



Assessment of Cassava Diversity by DNA Fingerprinting: Breeding Tool to Conserve Diversity and Reduce Redundancy in Germplasm Collections

Winnie Gimode, Luz Gómez-Martínez, Adriana Bohorquez-Chaux, Vianey Barrera-Enríquez, Alejandra Bedoya, Erik Delaquis, Luis Becerra Lopez-Lavalle



Cassava

Staple crop in **Africa**

Second largest starch crop after corn

Alliance



A photograph of a cassava processing facility. In the foreground, there are large piles of cassava roots. Two workers are visible: one in a red shirt and a hat is standing near a pile of sacks, and another is holding a large sack. In the background, there is a large industrial building with a gabled roof and two large metal pipes extending upwards. The sky is overcast, and there are hills in the distance.

Cassava

Supporting smallholder **livelihoods** and a multi-billion-dollar **industry** in Asia

Alliance



Cassava



No poverty
Zero hunger



Climate action



500 Million people's staple

Alliance



How We Consume Cassava



**Biofortified
cassava
for human
consumption**

(LAC, SSA)



**Fresh &
dried roots
for human
consumption**

(LAC, SSA & SEA)

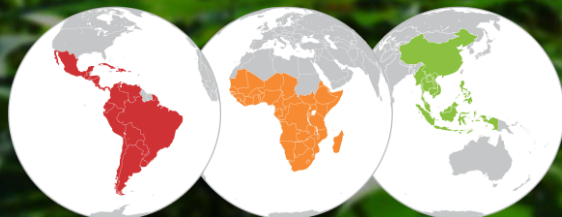


**Industrial
cassava -
starch &
animal feed**

(LAC, SSA & SEA)



**Cassava
specialty
starch
(LAC)**



**Latin America and the Caribbean (LAC)
Sub-Saharan Africa (SSA)
South East Asia (SEA)**

DIVERSITY

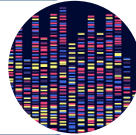
Alliance



Cassava Fingerprinting and Duplicate Analysis

Why is this important

Detect genetic duplicates



Genetic diversity studies



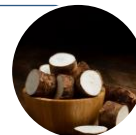
Verify crosses
in breeding programs



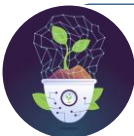
Select true-cross progeny



Guide selection of parental lines

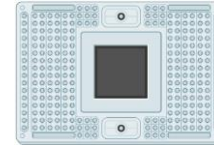


Help to assess diversity, and conservation



How does it work?

Genotyping



Data Collection
96 SNPs

Python 3.8.8



Distance Matrix
Hamming distance

DBSCAN
clustering

Same Fingerprint = One cluster
Fingerprint without match = Unique

Cassava Reference Data set
> 15000 samples



Cassava Fingerprinting and Duplicate Analysis



Vegetative propagation in germplasm collections



Breeding

Possibilities:

• Same variety with different names

Name confusion

Needs:

• Unique genotypes and varieties

identification



Vegetative propagation in the field

CIAT Future Seeds Gene Bank



>6000 Cassava
accessions

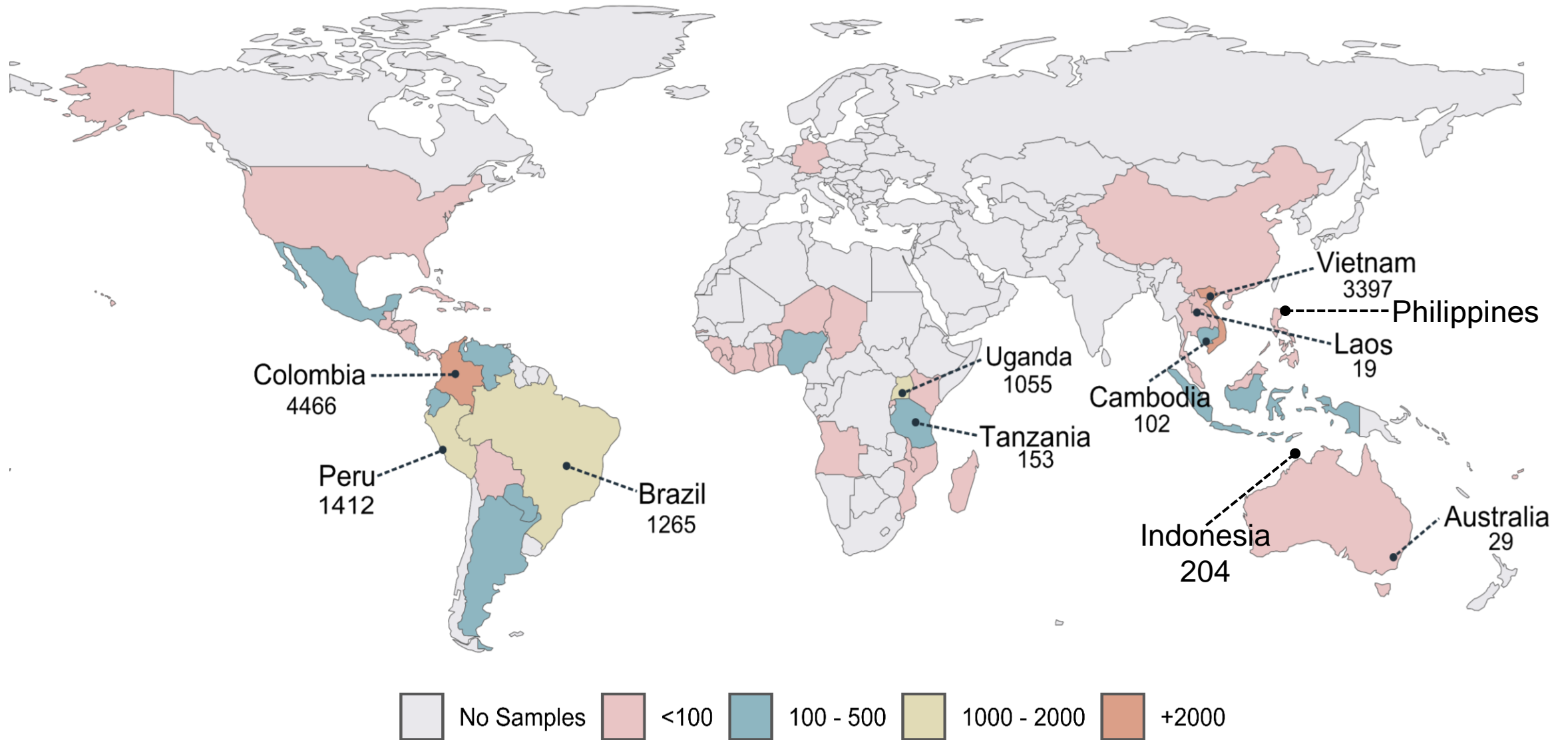


Cassava Donor germplasm and improved genotypes

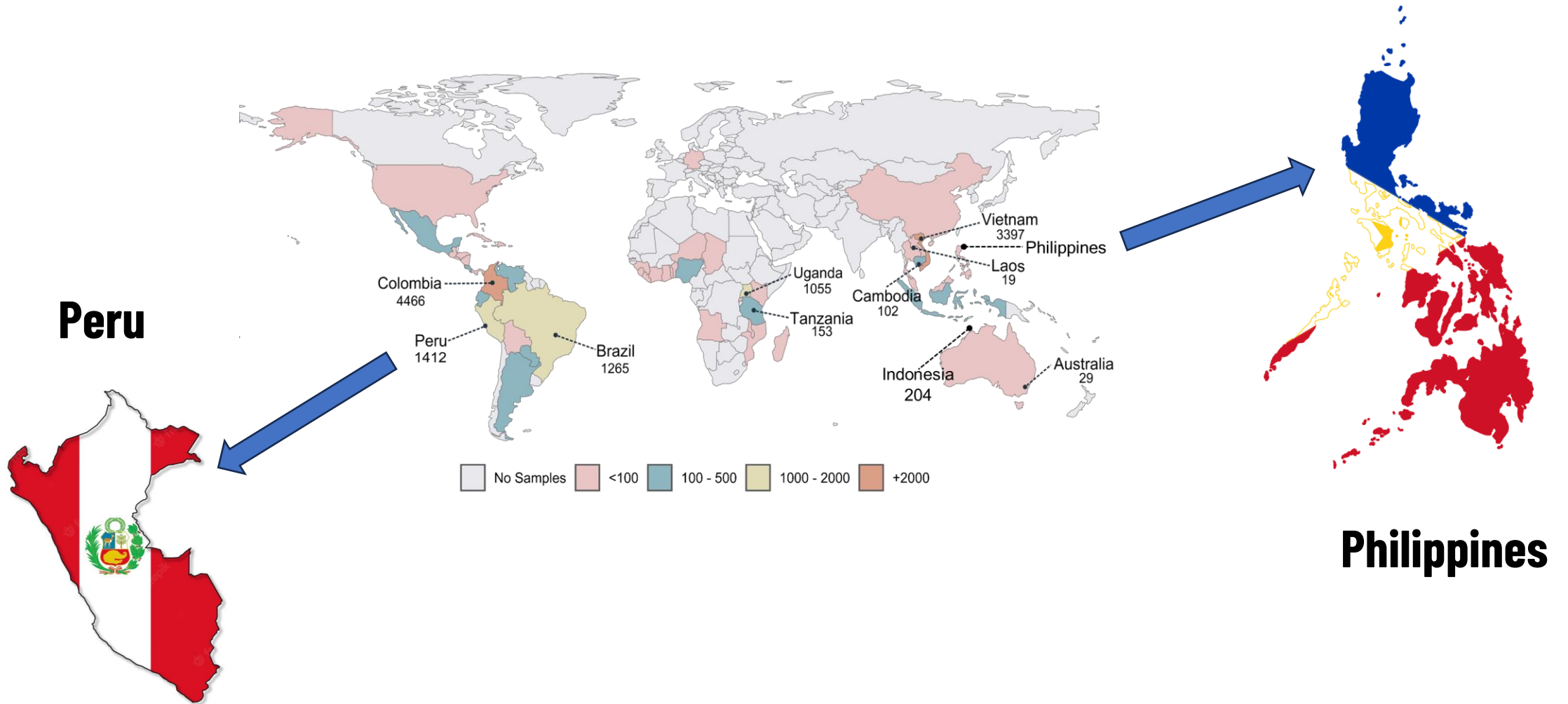
- **Whitefly Resist.**
- **Beta-carotene**
- **High Starch**
- **Cooking Quality**
- **Low PPD**
- **Waxy**
- **CBSD Resist.**
- **CMD Resist.**
- **Cold Tolerance**
- **Stable DMC**

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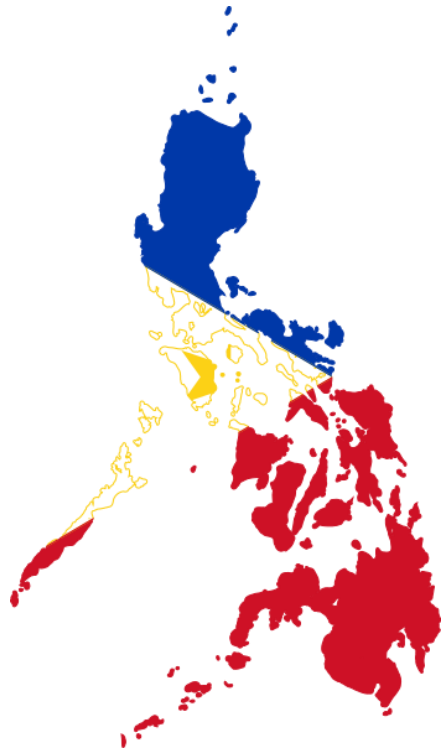
Cassava Database > 15000 samples



Case study of Philippines and Peru (FECONAYA)



Philippines Collection genotypes



30

Unique
Genotypes

61

Landraces
duplicates of **CR63**

44

Landraces
duplicates of **SC9**

2

Landraces duplicates of **KU50**

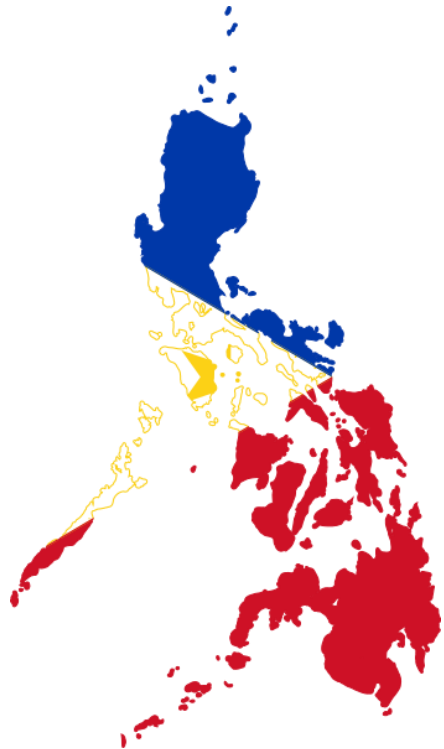
Samples called **KU50** and **Rayong72** are not duplicates of **KU50** and **Rayong72** from the database

286 Samples

Redundancy → **69%**

Unique Varieties → **10%**

Philippines Collection genotypes



286 Samples
Redundancy → **69%**
Unique Varieties → **10%**

- **High redundancy**

The identification of duplicates will guide reduction of redundant germplasm

- **Name confusion?**

Samples called **KU50** and **Rayong72** are not duplicates of KU50 and Rayong72 from the database

KU50: High yield, high starch, adaptable

Main cassava variety in Asia. Most planted, most demanded by starch industry in Asia

Peruvian Collection genotypes

FEDERATION OF NATIVE YANESHA COMMUNITIES (FECONAYA)



- **208** samples
- **48** unique genotypes
- Low redundancy

45 unique genotypes match only with their replicate (90 samples)

3 unique samples are not duplicates of their replicates

48 unique genotypes

34 genotypes (61 samples) in **9** clusters with only FECONAYA samples

29 genotypes (52 samples) grouped in **17** clusters and match with other genotypes in the data set

9 potential unique genotypes
17 non-unique genotypes

Peruvian Collection genotypes

FEDERATION OF NATIVE YANESHA COMMUNITIES (FECONAYA)



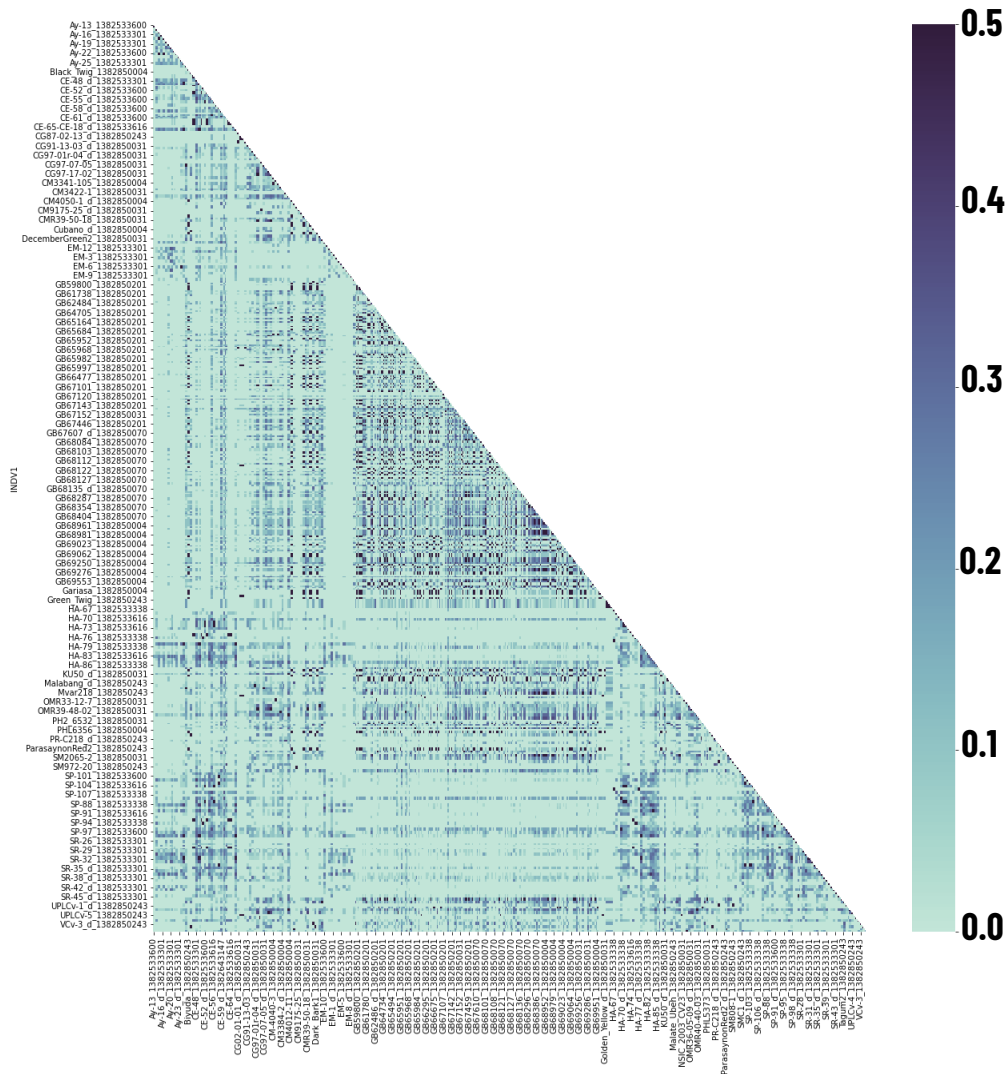
- **Unique germplasm**

Great biological diversity that should be conserved

Unique or 'new diversity' may be sources of favorable alleles for key traits in cassava

- **208** samples
- **48** unique genotypes
- Low redundancy

Kinship Analysis: Philippines vs FECONAYA samples



1st degree relationships observed among some genotypes from Peru and Philippines

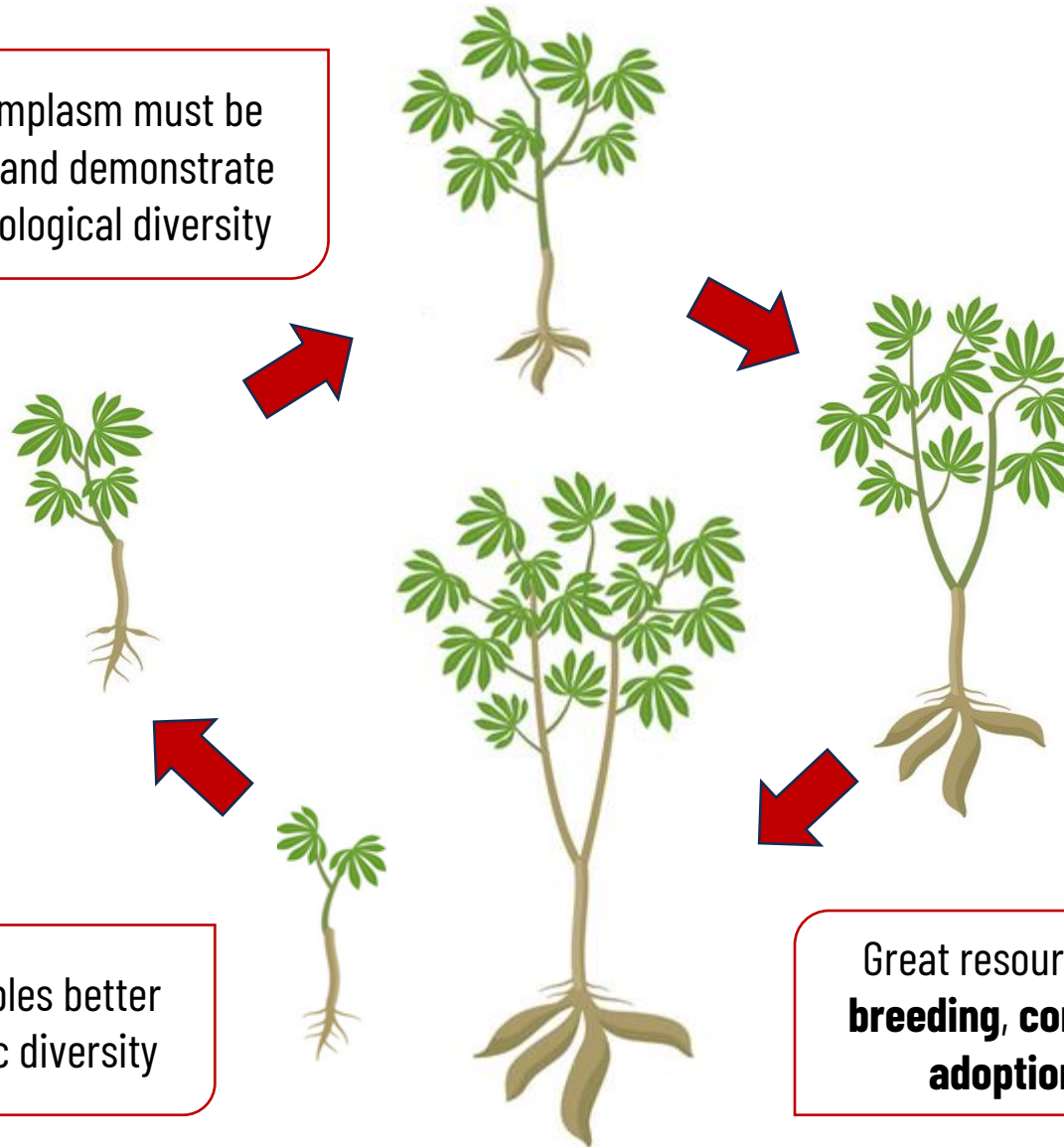
The > the number (darker blue on scale), the > the statistical evidence that they are related.

Highlights and Conclusions

Unique germplasm must be **conserved** and demonstrate the great biological diversity

CIAT hosts a diverse **gene bank collection** and **database** that is a great resource

DNA fingerprinting enables better understanding of genetic diversity



Duplicate sample identification will **reduce redundancy** in gene banks, hence **proper prioritization of resources**

Great resource for cassava **breeding, conservation** and **adoption tracking**



Thanks!