Summary on screening of breeding genotypes and identification of promising ones for boiled cassava, at CIAT Colombia

Deliverable for RTBfoods / RTB Breeding project, March 2025

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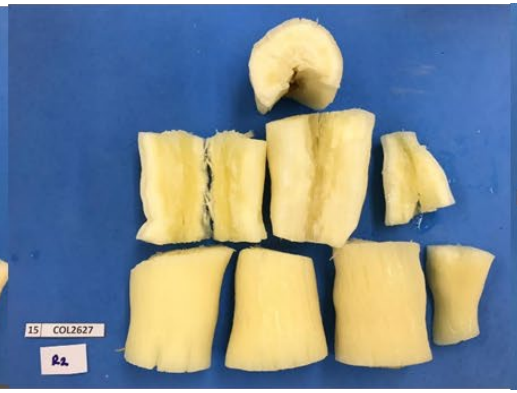
Outline

- Product Presentation: Boiled cassava.
- Phenotyping methods & SOPs developed at CIAT for RTBfoods & RTB Breeding, in particular Water absorption (WAB) and Texture-extrusion. ***Tran et al. (2020)***.
- Consumer preferences, sensory QDA descriptors (mealiness, hardness) and WAB and Texture-extrusion parameters are correlated. Using these results, acceptability thresholds were defined. Joint work between NaCCRI and CIAT. ***Iragaba et al., 2024***.
- In parallel, WAB is being applied as routine method to screen cassava harvests at CIAT since 2021. This enabled the production of a large database (7585 samples as of December 2024) with NIRS and WAB data.
- This database was key to demonstrate for the first time that NIRS can be used to classify cassava genotypes into good cooking and bad cooking categories, and thus to screen out the bad-cooking genotypes at an early stage in the breeding cycle (F1C1).
- Using the database, we present the distribution of WAB among the 4091 unique genotypes tested at CIAT (clones and landraces), and identify the best and worst in terms of cooking quality.
- This demonstrates the achievement of one of the original objectives of RTBfoods, namely to develop phenotyping tools usable by breeders to routinely screen large numbers of genotypes for cooking quality.

Presentation of boiled cassava

- Peel and wash, cut in pieces, cook in boiling water.
- High diversity of textures after cooking, depending on genotype:
  - Hard vs soft
  - Mealy vs cohesive
  - Cooking time
  - Stability over different years and harvests



Sensory panel and laboratory SOPs developed in RTBfoods & RTB Breeding

Two standard operating protocols (SOPs) developed for phenotyping boiled cassava: Water absorption, Texture-extrusion in relation to mealiness and hardness.

Additionally, protocol to measure HCN in relation to sweetness/bitterness.

Water absorption now used as routine analysis on various breeding populations

International Journal of Food Science +Technology

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Original article | Open Access

Correlation of cooking time with water absorption and changes in relative density during boiling of cassava roots

Thierry Tran, Xiaofei Zhang, Hernan Ceballos, Jhon L. Moreno, Jorge Luna, Andrés Escobar, Nelson Morante, John Belalcazar, Luis A. Becerra, Dominique Dufour

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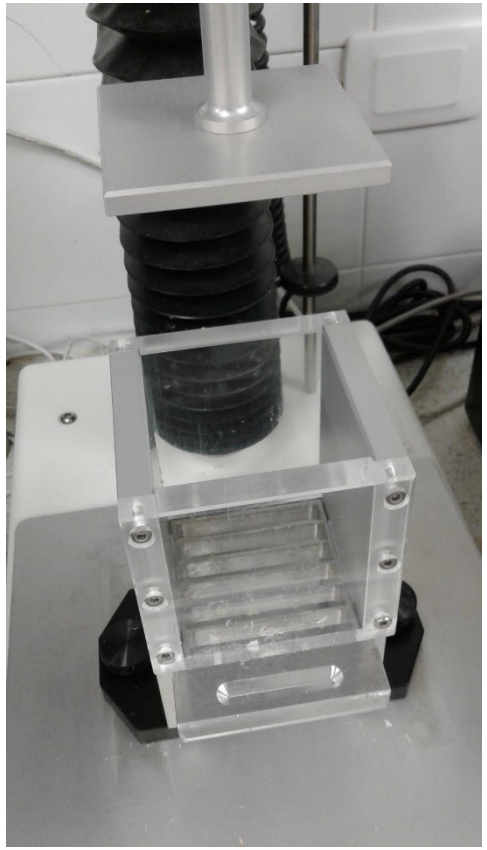
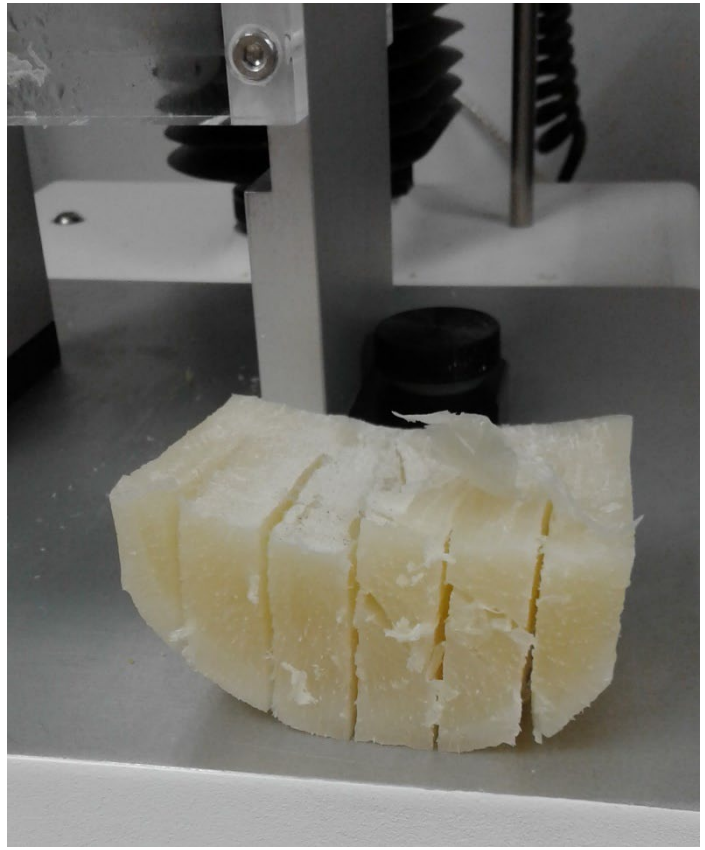
Lab SOPs developed in RTBfoods & RTB Breeding

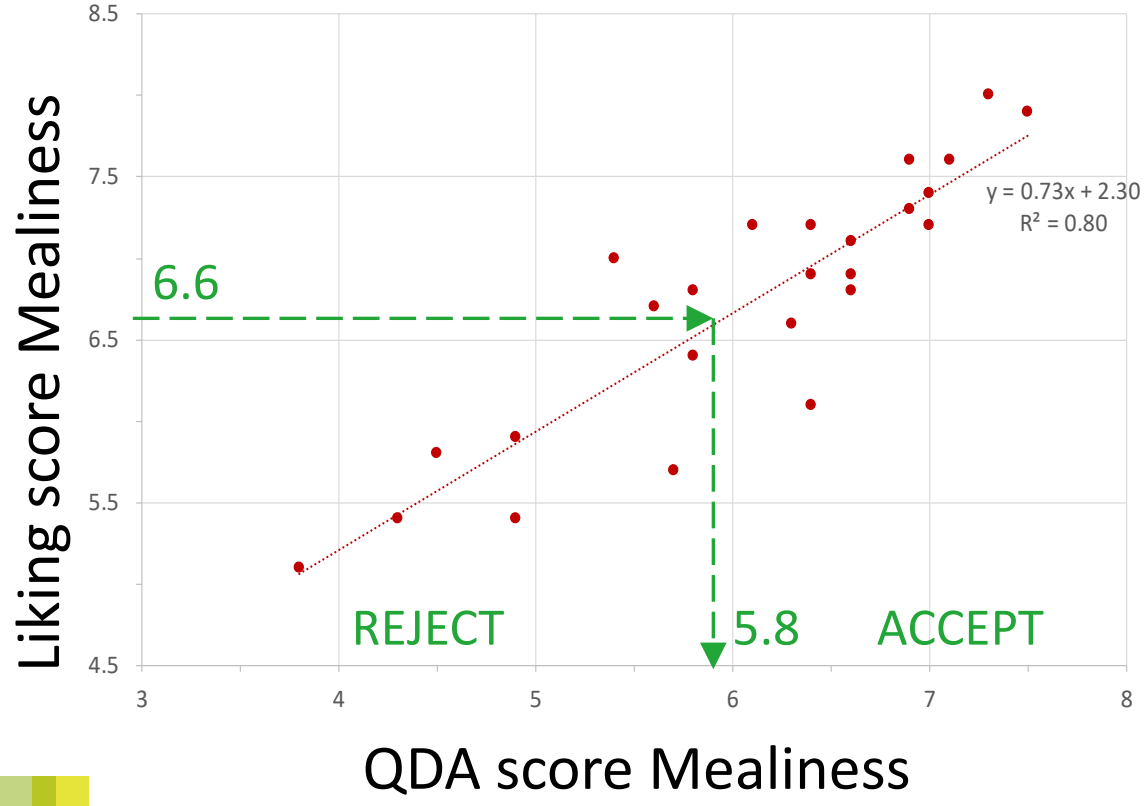
Texture extrusion

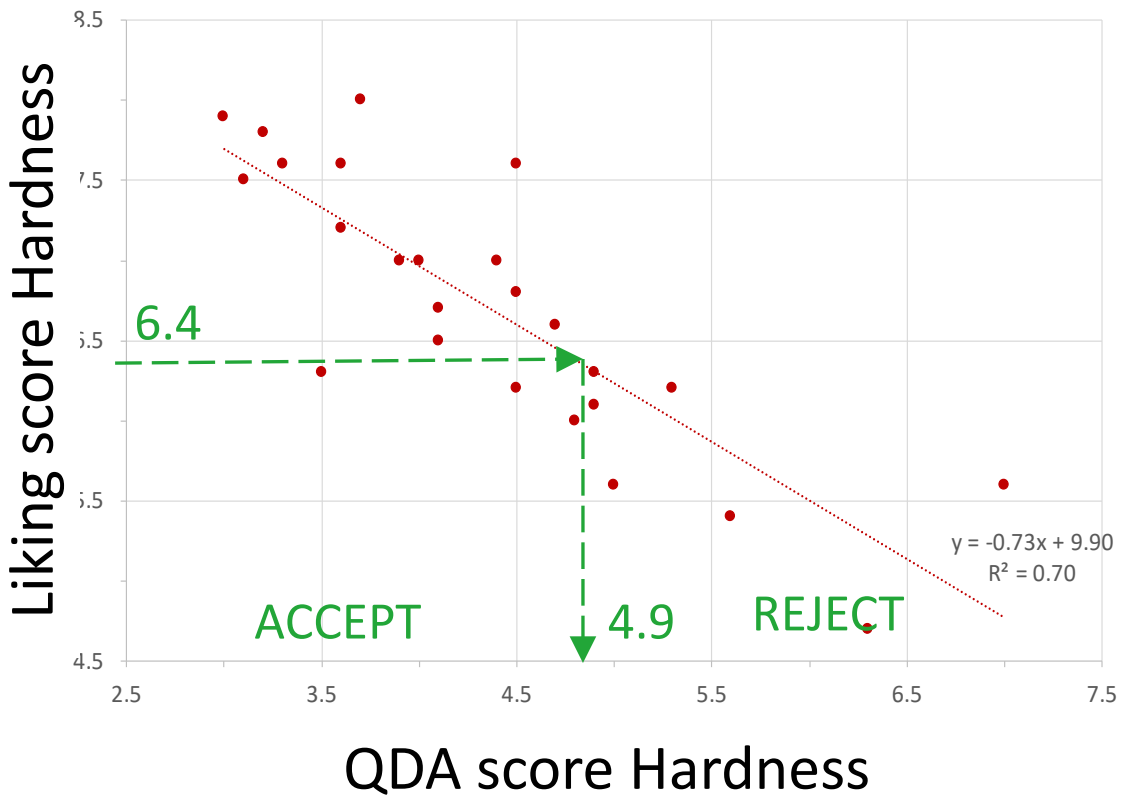




Determination of acceptability thresholds – Boiled cassava

1. Correlations between liking scores and sensory QDA

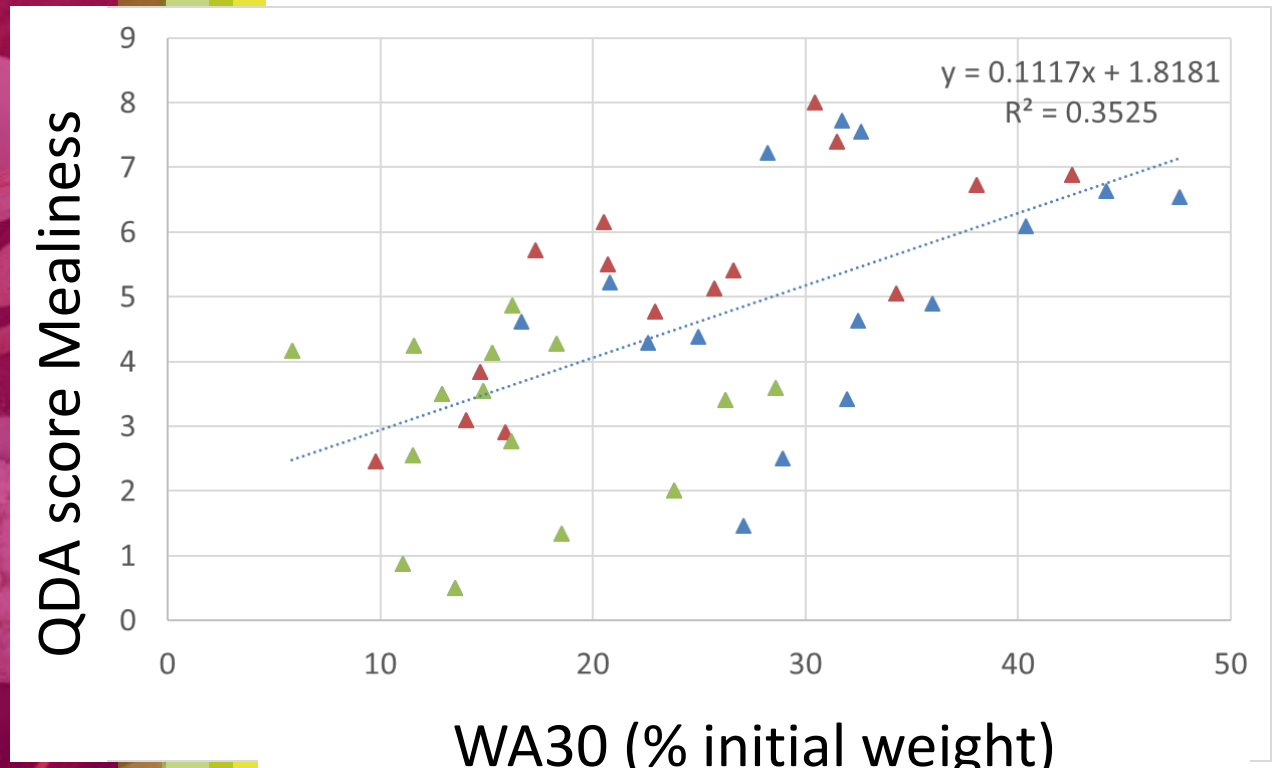


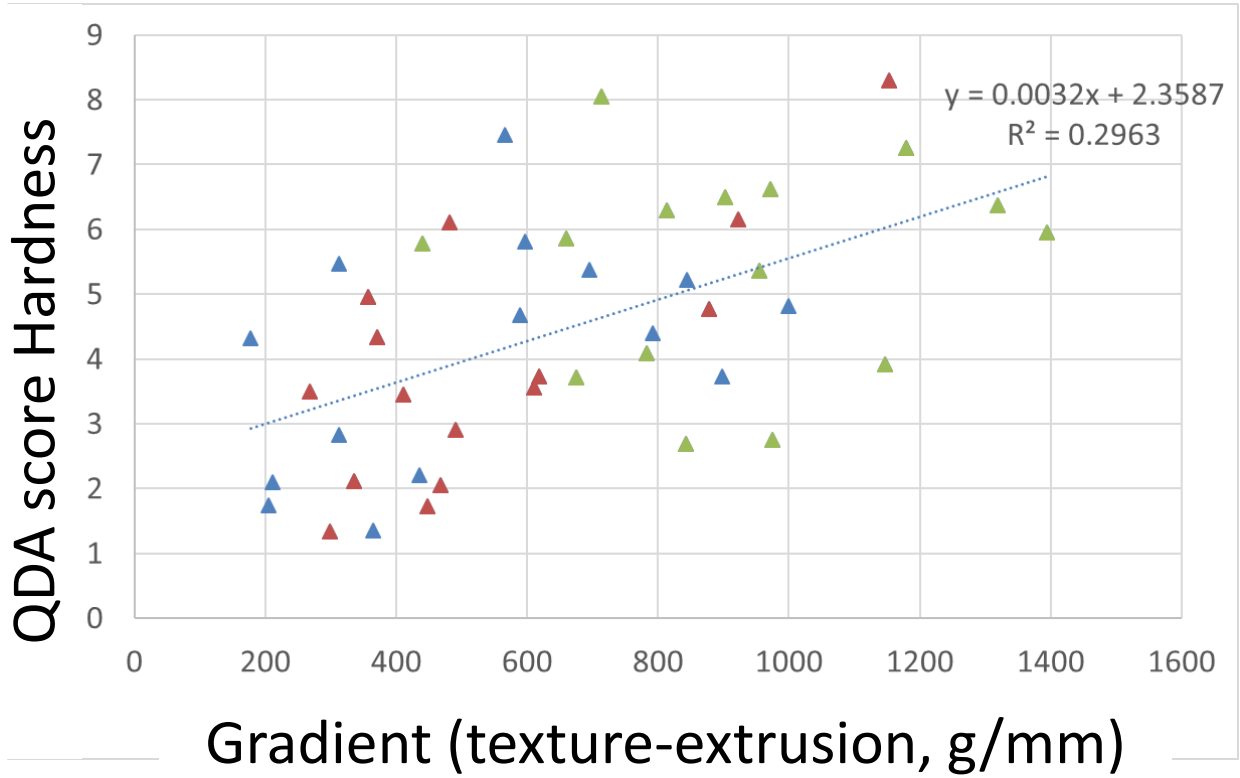


Threshold criteria: (Max. liking score – Min. liking score) / 2

Determination of acceptability thresholds – Boiled cassava

2. Correlations between sensory QDA and laboratory SOPs





Boiled cassava (CIAT). Blue, red, green markers indicate harvests at 9, 10, 12 MAP

Determination of acceptability thresholds – Boiled cassava

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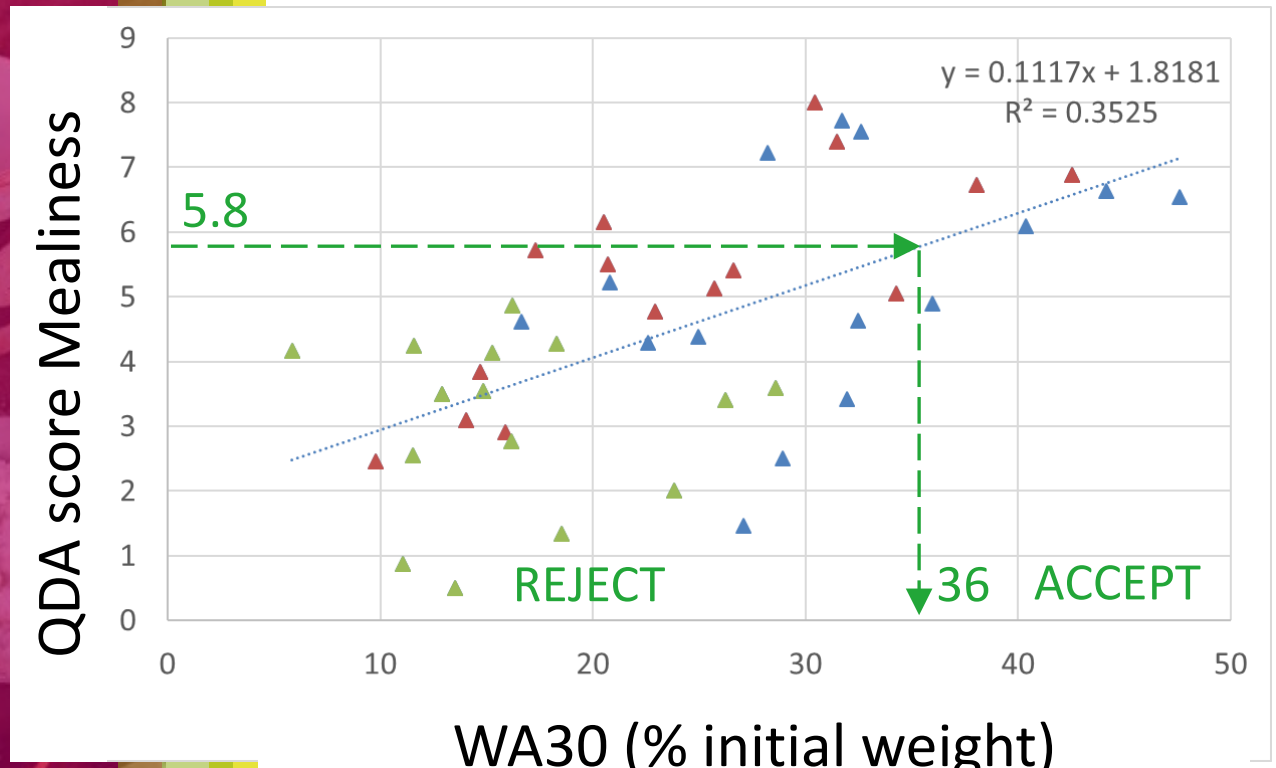

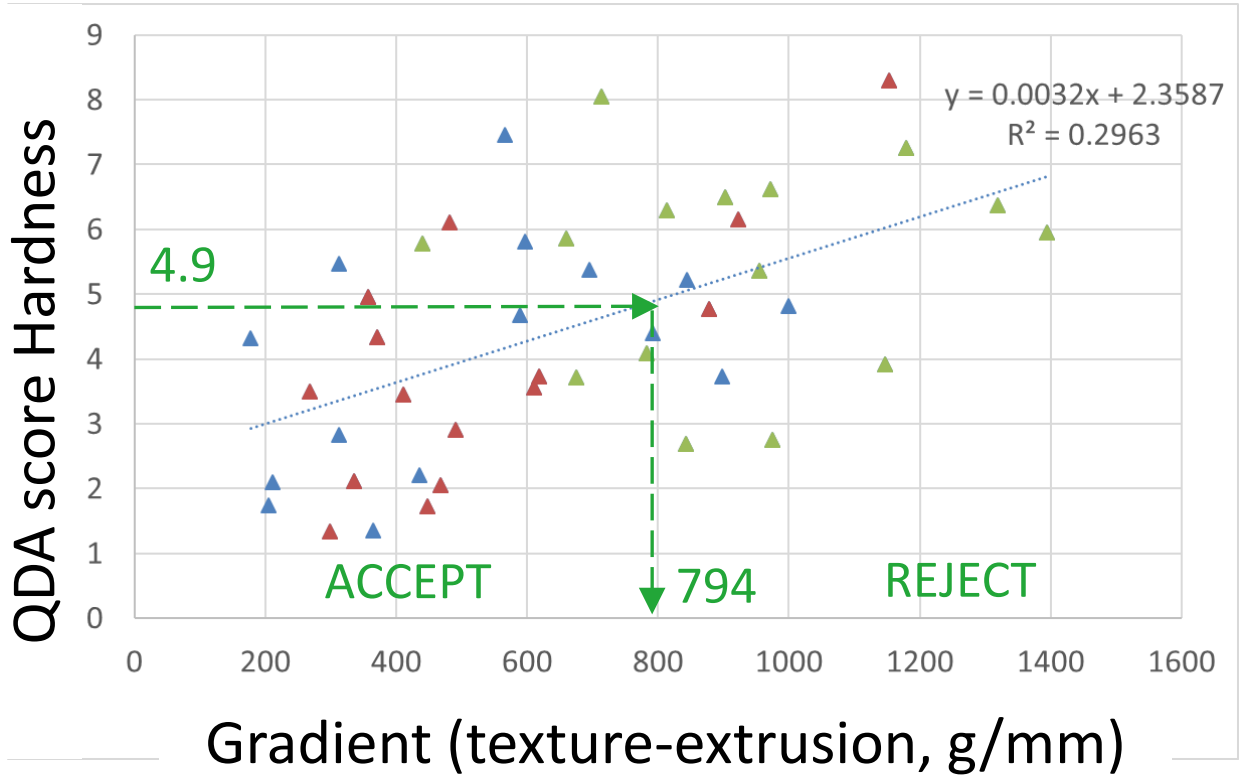

Need for flexibility: For WA30, threshold at 36% means rejecting 90% of candidate progeny → Use 12% instead

Determination of acceptability thresholds – Boiled cassava

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Definition of sensory and instrumental thresholds of acceptability for selection of cassava genotypes with improved boiling properties

Paula Iragaba, Laurent Adinsi, Luis Fernando Delgado, Ann Ritah Nanyonjo, Ephraim Nuwamanya, Enoch Wembabazi, Michael Kanaabi, Laurenda Honfozo, Francis Hotegni, Imayath Djibril-Moussa, Luis Fernando Londoño, Christophe Bugaud, Dominique Dufour, Robert Sezi Kawuki, Noël Akissoé, Thierry Tran ... See fewer authors

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Acceptability thresholds for Key Priority Quality traits of boiled cassava

Summary: Instrumental/sensory acceptability thresholds
(Lower value / targeted value / Upper value)

Trait	Sensory acceptability	Lower	Target	Upper
	(scale 0-9)		**WA30 (%)**	
Mealiness	5.8	10	> 12	-
			Gradient (g/mm)	
Hardness	4.9	n/d	< 800	n/d
			HCN (ppm)	
Sweetness/bitterness	n/d	0	< 60 - 80	100

High-throughput screening by NIRS

- Routine determination of dry matter by NIRS
- Classification of cooking quality (water absorption > 12%) with 81.4% accuracy
- 5 years data (2019-2023): 5815 spectra

C1: Genotypes predicted with WA ≤ 12%
C2: Genotypes predicted with WA > 12%

From / To	C1	C2	N	Rates	
C1	421	87	508	82.9%	specificity
C2	75	289	364	79.4%	sensitivity
			872	81.4%	Accuracy

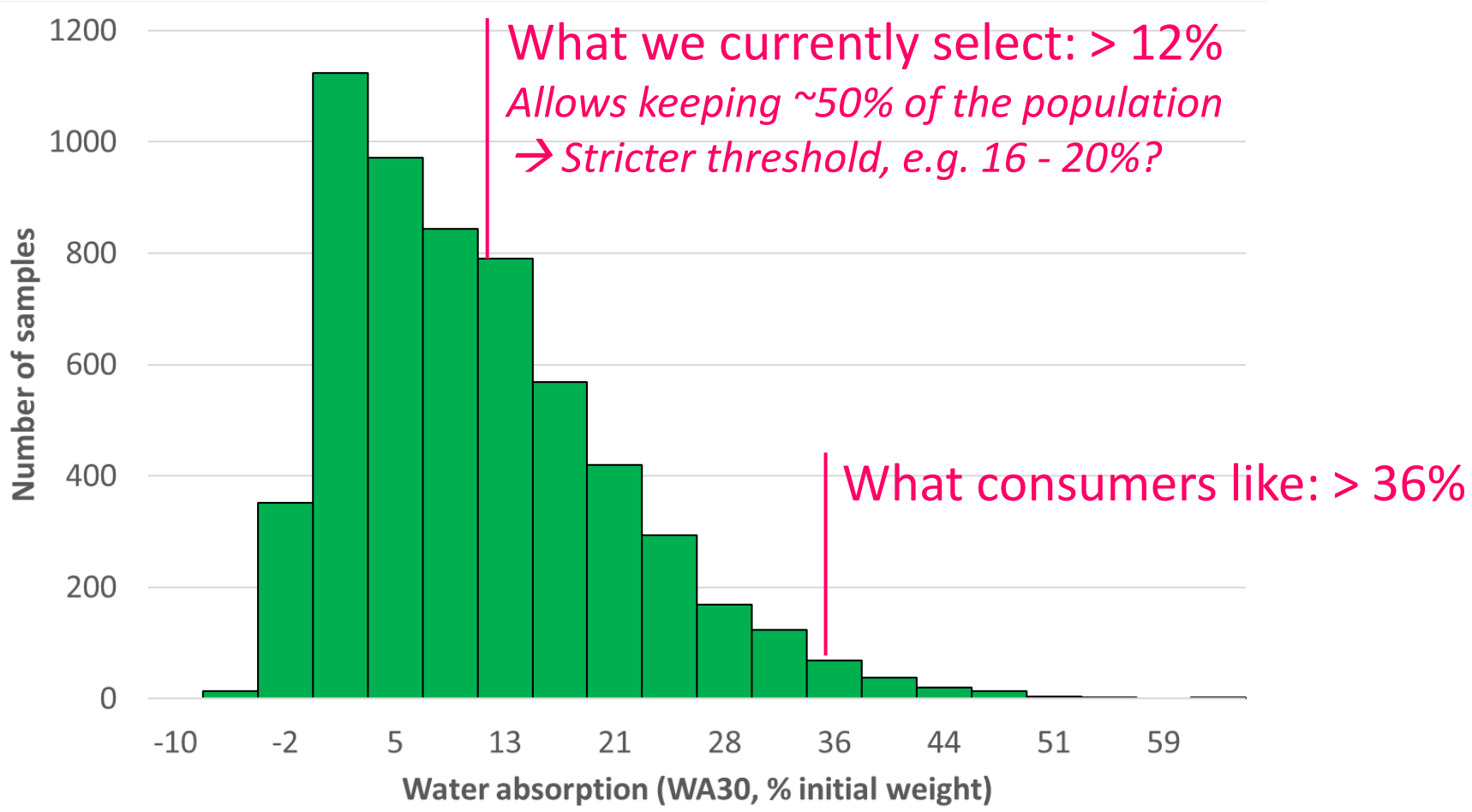
- NIRS can also predict HCN, amylose and starch
- Benchtop NIRS (FOSS DS2500) and portable NIRS (Quality Spec, SCIO)

Both NIRS and Water absorption are used routinely in breeding operations at both NaCRRI and CIAT

- DM, mealiness/cooking quality, HCN, Starch, Amylose, Beta-carotene
- High throughput NIRS makes possible early screening for cooking quality at F1C1 !

Screening of new genotypes for boiled cassava

Distribution of water absorption among 7585 cassava samples (2020 – 2024 harvests)



Screening of new genotypes for boiled cassava

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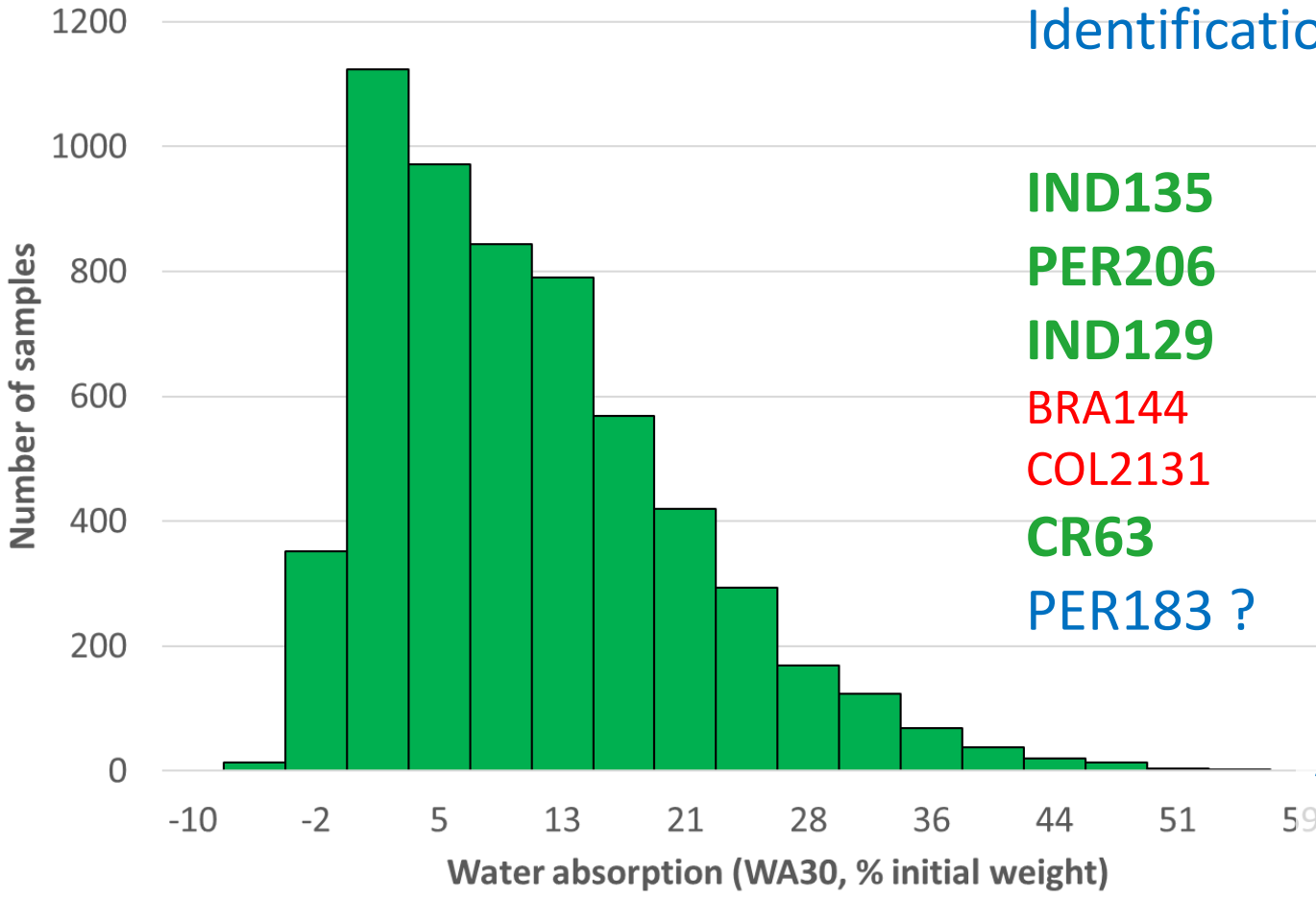

Identification of outstanding genotypes:

	WA30 (%)	Coef. var. (%)
IND135	**39.6**	**22.5**
PER206	**31.7**	**26.7**
IND129	**29.4**	**18.1**
BRA144	29.2	61.4 not stable
COL2131	28.8	42.7 not stable
CR63	**26.3**	**27.2**
PER183 ?	16.5	53.0

Also, many clones identified with high WA30, but still in the breeding cycles (not released & not landraces)

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Field & Breeding team

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NaCRRI Cassava Breeding

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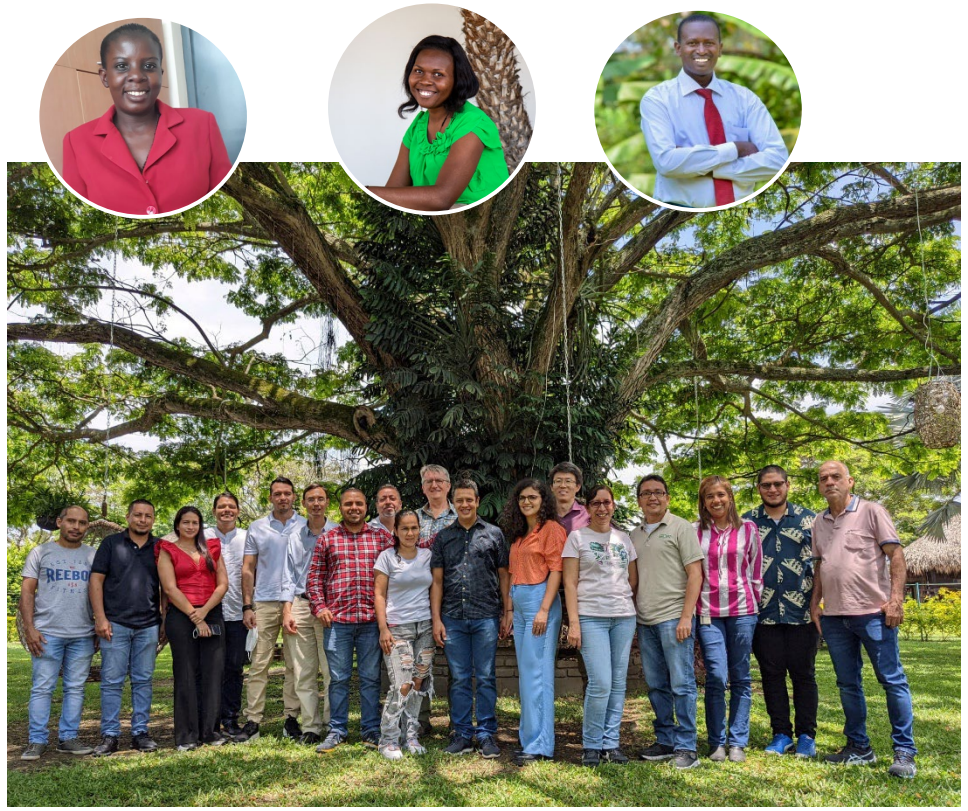

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