



Foro Latinoamericano- Caribeño de Cacao

Desafíos y pautas para una cacaocultura moderna y sostenible en la región

APORTES DEL CATIE A LA CACAOCULTURA MUNDIAL: germoplasma

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Turrialba, Costa Rica



Colección Cacao CATIE

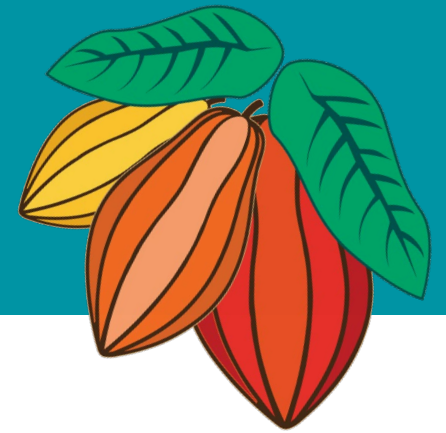


- 1944 Primera introducción (Matina).
- 1945 IPGRI le asigna estatus de colección internacional.
- 1978 Primer banco de genes de *T. cacao* bajo dominio público (FAO).
- 2004 Pieza clave en los esfuerzos de distribución y uso de germoplasma a nivel mundial.

Desafíos, retos y oportunidades



Intercambio de Germoplasma en dos vías



SISTEMA MUNDIAL PARA LA CONSERVACIÓN DE LOS RECURSOS GENÉTICOS DEL CACAO

Ex situ collections worldwide



Asia/Pacific:

Fiji - Dobuilevu
India - CPCRI
Indonesia - Bah Lias & ICCRI
Malaysia - MCB
Papua New Guinea - CCI
Philippines - USMARC/PICRI
Solomon Islands - BPCU
Thailand - CHRC
Vanuatu - VARTC
Vietnam - Nong Lam Uni.

Americas:

Bolivia - El Ceibo Cooperative
Brazil - CEPEC - SUEPA -
SUERO- ICA
Colombia - CORPOICA
Cuba - EIC/ECICC
Dominican Republic - IDIAF
ERO - ICA
Ecuador - INIAP
French Guiana - CIRAD
Guyana - MHOCGA
Honduras - FHIA

Mexico - INIFAP

Nicaragua - UNAN
Peru - CEPICAFE - ICT-
UNAS - UNSAAC
USA - USDA
Venezuela - INIA

International collections:

Costa Rica - CATIE
Trinidad & Tobago - CRU/UWI

Africa/Europe

Benin - CRA/SB
Cameroon - IRAD
Côte d'Ivoire - CNRA
Ghana - CRIG
Nigeria - CRIN
Togo - CRAF
France - CIRAD

International quarantine:
UK - ICQC,R

Recibidos: ~ 500 Clones Reading, Suramérica, Puerto Rico, etc.

Remitidos:

- Depositario Series UF, CC, ARF, PMCT, CATIE R-
- Clones resistentes a *M. roreri* y *P. palmivora*
- Clones para estudios específicos o para enriquecer otras colecciones.



CC-267 o Matina 1-6



The genome sequence of the most widely cultivated cacao type and its use to identify candidate genes regulating pod color

Motamayor *et al.*



Motamayor *et al.* *Genome Biology* 2013, **14**:53
<http://genomebiology.com/2013/14/6/53> (3 June 2013)

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RESEARCH PAPER

Open Access

The genome sequence of the most widely cultivated cacao type and its use to identify candidate genes regulating pod color

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Abstract

Background: *Theobroma cacao* L. cultivar Matina 1-6 belongs to the most cultivated cacao type. The availability of its genome sequence and methods for identifying genes responsible for important cacao traits will aid cacao researchers and breeders.

Results: We describe the sequencing and assembly of the genome of *Theobroma cacao* L. cultivar Matina 1-6. The genome of the Matina 1-6 cultivar is 445 Mbp, which is significantly larger than a sequenced Criollo cultivar, and more typical of other cultivars. The chromosome-scale assembly, version 1.1, contains 711 scaffolds covering 346.0 Mbp, with a contig N50 of 84.4 kbp, a scaffold N50 of 34.4 Mbp, and an evidence-based gene set of 20,408 loci. Version 1.1 has 10x the scaffold N50 and 4x the contig N50 as Criollo, and includes 111 Mb more anchored sequence. The version 1.1 assembly has 4.4% gap sequence, while Criollo has 10.9%. Through a combination of haplotype, association mapping and gene expression analyses, we leverage this robust reference genome to identify a promising candidate gene responsible for pod color variation. We demonstrate that green/red pod color in cacao is likely regulated by the R2R3 MYB transcription factor *TcMYB113*, homologs of which determine pigmentation in Rosaceae, Solanaceae, and Brassicaceae. One SNP within the target site for a highly conserved trans-acting siRNA in dicots, found within *TcMYB113*, seems to affect transcript levels of this gene and therefore pod color variation.

Conclusions: We report a high-quality sequence and annotation of *Theobroma cacao* L. and demonstrate its utility in identifying candidate genes regulating traits.

Keywords: *Theobroma cacao* L., genome, Matina 1-6, haplotype phasing, genetic mapping, pod color, *MYB113*

Background

The cacao tree (*Theobroma cacao* L.) is a neotropical species native to Amazonian lowland rainforests [1,2] and is now grown in more than 50 countries throughout the humid tropics. *T. cacao* is a member of the Malvaceae family, and its beans (seeds), harvested from pods (fruits), are used for the chocolate, confectionery, and cosmetic

industries [3]. Cacao production is essential to the livelihoods of 40 to 50 million people worldwide, including the smallholder farmers who cultivate the crop, who number more than 5 million [4]. The crop is often grown in agroforestry-type ecosystems alongside other fruit and commodity crops, thereby providing sustainable economic and environmental benefits to some of the poorest and most ecologically sensitive areas of the world [5]. Cacao growing regions are also largely centered in important biodiversity hotspots and in proximity to 13 of the world's most biologically diverse regions [6].

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Distribución de semillas híbridas de cacao (1976-1989)



COUNTRY	NUMBER OF SEEDS
Costa Rica	15.277.980
Panama	6.527.156
Guatemala	1.160.095
Honduras	1.115.619
Nicaragua	770.000
Belize	461.265
USA (Malasya	302798
Rep. Dominicana	107603
Saint Lucia	74720
Bolivia	73270
Cuba	70316
Saint Vincent	20000
El Salvador	4420
Puerto Rico	3480
México	2700
Madagascar	1655
Ecuador	1200
Singapur	1110
Peru	200
TOTAL	25.975.587

26 millones de semillas distribuidas en tres continentes

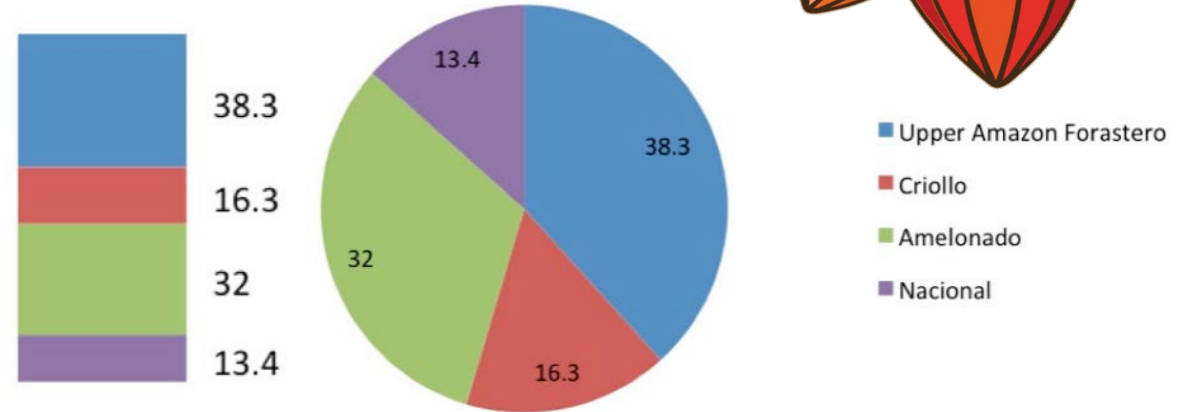


Finca Terciopelo. Coto Brus, Costa Rica

Designación HCP (Heirloom Cacao Preservation Fund)



USDA Genetic Profile



Identificación clones resistentes



Base de programas de
mejoramiento en Honduras,
México, Brasil, etc.

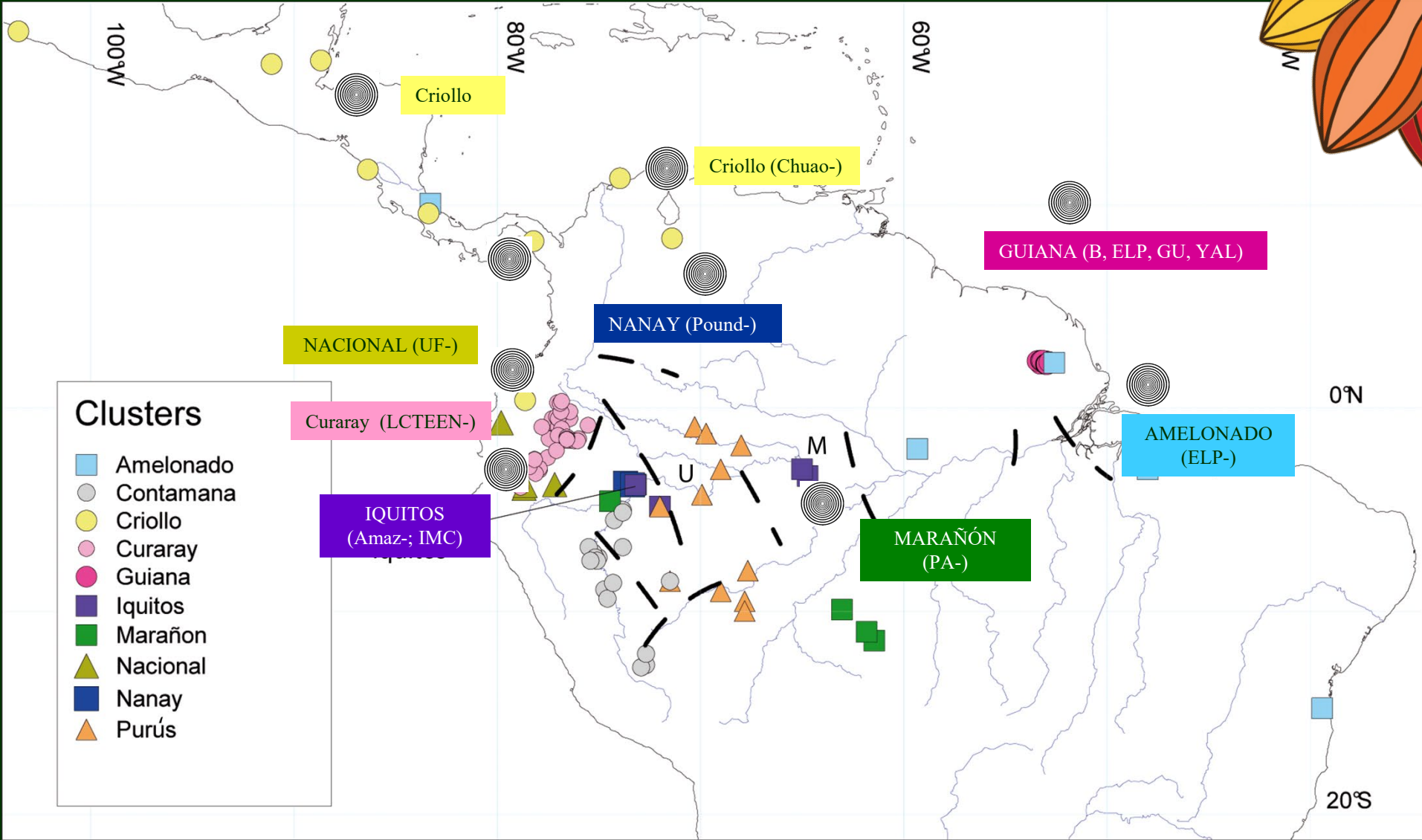


UF-273
Resistentant

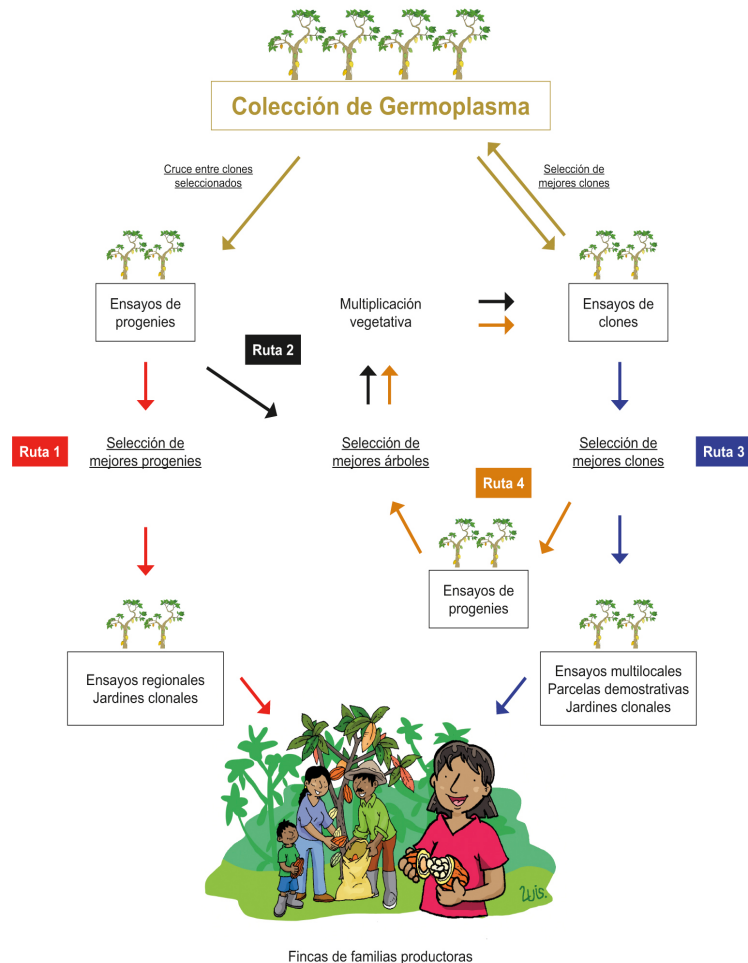


POUND-7
Susceptible

Genes de resistencia a moniliasis presentes en diferentes grupos.



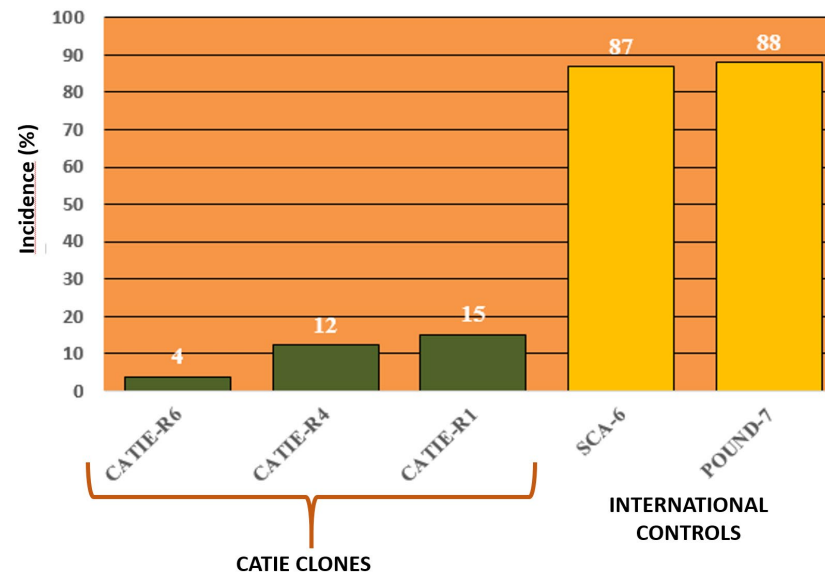
Programa de mejora genética



Fincas de familias productoras

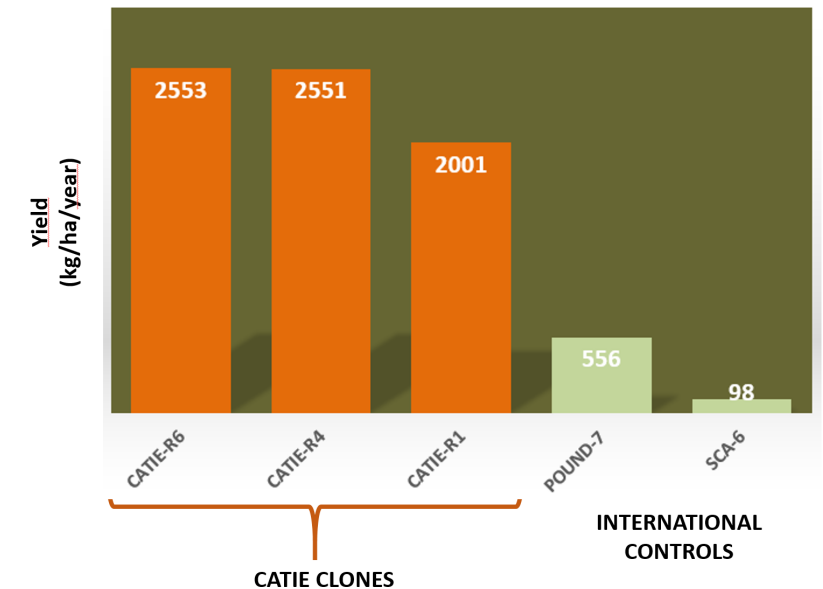
RESISTENCIA A MONILIASIS

Moniliasis incidence in L6 (Avg last 10 years of data)



PRODUCCIÓN

Yield (kg/ha/year) in L6
Avg of the last 10 years (July 2005 to June 2015)



6 Clones élite de cacao

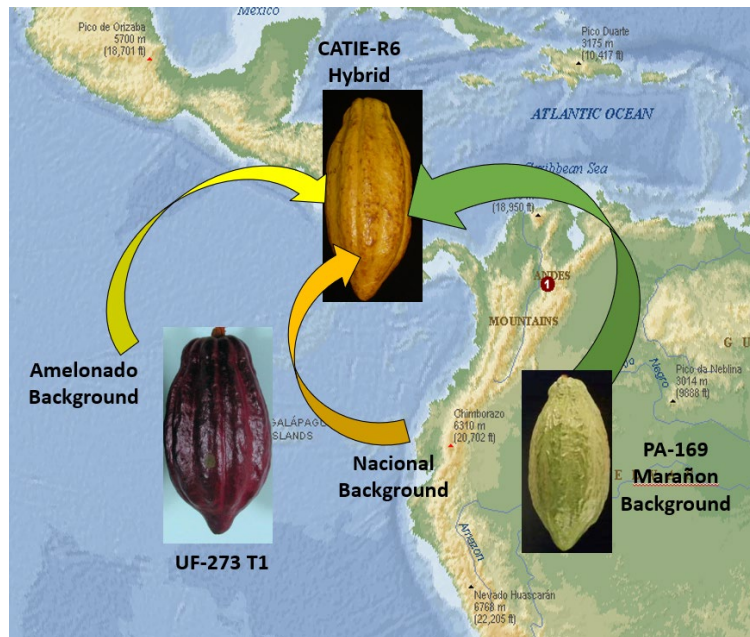


- ✓ Alta producción
- ✓ Resistencia a moniliasis
- ✓ Resistencia a mazorca negra
- ✓ Calidad notable
- ✓ Intecompatibilidad



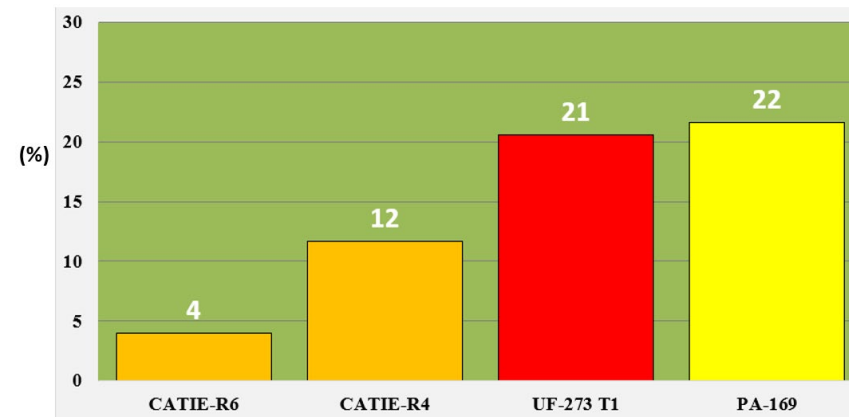
CLONES SELECCIONADOS POR EL CATIE

Vigor híbrido: producción y resistencia a enfermedades



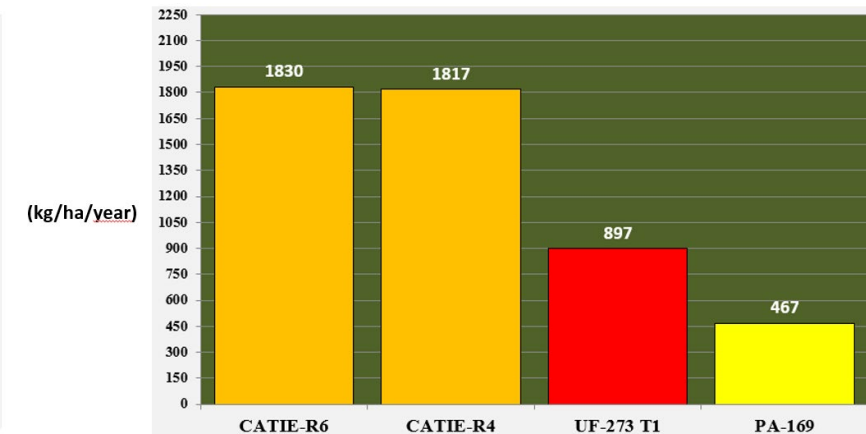
Heterosis para moniliasis

(L6, promedio de 15 años)



Heterosis para producción

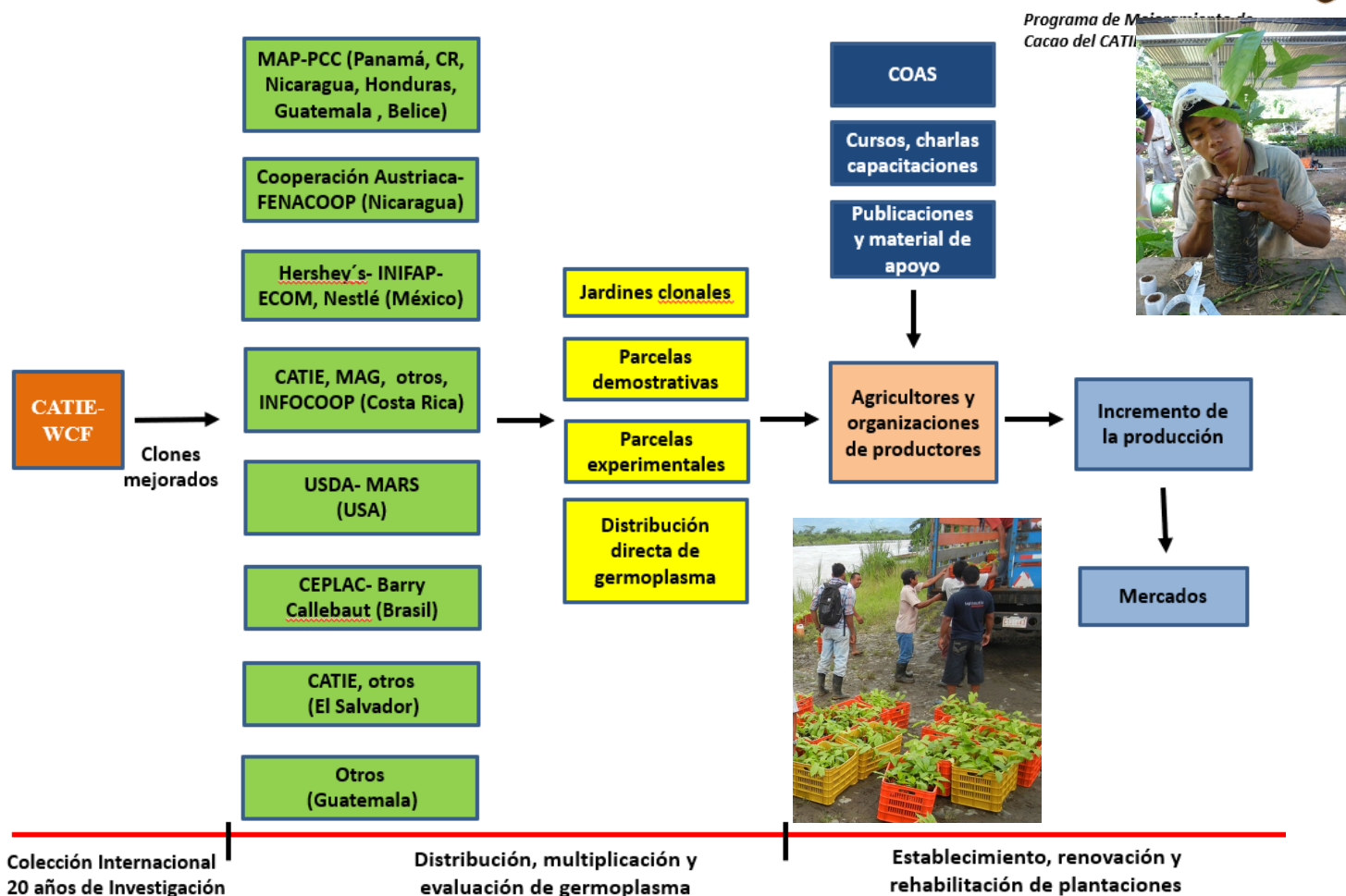
(L6, promedio de 15 años)



Presencia y rutas de impacto



RUTA DE IMPACTO DE LAS VARIEDADES DE CACAO SELECCIONADAS POR EL CATIE



La calidad de los clones CATIE ya la disfrutan los consumidores

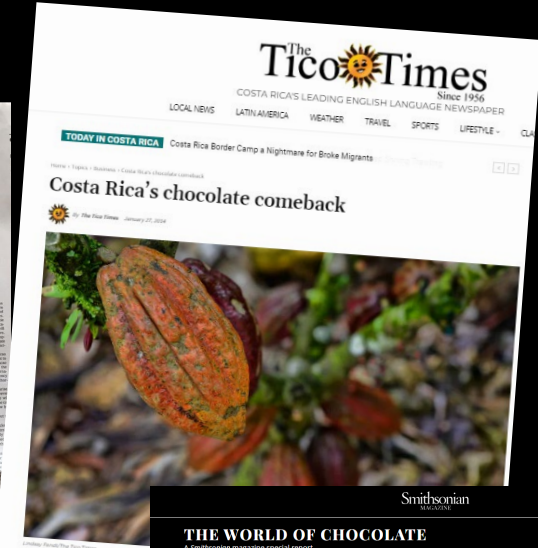
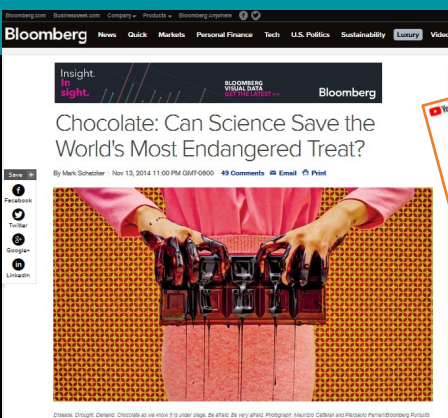


Calidad reconocida en el “Cocoa of Excellence” del 2009 y 2010, y por varias empresas chocolateras.



Foto Allan Mata

Promoción y Divulgación



TURRIALBA, Costa Rica — The trees of the International Cacao Collection grow here in an astonishing diversity of forms, bearing skinny cacao pods with scorpion-stinger protrusions, spherical green pods that could be mistaken for tomatillos, oblong pods with bumpy skin resembling the horned lizard — and

Within each of these billions: chocolate.

But despite this diversity that's a problem: Like from diseases and even grow only a few varieties

"Most varieties produce selected in the forties," collection of 1,235 types Improvement Program: Tropical Agricultural Research

A narrow gene pool means



The fungus — Moniliophthora roreri, also called monilia or frosty pod rot — soon spread around the country, and by 1983 Costa Rican exports of dry

try here has never

it. "Monilia, you've belly/You say you no

on to the region's Rican outbreak is

use intentionally or flight," said Dr. developing world

amaica in September moving covertly infected cacao pods

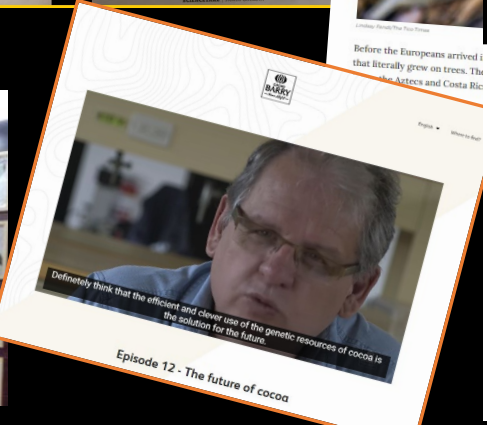
merica, and it has travel than as West Africa — produced products

Huracán Idalia se fortalece: Florida en alerta de 'categoría devastadora'

ONU alerta: Miles de personas son forz en Asia para estar en línea

¿Dónde puede ver los partidos de Super el Cartaginés en la Copa Centroamericana

Leandro deportivo de Sa





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GRACIAS

