




Linking conservation to local use: Maize bread from LRs

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Conservation strategies for European crop wild relative and landrace diversity
7–9 September 2011 Hotel Palangos vetra, Palanga, Lithuania

From the kernel to the bread

1 - Diversity

2 – Yield components

3 - Quality

4 - Socio-economic aspects

1 - Diversity

Hallauer (1994) proposed distinct four stages for maize breeding

1) domestication process

2) development of more than 250 or less distinct races of corn by native American civilization till 16th century

Shamel, 1905; East (1908) and Shull (1908); Shull (1909, 1910) and Jones (1918)

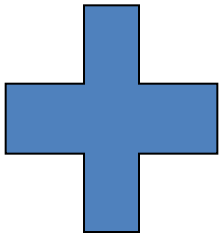
4) development of the concept of inbreds and hybrids (1909 till present).

Columbus (1492)

3) development of distinct varieties from original races by American and European colonists (1500 to 1925)

PPB

Stage three (more than 500 years relationship)







- "Portuguese Agricultural Revolution" in the XVII/XVIII Cent.
- Adaptation led to a bigger expansion of the crop lead to a different types of maize adapted to a diversified number of microclimates (Northwest and Algarve), according to the sequence of valleys and mountains.
- The population diet was improved directly with maize bread ("Broa"), and indirectly due to the increase of meat consumption




Adaptation do Portugal conditions *versus* adaptation to Portuguese farmers needs

American hibrids

Poor grain quality for human use as bread

Monocropping technology

No success

National breeding stations

Estação Agrária de Braga **(NUMI)**

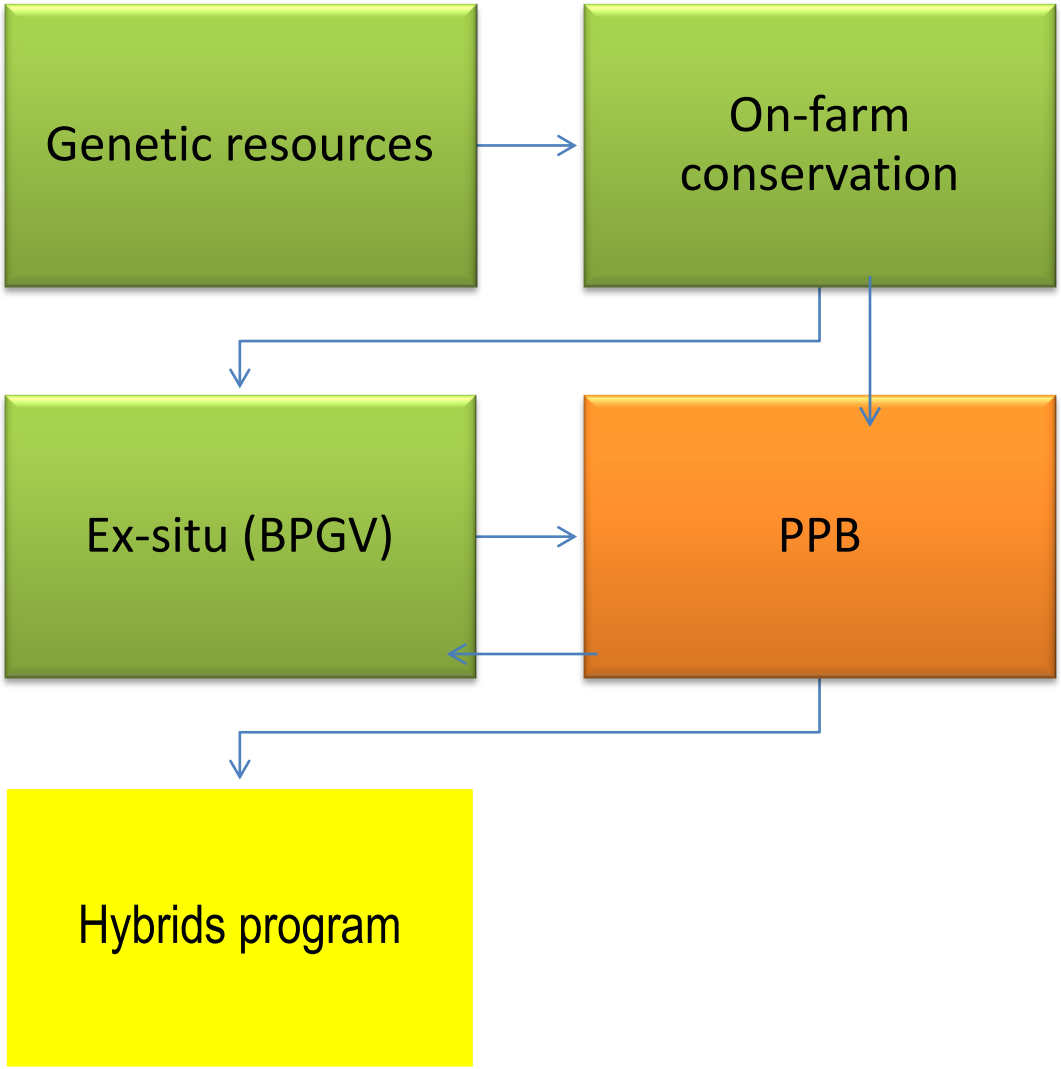
Portuguese hybrids

ADAPTATION TO FARMER's NEEDS

Grain quality for human use as bread

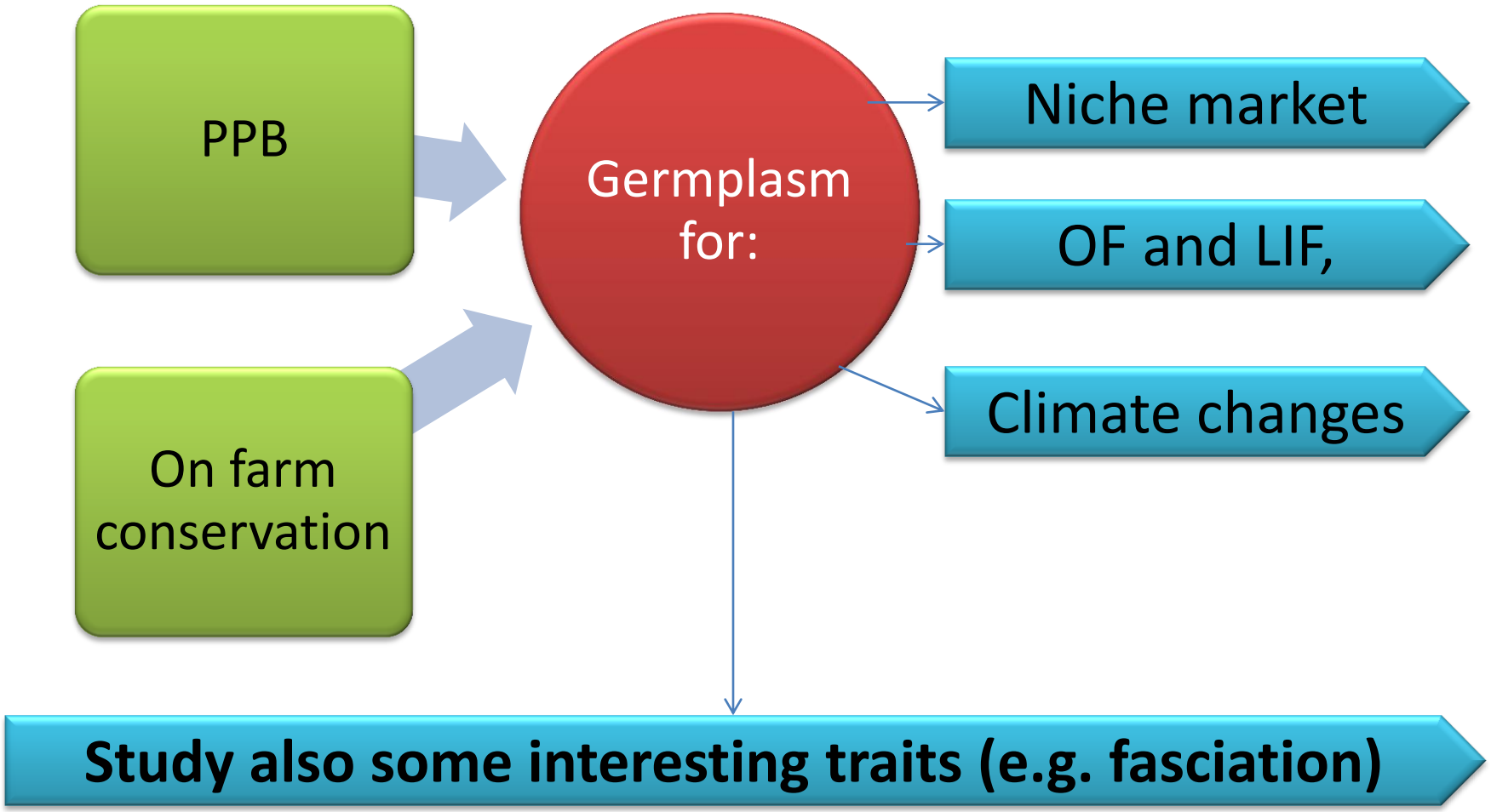
Early-maturing varieties adapted to highly intensified cropping systems

Success



Conservation needed for specificities of germplasm

New needs new chalenges, (re)newal uses



Participatory Maize Breeding
(Breeding on-farm)

PPB – VASO started in 1986

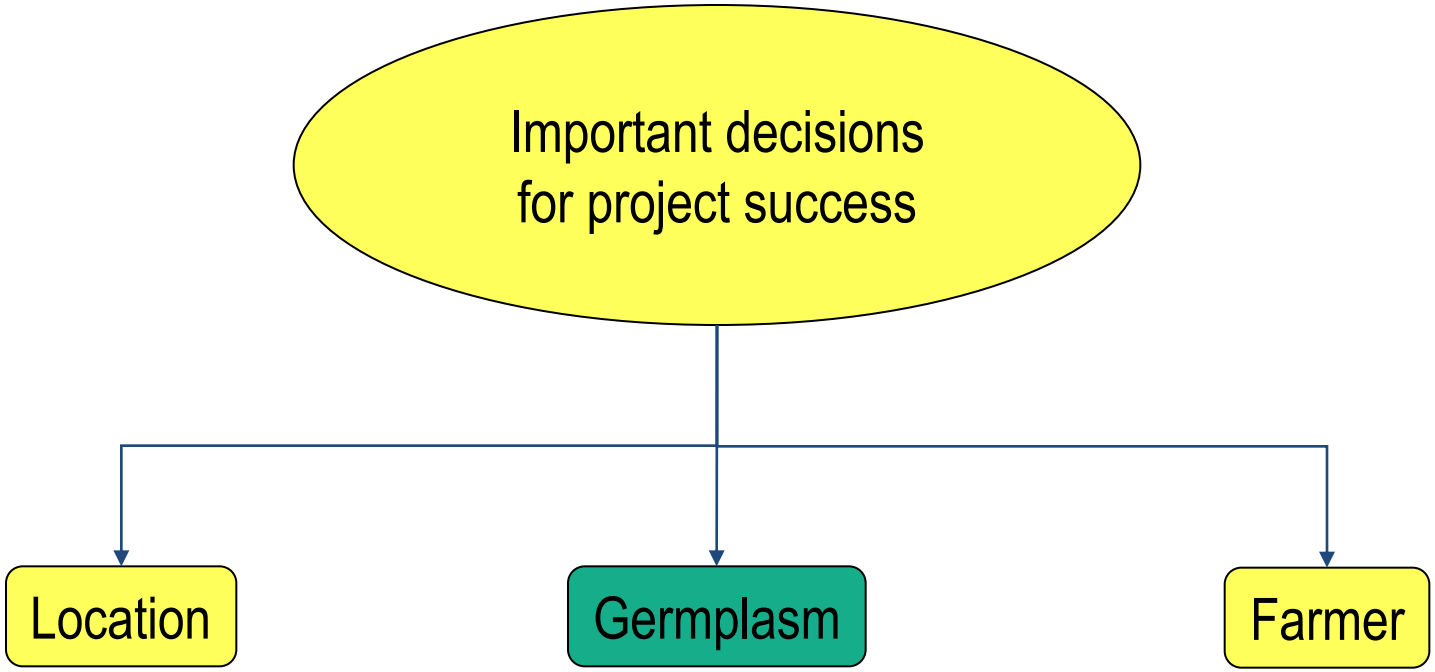
The main question

- “How to solve the problem of the small Portuguese farmers where the land is scarce and the high demographic density exists”

i.e.

- where the American model do not fit and where the multinationals do not have market to operate?

VASO Project



traditional maize area
Agro/sociologic/economics data availability
Support of a local elite farmers' association (CGAVS)
Test the efficiency of an alternative project supposed to improve the local germplasm in order to be competitive, at least in certain specific circumstances, side by side with the local hybrids production

1 -Local Germplasm (e.g. 'Pigarro', 'Amiúdo')

2 -Exotic germplasm 'FANDANGO'

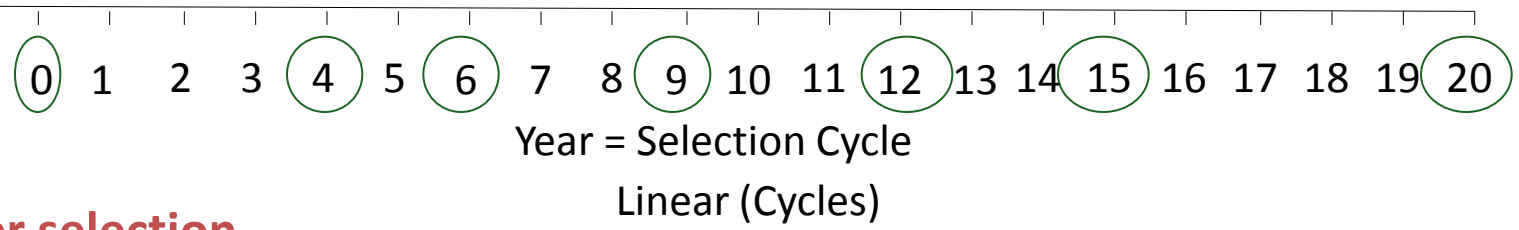
The right people to work with,
Work side by side with the farmer, to whom the decision power will be allowed

Their initial acceptance and enthusiasm


PIGARRO
Co-07
2007 10 11

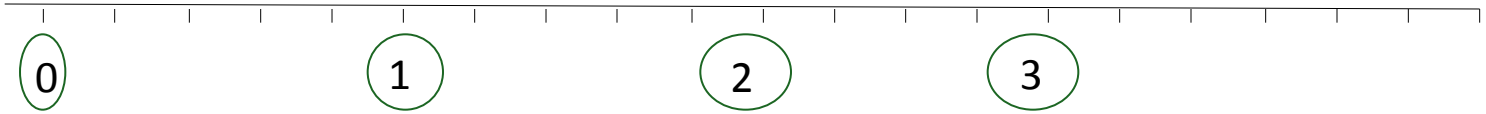
VASO Project (breeding methodologies)

Pigarro Mass Selection 1984-2009…



Farmer selection
(A-B-C selection process)

Pigarro Recurrent Selection (S2) 1984-1998



Breeder selection
S2 selection process)


Mr Meireles as winner of Sousa Valey Best Ear contest(14 years)
2005 10 4

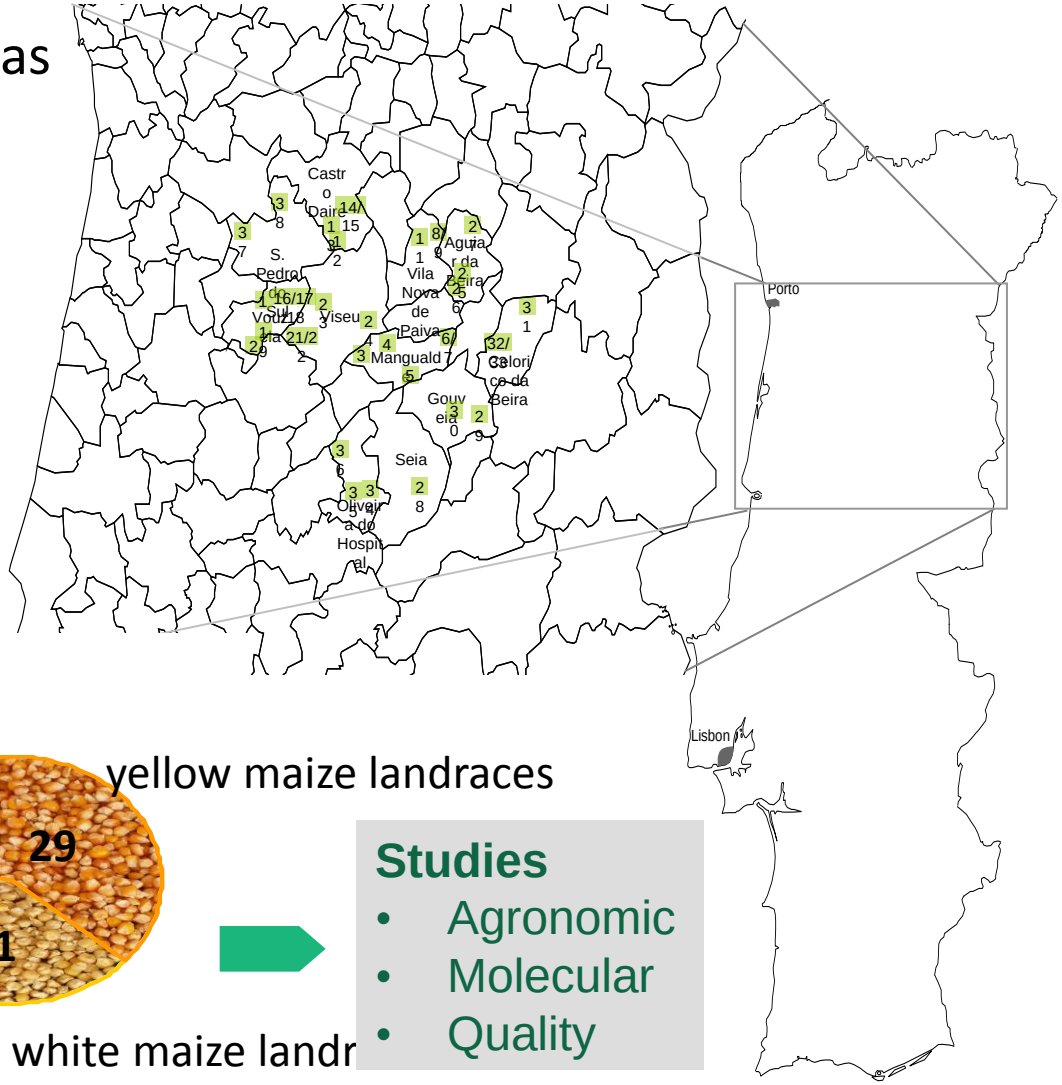
On farm conservation


Collecting missions in 2005
Helping to keep this long legacy…
Collecting the system with all their seed components

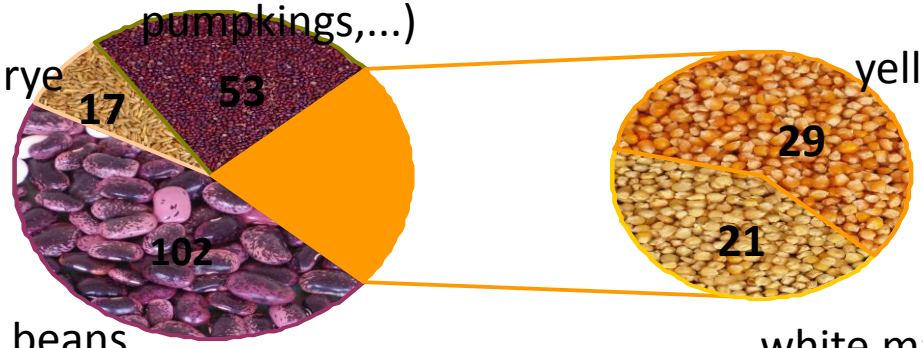
- Organization of collecting missions

Collecting missions in 2005

-Serra da Estrela, National Park was included



other crops (cabagges, pumpkings,...)



Studies

- Agronomic
- Molecular
- Quality

Number of landraces seed samples collected on the field expeditions

- Vaz Patto MC, Moreira PM, Carvalho V and Pego S 2007 Collecting maize (Zea mays convar. Mays) with potential technological ability for bread making in Portugal. Genetic Resources and Crop Evolution

Biodiversity conservation so as traditions and empirical knowledge, i.e., colective memory

2 – Yield components

Evaluation trials

Material and Methods

- Trials in 2007 and 2010
- 39 maize entries from PPB and on-farm, plus populatiom hybrids
- 9 locations in Portugal
- 3 Replications

- Plots
  - **9.6 m²** (2 rows x 7.00 m lenght x 0.75 m between rows);

Material and Methods Traits

Yield, mg ha-1

Moisture %

Days-to-silk, nº †

Days-to-silk, nº † end

Days-to-anthesis, nº †

Days-to-anthesis, nº † end

OI

H

U

N

T

E

S

R

Plant height, m (x10) ‡

Ear height, m (x10) ‡

Ear Lenght, cm

Ear Diameter 1, cm (x10) ‡

Ear Diameter 3, cm (x10) ‡

Ear Diameter 2, cm (x10) ‡

Ear Diameter 4, cm (x10) ‡

Kernel-row number 1, nº

Kernel-row number 2, nº

Fasciation

D/I %de Ind

Convulsion

F/D

Ear weight, g

Kernel weight, g

Cob weight, g (x10) ‡

CW/EW

Ear%Moisture

Kernel dept, cm (x10) ‡

Kernel number, nº

Thousand kernel weight, g

Kernel per row, nº

Cob diameter 1, cm (x10) ‡

Cob diameter 3, cm (x10) ‡

Cob diameter 2, cm (x10) ‡

Cob diameter 4, cm (x10) ‡

Medula 1, cm (x10) ‡

Medula 2, cm (x10) ‡

Raquis 1, cm (x10) ‡

Raquis 2, cm (x10) ‡

Data treatment

- ANOVA and Multivariate Adaptive Regression Splines (MARS)

Results

- Yield range from 3.7 to 6.3 Mg/ha

Some population hibrid with - Pop Hib 1 – 7.1 Mg/ha

DATA treatment is on going

3 – Quality

End-use quality

- Viscosity profiles
- Rheological properties
- Breadmaking ability

Viscosity profiles: -Rapid Visco Analyzer (RVA)

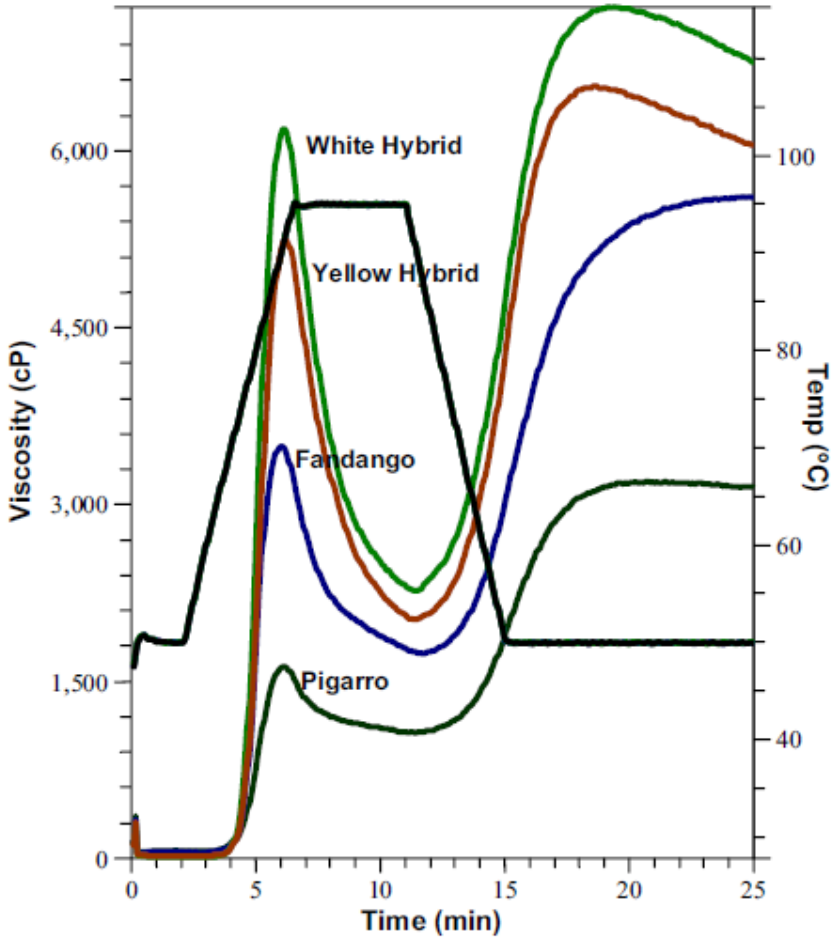


Fig. 1 Viscosities prof of maize flours obtained from electric mill determined by RVA (Rapid Visco Analyser)

- **Viscosity profiles** (maximum, minimum and final viscosity (cP units)
- Viscosities profiles express gelatinization and retrogradation phenomenon of starch that occur during heating/cooling and agitation of flour and water suspension
- (Brites *et al.* 2010)

Portuguese OPV

- Portuguese OPV exhibited significant higher protein,lower amylose contents and lower viscosity profiles than commercial hybrids varieties
  - Categorization on three distinct clusters:

A	• High oil and amylose content/low viscosity profiles
B	• High protein content, high viscosity profiles/low oil and amylose content
C	• Low protein content

Vaz Patto *et al.* (2009)

Breadmaking ability

Carla Brites

- Volume (cm3), Weight (g), Specific volume (polyethylene spheres displacement method)
- Crumb firmness, compression test (Texture analyser TA Hdi)

Greater dietary fiber and resistant starch, lower volume and denser loaf matrix in maize than in wheat bread (Brites et al., 2010)

- Sensory analysis

- ***Viscosity***

  (Vmax.>2000 cP)
- Collor (b>30)
- Protein > 12,5%

4 - Socio-economic aspects

Farmers participation

Using

- Agronomic field data
- VASO experience
- Engage more farmers
  - Some of them where contacted by us, based on the colection mission
  - Others contact us, because they where interested in maize for OF and also to use these landraces for maize bread

Meetings, at 16th April (in Social Farm Institution – APCC)


F03974 94
11 Broa 92
65
19 Broa
Broa 102
Broa 164
CMSPH3
5xPig
arro 08
VA 2005
ro C0(C3) 08
41 B
34

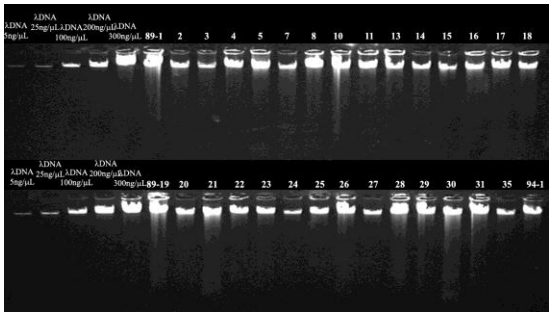
Socio economic aspects

Reasons for variety choice

Traits	Tomato	Cabbage	Broccoli	Beans	Faba beans	Maize	Total
Organoleptic features	23	7	5	10	5	3	53
Cooking and processing qualities	8	8	0	7	2	9	34
Yield	2	4	0	9	10	9	34
Rusticity	3	5	4	7	4	5	28
Plant morphology and crop architecture	0	1	5	11	1	5	23
Speed and length of crop maturation	4	2	5	2	5	0	18
Caliber	5	2	5	3	3	0	18
Suitability as livestock feed	0	4	0	0	0	5	9
Resistence to diseases and pests	3	2	1	1	0	0	7
Appearence	3	1	0	1	0	0	5
Storability	3	1	1	0	0	0	5
Others	4	2	1	3	2	1	13
Total respondents	25	21	18	23	18	18	28

Solibam

Dinis et al, 2011

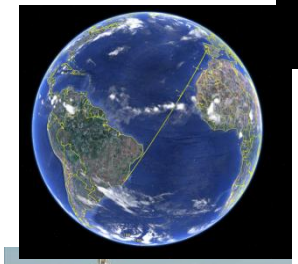


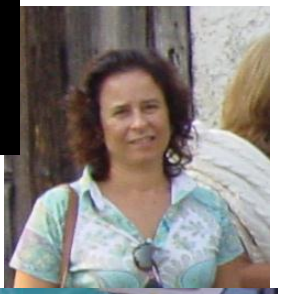
Pre-breeding, breeding, PPB

Pedro Mendes Moreira
ESAC

Molecular
Carlota Vaz Patto
ITQB

FCT (PTDC/AGR-ALI/099285/2008)
«Exploiting antioxidants, flavours and aromas diversity on 'broa' bread maize breeding »





Solibam

Winter nursery
João Cândido Souza
UFLA

Food quality
Carla Brites
EAN

http://www.solibam.eu

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Strategies for Organic and Low-input Integrated Breeding and Management

A new collaborative project on organic and low input breeding and management!!

SOLIBAM will develop specific and novel breeding approaches integrated with management practices to improve the performance, quality, sustainability and stability of crops adapted to organic and low-input systems, in their diversity in Europe and taking into account small-scale farms in Africa.

SOLIBAM will:

1. Identify traits specific for adaptation to low-input/organic conditions over a wide range of agro-climatic conditions in Europe
2. Develop efficient phenotyping, genotyping and molecular tools to monitor heritable variation during selection. Molecular analysis of functional polymorphisms will increase accuracy in breeding methodologies and

Welcome to Solibam website

About Solibam

SOLIBAM

Project full title

Strategies for Organic and Low-input Integrated Breeding and Management

Collaborative Project (large-scale integrating project)

FP7 2010 - 2015

Conclusions

See Valeria Negri, presentation

- **They are (Negri, 2011):**
  - widely used in breeding (e.g. pest and disease, **quality traits**)
  - used in developing typical and atypical (niche) products
  - useful in developing new farming systems

    (**e.g. environmentally friendly, organic, polycrop systems**)
  - promote landscape conservation
  - and maintaining local traditions

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