

## Who ?

N. Terrier<sup>1</sup>, F. De Bellis<sup>1,2</sup>, A. Berger<sup>1,2</sup>, C. Calatayud<sup>1,2</sup>, M. Singer<sup>1,2</sup>, A. Soutiras<sup>1,2</sup>, J.F. Rami<sup>1,2</sup>, D. Pot<sup>1,2</sup>, H. Mameri<sup>3</sup>, M.H. Morel<sup>3</sup>, E. Recoules<sup>4</sup>, A. Tricot<sup>4</sup>, D. Gourichon<sup>5</sup>, Q. Devaud<sup>6</sup>, P. Jeanson<sup>6</sup>, J. Alcouffe<sup>7</sup>, P. Dufour<sup>7</sup>, S. Melkior<sup>7</sup>, E. Pampouille<sup>8</sup>, L. Bonnal<sup>9,10</sup>, D. Bastianelli<sup>9,10</sup>

- (1) UMR AGAP Institut, Univ Montpellier, CIRAD, INRAE, Institut Agro, F-34398 Montpellier, France
- (2) CIRAD, UMR AGAP Institut, F-34398 Montpellier, France
- (3) INRAE, UMR IATE, Université de Montpellier, INRAE, Institut Agro Montpellier, France
- (4) INRAE, Université de Tours, BOA, 37380 Nouzilly, France
- (5) UE PEAT, INRAE, UE PEAT Centre Val de Loire 37380 Nouzilly, France

- (6) Eurosorgho, Domaine de Sandreau, 31700 Mondonville, France
- (7) RAGT2n, Site de BOURRAN, 12033 Rodez, France
- (8) ITAVI, Institut Technique de l'Aviculture, 37380 Nouzilly, France
- (9) CIRAD, UMR SELMET, Montpellier, France
- (10) SELMET, Univ Montpellier, CIRAD, INRAE, Institut Agro, Montpellier, France



institut

Analyseur génétique et sélection des

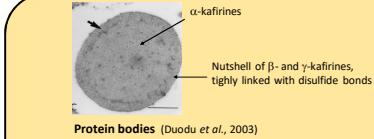
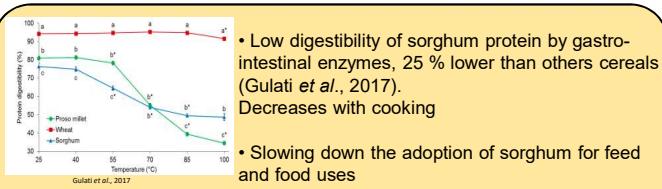
plantes méditerranéennes et tropicales



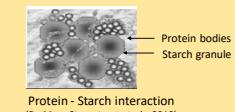
UE PEAT



## Context and objectives



- Low digestibility mainly linked to the Kafirin structure and properties (Kafirins represent 70 % of sorghum grain proteins).



- other component/properties of the seed:  
-starch, tannins  
-endosperm texture

Phenotypic characterization of those traits using high throughput tools

Development of breeding tools to optimize breeding efficiency

## Conduct of the project



## Screening of genotypes

- EU commercial varieties
- Parental lines of the partner breeding programs
- Worldwide panel

## Genotyping

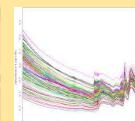


## Collecting seeds

-Low to middle throughput wet chemistry for protein, starch, tannins, protein digestibility (simple test with only one digestive enzyme) +texture

## Phenotypic characterization

-NIRS (Near Infrared Spectrometry)



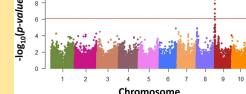
## Calibration

From Brodkorb *et al.*, 2019

## Breeding tools for grain quality traits

- identification of genomic regions

Mono- and multi-trait analysis



- Genomic prediction calibration

-Phenomic selection calibration using NIRS spectra (Rincinet *et al.*, 2018)

⇒Optimize breeding efficiency

Fine characterization of *in vivo* and *in vitro* digestibility

-on a small panel of varieties

-5 varieties selected (high and low digestibility, one with tannins)

-compared to maize/wheat feeding as control

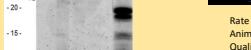
## ⇒Deciphering factors involved in protein digestibility

*In vivo* protein digestibility

6 groups of animals



Analysis of protein digestion in the digestive tract by SDS-PAGE electrophoresis

From Recoules *et al.*, 2017

Rate of growth, Animal welfare, Quality of the meat

From Recoules *et al.*, 2017

UMRBOA

Biotique des Oiseaux &amp; Aviculture

UE PEAT

ITAVI

L'INSTITUT TECHNIQUE DES PLUIRES ANIMAUX-CONDUITE ET PROSPECTIVE

*In vitro* protein digestibilityFrom Brodkorb *et al.*, 2019

Grain and flour characterization

Oral phase  $\alpha$ -amylase

Gastric Phase pepsin

Intestinal Phase pancreatin trypsin

Protein content, composition and size-distribution

RP-HPLC

Time (min)

Absorbance at 280 nm

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34

Time (min)

0.2 0.4 0.6 0.8

24 26 28 30 32 34