2021

UWI
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CRC

COCOA RESEARCH CENTRE
ANNUAL RESEARCH AND
DEVELOPMENT SYMPOSIUM

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

RESEARCH AND INNOVATION TO IMPROVE PROFITABILITY OF THE COCOA INDUSTRY

Sub-theme 1: Quality & Food Safety
Wednesday 21st July 2021
9:00 am – 12.00 pm
https://uwi.zoom.us/webinar/register/WN_g82S0ysATtCyV3dAKd_IGg

Sub-theme 2: Genetic Resources
Wednesday 28th July 2021
9:00 am – 12:00 pm
https://uwi.zoom.us/webinar/register/WN_TaGokvHySPyZtcd5adWv0g

CRA Ltd.

PROGRAMME

Opening Ceremony

9:00 – 9:05 Chairman of proceedings
Mr. Winston Rudder *– Chairman of the Cocoa Research Advisory Board of the Cocoa Research Centre*

9:05 – 9:10 Welcome remarks
Prof. Brian Copeland *– Pro-Vice Chancellor and Campus Principal*

9:10 – 9:15 Opening remarks
Prof. Pathmanathan Umaharan *– Director, Cocoa Research Centre, The UWI St. Augustine Campus*

9:15 – 9:30 Address
Senator the Honourable Clarence Rambharat *– Minister of Agriculture, Land and Fisheries*

SUB-THEME 1: QUALITY AND FOOD SAFETY

Chairperson: Antoinette Sankar
Rapporteur: Romina Umaharan

9:45 – 10:00 Building a cocoa quality and food safety ecosystem in the Caribbean.
Pathmanathan Umaharan

10:00 – 10:45 An evidence-based toolkit for monitoring cacao (*Theobroma cacao* L.) fermentations to optimise bean and flavour quality.
Darin A. Sukha*, Naailah A. Ali, Vickeisha Lall, Krystal Daniel, Lincoln McDonald, and Pathmanathan Umaharan*

10:45 – 11:15 Research and development towards the mitigation of cadmium bioaccumulation in cocoa.
Gideon Ramtahal*, Caleb Lewis, Marvin Lewis, and Pathmanathan Umaharan*

11:15 – 11:45 Genetic variation of cadmium uptake and partitioning in cacao.
Caleb Lewis, *Adrian M. Lennon, Gaius Eudoxie, and Pathmanathan Umaharan*

11:45 – 12:15 Genome-wide association study of cadmium accumulation in cocoa (*Theobroma cacao*) leaves and beans.
David Gopaulchan, *Caleb Lewis, Michael H. Wilson, Paulina Flis, Lambert A. Motilal, Adrian M. Lennon, Amrita Mahabir, Pathmanathan Umaharan, and David E. Salt*

SUB-THEME 2: GENETIC RESOURCES

Chairperson: Naailah Ali
Rapporteur: Albertha Joseph-Alexander

9:00 – 9:30 Leveraging the cacao genetic resources to support a sustainable cocoa industry.
Pathmanathan Umaharan

9:30 – 10:00 Field evaluation of Witches' Broom Resistance in the International Cocoa Genebank under a natural disease epiphytotic.
Romina Umaharan, *Vindra Singh, Keshan Mahabir, and Leon Ali*

10:00 – 10:30 Genetic diversity and ancestry of on-farm cocoa (*Theobroma cacao* L.) in Trinidad.
Tricianna Maharaj, *Lambert A. Motilal, Winston Elibox, and Pathmanathan Umaharan*

10:30 – 11:00 Phenotypic and molecular characterisation of the Marañon genetic group.
Frances L. Bekele, Gillian G. Bidaisee, ***Antoinette A. Sankar****, Naailah A. Ali, Rena K. Kalloo, Romina Umaharan, Lambert A. Motilal, and Junior J. Bhola*

11:00 – 11:30 Responses to high light in *Theobroma cacao* L. accessions.
Adrian M. Lennon, *Vernessa R. Lewis, Aidan D. Farrell, and Pathmanathan Umaharan*

11:30 – 12:00 The MOCCA Project: Rehabilitation and renovation of the International Cocoa Genebank Trinidad.
Rena K. Kalloo, *Lambert A. Motilal, Marvin Lewis and Pathmanathan Umaharan*

12:00 – 12:30 Fidelity and fingerprinting for a core collection.
Lambert A. Motilal

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

ABSTRACTS

Building a cocoa quality and food safety ecosystem in the Caribbean.

Pathmanathan Umaharan
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad and Tobago

Cocoa from Trinidad and Tobago and the CARICOM are traded in the fine or flavour market segment at a significant premium. Cocoa Research Centre with support from its partner institutions is engaged in research and innovations to improve cocoa quality and food safety with the aim of supporting the development of a quality ecosystem in this region. The research efforts focus on understanding the effect of genotype on quality, changes occurring during postharvest processing and their manipulation to improve quality and consistency of quality. Mitigating food safety risk through developing a range of cost-effective strategies that involves genetics and breeding, tailored agronomic practices and postharvest processing. The findings are being used to support development of certification and traceability systems, building of brands and a number of products and services to support the entire Caribbean through the international fine cocoa innovation centre.

Keywords: fine or flavour cocoa, premium cocoa market, flavour attributes, geographical indications, cadmium, ochratoxin

An evidence-based toolkit for monitoring cacao (*Theobroma cacao* L.) fermentations to optimise bean and flavour quality.

Darin Sukha, Naailah Ali, Vickeisha Lall, Krystal Daniel, Lincoln McDonald and Pathmanathan Umaharan
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad and Tobago

Fermentation and drying in cocoa (*Theobroma cacao* L.) play an important role in unlocking the flavour potential of freshly harvested cocoa beans. Cocoa is fermented through spontaneous fermentation, shaped by a variable interdependent microbial consortium, variable substrate (bean pulp, sugar content, moisture content), prevailing variable environment (temperature, moisture) and the type of fermentation vessel used; and hence a 'recipe book' approach to fermentation where turning times and end-points are fixed, more often than not, results in sub-optimal quality. Studies linking these variable factors to fermentation progression, turning regimes and fermentation end-points are lacking. The objective of the study was to investigate the effect of quality of starting material and prevailing environmental conditions on fermentation progression, fermentation end point and final quality in fermentations monitored over two locations (central north and western flank agroecological zones) and over multiple harvests. Fermentations were carried out in large wooden boxes with two turnings of the fermentation mass. Data was collected on the initial substrate (bean-to-pulp ratio, pulp index, pulp moisture content, °Brix) and environmental conditions (temperature, relative humidity and barometric pressure) that prevailed during fermentation at each harvest. Fermentation progression was monitored daily using fermentation mass temperature as well as cotyledon and testae pH as indicators. Bean samples were collected at days 2, 4, 6 of fermentation and dried under standard conditions, and physical and sensory quality tests carried out. Data was subject to analysis of variance, correlation analysis and principal component analysis. The results indicated that the fermentation end point based on optimum quality varied with location and harvest time and was shown to be a function of the quality of start material, size of the fermentation mass and prevailing environmental conditions. The paper discusses the best indicator for the determination of the fermentation end points based on real-time monitoring of fermentation and presents an evidence-based toolkit to better manage spontaneous fermentations to improve quality.

Keywords: cacao, fine or flavour, cocoa pulp, fermentation dynamics, sensory quality, certification

Research and development towards the mitigation of cadmium bioaccumulation in cocoa.

Gideon Ramtahal, Caleb Lewis, Marvin Lewis and Pathmanathan Umaharan
Cocoa Research Centre, The University of the West Indies, Trinidad and Tobago

Cocoa (*Theobroma cacao* L.) is a neotropical tree crop with its centre of diversity in Central and South America. The young volcanic soils in the Latin America and the Caribbean region has a relatively high levels of the heavy metal, cadmium, which under favourable soil conditions bioaccumulates into the cocoa bean and is transferred into products derived from cocoa. With the growing knowledge of the negative impacts of cadmium in human health, many food safety agencies including the European Union Food Safety Agency have set maximum permissible levels for cadmium in cocoa and chocolate products. This can have a significant negative impact on the livelihoods of cocoa producers of this region. To understand the sources and distribution of cadmium in cocoa growing areas, factors that contribute to its bioavailability to the cocoa plant, varietal differences in uptake and possible approaches to mitigation, a number of greenhouse and field studies were conducted supported by ECA-CAOBISCO-FCC. First an island wide study was conducted to map cadmium in bean and soils and to understand the factors that contribute to cadmium bioaccumulation in cocoa. Three greenhouse experiments were conducted to ascertain the effectives of various soil amendments on cadmium bioaccumulation, and the most promising of those were then tested under two field experiments. Field and greenhouse studies were also conducted to identify promising genotypes and the right stock-scion combination. Based on the understanding gained a systematic evidence-based approach to cadmium mitigation has been developed and is being tested in four countries in Latin America and three countries in the Caribbean with support from the MOCCA project (USDA-FAS) and a Cluster Project supported by Compete Caribbean. The study allows the development of a nuanced approach to cadmium mitigation, which is being rolled out across the Latin American and the Caribbean regions under various projects. The evidenced-based nuanced approach to mitigation developed allows for a cost-effective mitigation of cadmium in cocoa, based on an integrated approach that involves genetics, cultural, soil amelioration and postharvest practices.

Keywords: bioavailability, transfer and partitioning factors, soil amelioration, incorporation

Genetic variation of cadmium uptake and partitioning in cacao.

Caleb Lewis, Adrian M. Lennon, Gaius Eudoxie and Pathmanathan Umaharan
Cocoa Research Centre, The University of the West Indies, Trinidad and Tobago

Cadmium (Cd) bioaccumulation in cocoa beans has been identified as a health risk to chocolate consumers mainly due to the increase in chocolate consumption by certain vulnerable groups. The literature is replete with studies of cadmium bioaccumulation in annuals but studies on cadmium bioaccumulation in perennials such as cocoa are non-existent. Two studies were conducted with the objective of understanding Cd bioaccumulation and partitioning in young clonal cocoa accessions grown in a hydroponics system and field grown adult cocoa accessions. The first study investigated Cd bioaccumulation and partitioning in five, 9-month-old cacao clones (low and high Cd accumulator genotypes as determined from a field study) in a hydroponic system under high and low Cd treatments (0.2 µM vs 20 µM). The plants harvested were separated into leaf, stem and roots and analysed for Cd, Mn, Ni and Zn. The second field study investigated the bioaccumulation of Cd, Mn, Ni and Zn in leaves over the flushing cycle and over the year in five 40-year old cocoa clones. There were significant ($P < 0.05$) differences in the uptake and partitioning of Cd between varieties with significant differences in Cd uptake between high and low Cd accumulators in the hydroponics study. The plant stem was found to be the most important sink for Cd accumulation under high Cd conditions. In the field study significant differences in metal concentrations were identified between leaf flush phases with levels increasing as the leaves matured. The period at which metal loading into the fruit was likely highest was determined. The study also identified the main pod factors that influence variations in cotyledon Cd concentration. The implications of the findings on selecting the appropriate rootstock for high cadmium areas, on the timing of application of soil amendments for Cd mitigation and leaf stage to be used as an indicator are discussed.

Keywords: Cd fruit loading, metal accumulation over time, genetic variation, Cd uptake and partitioning

Genome-wide association study of cadmium accumulation in cocoa (*Theobroma cacao*) leaves and beans.

David Gopaulchan, Caleb Lewis, Michael H. Wilson, Paulina Flis, Lambert A. Motilal, Adrian M. Lennon, Amrita Mahabir, Pathmanathan Umaharan and David E. Salt

Cadmium (Cd), a toxic, heavy metal that can accumulate in plants and be stored in their edible parts, poses a great threat to food safety and human health. Cacao (*Theobroma cacao* L.) is an accumulator of Cd, which is absorbed and stored in roots, shoots and beans. Beans from Latin America and the Caribbean have elevated Cd due to high Cd soils, and are a source for Cd entering the food chain which is an important food safety issue. Furthermore, the European Union has implemented maximum allowable limits for Cd in chocolates. The overall goal of this research is to reduce Cd accumulation in cacao beans through the identification of genetic markers linked to low Cd absorption and sequestration. Leaves and beans from more than 500 cacao accessions, representing the different cacao populations, were collected from the International Cocoa Genebank, Trinidad (ICGT) and analysed using ICP-MS. Significant differences in Cd were noted between varieties with more than a 10-fold difference between the highest and lowest concentrations. Significant differences in Cd concentrations were observed between the leaf, cotyledon and testa fractions analysed. Cd was highest in the leaf, followed by the cotyledon and was lowest in the testa of the bean. We sequenced the genomes of the accessions and performed a genome-wide association (GWA) mapping for Cd accumulation in different organs. GWA mapping detected multiple quantitative trait loci (QTL) for the leaf, cotyledon and testa, with common QTLs identified in all three. The genetic variation in Cd accumulation and QTL detected provide useful information for developing genetic markers for screening varieties for Cd accumulation and breeding low-Cd cacao varieties in the future.

Keywords: molecular markers, candidate genes, partitioning, chocolates

Leveraging the cacao genetic resources to support a sustainable cocoa industry.

Pathmanathan Umaharan
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad and Tobago

The International Cocoa Genebank, Trinidad is regarded as the largest and most diverse repository of cacao genetic resources in the public domain. The research and development efforts at the Cocoa Research Centre along with its partner institutions focus on research and innovations towards effectively and efficiently utilising the genetic resources to support the development of a sustainable global cocoa industry. In this regard, work is underway to understand the genetic diversity and ancestry of cacao accessions held to establish a core and strategic collections. To better exploit the collection accessions are being screened for yield and yield components, self-compatibility, pest and disease resistance, abiotic stress tolerance, tolerance to high light intensity, and heavy metal bioaccumulation, butterfat and flavour attributes. Using GWAS and QTL mapping potential molecular markers for these traits are being identified and validated. Transcriptomics and metabolomics studies are being carried out to identify candidate genes. Two pre-breeding programmes have been established for black pod and witches' broom resistance. It is our intention to use the information to develop a genomic selection strategy to develop genotypes adapted to various biotic and abiotic risk factors as well as different production environments towards improving the sustainability of cocoa production.

Keywords: population enhancement, breeding objectives, deployment of genotypes, adaptation, selection

Field evaluation of Witches' Broom Resistance in the International Cocoa Genebank under a natural disease epiphytotic.

Romina Umaharan, Vindra Singh, Keshan Mahabir and Leon Ali
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad and Tobago

The witches' broom disease caused by *Monoliophthora perniciosa* is an important pathogen of cocoa (*Theobroma cacao* L.) in the Americas contributing to significant yield loss and occasional tree death. The disease was first reported in South America but is moving Northward along the Caribbean chain of islands and poses a threat to the cocoa industries in the Greater Antilles and Central America. The International Cocoa Genebank, Trinidad is regarded as the largest and most diverse collection of cocoa genetic diversity in the public domain and contains within it useful levels of resistance to various diseases. The genebank consists of 2300 accessions planted in plots of 4-16 clonal trees. The witches' broom disease is manifested in trees as vegetative infection, cushion infection and pod infection. The relative susceptibility/resistance of cocoa germplasm to infection of these organs and the inter-relationships between them is not well understood. Trinidad and Tobago experienced a serious epiphytotic of the witches' broom disease that significantly affected the 2020/21 cocoa crop and poses a threat to the 2021/22 crop. This epiphytotic has also affected the genebank resulting in high and uniform disease pressure throughout the collection. The objective of the field study was to assess the resistance of a strategic subset of the genebank (552 accessions) for disease incidence and severity of vegetative infection, cushion infection and pod infection with the objective of identifying sources of resistance. All the selection accessions were pruned in July-September, 2020 and were fertilised. The study also investigated the interrelationship between the susceptibility of various organs to the witches' broom pathogen. This also allowed for the determination of the correlation between field vegetative resistance to witches' broom disease and that determined based on a greenhouse screening study. Considerable variation in the levels of susceptibility of cocoa clones to witches' broom disease was observed. The impact of these findings to breeding for resistance to the witches' broom disease is discussed.

Keywords: cacao, genetic resources, field resistance, concordance of organ resistance

Genetic diversity and ancestry of on-farm cocoa (*Theobroma cacao* L.) in Trinidad.

Tricianna Maharaj[b], Lambert A. Motilal[a], Winston Elibox[b] and Pathmanathan Umaharan[a]
Cocoa Research Centre[a] and Department of Life Sciences[b], The University of the West Indies, St. Augustine

Trinidad and Tobago is regarded as an exclusive fine or flavour cocoa producer, and its reputation for quality comes from the Trinitario cacao (*Theobroma cacao* L.) widely grown in the country. However, this natural on-farm genetic resource has not been adequately genetically characterised and the ancestry of Trinitario cacao is still uncertain. A total of 837 Trinitario cacao trees in six agro-ecological zones (AEZs) of Trinidad were assessed with 192 single nucleotide polymorphic markers and compared with 323 reference samples from 16 genetic clusters found in the International Cocoa Genebank, Trinidad (ICGT) to elucidate the genetic diversity and ancestry of farm grown cacao. Genetic diversity assessment, group differentiation statistics, cluster analysis, core selection and ancestry analysis were undertaken. The study found that 19% of the samples were duplicated, 112 were matched to 20 reference accessions and 705 were unique samples (TUS). The TUS was significantly different ($P < 0.001$) from those held in the ICGT but had comparable gene diversity to the ICS and TRD accession groups. A core set of 77 samples encompassed the genetic diversity of the TUS. The ancestry of cacao from the six agro-ecological zones were closely related but statistically different ($P = 0.001$) from each other. Genetic diversity was highest in the Central Range and lowest in the Eastern Lowlands. Ancestry analysis, based on 679 TUS samples identified nine samples with a single ancestral origin while 670 samples (98.6%) were admixed with 2-7 populations. Overall, the TUS had a strong Amelonado ancestry with variable contributions from Criollo and Upper Amazon Forastero groups including Iquitos, Marañon, Contamana, Nanay and Nacional in decreasing order of contributions.

Keywords: SNPs, on-farm genetic diversity, Trinidad, Trinitario ancestry, core collection

Phenotypic and molecular characterisation of the Marañón Genetic Group.

Frances L. Bekele, Gillian G. Bidaisee, Antoinette A. Sankar, Naailah A. Ali, Rena K. Kalloo, Romina Umaharan, Lambert A. Motilal, and Junior J. Bhola
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad & Tobago

Cocoa (*Theobroma cacao* L.) is a neotropical understory tree and is the basis of a multi-billion-dollar confectionery industry, which supports the livelihoods of approximately 5 million farmers as well as other value chain actors, worldwide. Cocoa breeding is at the heart of developing a sustainable cocoa industry through the provision of elite planting material with high yields, good quality and the ability to withstand biotic and abiotic stresses associated with climate change, pests and diseases. The genetic resources of cocoa, the raw material for breeding, are classified into 10 genetic groups of which the Marañon is one. To understand the genetic potential of the Marañon genetic group the accessions within the group (Parinaris) held at the International Cocoa Genebank, Trinidad were subject to morphological and molecular characterisation as well as evaluation of yield potential, resistance and quality. The study revealed considerable genetic diversity for the morphological and agronomic characters evaluated and identified accessions with important traits. Highlights of the results with an emphasis on valuable traits, as well as other noteworthy observations unearthed will be presented. The employment of genotypes from the Marañon genetic group in breeding programs around the world is also presented. Fermentation and drying of beans obtained from accessions from the Marañon genetic group also revealed novel flavour compounds and sensory attributes that makes this genetic group interesting. A field guide for the identification of the accessions within the Maroñon genetic group is near completion and will contain salient data from this study. The guide consists of photos of pods, flowers, leaves and data collected by various teams within Cocoa Research Centre, and would be useful to farmers, researchers and cocoa enthusiasts.

Keywords: field guide, breeding, disease resistance, Parinari, cacao, Marañon

Responses to high light in *Theobroma cacao L.* accessions.

Adrian M. Lennon[a], Vernessa R. Lewis[a], Aidan D. Farrell[a] and Pathmanathan Umaharan[b]
[a]Department of Life Sciences, Faculty of Science and Technology, the University of the West Indies, St. Augustine Campus
[b]Cocoa Research Centre, The University of the West Indies St. Augustine Campus

Light can be a limiting factor for photosynthesis, however excess local photosynthetically active radiation (PAR) can equally limit plant performance. Under high light intensity, plants are required to efficiently utilize solar energy whilst avoiding photodamage to their cells. When light absorption exceeds the capacity of photosynthetic electron transport, the quinone acceptors of PSII become overly reduced and the probability of ROS generation increases. *Theobroma cacao* is a tropical understory crop that is traditionally grown in an agroforestry system under a shade canopy but is increasingly being grown in an orchard system with limited or no shade. Shade-grown plants are more susceptible to light, drought and heat stress when exposed to high irradiance includes a high concentration of chlorophyll per leaf area, a greater capacity for light capture due to the larger antenna size of PSII with less reaction centres and lower light-saturated photosynthetic rates due to reduced Calvin cycle photosynthetic enzymes content. Using a combination of chlorophyll fluorescence and biochemical assays we have shown that photosynthetic plasticity does exist between sun exposed and shade leaves in *Theobroma cacao* with sun leaves having an increased capacity for photosynthesis and an increase in ROS protective mechanisms. Although the ability to mitigate ROS species was limited as demonstrated by increased electrolyte leakage in the sun exposed leaves. Further studies demonstrated considerable genetic variation in these parameters between accessions and indicate that screening for SOD activity, carotenoid content and light saturation point may provide useful markers in breeding for plants with an increased tolerance for high light conditions.

Keywords: photosynthesis, biochemical, light exposure, shading

The MOCCA Project: Rehabilitation and renovation of the International Cocoa Genebank, Trinidad.

Rena K. Kalloo, Lambert A. Motilal, Marvin Lewis and Pathmanathan Umaharan
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad & Tobago

The International Cocoa Genebank, Trinidad is regarded as the largest and most diverse collection in the public domain with over 2300 accessions of *Theobroma cacao* L. and allied species maintained in clonal plots of 4-16 trees per accession. The collection is supported by generous contributions from the Cocoa Research Association, UK and the Government of Trinidad and Tobago and supports breeding programs globally through the provision of germplasm and germplasm services. Since its establishment in the 1980s, trees within the plots have died through a variety of reasons, debilitated by pests and diseases or identified as not true-to-type. With funding generously provided by USDA-FAS through the MOCCA project (executed by Technoserve/LWR and implemented by Bioversity-CIAT Alliance) the Cocoa Research Centre initiated an ambitious agenda to improve the health of the genebank. A survey was conducted to identify 'at risk' accessions within the genebank, with 1-2 trees per plot, determine the fidelity of plots through DNA fingerprinting and to identify a core collection, earmarked to be duplicated. The 'at risk' plots and core collection plots were subjected to sanitation pruning and structural pruning, fertilised and rehabilitated. To enhance the capacity to propagate rooted cuttings to infill vacancies and duplicate the core collection, a propagation greenhouse with mist irrigation was established. The 'at-risk' accessions were grafted and copies of accessions maintained in the CRC greenhouses, while propagation efforts through rooted cuttings were initiated to re-populate the plots. A plot and tree level GIS mapping of two fields in the genebank was undertaken to develop a geo-referenced database and barcoding system to better manage the genebank. A fully functional SQL-based database has also been developed to access up-to-date information to guide genebank management decisions and utilisation. While the R&R activities are an on-going process and require long-term funding the injection of funds by MOCCA provided much needed rehabilitation to avoid the risk of genetic erosion of the genebank.

Keywords: cocoa germplasm, genetic erosion, database; fidelity, SNP, curation

Fidelity and fingerprinting for a core collection.

Lambert A. Motilal
Cocoa Research Centre, The University of the West Indies, St. Augustine, Trinidad & Tobago

The International Cocoa Genebank, Trinidad (ICGT) is regarded as the largest and most diverse collection in the public domain with over 2300 accessions planted as clonal plots of 4-16 trees per accession. Over the years, studies at the Cocoa Research Centre (CRC) have indicated genetic heterogeneity within plots arising from mistakes in labelling and planting during the establishment phase. To understand the genetic diversity and fidelity of the collection, CRC undertook an ambitious project to DNA fingerprint every accession and every tree within the accession. About 10,000 samples (inclusive of repeat typing) were genotyped at a maximum of 192 single nucleotide polymorphic markers. The data was used to (a) assess accession and plot homogeneity in the germplasm collection (b) establish the genetic identify and ancestry of each accession (c) establish the genetic diversity of the collection towards developing a core and a minicore collection. The information on genetic ancestry, morphological characterisation and evaluation are being used to construct a strategic collection. The paper discusses how the information is being used to improve the management of ICGT as well in utilisation of the genetic diversity in cocoa breeding programmes, globally.

Keywords: germplasm curation, core collection, fidelity, identity analysis, genetic ancestry, SNP genotyping

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

ABOUT COCOA RESEARCH CENTRE

Cocoa Research Centre (CRC) of The University of the West Indies is a research and development Centre within The University of the West Indies (UWI), St. Augustine campus in Trinidad and Tobago. The Centre has a triple mandate to (a) support conservation of cocoa genetic resources, (b) research to improve productivity and quality and to overcome constraints to cocoa production and (c) to support development through a variety of outreach activities. A Cocoa Research Scheme was established in 1930 as part of the predecessor institution to The University of the West Indies, the Imperial College of Tropical Agriculture, which has over time morphed into the Cocoa Research Centre. It has continued its research and development mandate unabatedly over the past 90 years; and is regarded as one of the oldest cocoa research institutions, worldwide.

CRC is the custodian of The International Cocoa Genebank Trinidad (ICGT), consisting of 2300 cocoa varieties maintained in a 100-acre estate in Centeno. This is recognised as the largest and most diverse cocoa collection in the world. The genebank offers a range of germplasm services including distribution of primary genetic material, enhanced material and a global DNA fingerprinting service.

In research, CRC is recognised for its early work that led to the development of cocoa varieties tolerant to black pod and witches' broom diseases. Its present work on fermentation and drying, cocoa quality standards, cocoa flavour characterisation, branding and traceability as well as its work on genome wide association studies to develop molecular markers, climate resilience and mitigation of cadmium contamination of cocoa is well known. CRC also works with global chocolate companies, industry organisations such as industry organisation such as the International Cocoa Organisation (ICCO), World Cocoa Foundation (WCF) and European Cocoa Industry Associations such as ECA, CAOBISCO. CRC also supports work in Latin America directly or through NGOs such as Technoserve and Lutheran World Relief.

CRC has set up the International Fine Cocoa Innovation Centre (IFCIC) as a coordinated outreach mechanism to support the fine/flavour sector in the LAC region through a range of training products, technology products and support services. The physical hub will consist of a model cocoa orchard, a modern cocoa postharvest facility, a flexible cocoa processing facility, as well as technology and business incubators to provide support SME development. CRC also offers introductory and advanced chocolate making training host of technology services, apprenticeship training and start- up support.

ABOUT CARDS
Cocoa Research Centre Annual Research and Development Symposium

SYMPOSIUM DESCRIPTION

The Caribbean region is highly regarded as a fine or flavour cocoa producing region. Research and development efforts at the Cocoa Research Centre of the University of the West Indies has been focusing on modernising and rejuvenating the cocoa industry to emerge as an important supplier of high quality cocoa and cocoa based value added products. The symposium will focus on innovations in research as well as new developmental initiatives to nurture the growth of the cocoa industry locally and regionally to create lucrative livelihoods within the cocoa industry.

OBJECTIVE OF CARDS 2021

The objective of the symposium is share local research and innovations in cocoa research to stakeholders nationally, regionally and internationally and to obtain feedback from stakeholders.

SPONSORS AND COLLABORATORS

Cocoa Research Centre
Sir Frank Stockdale Building | The University of the West Indies
St. Augustine, Republic of Trinidad and Tobago
Tel/Fax: (868) 662 – 8788

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