Genetic Resources and Cacao Flavor
Putting Farmers and Consumers First

Genetic Resources
And Cacao Flavor

You won’t have it
If you don’t have the genes
And if you don’t measure it

October 2013 Partnership Meetings
Santo Domingo, Dominican Republic
Ed Seguine
Chocolate Research Fellow
Mars Global Chocolate Science & Technology
1 Million Ton Shortfall by 2020

Projected at beginning 2010

ICCO Actual
The Farmer’s Perspective

4 hectares

Average yield – 500 kg / ha

2 mt / year

at $2640/mt*

$3,696 / year

$1.69 / person – day

6 member family

* Sept 27, 2013--NASDAQ
Genetic Resources and Cacao Flavor  
Putting Farmers and Consumers First

Farmers need security of livelihood  
Industry needs security of supply
Cacao farming must not be an end
It must be a beginning
A springboard for a family’s future
Problems in Paradise: Sector Issues—

- Yields have not changed
- Diseases & pests continue to devastate
- Aging trees / exhausted soils
- Climate change effects
- No agronomy support—extension
- Major quality declines all origins
- Not a career future
- Major volume needs in next 10 yrs. (BRICS countries)
Corn and Cocoa Yields Over Time

Source: USDA, ICCO
Genetic Resources and Cacao Flavor - Putting Farmers and Consumers First

Source: USDA, ICCO

**Corn and Cocoa Yields Over Time**

- CCN 51, PS 1319, EET 576
- Indonesia

Source: USDA, ICCO
Breeding Including Flavor as a criteria

- Trinidad since ICS and TSH starting with Pound
- PNG — Yoel Effron
- CATIE
- Nigeria (Peter Aikpokpodion)
- INIAP

Not including flavor
- CCN 51

But you must have enough genetic diversity to be able to stack the traits—including flavor.
EET 544 Y EET 558
NUEVOS CLONES DE CACAO NACIONAL PARA LA
PRODUCCION BAJO RIEGO EN LA PENINSULA DE SANTA ELENA

Freddy Amores
Juan Agama
Francisco Mite
Juan Jiménez
Gastón Loor
James Quiroz

QUEVEDO - LOS RIOS - ECUADOR
MARZO, 2009

EET 575 y EET 576
NUEVOS CLONES DE CACAO NACIONAL PARA LA ZONA CENTRAL DE MANABÍ

Freddy Amores
Juan Agama
Carmen Suárez
James Quiroz
Nelson Motato

QUEVEDO - LOS RIOS - ECUADOR
FEBRERO 2009
New clones at 1.5 years (TAP 6 x TIP 1) and 2.5 years (AMAZ 14 x EBC 148) in Ecuador.
65% Cacao

Ecuador INIAP

Released Clones

EET 544
EET 575
EET 576

Roast: 121°C x 23 min (Binder convection oven)

Source: La Victoria Farm, Ecuador at scale planting, fermented by Freddy Amores, INIAP
Color: Deep, dark brown (typical of Ecuador)
Aroma: Mild chocolate with dark wood and mild green notes
Flavor: Mild chocolate with smooth, velvety astringency. Dark wood with green vegetative and trace green cut grass floral notes. Shifts to a mild herbal-like character. Finish is relatively short with chocolate fading quickly leaving a mild green floral and mild astringent notes.
You CAN have flavor—

But only if you look for it!
Celebrating Diversity
Conserving Genetic Resources

Martin Gilmour
Brigitte Laliberté
Stephan Weise
Cocoa diversity is necessary because...

• We don’t (and shouldn’t) grow the same varieties everywhere

• There are different:
  – Markets: quality bulk, fine flavour, single origin, etc.
  – Flavour profiles (consumer preferences)
  – Pest and disease pressures
  – Environmental conditions
  – Cultivation practices: organic, shade, inputs, etc.
  – Farmer preferences

• Like other agricultural crops, for cocoa there isn’t “one size fits all”
Why diversity matters...

• Demand is increasing rapidly eg. Asia, Middle East
• We need to increase production in an environmentally sustainable way (reduced inputs, reduced footprint).
• New and improved planting material is an important part of the solution, optimized by good agricultural practices.
• Good quality, locally adapted planting material are continuously required, whatever country, region or farming system.
Why diversity matters - disease
Why diversity matters - climate

Effects of temperature on four cocoa genotypes

Four cocoa genotypes were grown in greenhouses where thermal conditions of cocoa-growing regions of “Brazil”, “Ghana” and “Malaysia” were simulated.

Most sensitive to temperature changes

Least sensitive to temperature changes

Why diversity matters – consumer choice
Organisation of Cocoa Genetic Resources - A Global Strategy

- Developed by CacaoNet (Global Network for Cacao Genetic Resources)
- Result of a consultation process, drawing upon the global cocoa community’s expertise in all aspects of cacao genetic resources (over 75 individuals from 26 institutes contributed)
- Provides a clear priority list for funding
  - the most urgent needs to ensure that cacao diversity is conserved, used, and provides direct benefits to the millions of small-scale farmers around the world
Celebrate cocoa diversity, but...

- It's clear cocoa diversity is of long term strategic importance
- It's somewhat taken for granted
- Some cocoa germplasm has been lost, more could be made available
- A fit for purpose system doesn’t come for free
- Currently run on a shoestring, and is unsustainable
- Our industry needs and deserves better
COLECCIÓN DE CLONES DE CACAO EN IDIAF, REPÚBLICA DOMINICANA. SU VALOR Y UTILIZACIÓN POR LA INDUSTRIA Y LOS AGRICULTORES LOCALES.

MARISOL VENTURA LOPEZ

OCTUBRE, 2013
A finales de la década del 60 y principios del 70 se hizo la introducción de clones, procedentes de: Trinidad, Ecuador, Costa Rica, Brasil, México y otros países.
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### COLECCIÓN DE CLONES INTRODUCIDOS

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## CARACTERÍSTICAS DE RENDIMIENTO E INDICADORES DE CALIDAD DE SELECCIONES LOCALES

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DIVERSIDAD MORFOLOGICA DE MAZORCAS DE CACAO CRIOLLO
DIVERSIDAD MORFOLOGICA DE SEMILLAS DE CACAO CRIOLLO
DIEZ GRUPOS GENETICO (Motamayor et al., 2008)
VARIABILIDAD GENETICA DE

VARIABILIDAD GENETICA DE LAS SELECCIONES LOCALES

FUENTE: Caracterización Molecular de los Recursos Genéticos del Cacao (Theobroma cacao L.) en la República Dominicana. Edward Boza, Brian Irish, Alan Meerow, Juan Carlos Motamayor, Orlando Rodríguez, Dapeng Zhang, Marisol Ventura-Lopez, Jaime Gomez, Michael Moore, y Raymond Schnell, 2008
PERFIL SENSORIAL DEL CLON ICS -1

RADAR SABORES

- OLOR y AROMA CACAO
- AMARGO
- ASTRINGENTE
- ACIDO
- FRUTAS AMARILLA (MELOCOTON)
- FRUTA SECA (NUECES)
- FRUTA FRESCA
- CEREZA MADURA
- CIRUELA
PERFIL SENSORIAL DEL CLON IML- 119

RADAR SABORES

SABOR A CHOCOLATE

ESPECIA

AMARGO

FRUTA SECA

ASTRINGENCIA

FRUTA FRESCA

ACIDEZ

0

1

2

3

4

5
VALOR DE LA COLECCIÓN POR LA INDUSTRIA
La colección dispone de recursos fitogenéticos que han sido valorados como excelentes por la diversidad de aromas y sabores encontrados.
Ana Sofia Wallstron quedó gratamente impresionada con la diversidad de sabores del cacao dominicano, los cuales le habían recomendado para la fabricación de chocolates de alta calidad. Atrajeron gratamente su paladar los chocolates con sabores a nueces y frutas.
USO DE LA COLECCION POR LA INDUSTRIA
USO DE LA COLECCION POR LA INDUSTRIA
Es posible mejorar los niveles de productividad de las plantaciones del país, mediante el uso de los recursos fitogenéticos existentes.

La siembra de material genético de buena calidad proveerá la producción de cacaos de calidad para los mercados diferenciados. Esto se traduciría en mayores ingresos.
Una empresa local comercializó al mercado Europeo lotes de cacao clonal. (ML-3, IML-44, ICS-39, ICS-40, ICS-95, UF-613, UF-221, ML-22, IML-53,)
Se encontró un peso promedio de 1.9 g y un 16% de semillas con características de criollo.
USO DE LA COLECCIÓN POR LOS AGRICULTORES

Recursos fitogenéticos indispensables para la producción de semillas y toma de vareta utilizadas en la renovación de plantaciones.
PERFIL SENSORIAL DE CACAO DE FINCAS DE AGRICULTORES

RADAR SABORES

- Aroma CN
- ACB
- Ciruela pasa
- floral
- Fruta fresca
- Fruta seca
- Amargor
- Astringencia
- Acidez
CARACTERÍSTICAS QUÍMICAS DEL CACAO Y RELACIÓN CON LAS VARIABLES SENSORIALES
GRACIAS
The Role of Conserving Cocoa Genetic Resources in sustaining the industry

S. Surujdeo-Maharaj, Cocoa Research Centre, UWI
Demand for cocoa beans will jump 3 percent to 5 percent in 2013-14, Peter B. Johnson, chief executive officer of Fehrbellin, Germany-based cocoa processor Euromar Commodities GmbH, said at the conference. Futures rose to the highest in almost a year in London to 1,685 pounds.

Current demand outstrips supply...

Global cocoa prices could more than double by 2020 if output lags - Petra
Some thoughts on intensive agriculture...

Increases stresses on plants and their growing environment

Pathogen evolution and build up

The Brazilian experience (Witches’ broom disease)

Situation in West Africa (built on one genetic group

CCN 51 in SAM (single genetic group)
Challenges to increasing production

Diseases
- Frosty pod
- Black pod
- Witches’ broom
Environmental changes

Flooding
Drought
Salinity
Heavy metal toxicity (Cadmium)
Low yields

Aging fields
Poorly managed fields
Aging farmers
Poor yielding varieties
Variation among varieties low in national collections
Value chain inequities

Socio-economic
Political
How can some of these challenges be resolved?
Several ways to address these issues

WCF Partnership Meetings to facilitate...have advanced a long way

Government and allied bodies

Trading

Industries

Grower groups

Improving the crop through Science and Technology
<table>
<thead>
<tr>
<th>National</th>
<th>International</th>
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<tbody>
<tr>
<td>• Consists of local varieties</td>
<td>• Recognized by International biodiversity organizations</td>
</tr>
<tr>
<td>• Grower selection and local breeding efforts</td>
<td>• Contains representative members (10 genetic groups) collected from centers of origin and diversity of the crop</td>
</tr>
<tr>
<td>• Few varieties with few variability in traits of industry interest</td>
<td>• Enormous variation in traits (commercial and non-commercial)</td>
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<tr>
<td>• Can apply for plant variety protection if breeding is carried out</td>
<td>• Enormous potential for exploitation</td>
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<td>• May not be shared among competitors</td>
<td>• Contains wild non-commercial types</td>
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<tr>
<td>• Coordinated by local efforts and private interests</td>
<td>• Cannot be protected by plant variety protection</td>
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<td>• Available for sharing among the cocoa community</td>
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<tr>
<td></td>
<td>• Coordinated by international stakeholders, interest groups and well wishers</td>
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</tbody>
</table>
What are genebanks and how can they help the cocoa industry?

Conservation sites outside the crop’s center of origin and diversity hold huge potentials for finding solutions for some of the problems related to the crop.
International Cocoa Genebank, Trinidad
Disease resistance solutions
Future cocoa farms made to order from conservation sites...

Enhanced populations rather than varieties that are:

• High yielding dwarf varieties amenable to mechanical cultivation
• Tolerant to different environmental stresses
• Eradicates heavy metal uptake
• Novel flavor combinations
• Nutraceutical and pharmaceutical value