Improving cooking quality in Bambara groundnuts (*Vigna subterranea* (L.) Verdc)

Bambara Symposium

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UNIVERSITY OF KWAZULU-NATAL
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CTAFS
Centre for Transformative Agricultural and Food Systems

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Background

- Importance of cooking quality

1 Nutritional value

Cooking quality affects the nutritional content and digestibility of BGN, influencing its benefits for human health

2 Palatability

High cooking quality enhances the flavor and texture of Bambara groundnut, making it more appealing to consumers

3 Potential variants

Improving the cooking quality can unlock new culinary uses and innovative products from Bambara groundnut

Problem statement

- Long cooking time and high energy use limit BGNs' consumption in rural communities
- Seed hardness affects cooking quality, reducing nutritional value and increasing consumption cost
- Some cultivars cook faster than others—mechanisms behind variations not fully understood
- Despite the supporting evidence in the literature detailing the heritability of the cooking time in legumes, little effort has been made to use this information in the breeding of orphaned crop species, including the BGN.

Aim

To develop improved Bambara groundnut varieties with enhanced agronomic performance and shortened cooking time

Preliminary research

- Developed BGN breeding population from parental lines
- S19
- ANKPA 4
- IITA686
- Lun T

- Phenotyping for cooking quality
- Conventional finger pressing method (subjective!)

Results

Table 1: Descriptive statistics for the cooking quality traits of 156 BGN genotypes

Parameters	Minimum	Maximum	Mean	Std. deviation
Seed size	0.250	0.830	0.511	0.102
Seed volume	0.230	0.670	0.407	0.084
Density	0.010	1.850	1.257	0.169
Hydration capacity	0.010	0.420	0.100	0.086
Hydration index	0.020	0.890	0.210	0.194
Swelling capacity	0.020	0.470	0.104	0.087
Swelling index	0.030	1.600	0.281	0.263
Cooking time (min)	40.000	147.000	88.410	18.581
EC	4.460	9.870	7.424	1.126
pH	5.330	8.880	7.042	0.719
L*	13.920	58.450	29.534	13.244
a*	0.560	22.920	8.717	6.276
b*	-0.040	33.940	11.715	11.575
Texture	5.400	32.700	18.504	5.566

.L* - degree of lightness, a* - degree of red to green, b* - degree of blue-yellow

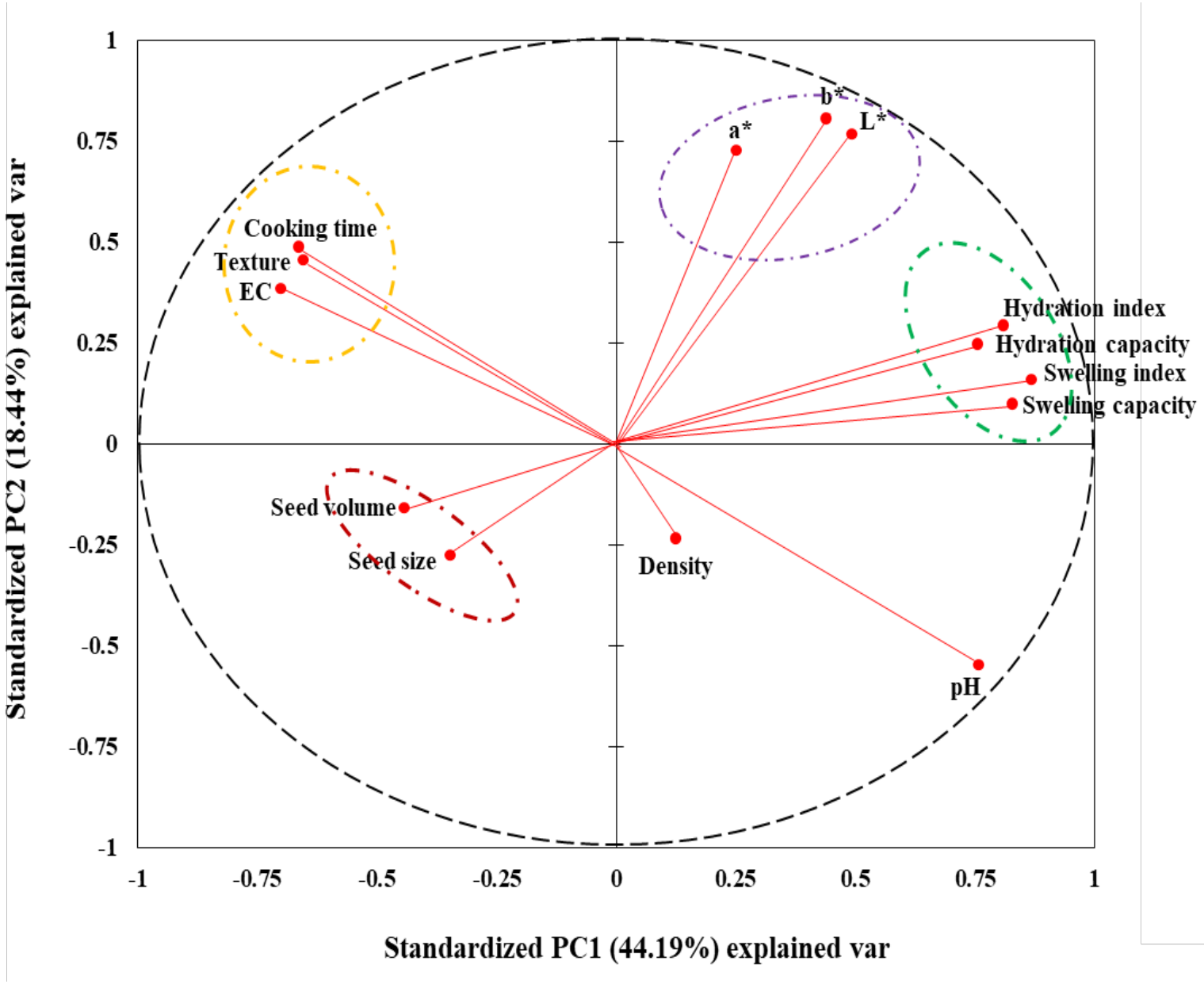


Figure 1: Principal component analysis for cooking quality traits in BGN

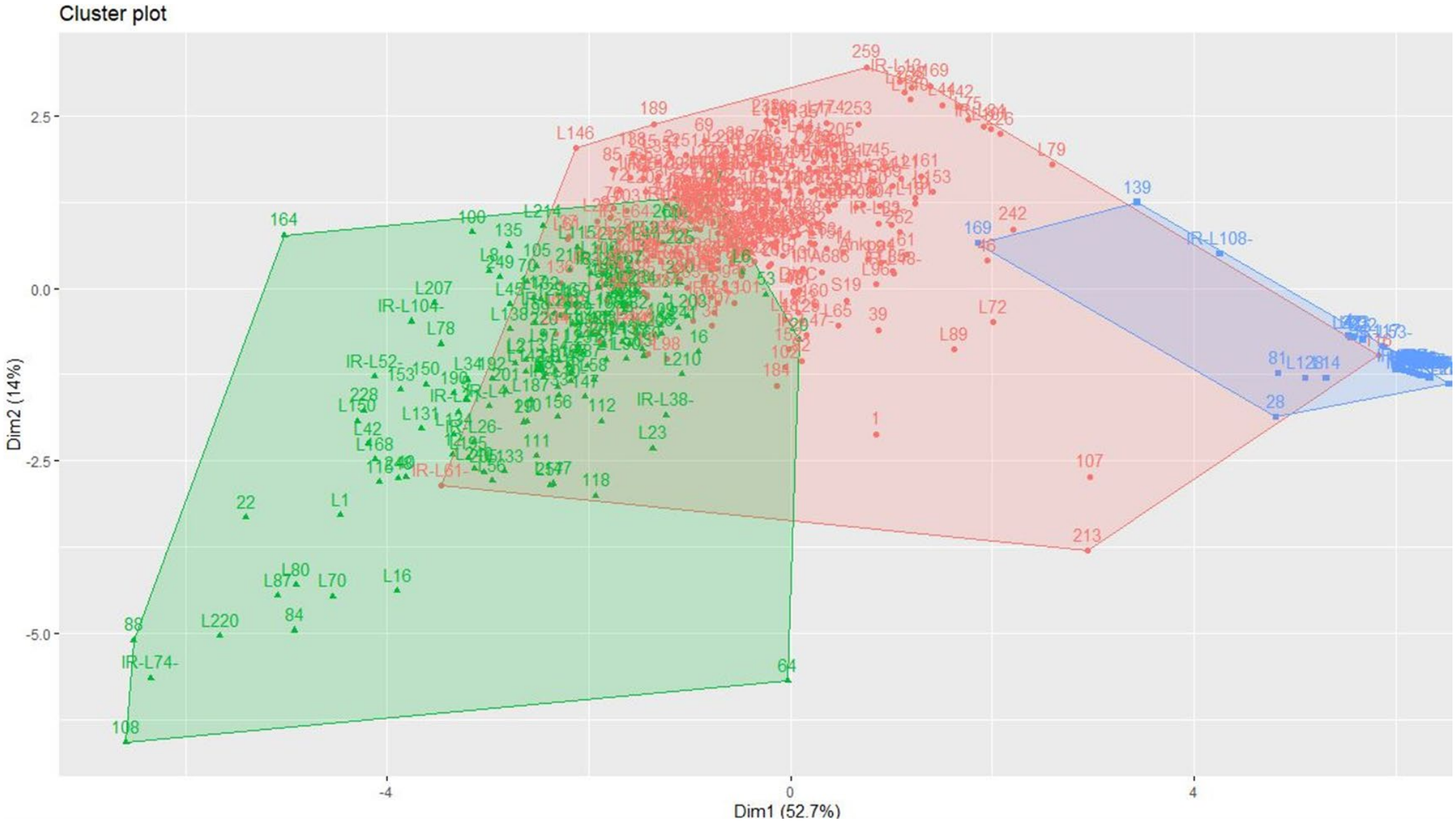


Figure 2: Phenotypic clustering of BGN germplasm

Present challenge (research gap)

- Convectional approach (finger pressing method)……not reliable for selection
- Environmental influence on quantitative traits obscure our selection decision

Proposed approach and methods

- Integrate molecular marker assisted selection

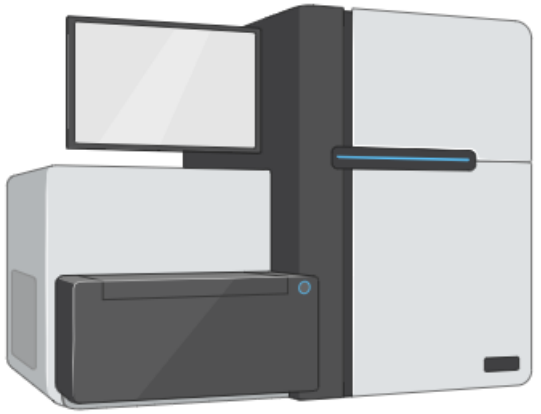
Accurate phenotypic data

Mattson bean cooker

- Accurate phenotype instead of finger pressing method

Reliable genomic data

Illumina HiSeq



- Whole genome sequencing

Proposed approach and methods

- Stomatal conductance
- Transpiration rate
- net CO_2 assimilation rate
- intrinsic water use efficiency
- instantaneous water-use efficiency
- maximum quantum efficiency of photosystem II photochemistry
- photochemical quenching
- Electron transport rate

Figure 3: Measuring gas exchange and chlorophyll fluorescence parameters using Licor (LI-6400 XT)

Data analysis

- Marker trait association mapping
- 1st analyse phenotypic data from cooking assay and agronomic evaluations
- 2nd population structure analysis
- Genome-wide association studies (GWAS)

Expected outcomes

1 Accurate phenotypes

Detailed observation, measurement, and classification of traits in a standardized manner to ensure consistency and reliability

2 Population structures

Identify distribution of genetic variation within and among populations of BGN

3 Gene(s) identification

Identification of significant major genes controlling cooking time in Bambara groundnuts

THANK YOU

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