers at grass-root level. Shelf-life studies were continued.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY:**

In Sri Lanka, mechanical devices are used in producing sesame oils without the application of heat. Seeds were prepared by traditional/mechanical means of dry cleaning, washing with water (in some cases) and solar drying. Oil was clarified by gravity settling. The said features render Sri Lankans sesame oils to be categorised as virgin or cold-pressed oils which has better market value. Landrace sesame seeds are dry-zone crops requiring no irrigation, no fertilizer and no pesticides and, therefore, qualify as an ecologically sound raw material. We recommend the use of these information to add value to sesame oil produced from Sri Lankan landrace seeds. Oil quality parameters of DSE and CSE-made sesame oils resemble those of refined oil: lighter colours; lower FFA; longer shelf-life; stable RSA values upon heating. They are, however, not refined by external means. It means that refined oil is produced without the additional economical and ecological costs of refining. This offers a unique opportunity to market DSE and CSE-made sesame oils for a good profit. Ecologically sound production of oil, at cottage-level, from ecologically sound raw material grown in Sri Lanka, using equipment fabricated in Sri Lanka with Sri Lankan raw material, would perfectly fit the demands of self-dependence in post-Corona world. A point to be taken very seriously.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY:**

Olive oil is a successfully marketed edible oil. Major driving force behind it may well be the International Olive Council. There is no International Sesame Council. There is not even a national level of any council dealing with sesame oil. We highly recommend one.

# Development of a unified vertical reference framework for Land and Hydrographic surveying in Sri Lanka

RG/2017/EA & ICT/01

## Principal Investigator:

Dr H M I Prasanna

## Co- Investigator:

Dr M D E K Gunathilake

Dr D R Welikanna

Department of Survey and  
Geodesy

Faculty of Geomatics

Sabaragamuwa University  
of Sri Lanka

## INTRODUCTION

In order to manage our marine spaces in a more structured and sustainable manner, it is required to provide seamless spatial data across the land /sea interface. The solution lies in developing a separation model from which users can transform data between different vertical datums.

## PROJECT ACHIEVEMENTS/OUTPUTS

- A global based local geoid model was developed using a high resolution GGM, SGG-UGM-1 and SRTM elevations.
- In chart datum determination, tidal data of six stations were processed and analyzed to obtain the variations of the MSL with the MSL and chart datum.
- The overall results with the IDW interpolation as well show the chart datum variation compared to the Datums in concern is gradual with the mean value is in the range of 0.4.m.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

The computed geoid model is being further analyzed against newly observed gravity data. A new paper titled “Development of a unified vertical reference framework for Land and Hydrographic surveying in Sri Lanka” has been accepted by the Journal of Marine Geodesy (IF-1.2) and currently in the publication process.



Gravity data collection in Jaffna



Tide gauge installation



Observing the gravity on levelled Bench Mark at Jaffna

***For more details, contact:***

Dr H M I Prasanna  
[indika@geo.sab.ac.lk](mailto:indika@geo.sab.ac.lk)

## **RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

One example application is storm surge inundation from hurricanes. Further, this seamless vertical reference surface is important for number of coastal applications, such as coastal zone management and marine boundary delimitation. The vertical reference surface along with suitable models relating to the working vertical datums in an area, will also allow data/products to be output on various vertical datums as requested by the client.

## **RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Datum inconsistencies were found in the current vertical datum determined by establishing fundamentals benchmarks over century ago mainly due to the global sea level rise. Therefore, it is important to correct this deviation in order to fit the local surveying activities to the global framework.

The finding of chart datum variations in different tide gauge stations is also a new outcome of this research.

Vertical datum transformation parameters can be used to convert heights to bathymetric data and the vice versa.

# Checklist preparation of finfish, shellfish and plankton population of the Batticaloa lagoon along with study on water quality parameters

RG/2011/ES/04

**Principal Investigator:**  
Prof. P Vinobaba

**Co- Investigator:**  
Mrs. Sangeetha Ashan

Department of Zoology  
Faculty of Science  
Eastern University



Map shows 16 sampling sites within the Batticaloa lagoon covering the entire lagoon. Different River discharges, different land use practices, municipal dumping, aquaculture and agricultural effluents and urban runoffs were also taken into account when choosing the sampling sites.

## INTRODUCTION

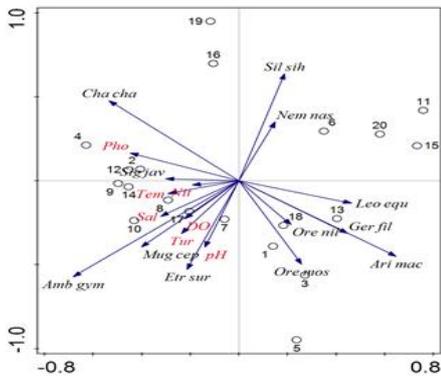
The Batticaloa lagoon supports the economy of the district through the estuarine fishing and promoting tourism. However, this lagoon has been subjected to significant degradation as a result of various unplanned activities. Sustainability of this lagoon, depend on routine monitoring of physico-chemical and biological parameters of the lagoon.

## PROJECT ACHIEVEMENTS/OUTPUTS

- Check list for existing finfish, shellfish and plankton prepared
- Geo-referenced interpolation map prepared using ArcGIS for seasonal variation of measured water quality parameters
- Canonical Correspondence Analysis (CCA) map prepared for economically important fish in relation to abundance and water quality variation.
- Suggested the plausible restoring mechanism to control the anthropogenic pollution of Batticaloa lagoon
- Publication produced in Science Citation Index (SCI) and Science Citation Index Expanded (SCIE) indexed journal (Elsevier)

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

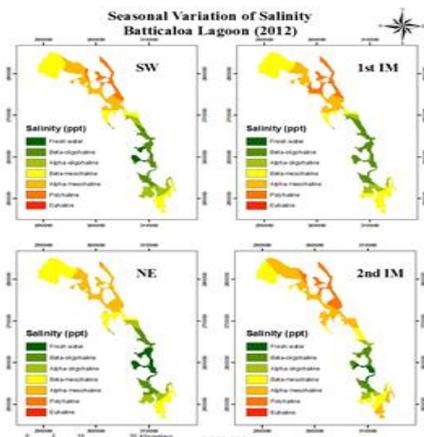
Deteriorating water quality pave the path for finfish and shellfish catch decline to a considerable extent. The preparation of check lists attract ecotourism. Increased demand for finfish and shell fish has become a major income generating livelihood option for lagoon fishermen. Study of the finfish and shell fish abundance in relation to water quality and plankton, ensures the lagoon food safety and sustainability while suggesting a plausible restoring mechanism.



Canonical Correspondence Analysis (CCA) map shows how economically important fish abundance vary with measured water quality parameters

### RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

- Assessing and continuous monitoring of water quality for 5 years (2012-2016) in order to predict the clear seasonal and annual variation
- Attempts taken to prepare the pictorial field guide along with photographs to promote ecotourism
- To ensure whether heavy metal bio accumulation in fish muscle is through water or food
- Restoring mechanism suggested through awareness programs to all stakeholder departments and fish folks
- GIS based map prepared for annual variation of water quality



Interpolation map for the year 2012 for varied salinity among study sites in different seasons

### Postgraduate degrees

#### Completed:

J M Harris

M.Phil (2016) and PhD work started 2017 onwards

Thesis title:

Monitoring of Batticaloa Lagoon in the view of sustainability and lagoon food safety (Tentative)

#### For more details, contact:

Prof. P Vinobaba

[vino\\_peria2004@yahoo.co.uk](mailto:vino_peria2004@yahoo.co.uk)

“Research is the Foundation of Knowledge”

## Exploring biological and chemical diversity of genera *Flueggea* and *Tephrosia* (vern: Pila) and to develop effective propagation systems

RG/2011/NRB/06

**Principal Investigator:**  
Prof. R A S P Senanayake  
Department of Botany  
University of Kelaniya

**Co-Investigators:**  
Dr M P Jayatilleke  
Biotech Associate Scientist  
JR Simplot Company  
USA

Dr R G S C Rajapakse  
Department of Molecular  
Biology & Biotechnology  
Faculty of Science  
University of Peradeniya



*Tephrosia purpurea*



*Tephrosia tinctoria*

### INTRODUCTION

*Flueggea leucopyrus* and genus *Tephrosia* (vern: Pila) are become increasingly popular as an ingredient in several traditional therapeutic systems in Sri Lanka. This research project was planned to infer phenetic and genetic diversity, character elucidation of secondary metabolites of these taxa and to establish suitable propagation systems for medicinally important species.

### PROJECT ACHIEVEMENTS

Phenetic variability was inferred and multiaccess key was developed for accurate identification of the species of *Tephrosia* and *Flueggea* (ver: Pila) in Sri Lanka. Sequence homology of ITS and *trnH-psbA* regions of *Tephrosia* spp. were analyzed and compared to determine intra specific relationships. Phytochemical variation was evaluated by phytochemical screening and analyzing phenolics, flavonoid aglycosides and anthocyanidins in leaves. Effective propagation systems for the medicinally important species of *Tephrosia* and *Flueggea* were developed by determining suitable seed dormancy methods and potting media.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Developed propagation system has been used by several growers in herbal gardens and was successful. Hence, it can be recommended as a suitable and effective propagation system for cultivation. Multi access key is using in research and academic activities related to these taxa.



*Tephrosia noctiflora*



*Tephrosia villosa*



*Flueggea. leucopyrus*

**Postgraduate degrees completed:**

Ms. Asha Ishani Sri  
Priyadarshan  
M Phil (2015)

Thesis title:

Exploring biological and chemical diversity of genera *Flueggea* and *Tephrosia* (vern: Pila) and developing effective propagation systems

***For more details, contact:***

Prof. R A S P Senanayake  
[priyangi@kln.ac.lk](mailto:priyangi@kln.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Establishment of suitable propagation systems ensure reproducibility of these plants and supply of economically feasible produce to the pharmaceutical industry. Accurate identification of the plants and the recognition of inherent variability of individuals contribute in drug standardization process by preventing adulteration. These outcomes of the project uplift the quality of therapeutic systems in traditional medicine and its recognition. The area of study is fairly new to the country, and training a qualified person in the field of study at postgraduate level enhance research and development in the field and institutional development.

**FOLLOW-UP**

Establishment of cost-effective mass propagation methods for the genus *Tephrosia* to ensure reproducibility. The multi access key and the database were further improved, and a pictorial guide will be developed after securing funds.

# Impact of Tropical Forest Fragmentation on Figs and Wasp Pollinator Interactions

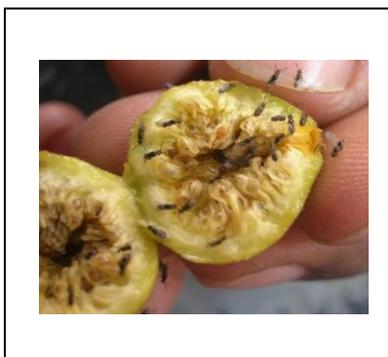
RG/2011/NRB/01

**Principal Investigator:**

Prof. W A I P Karunaratne  
Department of Zoology  
University of Peradeniya.

**Co-Investigator:**

Dr A M T A Gunaratne  
Department of Botany  
University of Peradeniya



Emerging pollinator female wasps from open syconia of *F. exasperata*

## INTRODUCTION

Rich biological diversity of tropical forests is seriously threatened due to forest fragmentation. The importance of keystone figs in the conservation of many tropical forest communities is becoming increasingly recognized. Present study investigated the effect of forest fragmentation on four fig species and their wasp pollinators and associated wasp species.

## PROJECT ACHIEVEMENTS/OUTPUTS

An M.Phil thesis will be published by the postgraduate student. One peer review publication is almost completed (reviewed manuscript was submitted after corrections, to International Journal of Fruit Science) and three oral communications with abstracts were published in proceedings of local symposia.

The results identified through the fragmentation impact on fig species and their criteria indicate that level of fragmentation has no effect on the present wasp emergence.

Findings and collections made from this project are already being used in undergraduate and postgraduate teaching and in their research projects. The findings can also be used in formulating guidelines for protected areas.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

M.Phil. thesis submitted by the student and one oral communication and one peer reviewed publication.

M.Phil awarded in 2020.



*F. exasperata* pollinator –  
*Karadibia gestroi*



Externally ovipositing non-pollinator fig wasp, *Philotrypesis quadrisetosa* on syconia of a male tree of *F. exasperata*.

**Postgraduate degrees completed:**

W M G A S T B Wijethunga  
M Phil (2020)

Thesis title:  
Impact of Tropical Forest fragmentation on figs and wasp pollinator interactions

**For more details, contact:**  
Prof. W A I P Karunaratne  
[inokap@pdn.ac.lk](mailto:inokap@pdn.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The present study identified the impact of forest fragmentation on fig pollination system and thereby the threat to key stone *Ficus* species and to the forest biodiversity. Therefore, it highlights the importance of conserving keystone species and natural ecosystems to sustain biodiversity. The results of the study can be used in formulating guidelines in declaring and identifying reserves to conserve biodiversity.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Not applicable

# Seed Biology of Twenty-Five selected Tropical True Mangrove or Mangrove Associate Species of Sri Lanka, Towards Restoration of Degraded Mangrove Systems.

RG/2011/NRB/08

## Principal Investigator:

Prof. K M G Gehan Jayasuriya  
Department of Botany  
University of Peradeniya

## Co- Investigators:

Prof. C V S Gunatilleke  
University of Peradeniya

Prof. I A U N Gunatilleke  
University of Peradeniya

Prof. Jeffery Walck  
Department of Biology  
Middle Tennessee State  
University, USA



Mature seeds in the fruit (A), mature fruit (B), and seedling (C) of *Xylocarpus granatum*, one of the studied species in the current project.

## INTRODUCTION

Despite their significance, mangroves have been disturbed worldwide. To continuously receive benefits from them, these ecosystems have to be restored. Lack of information on seed biology of mangrove species is a significant drawback for their restoration. Thus, seed biology of selected mangrove community species in Sri Lanka were assessed.

## PROJECT ACHIEVEMENTS/OUTPUTS

Using the experiments, phenology of 18 mangrove community species were recorded. Further, seed storage of 25 and seed dormancy classes of 31 mangrove community species were identified. This information is valuable in conserving these species. Seed dormancy and storage behavior profiles for Sri Lankan mangrove community was constructed first time. New type of epicotyl physiological dormancy was identified from the *Aegiceras corniculatum*. This was the first-time epicotyl dormancy has been identified from mangrove species.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Paper was published in an ISI indexed Journal “Seed Science Research” (Impact factor 2.03) on the effect of salinity on seed germination of mangrove species based on the project. Two more manuscripts been prepared for publication. More information on other seed traits of the studied mangrove species were gathered through undergraduate projects for more ecologically meaningful analysis. The information gathered were shared with the national mangrove expert committee in preparation of the mangrove propagation guidelines.



Different stages of *Cynometra iripa* seed germination



*Aegiceros corniculatum*, experimental setup (A), germinating fruit (B), crypto-viviparous fruits (C)

**For more details, contact:**

Prof. K M G Gehan Jayasuriya  
[gejaya@gmail.com](mailto:gejaya@gmail.com)  
[gjayasuriya@pdn.ac.lk](mailto:gjayasuriya@pdn.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Mangroves are connected with the social and economic aspects of the coastal people as mangrove ensure and enhance the fish production and also the aesthetic beauty of them could be utilized for the eco-tourism of the area. However, mangrove degradation disrupts all these socio-economic functions of them. The information gathered is vital in restoration and conservation of mangrove ecosystems through which the socio-economic development of coastal zone people and hence the country could be enhanced.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Physiological epicotyl dormancy identified in the *Aegiceros corniculatum* is new type of dormancy to the seed biology world. Thus, more research should be conducted to identify this phenomenon more and its' molecular biological mechanism should be studied. This mechanism may shed light to develop epicotyl dormant seedlings in ornamental plants which is an easy way of transporting these plants.

## Estimating subsurface extension of Eppawala apatite deposit and its parent rock using geophysical techniques

RG/2012/NRB/03

**Principal Investigator:**  
Prof. N D Subasinghe

**Co-Investigators:**  
Prof. C B Dissanayake

National Institute of  
Fundamental Studies,  
Hantana Road, Kandy

### INTRODUCTION

Eppawala phosphate deposit is the only phosphate deposit currently mined commercially in the country. Since its discovery in 1976, there have been no serious attempts to explore the area for possible extensions beyond the originally discovered areas. This project explored the area for possible extensions of phosphate ore, using geophysical methods.

### PROJECT ACHIEVEMENTS/OUTPUTS

For the first time in Sri Lanka, magnetic geophysical technique was successfully utilized to map a phosphate deposit. This study revealed that the boundaries of the phosphate-bearing rock extend further than the hitherto known areas. Results indicate that the phosphate-bearing rock has an average width of 100 m and a varying thickness between 50 and 100 m. Two journal papers and few abstracts were published and, one postgraduate student was trained.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

A student conducted a ground truth survey as a part of her honest degree to assess the validity of the results obtained by geophysical techniques described above. A dissertation was submitted and a research paper is in progress.

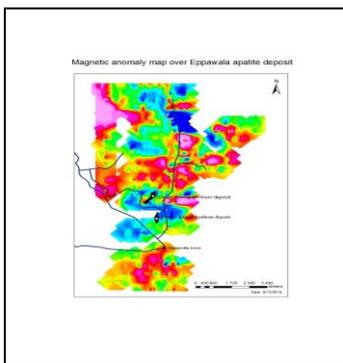
After the success of applying the magnetic technique to demarcate the boundaries of Eppawala phosphate deposit, another, relatively smaller phosphate occurrence in Kurunegala district was also mapped using the same technique. A research paper is in preparation.



Conducting magnetic survey using portable magnetometers, over a lake in Eppawala area



Field work at Eppawala by Postgraduate student and the Technical assistant



Magnetic anomaly map of Eppawala area, produced using results from the research project

**Postgraduate degrees completed:**

Mr. D R Charles  
M Phil (Pending)

**Thesis title:**

Estimate of the subsurface extension of Eppawala apatite deposit and its parent rock using geophysical techniques

***For more details, contact:***

Prof. N D Subasinghe  
[deepal.su@nifs.ac.lk](mailto:deepal.su@nifs.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Discovery of extension of the phosphate deposit means there is a huge potential for developing the newly discovered areas as a mineable deposit. This can bring economic benefits to the country. Also, we discovered that certain areas of the currently mining faces of the deposit have reached their limits. The mining operations can be shifted to newly discovered areas.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Another survey with better spatial resolutions may be carried out at areas identified by this work. A thorough investigation using other techniques should also be carried out to confirm the newly discovered areas of the phosphate deposit.

Once confirmed with geophysical techniques, geological mapping and drilling, together with geochemical studies, should be carried out to establish the extent, grade and the economic potential of the ore.

# Identifying the culprits threatening local amphibians: trematode induced deformities and toxicity to agrochemicals and ultraviolet radiation

**RG/2014/EB/02**

**Principal Investigator:**

Prof. Rupika Rajakaruna

**Co- Investigator:**

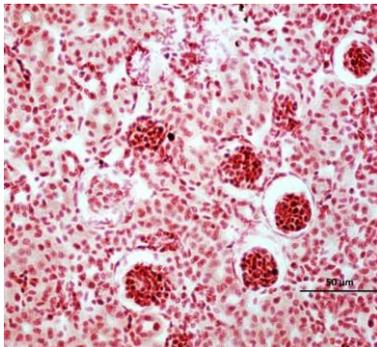
Prof. Madhava

Meegaskumbura

Department of Zoology

Faculty of Science

University of Peradeniya



Histological preparations of testes of male frogs of *Polypedates cruciger* at Gosner stage 42 exposed to pesticide showing multiple oocytes



Stained skeletons of metamorphs of *Polypedates cruciger* infected with digenetic trematode larvae (cercariae) showing kyphosis

## INTRODUCTION

Widespread reports of malformed amphibians and population declines have prompted the investigation of the effect of infection of trematode parasites, pesticides and ultraviolet radiation on the development malformations and survival of local amphibian species, the common hourglass tree frog (*Polypedates cruciger*) under laboratory conditions.

## PROJECT ACHIEVEMENTS

Types of pesticides and cercarial types that induce mortality and malformations in local frog species were documented. Prevalence of frog malformations in paddy-fields and knowledge, practices and attitudes (KPAs) of farmers on pesticide usage have been assessed. This work is published as two papers in indexed journals and two articles in referred journals. Human resource development was achieved through registering three M.Phil. students at the University of Peradeniya. Two students have graduated.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Laboratory work is being continued by staining the skeletons of the malformed frogs collected in the paddy-fields. Two more research articles have been submitted and three more are in preparation. Another M.Phil. student (Mr. N B Karunaratne) is writing his thesis.



Tadpoles of *Polypedates cruciger* exposed to cercariae developed scoliosis

**Postgraduate degrees completed:**

Nuwandi U.K. Pathirana  
M. Phil (2018)

Thesis title:  
Trematode infections in common  
hourglass tree frog (*polypedates  
cruciger*): Multiple parasitism and age  
dependent resistance and tolerance

Praveena Jeganathan  
M. Phil (2018)

Thesis title: Knowledge, practices and  
attitudes of fruits and vegetable  
farmers on pesticide usage and effect  
of three commonly used pesticides on  
common hourglass tree frog,  
*polypedates cruciger* in sri lanka

**For more details, contact:**

Prof. Rupika Rajakaruna  
[rupikar@pdn.ac.lk](mailto:rupikar@pdn.ac.lk)  
[rupika.rajakaruna@yahoo.ca](mailto:rupika.rajakaruna@yahoo.ca)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Amphibians are good ecological indicators of eco-health. Our laboratory and field studies signal an emerging problem in amphibian conservation. The agro-chemicals used in the study are widely used in the country and although the parasite is a naturally occurring species, the numbers have increased due to anthropogenic activities. These two environmental stressors have severely affected the health of the amphibians. This could be a warning of environmental degradation which also impacts upon human health.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Although laboratory studies have led to identify the culprits of amphibian deformities, and the prevalence of these deformed amphibians in human altered habitats like paddy-fields, natural habitats, further studies are needed to determine the prevalence of deformed amphibians in pristine nature reserves.



# Ecotoxicological assessment of effects of phenoxy and sulfonylurea herbicides and their commercial formulations on tropical earthworms: A physiological, population and functional approach

RG/2015/EB/01

**Principal Investigator:**

Prof. P Mangala C S De Silva

**Co-Investigator:**

Prof. D L A Leelamani

Department of Zoology  
University of Ruhuna

**Postgraduate degrees completed:**

Ms M A G D Samanmali  
M.Phil (2019)

**Thesis title:**

Ecotoxicological assessment of effects of phenoxy and sulfonylurea herbicides and their commercial formulations on tropical earthworm *Eisenia andrei*.

**For more details, contact:**

Prof. P Mangala C S De Silva  
[chathura@zoo.ruh.ac.lk](mailto:chathura@zoo.ruh.ac.lk)

## INTRODUCTION

This study aimed at determining the effects of phenoxy and sulfonylurea herbicides on earthworm communities in Sri Lanka agricultural areas by using physiological and behavioral endpoints in the laboratory. Our second aim was to link such effects to effects on decomposition processes and to investigate the suitability of biomarkers and bio-indicators as early-warning indicators of herbicide effects on earthworm community structure and functioning.

## PROJECT ACHIEVEMENTS/OUTPUTS

This project generated toxicity endpoints with relevant to herbicides and their commercial formulations. Results of this project will assist in understanding the link between effects at different levels of biological organization, e.g. between biomarker and individual responses and between individual responses and effects on functioning of earthworms in important soil processes. This will contribute to important ecological theories on the relationship between the structure and functioning of soil communities.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Two publications in SCI indexed journals are in process.

## RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

This project results will contribute to improvement of the scientific evaluation of phenoxy and sulfonylurea herbicides effects on soil organisms. It will yield tools that may be useful for the assessment of such side effects. In addition, results of this project may help the Sri Lanka authorities in taking decisions on further reducing pesticide use and increase sustainable agriculture.

## RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

Not applicable

# Survey on the occurrence and nest density of *Aneuretus simoni* Emery (Family: Formicidae) and associated ant fauna in a selected forest in Colombo and Kegalle Districts and preparation of a preliminary ant inventory of each forest

RG/2015/EB/03

**Principal Investigator:**

Prof. R K Sriyani Dias  
University of Kelaniya

**Co- Investigator:**

Mr. W Sudesh Udayakantha  
University of Kelaniya



A worker of *Aneuretus simoni*



A worker ant walking on a nesting substrate

## INTRODUCTION

*Aneuretus simoni* Emery, 1893 (Aneuretinae), the island endemic Sri Lankan Relict ant, had been recorded in wet zone and intermediate zone forests in Sri Lanka and very little was known of the species. During this survey, the species was recorded in two Forest Reserves outside the previously recorded Districts, Colombo and Kegalle and ecological aspects of the ant community associated with *A. simoni*, environmental conditions and life history of the species were investigated.

## PROJECT ACHIEVEMENTS/OUTPUTS

The status of *A. simoni* at Indikada Mukalana Forest Reserve and Lenagala Forest Reserve was assessed through the estimation of mean nest density, frequency of nest occurrence and frequency of worker occurrence and ant inventories of each forest was prepared. The habitats of *A. simoni* were defined by recording selected environmental parameters. Life history, types of microhabitats, colony demography and natural enemies of *A. simoni* were investigated.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

- Two full papers published one in a foreign journal and the other in a foreign bulletin.
- 07 communications (in the form of abstract submission) done.



Soil sifting at Lenagala Forest Reserve

**Postgraduate degrees completed:**

Dr W Sudesh Udayakantha  
PhD (2018)

Thesis title:

Dynamics of Nest Attributes and worker Occurrence in *Aneuretus simoni* Emery Associated Ant Community in a selected Region of Two Forest Reserves in the Wet Zone, Sri Lanka

***For more details, contact:***

Prof. R K Sriyani Dias  
[rksdias@kln.ac.lk](mailto:rksdias@kln.ac.lk)

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This successful approach has gained valuable knowledge about the diversity and biology of ants in Sri Lanka. This biodiversity knowledge will be an advantage for future researchers and professionals in the field of biodiversity and ecosystem services to take better decisions in future.

Conservation of biodiversity is a major need at the national level and Indikada Mukalana Forest Reserve and Lenagala Forest Reserve should be maintained as forest reserves in future to conserve this globally rare ant species.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

N/A

# Detection and Removal of Geosmin and 2- MIB in Drinking Water by Native Bacteria; Bioremediation Approach for Green Solution

RG/2016/EB 04

## Principal Investigator:

Prof. Pathmalal Manage  
Faculty of Graduate Studies  
University of Sri  
Jayewardenepura

## Co- Investigator:

Prof. S D M Chinthaka  
Department of Chemistry  
University of Sri  
Jayewardenepura



Innovate Sri Lanka 2019  
Competition Award Ceremony

Won 02 awards in this  
competition for the domestic  
filter unit

- Bronze Award and Third place  
all categories
- First place: Energy and  
Environment' category

## INTRODUCTION

Off flavors in drinking water caused by Geosmin and 2-Methylisoborneol (2- MIB) is a major issue in water industry since aesthetic quality of drinking water is the primary determinant for the end consumers. Current study focused on detecting and removing these compounds from drinking water using a bioremediation approach via native microbes.

## PROJECT ACHIEVEMENTS/OUTPUTS

- 06 Total Awards
- 01 Patent Ref. Numb: 20615 (Pending)
- Publications
- 22 Conference proceedings (Abstracts Published)
- 03 Conference proceedings (Abstracts Submitted)
- 02 Full papers published (Science Citation Index and Scopus index)
- 02 Full papers submitted
- 04 Full papers under preparation
- 05 Dissemination of Knowledge instances (Exhibitions, Ministry level discussions, TV programmes)
- 01 Product ready for commercialization (Domestic drinking water filter)

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Patent obtaining clarification and water filter commercialization procedures are being carried out. Current study related other full papers are being prepared at the moment.



Lab scale filter unit which can be applied industrially



Knowledge Dissemination:  
'Knowledge First TV  
programme'

**Postgraduate degrees completed:**

Ganegodage Sathya Sandarenu  
Ganegoda  
PhD (2020)

**Thesis Title:**

Detection and Removal of  
Geosmin and 2- MIB in Drinking  
Water by Native Bacteria;  
Bioremediation Approach for  
Green Solution

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

The current study focused on providing safe and aesthetically sound drinking water to our nation. Some areas like Anuradhapura, Polonnaruwa, Monaragala, Batticaloe, etc. people tend to reject pipe born treated water due to the bad taste and odour and go for other water sources where water safety is questionable. From this study two filter units have been produced. An industrial scale filter model which can be applied for water treatment at commercial level and a low-cost domestic filter unit which can be used to obtain safe drinking water in rural areas of the country, were the two developed.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

The domestic drinking water filter unit could be developed further to be commercialized as a startup business. Further, locally available cost-effective raw materials like rice husks and bamboo wood can be used to prepare biochar and activated carbon as a solution to remove T &O issues in Sri Lanka which can be used at the water treatment processes. Geosmin and 2-MIB threshold levels can be incorporated into SLSI drinking water standards using the data from the present study.

# Species diversity and the potential vector status of frog-biting mosquitoes in selected localities in the wet and dry zones of Sri Lanka

RG/2016/EB/05

**Principal Investigator:**

Prof. W A Priyanka P de Silva  
Department of Zoology  
Faculty of Science  
University of Peradeniya

**Co- Investigators:**

Prof. S H P P Karunaratne  
University of Peradeniya

Prof. Ximena Bernal  
Purdue University, USA



Uranotaenia mosquitoes feeding on *Duttaphrynus melanostictus*

## INTRODUCTION

High diversity, endemism of amphibian fauna and mosquitoes in Sri Lanka provide ample opportunities to study unique relationships between mosquitoes and anuran hosts. For the first time, we investigated the diversity of frog-biting mosquitoes in this island and the use of host emitted cues and species-specificity of mosquitoes' interact with frogs.

## PROJECT ACHIEVEMENTS/OUTPUTS

We reported the new recordings of frog-biting mosquito present in different climatic conditions in Sri Lanka (four species of *Uranotaenia* species including *Uranotaenia rutherfordi* & *Mansonia uniformis*). We further report the degree of species-specificity of their associations with the frogs and toads in this community. We confirmed the use of acoustic signals by frog-biting mosquitoes to locate their anuran hosts. This study reveals a community with surprisingly tight species interactions between mosquitoes and their host.

## UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

Peer reviewed Publication:

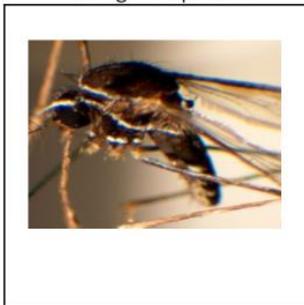
De Silva, W. P. P., Bernal, X. E., et al (2020). Feeding patterns revealed host partitioning in a community of frog-biting mosquitoes. *Ecological Entomology*, 45(5), 988-996.

International conference:

De Silva, W.A. P.P, Ximena E. Bernal, et al (2018). Mosquito anuran interactions and feeding patterns of frog-biting mosquitoes (Culicidae) in Sri Lanka. *Proceedings of the 9th International Congress of Dipterology*, Windhoek, Namibia, West Africa. Pp 63



Sound trap designed to collect frog biting mosquitoes



Characteristic thoracic bands of *Uranotonia rutherfordi*

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Undergraduate and Post-graduate students were trained to study mosquito–anuran interactions. Findings were incorporated to undergraduate teaching (Vector Borne Disease course). Outcomes were presented to many audiences and shared new-knowledge about vector-host interactions, possible pathogens of anurans and vectors of anuran diseases. Findings were shared with international communities and collaborations were established. DNA sequences of three new mosquito species were submitted to the gene bank and new acoustic traps were designed.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Potential vector status of anuran –biting mosquitoes were identified and the emergence of possible zoonotic diseases via the biting pattern of mosquitoes that have a broader range of hosts were evaluated. This information will be crucial in identifying possible causes of emerging infectious diseases to human and wildlife. The interactions between blood feeding insects and their hosts via host-emitted signals were described. This will be important knowledge in applying control traps for many vector mosquitoes.

# Monitoring the management response following the detection of malaria cases during the phase of malaria elimination in Sri Lanka

RG/2014/HS/03

## Principal Investigator:

Prof. S D Fernando  
Senior professor in Parasitology and  
Consultant Parasitologist  
Faculty of Medicine,  
University of Colombo

## Co-Investigators:

Dr Risintha Premaratne  
Department of Communicable  
Diseases, WHO Regional Office for  
South-East Asia

Prof. Shiroma Handunetti  
Prof. O V D S J Weerasena  
BMBB, University of Colombo

Prof. Sunil Premawansa  
Emeritus Professor, Faculty of Science,  
University of Colombo

## INTRODUCTION

Sri Lanka launched a malaria elimination drive in 2009, reported the last case of indigenous malaria in October 2012 and received malaria-free certification from WHO in September 2016. A robust prevention of re-establishment programme is now being sustained in Sri Lanka owing to the country's high receptivity and vulnerability to malaria. A case-based epidemiological study was conducted on all imported malaria cases reported in the country in 2015 and 2016 with the aim of profiling imported malaria to improve the effectiveness of the surveillance and case management system for malaria. In addition, the effectiveness of the passive case detection (PCD) system for imported malaria was assessed in Government hospitals in Sri Lanka post elimination of malaria.

## PROJECT ACHIEVEMENTS/OUTPUTS

- 10 publications in peer reviewed indexed journals
- 15 abstracts presented at National Conferences including, Annual academic sessions of the Sri Lanka Medical Association, Sri Lanka Association for the advancement of Science and Colombo University Annual Academic sessions
- Presidential Research Awards were received by the two students registered for higher degrees.
- Ms. Gunasekera, the Parasitologist assessed the PCR work on malaria diagnosis carried out at the AMC
- Ms. Gunasekera also received sufficient training to carry out the necessary laboratory tests for assessment of treatment failure.

**Postgraduate degrees completed:**

Dr W M Kumudunayana T de A  
W Gunasekera

PhD (2021)

Thesis title:

Comparison of parasitological and molecular diagnostic methods used for malaria diagnosis and molecular characterization of malaria infections in the phase of prevention of reintroduction of malaria in Sri Lanka

Dr H P R Dharmawardene  
M Phil (2021)

Thesis title:

Assessment of Malaria surveillance in in-ward patients and therapeutic response to currently used anti-malarial drugs in the phase of prevention of re-introduction of malaria in Sri Lanka.

***For more details, contact:***

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**UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF**

MPhil degree received by Dr. Priyani Dharmawardane, Regional Malaria Officer Anti Malaria Campaign on the 6<sup>th</sup> of April 2021 for the thesis titled “Assessment of Malaria surveillance in in-ward patients and therapeutic response to currently used anti-malarial drugs in the phase of prevention of re-introduction of malaria in Sri Lanka” funded by the NSF

Ms. Kumudu Gunasekera, Parasitologist, Anti Malaria Campaign has submitted the thesis titled “Comparison of parasitological and molecular diagnostic methods used for malaria diagnosis and molecular characterization of malaria infections in the phase of prevention of reintroduction of malaria in Sri Lanka” for a PhD degree to the IBMBB, University of Colombo and it is currently under evaluation by the examiners.

**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

Up until the time Ms. Gunasekera completed the laboratory work required for her PhD degree, genotyping and sequencing of malaria parasites was carried out at the National Institute of Health, Singapore. However, now as she has been trained in genotyping and sequencing under NSF, it is expected that these investigations will be carried out in Sri Lanka.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

None

## Water based UV-curable polyurethane latex coatings with nano- particles to impart special properties

RG/2011/NANO/01

### Principal Investigator:

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Faculty of Applied  
Sciences  
University of  
Jayewardenepura

### Co-Investigators:

Dr S Amarasinghe  
Department of Chemical  
and Processing  
Engineering  
University of Moratuwa

Prof. V Karunaratne  
Department of Chemistry  
Faculty of Science  
University of Peradeniya

Dr M Koneswaran  
Department of Chemistry  
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### INTRODUCTION

An aqueous polyurethane system was developed and it has been end-capped with ene groups to facilitate UV curing. Stability of the Polyurethane Dispersion (PUD) produced was studied in detail. Dispersion properties such as particle size and stability were studied. In addition, properties such as thermal, IR, crystallinity and photo properties of films produced were studied.

### PROJECT ACHIEVEMENTS

In this project, we produced a water based polyurethane dispersion that can be used as a coating. The polyurethane films produced show special fluorescence properties. It has been found that fluorescence property can be made reversible. Hence, the possibility of using it as a sensor material would be studied in future. Nano-iron composites of the polyurethane were produced and fluorescence properties were investigated. The polyurethane produced were capped with ene-end groups to impart UV curing characteristics.

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

Water based polyurethanes are the current trend in the industry albeit information on production or the synthesis of water-based polyurethane is not available in Sri Lanka. Hence, the acquiring of the basic chemistry of manufacture of this material is very valuable. Beside the economic value, if one can manufacture this material in Sri Lanka, it will be a very environmentally friendly VOC free product. In addition, as we have observed, there is an immense potential in this novel material to be developed as a sensor.

### RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

The possibility of using the reversible fluorescent properties as a sensor is investigated. Mechanism for the reversible fluorescent property is suggested and another project is initiated to use a theoretical approach to support the mechanism proposed. Three research papers are being compiled and first paper will be submitted soon.

## Constructing quaternary sea level curve for Sri Lanka

RG/2014/OMR/01

### Principal Investigator:

Dr P N Ranasinghe  
University of Ruhuna

### Co- Investigators:

Dr W K B N Prame  
Geological Survey & Mines  
Bureau

Dr Terney Pradeep Kumara  
University of Ruhuna

Commodore  
Y N Jayaratne  
Sr Lanka NAVY



Measuring the height of the  
sampled in-situ coral heads

### INTRODUCTION

Understanding long-term sea-level variability is key to recognizing future variability. Lack of long-term sea level record for the Central Indian Ocean and discrepancies in existing Holocene records prompted to carry out the proposed research using corals on raised and submerged reefs at northern island, and along the southern coastal belts. Main objectives of the research were to contribute to developing a long sea level record for the Central Indian Ocean and identification of forcing mechanisms.

### PROJECT ACHIEVEMENTS/OUTPUTS

Results show that the sea level was at a minimum of +3m MSL during the last interglacial (before around 107-125 kyrs BP). The Holocene transgression started submerging the lowlands of the coastal plains around 7300 yrs BP. At the peak of the Holocene high stand, which occurred around 6500 yrs BP, sea level reached a minimum of +2.5MSL and the high stand ended around 2500 yrs BP. Hydroisostasy could be recognized as the most reasonable cause for the mid Holocene high stand. Three phases of island formation during the Miocene, Pleistocene, and Holocene could be recognized in the Palk Strait area. Changes in sea level have resulted in these island formations. It was recognized that future anthropogenic sea level rise could submerge a large area of coastal lowlands in the south and in the Jaffna peninsula.



Studying buried corals at Polhena



Rotary core drilling of coral and Limestone basement at Kachchativu Island

**Postgraduate degrees**

**Completed:**

Tharanath Ambillapitiya  
M Phil (2018)

**Thesis title:**

Reconstructing the Quaternary sea level changes around Palk Bay of the central Indian Ocean and evolution of Palk Strait islands of Sri Lanka

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**RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY**

This study glimpsed the coastal landscape changes at the anthropogenic sea level rise. According to the gathered data, coastal lowlands including Jaffna peninsula will be at risk with the rising sea level. This information can be used for urban planning and coastal zone management. Modeling the coastal areas with accurate leveling data is essential to predict flooding areas at different levels of sea level rise in future. It is necessary to consider the early hydroisostatic respond of the Sri Lankan continental shelf to the rising sea level when preparing the submergence models. Our future coastal zone planning and disaster management planning should be based on such models.

**RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY**

Preparation of inundation models to future predicted sea level rise and modeling the potential landscape changes should be done. Hydroisostaticy has to be considered as an important factor when constructing the inundation models.

## The subjective well-being of married women in and out of the work force in Sri Lanka

RG/2014/SS/01

**Principal Investigator:**

Prof. Sunil Chandrasiri  
Faculty of Graduate Studies  
University of Colombo

**Postgraduate degrees completed:**

Dr Ann Shelomi  
Panditharatne  
PhD (2019)

**Thesis title:**

The subjective well-being of married women in and out of the workforce in Sri Lanka

**For more details, contact:**

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### INTRODUCTION

The objective of this study is to, investigate the extent to which the roles that married women play influence their subjective well-being and to find out whether going out to work, in addition to their other care-giving responsibilities, makes married working women's subjective well-being higher than those who do not engage in market work.

### PROJECT ACHIEVEMENTS/OUTPUTS

This study was found that while most married women who were interviewed are happy, being employed significantly lowers their happiness. On the other hand, the different roles which married women play as wife, daughter, daughter-in-law, and mother influence their happiness in different ways.

### UPDATED STATUS AFTER THE FINAL REPORT ACCEPTED BY THE NSF

The thesis titled “The subjective well-being of married women in and out of the work force in Sri Lanka’ was submitted to the Faculty of Graduate Studies, University of Colombo and was accepted in 2019(after two Viva s held at the university premises).

### RELEVANCE TO SOCIO ECONOMIC DEVELOPMENT OF THE COUNTRY

The findings of the current study have enabled us to understand the factors associated with the subjective well-being of married Sri Lankan women. More importantly it has shed some light on the very important issue of why married women do not engage in paid labour, from the perspective of their well-being. Additionally, the study has enabled us to see the real issues and the state of well-being of the average married working woman in Sri Lanka. All of these findings have positively contributed to the existing knowledge on subjective well-being in Sri Lanka; which stands at a very primary level.

### RECOMMENDATIONS FOR FOLLOW-UP IN TERMS OF TECHNOLOGY DEVELOPMENT/ START-UP BUSINESSES, IF ANY

The research findings will be useful for further researchers in this area.