March 2023

Newsletter

NATIONAL RESEARCH COUNCIL
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CONTENT

CeDARC

Centre for Diagnosis and Research in Cancer (CeDARC)

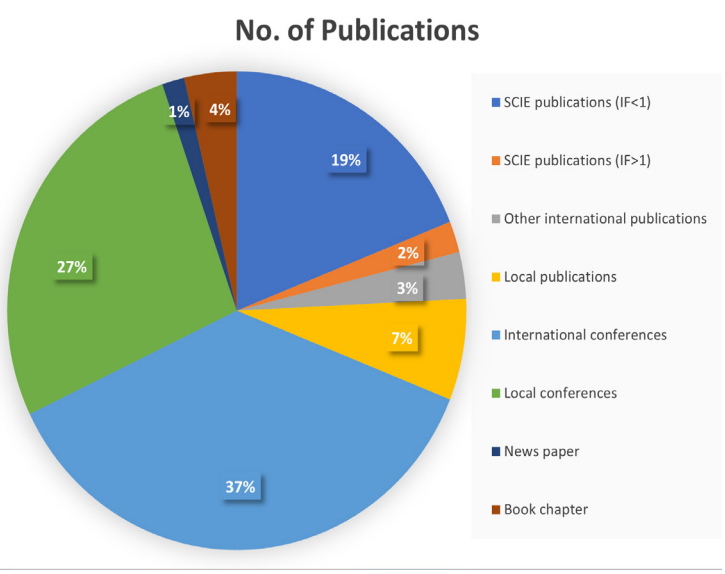
A state-of-the-art cancer research laboratory was established under the NRC Special grant SP 21-01, at the University of Colombo.

The laboratory was inaugurated by Senior Professor H.D. Karunaratne, Vice - Chancellor / UoC, Prof Chandu Silva, Principal Investigator of NRC SP 21-01, Chair & Senior Professor of Pathology Department of Pathology Faculty of Medicine, UoC, Prof. Hemantha Dodampahala, Chairman / NRC on 24th March 2023 at the Department of Pathology, Faculty of Medicine

Objectives

- To establish a state-of-the-art National Referral Centre for Cancer Diagnosis and Research as it is a current need of the country because cancer treatment involves a wide array of tests including genetic tests and expertise backed by evidence.
- Provide timely, accurate and complete diagnosis which can provide the maximum benefit, both for the patient in terms of survival and treatment tailormade according to the specific biologic behavior of the cancer, and also for the government in optimization of the use of public funds.
- An established referral system accepted nationally which opens the access of these facilities to all citizens irrespective of social status and place of residence.

Completed Research Projects In Year 2022



There were 37 Investigator Driven (ID) research projects completed in year 2022, the following fields.

- Medical sciences/ Food & Nutrition
- Agriculture / Plantations / Livestock & Fisheries
- EngineeringTechnology/IT/PhysicalSciences
- Environment, Chemical Sciences / Others

Mainly the ID grants are focused on scientific aspects, the relevance of the study to national development, its contribution to strengthening the capacity of science and technology in the country, and the possibility of research findings being published in international journals. From the above 37 completed research projects, there were 24 research projects completed with Grade A, and 7 projects received B grade and 2 project received C grade and one project received D grade. As outcome of the projects there were 13 local & 6 international publications and 51 local & 71 international conferences and 4 patent obtained and 2 patent applications in progress. There were 11 MPhils & 9 PhDs completed and 3 MPhils & 3 PhDs are ongoing.

Number of Publications	SCIE publications (IF<1)	36
	SCIE publications (IF>1)	4
	Other international publications	6
	Local publications	13
	International conferences	70
	Local conferences	51
	News paper	3
	Book chapter	7
Number of patents	Obtained	4
	Applied	2
Number of PG students Completed	MPhil	11
	PhD	9
Number of PG students Ongoing	MPhil	3
	PhD	3

CONGRATULATIONS

Presidential Induction of the 37th President of the SLCOG, 2023

Prof. S H Dodampahala the Chairman NRC, Professor in Obstetrics and Gynaecology, was appointed as a 37th President of the Sri Lanka College of Obstetricians and Gynaecologists for 2023, NRC CEO Dr. Mrs. Shanika Jayasekera, Council members and the staff attended to the induction programme.

Some Highlights of Achievements Of NRC Research Projects

Highlights of achievements of few research projects are presented in this newsletter and in, each Newsletter, NRC will present to the reader a few more outputs of research projects funded by the NRC.

Natural mosquito repellents: a sustainable solution to tackle mosquito-borne diseases

Achievements in Investigator Driven Research Projects
NRC Grant No: IDG 18-032

Mosquito-borne diseases are a significant problem for healthcare providers in many countries, including Sri Lanka, where eradicating breeding places has been unsuccessful. While reducing vector populations and using biting deterrents were effective methods of controlling the spread of diseases, synthetic compounds used in most common mosquito repellents caused concerns about human toxicity reactions and their negative impacts on the environment.

As a result, mosquito repellents derived from plants are becoming increasingly popular worldwide. Numerous volatile oil-bearing plants are available in Sri Lanka, which has been traditionally used in local folk remedies and Ayurvedic practices. Generations of ethnobotanical methods provide evidence that the oils present in those plants can repel mosquitoes and are less harmful to humans. However, most are underutilized and underexploited for their mosquito repellent properties. While natural mosquito repellents offer a sustainable and eco-friendly solution, their production at a commercial level requires the collection of plant materials in large quantities. This will be more effective, particularly for low-income farmers who can cultivate these plants in home gardens with their other crops. Suppose the permits are given to villagers to collect those materials sustainably from their home gardens or nearby forests. In that case, it also creates opportunities to earn additional income for them. Therefore, first, suitable plant species which could be used to make effective mosquito repellents were identified using a questionnaire survey on traditional Ayurvedic practitioners and subject experts. Another survey was conducted to determine the availability and willingness to supply 25 top-ranked plant species identified in the previous survey in Badulla, Batticaloa, Rathnapura, Kurunegala, Matara, and Hambantota districts. Then, leaf samples were obtained from the selected 25 top-ranked plant species, and their essential oils were extracted and analyzed using Gas Chromatography-Mass Spectroscopy (GC-MS). Based on the chemical constituents identified by GC-MS analysis, the most effective five plant species with mosquito repellency were selected to produce mosquito-repellent sticks and sprays. Those plants are Lime (*Citrus aurantifolia*), Cinnamon (Cinnamomum verum), Stone apple (*Aegle marmelos*), Mexican sunflower (*Tithonia diversifolia*), and Tulsi (*Ocimum tenuiflorum Subtype Krishna*). The effectiveness of those was first tested using mosquitos, and the produced sticks were tested in semi-field-testing in residences.

Mosquito repellent sprays testing

Research Findings

The questionnaire survey on Botany experts and Ayurvedic practitioners revealed that 127 potential plant species bear volatile oil with mosquito-repelling properties. The household survey conducted in six districts found that the most encountered plant species were Lime (*C. aurantifolia*), Goatweed (*Ageratum conyzoides*), Betel leaves (*Piper betle*), Orange (*Citrus sinensis*), and Wood apple (*Limonia acidissima*). The survey also revealed that males were more willing to grow and supply aromatic plants with mosquito repellent properties than females in their home gardens. Participants in the Kurunegala District showed the highest percentage of willingness to grow and supply raw materials, while the Badulla District showed the least willingness.

Out of 127, the GC-MS analysis identified 41 chemical constituents bearing mosquito-repelling properties. Eugenol and Caryophyllene were the most abundant constituents.

The mosquito repellent sprays formulated in this study showed different levels of effectiveness against Aedes albopictus mosquitoes. The aerosol spray containing Lime (*C. aurantifolia*) was the most effective, followed by Cinnamon (*C. verum*), Stone apple (*A. marmelos*), Mexican sunflower (*T. diversifolia*), and Tulsi (*O. tenuiflorum Subtype Krishna*). The effectiveness of the mosquito repellent sticks confirmed Tulsi to be the best followed by Stone apple, Cinnamon, Mexican sunflower, and Lime.


Mosquito repellent sticks testing.

Outcomes of this project:

A database has been created for the 127 plant species with mosquito-repellent properties, which contains information on taxonomy conservation, geographic distribution, and the plant parts which contain volatile oils. It is accessible in the website www.tropicaltree-search.com.

A machine learning algorithm was developed to assist policymakers in determining the degree to which people are willing to cultivate plants with mosquito-repellent properties.

The input variables of this program are the ones identified during the household survey. Policymakers can use the output to ascertain the applications' level of willingness before allocating financial aid to them. This algorithm will be expanded into a mobile application for ease of use in the future. The algorithm is available on https://srilanka.shinyapps.io/grower/, with a video tutorial and usage instructions available at https://smart-research.github.io/grower/.

Two mosquito repellents made with Ankenda (Acronychia pendunculata) and Divul (L. acidissima) have been granted patents.

Dr.Upul Priyasantha Subasinghe
Department of Forestry and Environmental Science
University of Sri Jayewardenepura, Nugegoda

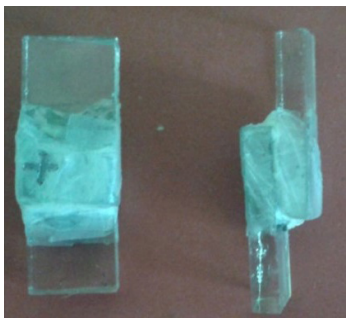
Value Addition to Sri Lankan Natural Rubber through exploiting for Energy Storage Devices

Achievements in Investigator Driven Research Projects
NRC Grant No: IDG 17-006

Introduction

Natural rubber is one of the three major exports crops in Si Lanka since time immemorial. The history of rubber plantation goes back to colonization era during which the first rubber (*Hevea brasiliensis*) seedling was brought to the island and planted in Henarathgoda Botanical Gardens in Gampaha. Rubber is grown in districts like Kegalle, Rathnapura and Galle. The milky, white liquid that is obtained by rubber tree is known as latex. The common practice of collecting latex is using suitable cups hang on to trees. Via the process called tapping, latex falls into the cups and it is then collected by tappers. After providing suitable treatments, natural rubber is used to produce a diverse range of items including toys, tires and gloves. Regrettably, Sri Lankan natural rubber has not been considered for any application in the energy and power sector though it has a potential to serve as a polymer in solid polymer electrolytes. Being a natural polymer, it is an ideal choice to substitute commercially available, expensive, toxic-polymers which are being commonly used.

In this investigation, main objective was to explore the potential candidacy of Sri Lankan natural rubber to be used for solid polymer electrolytes in non Li rechargeable cells and super capacitors.



Outputs

Since natural rubber is inherently an insulator, its structure needs to be modified. For this first ever project, natural rubber incorporated with methyl groups were used. Solid polymer electrolytes were prepared with four different salts and investigated in cells and super capacitors. For preparing electrolytes, modified natural rubber was dissolved in tetrahydrofuran and mixed with the relevant salt. All electrolytes which were prepared using conventional solvent casting method showed room temperature conductivities in the range of 10-4 -10-3 Scm-1. It is a very good sign to justify their suitability for electrolyte applications. Non Li rechargeable cells developed had open circuit potentials around 1 V which is convenient for low power requirements. Two types of super capacitors namely double layer capacitors, redox capacitors were fabricated and tested with natural graphite and conducting polymer based electrodes respectively. Performance indicators of all super capacitors were observed in terms of continuous charge discharge ability and stability etc. Those were also found to be within satisfactory levels.

Outcomes

One Ph.D. was produced with the financial assistance from the grant. In addition, one system was partially carried out as a final year undergraduate research project. Results obtained were outstanding which resulted several indexed journal articles as well as conference presentations. More importantly, this project discloses the suitability of Sri Lankan natural rubber for electrolytes in devices which in turn adds value to this crop.

Way forward

Study will be extended towards improving the performance of the electrolytes as well as the devices further and to develop up to prototype level.

Apart from salts, use of ionic liquids may be another option which generally discards the necessity of using toxic solvents. In addition, it is expected to test their performance in solar cells.

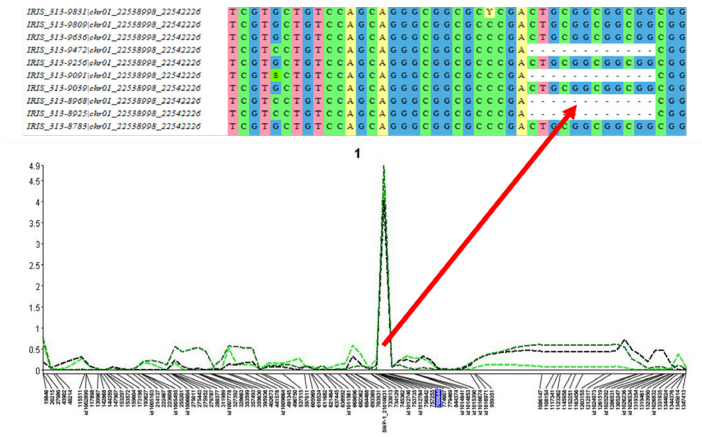
Prof. (Mrs) G.A.K.S. Perera
Senior Professor in Solid State Physics
Department of Electronics
Faculty of Applied Sciences
Wayamba University of Sri Lanka

Next Generation Sequencing of two rice varieties for exploring salinity-tolerant genes

Achievements in Investigator Driven Research Grants
NRC Grant No: IDG 16-016

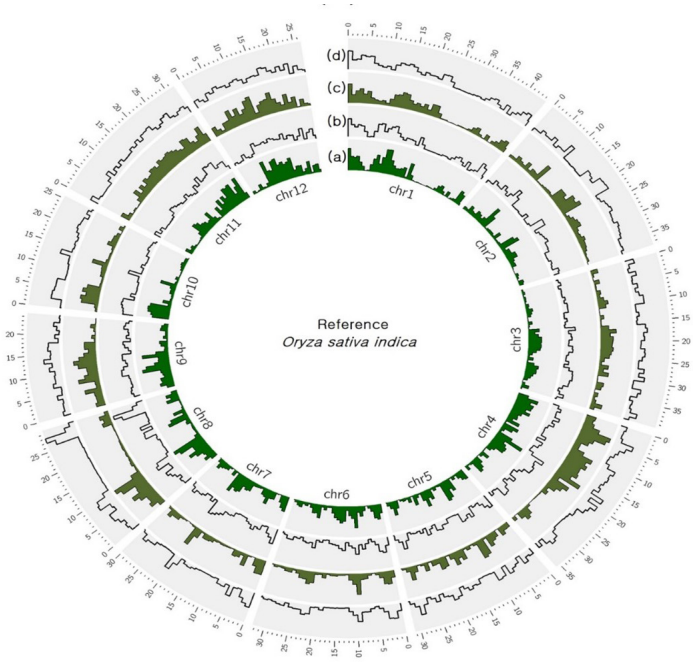
Introduction

In Sri Lanka salinization issue has developed remarkably in coastal areas and some inland rice-growing regions. Although several traditional rice varieties such as Nonabokra and Pokkali are tolerant to salinity for some extent, most of the modern varieties cannot be grown in saline soil with the expected yield potential. Eventhough breeding rice varieties for salinity tolerance is a promising strategy, such breeding programs have not been progressed much in the country that may be due to difficulty in harnessing genetic variation responsible for the desired trait.



Mapped region of salinity-responsive genes in Chromosome 1 revealed a mutant allele by sequencing

It is said that rice has more than 100,000 accessions throughout the world, but only few genetic variations have been explored and exploited in rice improving breeding programs. To bridge the gap between undiscovered genetic variations and phenotype, resequencing technology has been used extensively upon publishing of the Japonica rice variety, Niponbare as the reference genome.



SNPs and InDels Distribution in two genomes a) SNPs - At 354 (b) InDels -At 354 (c) SNPs - Bg 352 (d) InDels - Bg 352

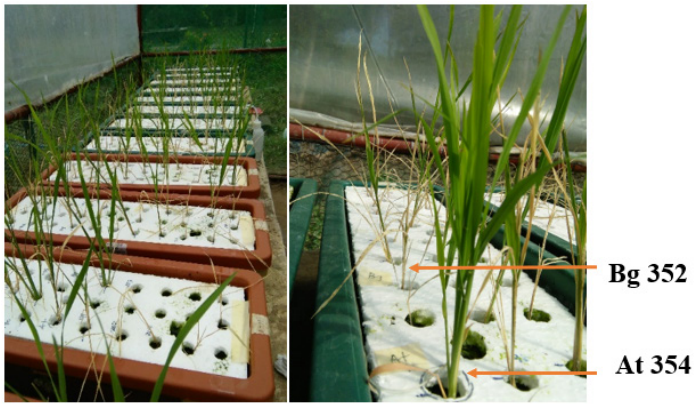
The rapid development in next-generation sequencing (NGS) has boosted the resequencing technology as it needs low cost and short duration to uncover the whole genome. Hence, to discover the salinity-tolerant candidate genes with specific alleles in At354 variety that is reported to be salinity tolerant, we sequenced its complete genome using Illumina Hiseq2500 NGS platform, in parallel with Bg352 which is comparatively a salinity-susceptible variety.

The sequences of these two varieties were mapped to two reference genomes, Oryza sativa japonica group cultivar Nipponbare and Oryza sativa indica group cultivar Shuhui498 (R498).

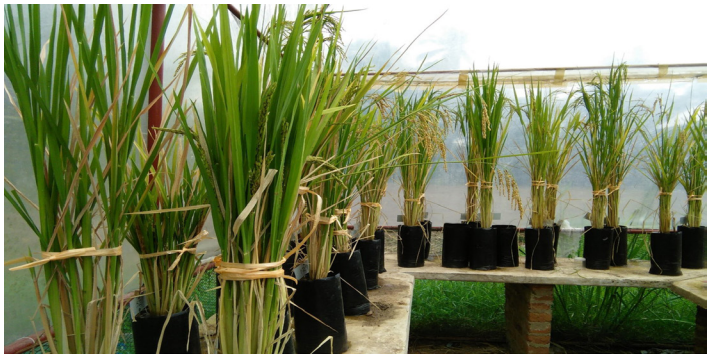
Previously, salinity tolerant promising Quantitative Trait Loci hotspots (gene-rich regions) had been mapped under a controlled environment of the International Rice Research Institute, Philippines using SNP-based saturated molecular maps developed from At354 and Bg352 cross. In this study, these gene-rich regions were explored in NGS-derived sequences using bioinformatics tools to catch the candidate genes giving salinity tolerance based on the polymorphism between At354 and Bg352. Moreover, the expression pattern of a few candidate genes also was examined to check their functional behavior under a saline-enriched environment.

Outputs:

Whole genome sequences of At354 and Bg352 were declared with the mapped length of 349,124,521 bp nucleotides (93.27%) and 348,205,846 bp nucleotides (93.03%), respectively. Approximately 2.4 million Single Nucleotide Polymorphism (SNP) and 0.2 million insertion and deletion mutations (InDel) were found in both varieties with reference to Nipponbare while 1.3 million SNPs and 0.07 million InDels with reference to R498 Indica variety. Altogether, 36 genes were identified as potential salinity responsive candidate genes containing polymorphic SNP mutations (26 genes) or InDel mutations (10 genes) between two parents. Five genes were selected as the most prominent salinity-responsive genes and of them, an InDel marker was designed flanking the longest InDel present in Os01g0581400 gene (showing protein kinase and hydrolase activity) which could be applied in marker assisted breeding.



At354, Bg352 and their Recombinant Inbred Lines grown under saline enriched hydroponics syst

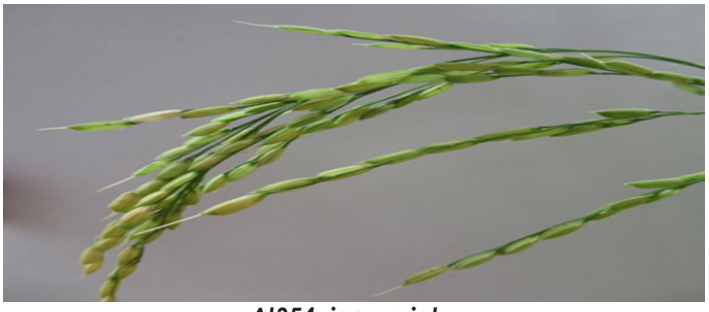


Outcomes

This is the first reported research in the world on whole genome sequencing of a Sri Lankan rice variety mapped with the Indica rice genome, R498 and it is the second reported research on mapping with the Niponbare rice genome in Sri Lanka. This research developed human resources including one PhD degree holder in the area of Bioinformatics where assembling whole genomes with respect to any reference genome was involved. Also, this project put the foundation steps to initiate a bioinformatics laboratory for the Department of Biotechnology at Wayamba University of Sri Lanka by providing Workstation type computer with a Bio-linnux platform. The VCF files of whole genome sequencing of At 354 and Bg 352 rice varieties with reference to Nipponbare and R498 genomes have been archived at European Nucleotide Archive and made available to general public at https://www.ebi.ac.uk/ena/data/view/PRJEB35319. This research showcased promising salinity tolerant genes and their allelic variants and their concordance with other indica rice varieties' giving rise opportunities to other local and international scientists to utilize these genes and varieties in their breeding programs.

Developing recombinant inbred lines

Bg352 rice variety



At354 rice variety

Way forward

Some collaboration has already been initiated with the Institute of Molecular Biology Biochemistry and Biotechnology, University of Colombo to examine the expression of selected genes under salinity stress. Also, whole genome sequences of At354 and Bg352 varieties are expected to annotate on finding yield-responsive candidate genes as there is a yield difference between two varieties. As these two genome sequences are not fully utilized, possible collaborations are being sought with a foreign university for further research.

Prof. Nisha Kottearachchi
Department of Biotechnology
Faculty of Agriculture & Plantation Management
Wayamba University of Sri Lanka

Event Highlights

NRC Celebrated new year 2023

NRC welcomes the New Year 2023 by chanting pirith. The first working day of the 2023 year began on January 2, 2023, by reciting Pirith.

As the first work of the year, all NRC employees refreshed their thoughts by administering the oath of government servants.

Research Skills Strengthening Workshops Series - Data Analysis & Thesis writing and publishing research articles webinar

The NRC organized a series of workshops on Statistical Data Analysis to strengthen the research skills of researchers, postgraduates and university students and this workshop consists of three parts. The first part of the workshop consisted of two sessions and was held on 24th and 25th November 2022 at 9.00 a.m. Second and third parts was held on the following days.

Part II (2 sessions, 8th and 9th December 2022)
Part III (1 session, 12th January 2023)

The resource persons were Senior Prof. S. Samitha, Faculty of Agriculture, University of Peradeniya and Senior Prof. T. Sivananthawerl, Faculty of Agriculture, University of Peradeniya.

In Thesis writing and publishing research articles webinar was conducted on 23rd February 2023. around 150 participants were participated for the session. The resource personProf. Nalin de Silva, University of Sri Jayawardhanapura.

New Appointments of the Chairman & Council for Year 2023

Prof. Hemantha Dodampahala

Prof. Veranja Karunarathne

Prof. Chandana Jayaratne

Prof. H. A. Dharmagunawardane

Prof. P. Ravirajan

Prof. Ranjith Mahanama

Prof. M. Ranagalage

Prof. G. Ranasinghe

Dr. Niranga Alahakoon

Dr. A. S. Nishshanka

Awarding Research Grants 2023

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Prof. P. Ravirajan / Council Member
Prof. T. Seresinhe / External member
Dr. Seetha Wickramasinghe / External member
Dr. Shanika Jayasekara/CEO /NRC

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Nadeeka Dissanayake
Scientific Research Officer

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