



**COCOA RESEARCH CENTRE**  
**ANNUAL RESEARCH AND**  
**DEVELOPMENT SYMPOSIUM**

Cocoa Research Centre  
 The University of the West Indies, St. Augustine Campus

# Research and Development Initiatives in Support of Economic Diversification

Wednesday May 2<sup>nd</sup> 2018  
 Lecture Room B  
 Sir Frank Stockdale Building  
 1<sup>st</sup> Floor, Faculty of Food and Agriculture  
 The UWI, St. Augustine Campus



## PROGRAMME

### 8:30 – 9:00 REGISTRATION

9:00 – 9:05 Chair

Mr. Winston Rudder – Chairman, Cocoa Research Advisory Board

9:05 – 9:20 Welcome Remarks

Prof. Brian Copeland – Principal, The UWI St. Augustine Campus

9:20 – 9:35 Opening Remarks

Prof. Pathmanathan Umaharan – Director, Cocoa Research Centre, The UWI St. Augustine Campus

9:35 – 10:00 Feature Address by the Honourable Minister of Agriculture, Land and Fisheries

Senator Clarence Rambharat

### 10:00 – 10:30 COCOA BREAK

## REINVENTING THE COCOA SECTOR

Moderator: Prof. Pathmanathan Umaharan

10:30 – 10:50 One, two, three go - reinventing a cocoa sector based on innovations.

Pathmanathan Umaharan

10:50 – 11:10 Technical support towards geographical indications - all systems “GO”.

Darin A. Sukha, Naailah A. Ali, Vickeisha Lall, Saila Ramkissoon and Pathmanathan Umaharan

11:10 – 11:30 Finding hidden treasures in your cocoa field.

Lambert A. Motilal, Tricianna Maharaj, Marvin Lewis, Amrita Mahabir, David Gopaulchan and Antoinette Sankar

11:30 – 11:50 A nuanced approach to engaging cocoa farmers to improve farm productivity and bean quality parameters – The IMPACTT project.

Kamaldeo Maharaj

11:50 – 12:10 A systems approach to support the continuous improvement of the cocoa sector.

Mario Simpson and Jason Renwick



12:10 – 1:30 **LUNCH BREAK**

### SEEDING INNOVATION

Moderator: **Dr. Lambert A. Motilal**

- 1:30 – 1:50 Harnessing phenotypic data on cacao accessions from the ICGT for the development of the cocoa industry.  
*Frances L. Bekele, Gillian G. Bidaisee and Junior J. Bhola*
- 1:50 – 2:10 Treasures of the Oriente - revisiting the LCT EEN collection.  
*Antoinette Sankar, Lambert A. Motilal, Dapeng Zhang and Pathmanathan Umaharan*
- 2:10 – 2:30 Basal Wedge (Cleft) graft of two-week-old rootstocks.  
*T.N. Sreenivasan and Annelle Holder-John*
- 2:30 – 2:50 A novel, small scale, flexible cacao fermentation system - validation and uses.  
*Naailah A. Ali, Darin A. Sukha, Rena K. Kalloo and Pathmanathan Umaharan*
- 2:50 – 3:10 Thinking outside the chocolate box - production development at CRC.  
*Kerry Ann Deo, Darin A. Sukha and Pathmanathan Umaharan*

3:10 – 3:40 **COCOA BREAK**

### MITIGATION OF RISKS

Moderator: **Mrs. Frances L. Bekele**

- 3:40 – 4:00 Disease evaluation at the Cocoa Research Centre.  
*Romina Umaharan*
- 4:00 – 4:20 The effect of fermentation and drying process on cocoa bean cadmium levels.  
*Gideon Ramtahal, Davinan Ramnath, Julia Parris, Carisa Davis, Corey Roberts and Pathmanathan Umaharan*
- 4:20 – 4:40 Climate impacts and resilience in Caribbean cocoa.  
*Aidan D. Farrell, Ariel Coolman, Teresa Alexander, Pathmanathan Umaharan, Kevon Rhiney and Anton Eitzinger*
- 4:40 – 4:50 Summary and conclusions.  
*Karen Lee Lum*

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# ABSTRACTS

## One, two, three go - reinventing a cocoa sector based on innovations.

Pathmanathan Umaharan

Why reinvent? The past rehabilitation programmes that had taken a top-down approach to supporting cocoa industry development have not succeeded. The niche and ultra-niche artisanal chocolate markets offer attractive prices but require an industry that is dynamic, knowledge driven, innovative and entrepreneurial and capable of responding rapidly to changes in the market place. The farm units/ value add outfits must become customer focused and be able to produce branded, certified products that are consistent in quality and traceable. This nuanced approach that empowers and incentivises the agri-entrepreneur must be information driven, must provide technology toolkits or support services to overcome their peculiar challenges while supporting linkage to lucrative markets thus improving profitability. The IMPACTT project (Improving Productivity and quality of Artisanal Cocoa in Trinidad and Tobago) takes on such an approach. The project working with 40 individual farms, will build successful models that would have a demonstrative effect that would provide for a successful bottom-up approach to development.

**Keywords:** IMPACTT, branding, ultra-niche, cocoa, chocolate markets, entrepreneur

## **Technical support towards Geographical Indications – all systems “GO”.**

Darin A. Sukha, Naailah A. Ali, Vickeisha Lall, Saila Ramkissoon and Pathmanathan Umaharan

According to Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, Article 22, of the World Trade Organisation (WTO); Geographical Indications (GI) “...*identify a good as originating in the territory [of a member] where a given quality, reputation or other characteristics of the good are essentially attributable to its geographical origin.*” The link of tangible and intangible quality attributes that may be of additional value and higher consumer appreciation to the sense of place where the good is produced is essential for the GI designation and used as a marketing tool to differentiate these products in the globalised marketplace.

Important in country items that are necessary to support successful GI registration include: legislation, available funding, administrative and research institutional support, as well as quality monitoring, evaluation and certification support. The Cocoa Research Centre (CRC) through its research and services pipeline and technology toolkits is well poised to provide critical technical support towards exploring and realising GI registrations. Our support systems span the entire cocoa value chain starting research and services provided for genomic fingerprinting, ancestry analysis together with morphological characterisation of genetic materials. This is followed by certification systems for best practices that includes agro-ecological mapping, post-harvest optimisation towards understanding “terroir” effects, genetics based branding and flavour mapping. Our quality management services include strong stakeholder linkages with targeted interventions of gap analysis, quality assessments (physical, chemical and sensory), training, value addition and branding.

Success stories from our technical support systems towards branding and geographical indications include the cadre of successful “choco-preneurs” coming out of our chocolate making courses with their regional, estate and varietal chocolate brands and The Monsterrat Cocoa Farmers’ Co-operative Society Limited (MCFCSL) in their successful filing of a GI for cocoa beans originating in the Monsterrat Hills, Gran Couva.

Registration of a GI provides significant benefits to the product that it protects as they not only attract a higher price premium in the local, regional and international markets but also contribute to country branding and enhancement of a country’s reputation. GIs also promote and enhance rural development, local culture and traditions. As such, Trinidad and Tobago stands to benefit substantially from the registration of GIs.

**Keywords:** cocoa genomics, branding, Terroir, certification, quality management

## **Finding hidden treasures in your cocoa field.**

Lambert A. Motilal, Tricianna Maharaj, Marvin Lewis, Amrita Mahabir, David Gopaulchan and Antoinette Sankar

Trinidad cocoa is classified as fine/flavour cocoa that is in part a result of the influence of the fermentation and drying processes. An additional dimension is whether fermentation quality is jeopardised by ad hoc bean mixtures especially with combined bean mass over fields and farms. Can the single country, single region, single plantation or single farm marketing strategy be strengthened from genetic data as opposed to existing traditional or sensorial knowledge? We propose a genetic evaluation that would serve to elicit the much needed reference data of country and on-farm cocoa diversity. Genetic diversity of cocoa in five Caribbean countries, including Trinidad, although having an Amelonado base was different among each other. A comparison of the cocoa regions in Trinidad revealed low but significant differences by agro ecological zone with differences among community clusters. Ancestral profiles indicated useful patterns and unique selling points. Recommendations are made for (i) fermentation practices based on genetic data, (ii) supporting the formation of co-operatives around farming clusters, (iii) better bargaining for farm gate or single estate prices, and (iv) farmers and others involved in cocoa production to use CRC's genotyping services.

**Keywords:** DNA genotyping, genetic diversity, on-farm diversity, ancestry

## **A nuanced approach to engaging cocoa farmers to improve farm productivity and bean quality parameters – The IMPACTT project.**

Kamaldeo Maharaj

Improvement in Productivity and Quality of Artisanal Cocoa (IMPACTT) is a project funded by IDB to improve the productivity and quality of cocoa farms and to link them to artisanal markets. A baseline study of 80 plus cocoa farmers in Trinidad over two crop seasons showed an average yield productivity of 141 and 151 kg dried beans per ha for small/medium farmers and large farmers, respectively. In addition, bean quality fitted into a fair average quality (FAQ) range based on its final market channels but required further improvements to meet the requirements of the artisanal cocoa markets. Considerable opportunities exist for the targeted beneficiary farmers under the IMPACTT Project to support and enable them to extract yield productivity gains in the range of 800 to 1200 kg ha, in the short term using better growing technologies (GAPs) and the application of a Quality Management System (QMS) that will contribute to high quality beans. These along with opportunities created under the project to link farmers to the lucrative niche markets will see tremendous improvement in farm income and profitability and will lead to the organic growth of the cocoa industry. Creating a facilitative and supportive environment for farmer motivation, investment and growth also requires a coordinated approach between all government and non-governmental agencies.

**Keywords:** cocoa farmers, baseline study, yield productivity, bean quality, GAPs



## **A systems approach to support the continuous improvement of the cocoa sector.**

Mario Simpson and Jason Renwick

As the old adage goes 'If you can't measure it, you can't improve it'. This is true for the development of the cocoa sector as for any other sector. Quality assurance is a proactive way of preventing defects in the product and service. The core of any holistic development strategy is to develop quality standards and indications which when met will ensure the profitability of the farmer, processor or value added operator while providing assurance to the buyer of the product. For instance, at the farmer level, any continuous improvement instrument should allow for the generation of a score based on defects pertaining to each indicator but also produce a list of actions that the farmer can undertake to improve his score and thus profitability. We are using 40 farms across different cocoa growing communities to validate the system. We have also developed an app with a dashboard that can indicate how a farm or cocoa community or cooperative is performing at a glance. This would also provide learning of the performance of cocoa communities, the critical items that need prevention and correction while providing an incentivised environment that supports cocoa production.

**Keywords:** quality standards, cocoa, farming communities, development

## Harnessing phenotypic data on cacao accessions from the ICGT for the development of the cocoa industry.

Frances L. Bekele, Gillian G. Bidaisee and Junior J. Bhola

The ICGT is rich in cacao genetic diversity. This variation can be harnessed to improve cacao planting material and, subsequently, increase income generation and improve livelihoods in cocoa communities. The diverse cacao collection at the ICGT may contain genes that can safeguard against future stress, both biotic (due to diseases and pests) and abiotic (due to environmental factors and climate change). It is essential to identify, select and utilise high-yielding, well-adapted and resilient (climate-smart) varieties, through the application of the large body of phenotypic and other data collated at CRC, to facilitate the development of the cocoa industry. Climate-smart varieties use inputs such as water and nutrients efficiently even under sub-optimal conditions. The utilisation of superior planting material under optimal field management, among other recommended practices, will allow the optimum productivity and production required for sustainable development of the cocoa industry. This presentation highlights how the valuable phenotypic data accrued at CRC can be harnessed in this process.

**Keywords:** abiotic, biotic, cacao, cocoa, phenotypic data, production, productivity, sustainable development

## Treasures of the Oriente - revisiting the LCT EEN collection.

Antoinette Sankar, Lambert A. Motilal, Dapeng Zhang and Pathmanathan Umaharan

Cacao is the precious resource upon which a global multi-billion dollar industry thrives. There are many threats to the survival of cacao as a species, including diseases and imminent climate change. Despite great uncertainty about what climate conditions will prevail, cacao must be fit to survive if the supply that sustains the livelihoods of the world's chocolate makers, chocolatiers, those in between and traders of the precious golden beans is to continue. The genomes of untapped germplasm such as the wild-type accessions collected during the London Cocoa Trade (LCT) Amazon project may possess vital characteristics that can be incorporated into varieties to be used in breeding and cacao production. Some of the LCT accessions have been successfully transferred to the International Cocoa Genebank, Trinidad (ICGT) as part of the original project agreement. Due to deforestation in the Amazon the original trees from which this collection arose may no longer exist. A complete genetic characterisation of this collection is long overdue to unlock the full potential. Using modern molecular markers called Single Nucleotide Polymorphism (SNP) markers which have a high resolution and a capacity to provide valuable insight into the genetic constitution of cacao, will form an important first step to allow the industry to utilise the hidden potential in this material. The work being reported here represents the beginning of the characterisation of the LCT EENs with SNPs to create a genetic profile and to use available geo-referencing information combined with the genetic information to assess spatial-genetic relationships. Results show LCTEENs are related to Purus, Nacional and Contamana populations and are good candidates for conservation.

**Keywords:** SNP, molecular markers, characterisation, genome

## Basal wedge (cleft) graft of two-week-old rootstocks.

T.N. Sreenivasan and Annelle W. Holder-John

There are several grafting protocols which are used to propagate cocoa in Trinidad and Tobago. Currently top wedge (cleft) grafting and side grafting are popularly used for mass propagation. These methods are simple to perform and do not require substantial post-graft aftercare. The possible disadvantages are that plants stay an extended period in the nursery and there is a tendency for plants to become root bound. The plants are also grafted at the epicotyl which increases the possibility of chupon growth from the rootstock. At the Cocoa Research Centre, top wedge (micro-graft) and side grafting of young seedlings with intact cotyledons, are also commonly used for research. These two methods utilise very young seedlings and the graft union is below the cotyledons on the hypocotyl region of the stem. This decreases the possibility of chupon growth from the rootstock. Both the methods require additional aftercare. The basal wedge graft technique combines the advantages of the micro-graft's strong wedge union and side graft's initial retention of the epicotyl which provides extra nutrition for the scion as the graft establishes.

**Keywords:** grafting, top wedge graft, side graft, micro-graft, basal wedge graft

## **A novel, small-scale, flexible cacao fermentation system – validation and uses.**

Naailah A. Ali, Darin A. Sukha, Rena K. Kalloo and Pathmanathan Umaharan

Traditional cacao fermentation methods used in Trinidad and Tobago require  $\geq 1000\text{kg}$  of wet cacao beans. With the advent of the niche and ultra-niche markets many small farms are attempting farm level fermentations. The typical local small farm produces much smaller quantities and requires a flexible size, but robust fermentation system that yields high quality beans. Fermentations in buckets, bags and heaps practiced at present at the farm level yield poor quality beans. Therefore, a fermentation approach that is modular, utilises 15-30kg of wet cacao beans, simple, flexible, requires no costly inputs and one that can be executed by a farmer in an estate setting was devised using easily available Styrofoam boxes. The process consisted of three phases; (i) assessment of the methods traditionally used; (ii) optimisation of selected method and (iii) validation of the optimised method (Styrofoam boxes). Validation included comparison of temperature, pH, colour, bean weights and sensory trends to that of traditional fermentation. Monitoring pH of testa and cotyledon as simultaneous fermentations progressed revealed very similar trends in both types of fermenting vessels. Colour of beans in both vessels as fermentation progressed only varied in terms of lightness (L) with traditional fermentation yielding a slightly darker product. Sensory assessment of liquors made from bean samples collected as fermentation progressed possessed similar profiles.

**Keywords:** fermentation, small-scale, cocoa, cacao, quality

## Thinking outside the chocolate box - product development at CRC.

Kerry Ann Deo, Darin A. Sukha and Pathmanathan Umaharan

The quality reputation and associated price premium offered for cocoa and the opportunity it provides to earn foreign exchange has made the cocoa industry an attractive one for Trinidad and Tobago. However, limited value-added sector has not allowed the country to extract the full value of sector. To support the growth of the value-add sector the Cocoa Research Centre (CRC) has launched a number of actions including, basic and advanced chocolate making courses, technical incubation and product development support, support for establishing micro-scale chocolate facilities including facility design, procurement of equipment, protocols/ SOPs for and hand-on operational and food safety support as well as support for product development and commercialisation for a range of products including chocolates, beverages, cocoa powders etc. CRC has launched 'Fridays with CRC' to market test some of these products at UWI. The CRC also hosts a World Cocoa and Chocolate Day Expo to support the budding entrepreneurs and is now working with other stakeholders to get them export ready. In this presentation I will highlight a few such successful strides supported by CRC and opportunities and services it offers to chocolatiers. One such example is the drinking chocolate, traditionally known as 'Cocoa Tea,' that has been made into a convenient form.

**Keywords:** cocoa, value-added, product development, drinking chocolate

## Disease evaluation at the Cocoa Research Centre.

Romina Umaharan

A brief overview of the two major cocoa diseases Black Pod and Witches' Broom, as well as the work being conducted with these diseases at the Cocoa Research Centre, is presented. Highlights of results and their implications on overall disease management is discussed.

**Keywords:** cocoa, disease management, *Theobroma cacao*, Black Pod Disease, Witches' Broom Disease

## The effect of fermentation and drying process on cocoa bean cadmium levels.

Gideon Ramtahal<sup>1</sup>, Davinan Ramnath<sup>2</sup>, Julia Parris<sup>2</sup>, Carisa Davis<sup>1</sup>, Corey Roberts<sup>1</sup> and Pathmanathan Umaharan<sup>1</sup>

<sup>1</sup>Cocoa Research Centre, The UWI, St. Augustine, Trinidad; <sup>2</sup>Ministry of Agriculture, Land & Fisheries, Trinidad

Cadmium contamination of cocoa beans has been attributed primarily to its pre-harvest stage from which a number of mitigation strategies are being developed. However, not much research has been done at the post-harvest stage to identify further points of contamination or its effect on the distribution of cadmium within the cocoa bean, so that other possible solutions can be developed. Thus the objective of this investigation was to determine any changes in cadmium concentrations before and during the fermentation and drying process of cocoa beans. The study employed two fermentation methods, a traditional box-fermentation system and a styro-cooler based micro fermentation system developed and validated at the Cocoa Research Centre. Two varieties of cocoa were fermented in triplicate either as nylon net bag inserts within the box fermentation system or using the micro-fermentation system in the same environment within an established cocoa fermentary. Beans were taken from each sample bag/styro-cooler on days 0, 3, 5 and 7 days respectively, and during early drying and end of drying and separated into their testae and cotyledons. Samples were subsequently processed and analysed for cadmium to determine the effect of fermentation and drying on cadmium content in cocoa beans and its distribution in the bean.

**Keywords:** cadmium, cocoa beans, fermentation, drying, food safety



## Climate impacts and resilience in Caribbean cocoa.

Aidan Farrell<sup>1</sup>, Ariel Coolman<sup>1</sup>, Teresa Alexander<sup>1</sup>, Pathmanathan Umaharan<sup>1</sup>, Kevon Rhiney<sup>2</sup> and Anton Eitzinger<sup>3</sup>

<sup>1</sup>The UWI, St. Augustine, Trinidad; <sup>2</sup>Department of Geography, Rutgers University, New Jersey, USA; <sup>3</sup>CIAT, Cali, Columbia.

Climate change is expected to present new challenges for cocoa growers globally. In particular, many cocoa growing areas are expected to experience increased instances of drought and heat stress. Here we explore the extent of these threats within the Caribbean and outline the options for increasing the resilience of the cocoa crop through plant breeding and agronomic approaches.

**Keywords:** climate change, cocoa

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