



UNDERSTANDING THE GENETIC STRUCTURE AND PARENTAGE OF THE CLONAL SERIES OF CACAO UF, CC, PMCT AND ARF PRESERVED IN THE INTERNATIONAL CACAO COLLECTION AT CATIE (IC3)

A. Mata-Quirós¹, A. Arciniegas-Leal¹, W. Phillips-Mora¹, L.W. Meinhardt² and D. Zhang²

¹CATIE, Turrialba, Costa Rica

²USDA-ARS SPCL, Beltsville, MD, USA



2017 International Symposium on Cocoa Research (ISCR), Lima, Peru, 13-17 November 2017





International Cacao Collection at CATIE (IC3)

1913: Introduction of Amelonado genotypes from T&T

1928: Introduction of Nacional cacaos from Ecuador

1936: Selection of UF clones by United Fruit Co.

1950 and 1959: Establishment of trials in Turrialba and La Lola

1957-1966: Selection of CC clones by IICA

1989-1992: Selection of PMCT clones by CATIE

1992: Selection of ARF clones by CATIE

International relevance of the clones

- Some present at the International Cocoa Quarantine Station Reading, UK.
- Parents for the generation of new varieties.
- Some are recommended for commercial plantings in Colombia and Peru.
- Widely used in crosses in Costa Rica, Mexico, Honduras for their tolerance to Frosty Pod Rot.
- Part of the polyclone recommended by CATIE for commercial plantings.

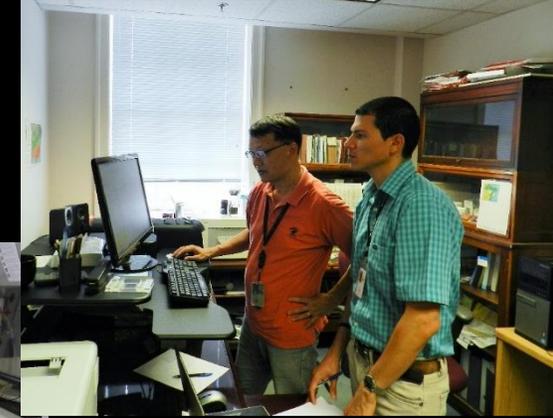


Objective

- To analyze molecularly the parentage and genetic composition of 266 cacao genotypes belonging the series ARF, CC, PMCT and UF originated in Costa Rica and compare them with a set of reference clones representing the known genetic diversity of *Theobroma cacao*.



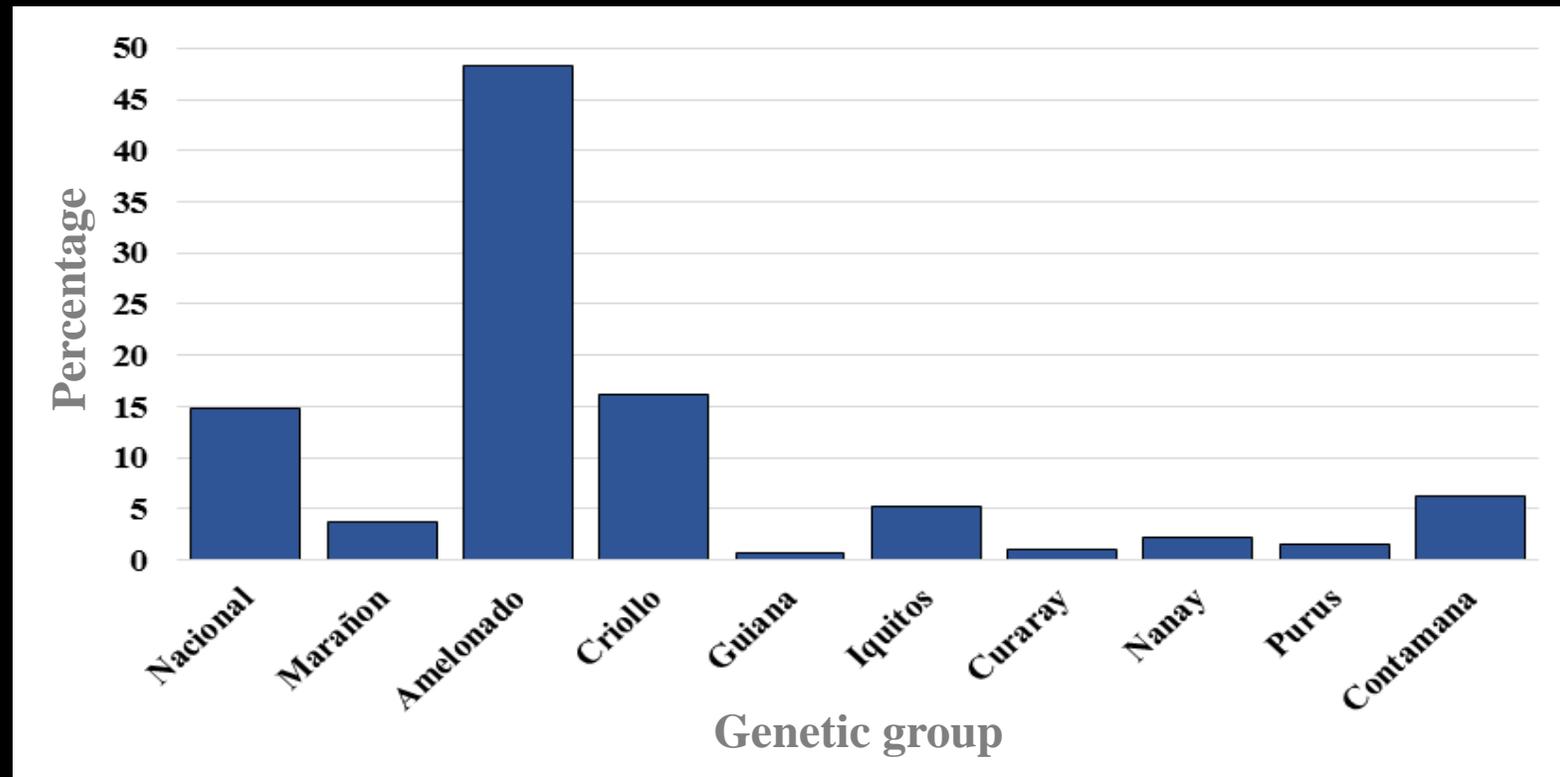
Materials and methods



- **266 clones:** 44 UF, 99 clones CC, 91 clones PMCT and 32 clones ARF from the IC3 (Turrialba, Costa Rica).
- **228 international clones:** genetic referents representing 10 groups (Motamayor *et al.* 2008).
- **Forty-eight SNP markers.**
- **Analysis using GenAIEx 6.2 and STRUCTURE**

Results

Information Index	Observed Heterozygosity	Expected Heterozygosity	Inbreeding Coefficient
Mean	0.301	0.428	0.295
SE	0.011	0.010	0.022



Ancestral contribution of ten genetic groups in the composition of the cacao series from CR

Parentage analysis

Percentage of contribution of ten genetic group in the composition of the clones ARF, CC, PMCT and UF

	Nacional	Marañon	Amelonado	Criollo	Guiana	Iquitos	Curaray	Nanay	Purus	Contamana
UF	22.8	1.3	48.7	21.3	0.6	1.6	0.4	0.9	0.4	2.0
CC	10.6	3.6	55.6	12.4	0.7	3.0	1.6	0.8	1.2	10.5
PMCT	7.2	4.3	41.9	13.0	1.1	14.6	1.7	6.0	2.0	8.2
ARF	4.4	17.4	36.7	8.4	1.0	8.6	1.7	3.5	7.8	10.6

Assignment of membership

Clones of the Costa Rican series assigned as a member to different genetic groups (Ancestral contribution $\geq 75\%$)

	Nacional	Marañon	Amelonado	Criollo	Iquitos
UF	20, 712		10B, 122, 602, 701, 706		613
CC			18, 33, 35, 41, 42, 47, 49, 83, 106, 107, 121, 132, 144, 152, 158, 169, 173, 256, 267		
PMCT			10, 14, 18, 22, 25, 26, 27, 28, 51, 67	11, 29	33
ARF		4	30		

Discussion

- A significant level of consanguinity among some clones and a predominant participation of the genetic groups Amelonado, Criollo and Nacional.
- Putative high participation of Matina in the conformation of the clones.
- The second most important group is the Criollo, introduced and domesticated in Central America a long time ago.



Pods of Matina-1/6 from the International Cacao Collection at CATIE



Pods of "Acriollados" from the International Cacao Collection at CATIE

Discussion

- Nacional is the third most important genetic background in the Costa Rican series, with a presence that decrease throughout time.
- Contamana group: due to the utilization of SCA clones in some crosses.
- Iquitos group: derived from the participation of the IMC-67 clone in some of the crosses.



The information generated in this study will be essential to guide the effective conservation, exchange and use of the involved clones, and to understand and interpret the results obtained in previous breeding efforts.

