

## Context and objectives

### Cacao varieties in Côte d'Ivoire

- In Côte d'Ivoire, farmers and support services officers often refer to cacao "varieties", such as Trinitario, Amelonado, Criollo, French, Togolese, Ghanaian or Mercedes
- Historically, names of cacao varieties were used to differentiate commercial hybrids or populations with distinctive agronomical characteristics
- This distinction was useful when selected hybrid varieties started to replace typical cacao varieties, with each kind of germplasm being associated to distinctive agronomical or quality traits
- Today, the release of hybrid germplasm of various parentages, along with the uncontrolled crossing and inbreeding in farmers fields, are responsible for high phenotypic diversity in cacao orchards grown from seedlings
- We question the good sense of the persistent use of "varietal distinction" in cacao germplasm, by both farmers, support officers and experts, in today's context of mixed and uncontrolled germplasm in Côte d'Ivoire.

## Methodology

### Data collection

- 174 cacao trees from two populations (10 and 20 years old cacao orchards, full-sun & AFS)
- Morphological description of each tree, using pods, flowers and growth habit qualitative descriptors
- Weekly monitoring of vegetative & reproductive activity & status during four years
- Study of phenotypic variability in mix-genotype cacao orchard
- Survey of 40 cacao farmer around the study site:
  - Farmer's perception and knowledge of "cacao varieties"
  - Farmer's criteria's for identifying a "quality tree"
  - Farmer's perception of best pod appearance and related quality trait

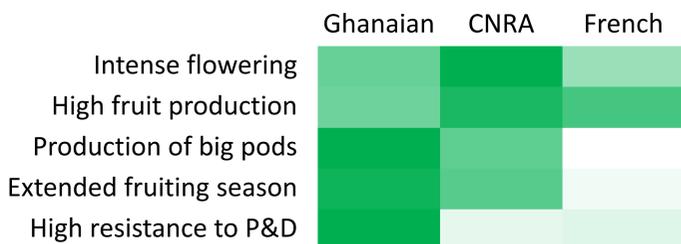


## Results

### Varieties identified by farmers

- In the area where our study took place, farmers often differentiate "CNRA", "Ghanaian" and "French" varieties.
- Each variety is associated with specific pod phenotypes, along with growth, flowering or fruiting habits.

Frequencies of quality traits quoted by farmers  
 Light green for low frequency; Dark green for high frequency



### Pod phenotypic variability in studied cacao orchard

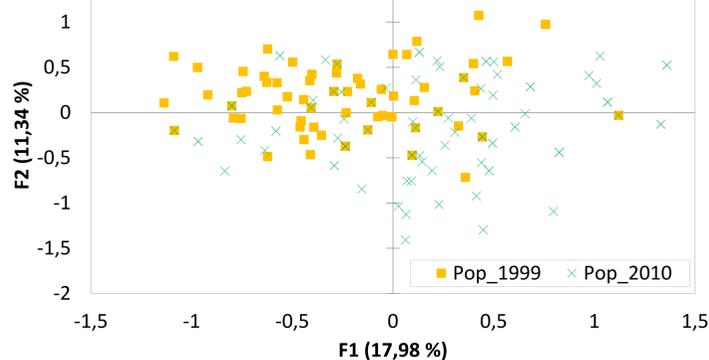
- Shannon-Weaver diversity indices show high levels of phenotypic diversity and evenness in the distribution of pod descriptors modalities in both populations.

SWDI on pod morphological descriptors in both populations



- MCA on typical descriptors of pods indicates marked differences between the two populations, but low levels of associations between morphological traits.

Observation plot of MCA on fruits morphological descriptors



- A total of 114 distinct pod phenotypes (combinations of fruit descriptors) were observed in the studied population of 174 trees.

Photos of pods from neighbour trees (SAO, Photos by T. WIBAUX)

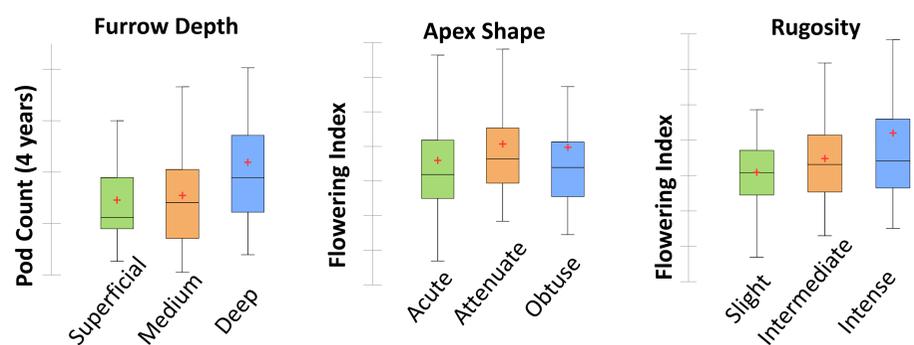


### Exploring relations between Pod descriptors and production habits

- Are morphological traits and morphotypes of pods related to expected fruiting and flowering behavior?
- Linear Mixed-Effects Models :
  - 3 production indices as dependent variables: Flowering Index (length and intensity of flowering events), Pod Count, Frequency of "big pods".
  - 6 morphological descriptors of pods as fixed effects: Shape, Basal constriction, Apex Shape, Rugosity, Colour and Furrow Depth.
  - 2 populations ("1999" and "2010") as random effects.

Results from the models: effects of Pod descriptors on production traits  
 Type 2 Wald Chi-squared test. Pr (>Chi<sup>2</sup>): "-" > 0,1; "\*" < 0,1; "\*\*" < 0,05

	Pod Count	Big Pods Frequency	Flowering Index
Shape	-	-	-
Basal Constriction	-	-	-
Apex Shape	-	-	*
Rugosity	-	-	**
Colour	-	-	-
Furrow Depth	*	-	-



## Conclusion

- Farmers still rely on fruit appearance to differentiate single cacao trees into "varieties", associating them with expected flowering, fruiting and growth habits.
- In typical orchards of mixed genotypes, phenotypic variability in terms of pod morphology, flowering, fruiting or growth habits, is high.
- The analysis of production traits reveals none to low effects of pod phenotype on the studied production traits.
- Thus, in the case of Côte d'Ivoire, predicting flowering, fruiting or growth habits of a cacao trees, based on the visual observation of its pod appearance, is hazardous and deceiving.

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