HARC Fine Cacao Field Day

September 21, 2019

Maunawili Breeding Station, Oahu

Agenda

9:00 AM	Varieties for New Plantings in Hawaii What to Get and What to Avoid
9:30 AM	Orchard Walk-Through Collecting budwood for scion Fine Flavor Graft vs Seedling
10:15 AM	Grafting Demo
10:30 AM	Workshop Stations: Grafting Liquor and Chocolate Tasting HARC Forestry

HARC Cacao Team, Partners and Funding

HARC
- Chifumi Nagai
- Tyler Jones
- Nick Dudley
- Daniel Adamski
- Becky Heinig
- Nick Dudley Jr.

USDA
- Cecile Tonde
- Dr. Ricardo Goenaga
- Dr. Brian Irish
- Mike Winterstein
- Jason Okamoto

Mars Inc:
- J. C. Motamayor
- Dr. Ray Schnell

Ed Seguine

Dole Foods HI
- Mike Conway

HI Cacao Growers
- Tom Menezes (Hakalau Farm, HI)
- Gini Choobua (HTFG, HI)
- + 12 farms

HI Botanical Gardens

Funding
- USDA- ARS
- Hawaii Farm Bureau Federation
- Hawaii State Department of Agriculture

Cacao varieties in Hawaii

Chifumi Nagai
Hawaii Agriculture Research Center

Variation of cacao of pods

Lower Amazon Type Forastero (LAF)
Upper Amazon Type Forastero (UAF)
Trinitario Type

Traditional Groups of Cacao
(*Theobroma cacao L.*)

Criollo

Forastero

Trinitario =
Criollo x Forastero

Distribution of Cacao types in Hawaii

Types	Number of tree samples (%total) Islands			
	Hawaii	Kauai	Oahu	Total
Criollo	2	10		12 (11.7)
Trinitario	18	2	27	30 (29.1)
Trinitario/UAF	11		22	33 (32.0)
UAF	4		7	11 (10.7)
Total	35	12	56	103

Wrong! Genetic analysis reveals many clusters.

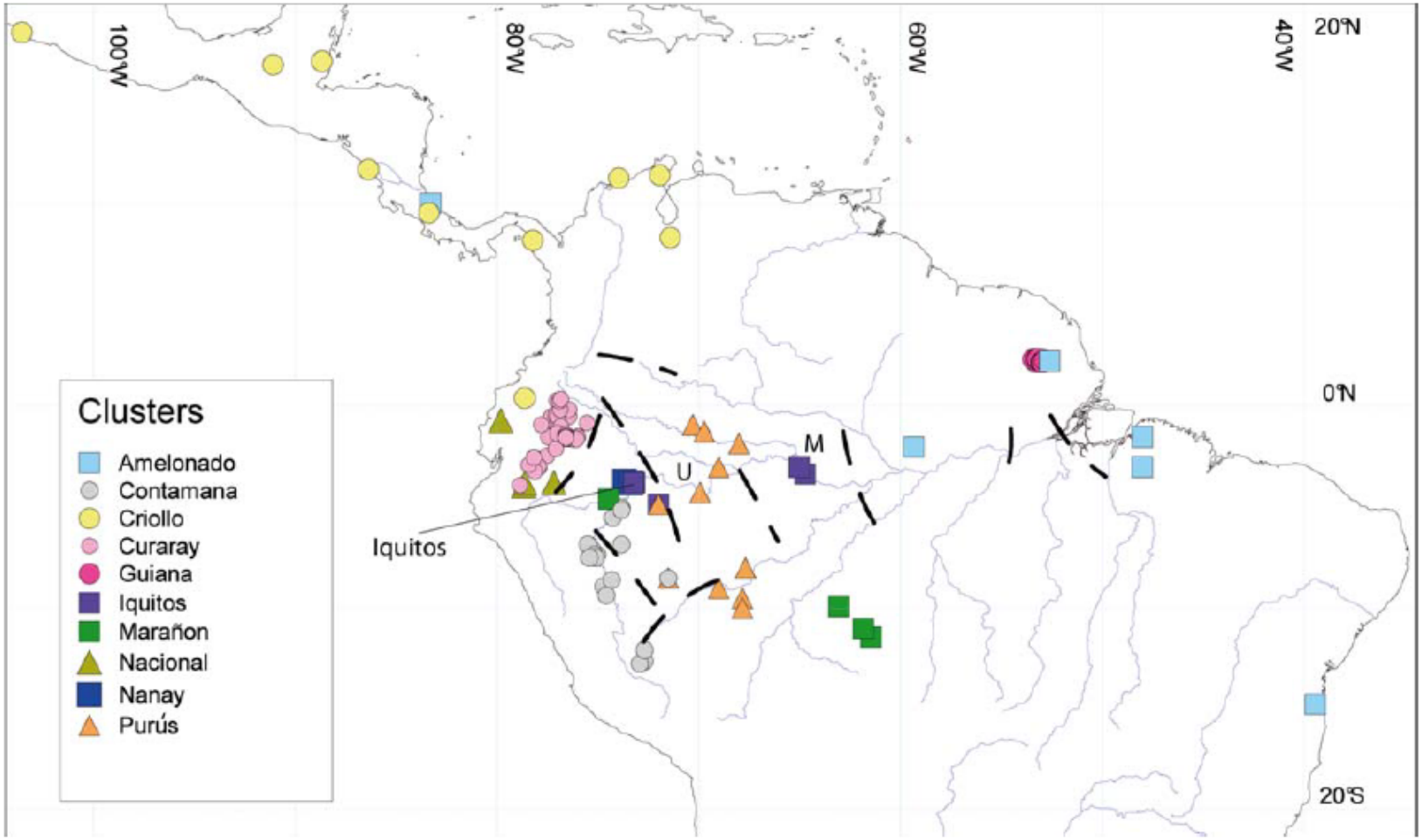
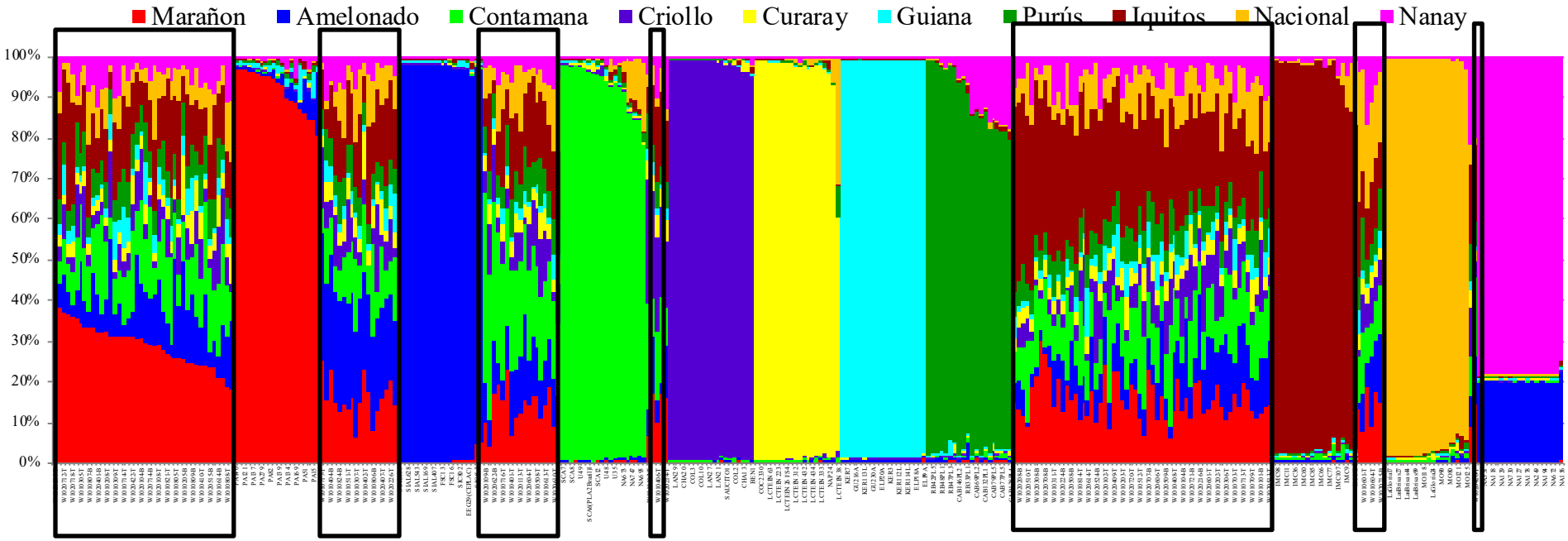


Figure 1. Localization of the origin of individuals analyzed; colors indicate the inferred genetic cluster to which they belong. Approximated location of Amazon ancient ridges ("palaeoarches") is shown, after [26], in order of apparition clockwise: Fitzcarrald, Marañon, Serra do Moa, Iquitos, Vaupés, Carauari, Purús, Monte Alegre and Gurupa. U: Upper and M: Middle Solimões.
doi:10.1371/journal.pone.0003311.g001

Motamayor et al. 2008

Structure analysis for 150 selected plants in Hawaii and Genetic Groups



Motamayor et al. 2008

Seedlings vs. Clones

Mother tree

seeds → seedlings

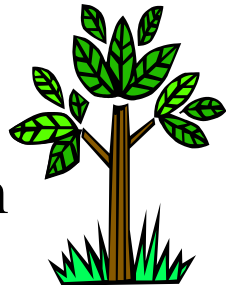
Bud woods
Scions

Grafted trees= clones (genetically uniform)

Seedlings vs. Clones

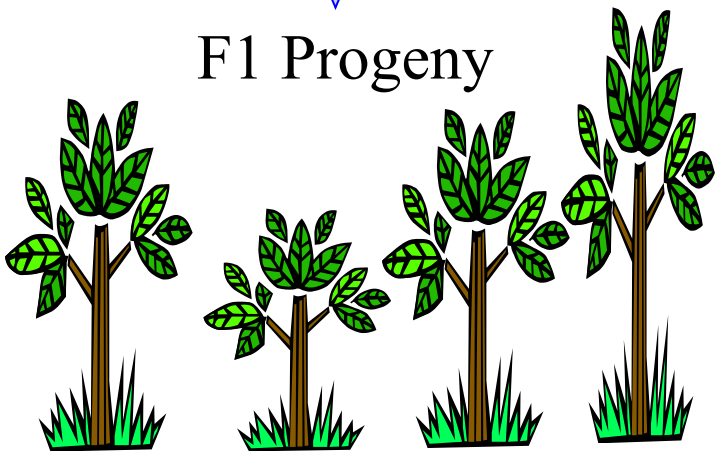
female

Cross pollination

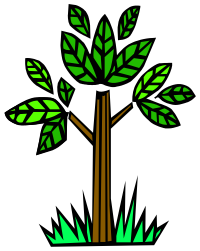


male

F1 Progeny



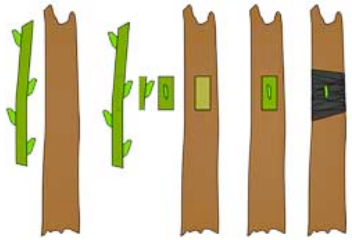
Variation in pod color & shape, tree height, pod#, etc

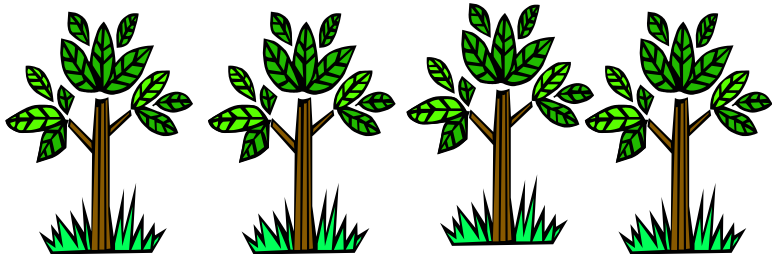


Select superior trees

Graft on rootstocks

Clones





Clones are genetically identical to the mother tree

Tips for Sourcing Cacao Germplasm in Hawaii

Dave Elliott

What to Avoid

- Seedlings of unknown progeny
- Nurseries selling “yellow pod” and “red pod” or similar “varieties”
- Importing new material (pods, fresh seed or budwood) without USDA quarantine procedures
- A small number of clones of unknown pollen compatibility and other traits
- Anything being marketed with wild adventure tales and NO data

What to Source for Your Farm

- Clonal releases from reputable sources with good flavor, agronomics and disease resistance (e.g. TARS)
- Vigorous, healthy seedlings from proven mother trees grown by a nursery with cacao expertise
- Farmer selections (from experienced operations with yield data!)

Traits to Assess Cacao

- **Yield:** dry bean weight / tree / year
- **Pod Index:** number of pods / kg of dry beans*
- **Early bearing**
- **Tree architecture:** upright, NOT droopy

- **Challenging Traits to Assess on a Farm:** Flavor, disease resistance and site adaptability

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Clonal Trial of Selected Genotypes at Maunawili (2008-current)

Superior Cacao Germplasm Selection at TARS, Mayaguez, Puerto Rico

- Evaluation of 5 inter-clonal full-sib families 1986-1993
- Selection for high yield and resistance to diseases.
- Final 9 clones were selected from 40 clones
  - TARS-1
  - TARS-9

Clone	Flavor profile of 65% chocolate
TARS-1	A very complex nut character comes through, more like chestnuts roasting with a blend of some hazelnut skins
TARS-9	Gorgeous color; very smooth in flavor profile; very mild chocolate notes up front with low overall bitterness and a distinct nut character that persists; aftertaste has a residual nut/nut skins note; really good chocolate

Goenaga et al. 2009

Hawaii State Cacao Trial

Bittenbender (unpublished work)

- Multiple sites across different islands
- 10 clones, including 2 HARC-Waialua selections and ICS-95.
- 3 years of production data

Comparison of clones in Hawaii

Trait	TARS	HSCT	HARC Fine Cacao cultivars
Pod Index	good	unpublished	acceptable – good*
Yield	good	unpublished	acceptable – good*
Fine Flavor	good	partial results**	good*
Disease resistance	***	**unknown**	**unknown**
Performance in Hawaii	**unknown****	multi-site HI trial	good at Maunawili, **unknown** elsewhere

*Preliminary results

**Bittenbender 2017

***parent lines selected for black pod resistance

**** CTAHR clonal trial underway (planted in 2020 by Isele and Kirk)

Evaluation of new cacao varieties in Hawaii

Team members: Osman Gutierrez, USDA-ARS, Miami
Tracie Matsumoto, USDA-ARS,Hilo,PBARC
Chifumi Nagai and Tyler Jones, HARC

Goals:

- Conduct cacao performance trials in Hawaii of new elite clones developed from the international cooperative breeding programs of USDA-ARS.

- Establish cacao germplasm with disease resistances for FP, BP and WB pro-actively.

Frosty Pot(FP)

Black Pot (BP)

Witches' Broom (WB)

Philips 2009