

# **HARC Coffee Research Update**



**HCA Conference 2004**

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**Hawaii Agriculture Research Center**

# Coffee Breeding and Selection

## Traditional tools

Existing varieties

Foreign germplasm

Hybridization

Visual selection

Data collection

Backcross

## New tools

DNA markers

Genetic Engineering

Quality Evaluation  
(Cupping)

Flavor Chemistry

**New coffee varieties**  
with high yielding and superior quality

**with rust and nematode resistance**  
having cupping quality



# *HARC Coffee Program*

- Breeding and Selection  
HCGA/State, DOA 1997-
- DNA Molecular Markers  
USDA grant (CMBRU)  
Ray Ming, Meghan Riley, C. Nagai
- Transgenic Coffee for Nematode Resistance  
USDA grant ( T-STAR, CMBRU )  
Brent Sipes, D. Schmit. H. Atkinson, Roxana Cabos,  
C.Nagai



# HARC Coffee Program

## New Projects

- Isolation and Characterization of Genes Involved in Organ Size

USDA grant ( T-STAR)

Ming-Li Wang, Monto Kumagai (UH),

Henrik Albert (USDA), C. Nagai



- Trigonelline, Caffeine, Sugar Metabolism in Developing Coffee Fruits and Seeds

USDA grant (CMBRU)

Hiroshi Ashihara

(Ochanomizu University, Tokyo)

Mel Jackson, C.Nagai



# ***Coffee Breeding and Selection***

## **HARC- team**

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R. Meinzer, W. Sun**

## **UH**

**C. Cavaletto, N.Nagai and S. Bittenbender,**

**Hawaii Coffee Growers' Association (HCGA)**



# ***Objectives***

- **Produce arabica coffee with high yielding and superior quality**
- **Develop disease/pest resistant cultivars with cupping quality as a long term goal**





**Kauai**  
yellow Catuai  
red Catuai



**Oahu**  
mokka hyb.  
Promecafe



**Molokai**  
red Catuai  
red Caturra



**Maui**  
mokka  
red Catuai



**Kona**  
'Guatemalan'  
typica  
'Old Hawaiian'  
Hawaiian



**37 family total**



Via seed and cuttings

**Common Field**  
**Kunia, HARC**  
**planted April, 1998**



**Crosses (spring 1999)**

| Group                             | # of crosses |
|-----------------------------------|--------------|
| mokka and other arabica varieties | 66           |
| with Promecafe (Catimor)          | 53           |
| with Icatu                        | 8            |
| mokka and other selfs             | 40           |
| <b>Total</b>                      | <b>167</b>   |



**H99 - series**  
**Progeny(1,500)**  
**H00- series**  
**(400)**



# New coffee cultivar development using mokka germplasm

## Goal:

The introgression of Mokka flavor traits into high yielding and larger bean size cultivars

- Mokka is an arabica coffee variety (*C. arabica*) originated in Ethiopia. Historically Mokka coffee was exported from Mokka port in Yemen.
- Mokka was introduced to the UH coffee germplasm collection in the mid 1950s
- Commercially cultivated on Maui (Kaanapali Coffee Co). The accession is now considered to be a Mokka hybrid.
- The cupping quality of Mokka hybrid is considered excellent but bean size is very small ( about 30-40% of Red Catuai beans).



# Example of Progeny from 1999 Crosses with Mokka and other genotypes



- **Tree height**

Red Catuai x Mokka hyb

Red catuai dwarf x Mokka hyb

Yel Caturra x mokka

- **Cupping Quality**

- **Increase bean Size**

Mokka hyb self

Mokka x Red Catuai

Red Catuai x SL28

Mokka hyb self

Red Catuai x 6661



## Typica vs. Catuai



## Ripe Coffee Cherries



'typica'



'mokka'



**H99-36:  
MA1-12 x Margogipe  
(mokka select)**



## Example of Progeny :

## F2 (2<sup>nd</sup> generation) from 1999 Crosses with Mokka and other parents

Variation in short stature mokka type progeny



At Kunia  
F2 (2<sup>nd</sup> generation )



# Cherry and green bean size of new hybrids at Kunia (2002)

| Cross#   | Parentage                                   | 100fruit wt<br>gram | Green bean<br>gram |
|----------|---|---------------------|--------------------|
| H97-0100 | MA1 self <sup>(1)</sup><br>(selected mokka) | 140                 | 20.5               |
| H99-22A  | MA1-12 self                                 | 179.4 ± 8.5         | 29.2 ± 1.4         |
| H99-56   | Catuai x MA1-12                             | 177.7 ± 6.5         | 25.4 ± 0.8         |
| H99-36   | MA1-12 x Margog                             | 258.3 ± 17.4        | 42.9 ± 4.3         |
| H99-46   | MA1-10 x Margog                             | 234.2 ± 7.8         | 42.2 ± 2.1         |
| H99-101  | KA16-4 self<br>(Catuai)                     | 147.8 ± 1.4         | 25.5 ± 1.7         |



# ***Field trial of selected new hybrids at Kauai coffee***

- **Objective:** Field evaluation of selected coffee hybrid families at a commercial coffee field
- **Current Operation:** Mechanical harvesting  
90% Yellow Catuai, 10% other varieties
- **Duration:** 2-5 years
- **Site:** Kauai Coffee Co. Field 200
- **Experimental Design :** RCB (Radomized Complete Block)
  - 14 Entries
  - 12 new hybrid families
  - 2 check varieties: Yellow catuai (KA17) and Kona typica (KO34)
  - 2 Location with 4 replications
  - 14 trees/plot (14 x 3.75 ft spacing- Kauai Coffee Standard)



# *List of 12 Selected hybrid families*

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| Hybrid # | Parentage                 | Pedigree                |
|----------|---------------------------|-------------------------|
| H99-54   | OA13-5 self               | Blue Mtn Mokka hyb self |
| H99-56   | MA8-3x MA1-12             | Red catuai x Mokka hyb  |
| H99-60   | MA10-5 self               | Mokka hyb self          |
| H99-74   | #6661xCatuai              | #6661xCatuai            |
| H99-131  | BMT1x 6661                | Typica x 6661           |
| H99-150  | MA6-2x SL28               | Red Catuai x SL28       |
| H99-153  | MA7-1 x SL28              | Red Catuai x SL28       |
| H99-160  | MO24-8x mocha2            | Red Catuai x mokka      |
| H99-169  | OA13-1 BMT-1              | BMT Mokka x Typica      |
| H99-22A  | MA1-12self                | Mokka hyb self          |
| H99-36   | MA1-12 x Mogogipe         | Mokka Hyb x Margogipe   |
| H99-43   | MA10-5x Y.Bourbon         | Red Catuai x Bourbon    |
| KA17     | Yellow Catuai(Kauai)      |                         |
| KO34     | Typica (Kona Mountain Co) |                         |



# Kauai Coffee Field Trial

Fd. 200 Mauka



Seedlings shipped to Kauai 10/03



Fd. 200 Mauka

## Field Planting 4/04



# Kauai Coffee Field Trial

Fd. 200 Mauka

Rep2 view



Experimental Design

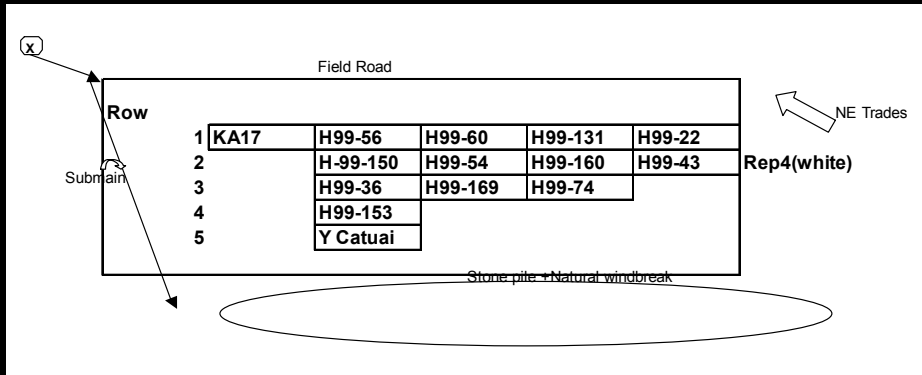
|    |             | Loc1 Mauka  |          | Planted 4/1/04            |         |
|----|-------------|-------------|----------|---------------------------|---------|
|    |             |             |          | 14' row spacing           |         |
|    |             |             |          | 3.75'(45") plant spacing  |         |
|    |             |             |          | 14plants/plot             |         |
| 20 | H99-150     |             |          | buffer=yellow catuai (YC) |         |
| 19 | H99-153     |             |          |                           |         |
| 18 | H99-160     |             |          |                           |         |
| 17 | H99-74      |             |          |                           |         |
| 16 | H99-43      |             |          | N.E.Trades                |         |
| 15 | H99-36      |             |          | Rep3 (orange)             |         |
| 14 | H99-60      |             |          |                           |         |
| 13 | KA17        |             |          |                           |         |
| 12 | H99-56      |             |          | Northfolk pine wind break |         |
| 11 | H99-22      |             |          |                           |         |
| 10 | H99-54      | H99-131     |          |                           |         |
| 9  | KO34        | H99-169     |          |                           |         |
| 8  | H99-74      | H99-169     | H99-131  |                           |         |
| 7  | H99-160     | H99-150     | KA17     | Rep2(blue)                |         |
| 6  | H99-60      | H99-36      | H99-153  | H99-54                    |         |
| 5  | H99-56      | KO34        | H99-22   | H99-43                    |         |
| 4  | H99-36      | H99-43      | H99-169  | H99-74                    |         |
| 3  | H99-56      | H99-22      | H99-131  | KA17                      | KO34    |
| 2  | H99-54      | H99-60      | H99-160  | H99-150                   | H99-153 |
| 1  | H99-54-1(L) | H99-25-5(L) | Y.catuai | Ycatuai                   | Ycatuai |
|    |             |             |          | Rep1(yellow)              |         |



# Kauai Coffee Field Trial

Fd. 200 Makai

Field Planting 4/04



HARC-KAUAI Coffee Team



Fd. 200 Makai



# ***Timeline of Kauai Field Trial 2004***

- Selection of hybrid families at Kunia Station(11/02)
- Harvest seeds and germinate at Maunawili (12/02)
- Shipment of seedlings to Kauai Coffee (10/03)
- Harvest of cherries (fruits) of 12 hybrid families from Kunia field for cupping (quality evaluation) (11/03)
- Acclimation at Kauai Coffee nursery(10/03-4/04)
- Planting (4/1/04)
- **Data Collection (10/04- 2009?)**
- **Selection of superior families and individual trees**
- **Propagation of selected trees/families**



# *Summary and Plan '04-'05*

- Field Trial at Kauai Coffee- New Hawaiian Varieties  
12 hybrid families were planted for field evaluation (4/04) ✓  
Data collection: Tree morphology, Yield, Bean quality (10/04-)
- Field planting of 2002 hybrids at HARC ( 7/03) ✓
- Crosses using new germplasm and selected genotypes (12/03-3/04) ✓
- Clonal propagation of selected hybrids using cutting and tissue culture
- Selection of H99- ,H00-and H01-for advancement
- Initiate collaboration with "Centre de Investigacao das Ferrugens do cafe" , Portugal, for rust resistance tests



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