LiveSeeding

Training in organic breeding

Module 3: Breeding methods fundamentals

Unit 3.4: Fundamentals in Participatory Plant Breeding

Authors: Pedro Mendes Moreira (PUC-ESAC, PT), Véronique Chable (INRAe)

Co-funded by the European Union

Funded by the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI).

UK Research and Innovation

Module 3 – Breeding methods fundamentals

February 13th 2025 - 9:00 to 18:00 CET

Unit 3.1: Generation of new diversity

- 9:00-10:30 - UPV (Adrián Rodríguez-Burruezo, Neus Ortega Albero)
- 10:30-11:00 Break

Unit 3.2: Common methods and strategies in organic breeding

- 11:00-13:00 - IPC (Pedro Mendes Moreira) + UPV (Adrian Rodríguez-Burruezo) + KIS (Barbara Pipan)
- 13:00-14:30 Lunch Break

Unit 3.3: Calculation and evaluation of key breeding parameters

- 14:30-16:00 - UPV (Adrian Rodríguez-Burruezo) + KIS (Barbara Pipan)
- 16:00-16:30 Break

Unit 3.4: Fundamentals in Participatory Plant Breeding

- 16:30-18:00 - IPC (Pedro Mendes Moreira) + INRAe (Véronique Chable)

T1.4 Training in Organic Breeding

Module 3: Breeding Methods Fundamentals

Unit 3.4 – Fundamentals in Participatory Plant Breeding

Véronique Chable* and Pedro Mendes Moreira**

*INRAE, Rennes, France

** Politecnich University of Coimbra, PT

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Module 3 – Unit 4 Fundamentals in PBB

Planned for today

DYNAMIC MIXTURE OF:

1. *Presentation about main topics on PBB: (from 4) introduction in PPB, (from10) the context of PBB for organic seed, (from 25) place of PBB in the seed history, (from 34) PPB for maize in Portugal (60 min)*
2. Fast quiz (about 10 min) *** slide 72
3. Debate, Wrap up & Proposed homework (about 10-15 min) *** slide 73, 74
4. QUESTIONS: THROUGH THE CHAT (Petra Jelincic will manage)

*** = IMPORTANT for CERTIFICATES (ALL THE UNITS!!!!)

SEND TO BOTH: adrodbur@doctor.upv.es petra.jelincic@ips-konzalting.hr

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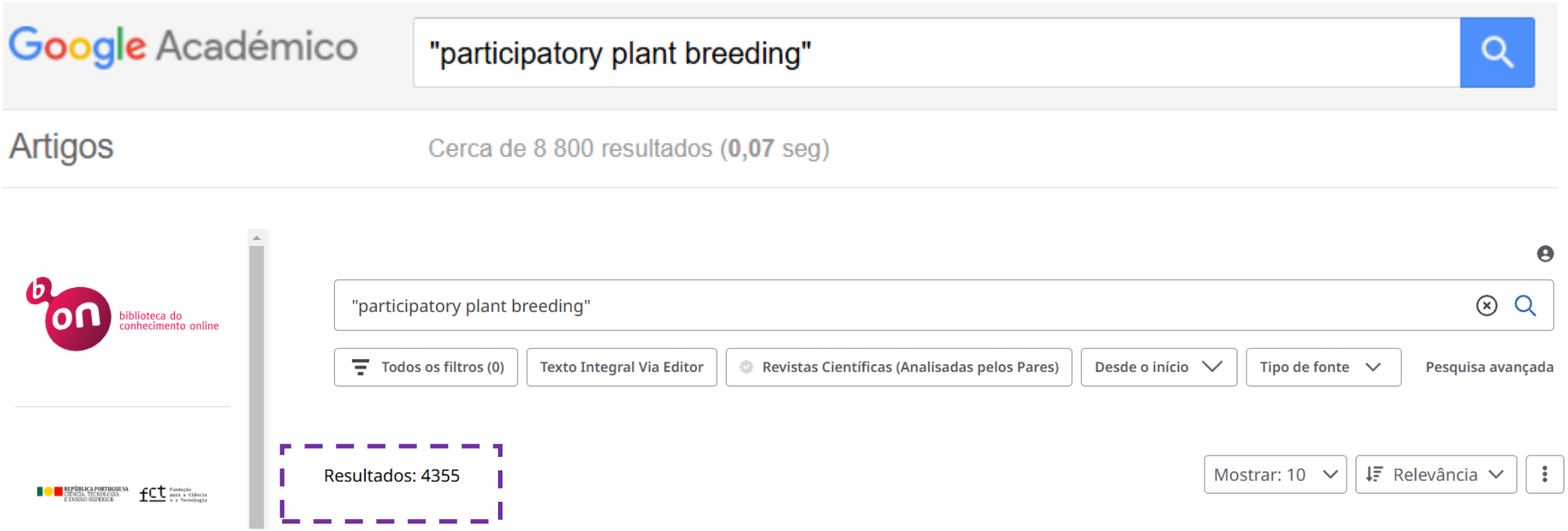
Making a flashback into PPB!



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Making a flashback into PPB!

Ceccarelli and Grando, 2019

- 254 publications
- period of 36 years participatory approaches in plant breeding
- 69 countries (10 developed and 59 developing)
- 47 crops including self-pollinated, cross-pollinated, and vegetatively propagated crops, by several Institutions including CGIAR centers, universities, and NGOs.

Participatory plant breeding: Who did it, who does it and where?

Published online by Cambridge University Press: **30 April 2019**

Salvatore Ceccarelli and Stefania Grando Show author details

Article Supplementary materials Metrics

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Global North, PPB

PPB increasingly utilized as an approach to address cropping system needs.

> 3 years duration projects, because Plant Breeding takes time

47 projects across the United States, Canada and Europe

22 crop species representing diverse crop biology.

Improved adaptation to organic farming systems and addressing principles and values of organic agriculture

Crop common name and species	Mating system/Life cycle[a]	Country	Institution(s)	Year initiated	Actors[b]	Drivers[c]
Apple and Pear (*Malus pumila, Pyrus communis*)	OB, P	DE	University Agroscope Changins-Wädenswil; University of Oldenburg, Saat:gut	–	FN, PR	OA, AB
Barley (*Hordeum vulgare*)	IB, A	IT	Rete Semi Rurali	–	F, FN, NR	OA, RA, UC, AB
	IB, A	IT	Italian Association for Organic Agriculture	2013	F, FN, NR	OA, RA, UC, AB
Beet root (*Beta vulgaris*)	OB, B	US	University of Wisconsin-Madison	–	F, PR, Cu, EU	CQ
Broccoli (*Brassica oleracea*)	OB, A	US	Oregon State University	2008	F, PR	OA, RA, BM, SS
Broccoli, Purple Sprouting (*B. oleracea*)	OB, A OB, A	US FR	Organic Seed Alliance French National Research Institute INRAE	2009 2011	F, NR F, PR, FN	OA, RA OA, RA
Buckwheat (*Fagopyrum esculentum*)	OB, A	FR	French National Research Institute INRAE	2018	F, PR, Cu, Ps	RA, AB, CQ
Cabbage (*B. oleracea*)	OB, B	FR	French National Research Institute INRAE	2001	F, FN, PR, SN	BM, RA, SS, AB
	OB, B	US	Organic Seed Alliance	2014	F, NR	BM, RA, SS
Cauliflower (*B. oleracea*)	OB, B	FR	French National Research Institute INRAE	2001	F, FN, PR, SN	RA, BM, SS, AB
Clover, Yellow Sweet (*Melilotus officianalis*)	OB, A	US	United States Department of Agriculture/ Agricultural Research Service USDA/ARS	2017	FN, PR, NR	OA, RA, UC
Einkorn (*Triticum monococcum* sp.)	IB, A	IT	Rete Semi Rurali	–	F, NR, Cu, Ps	OA, RA, SS, CQ
	IB, A	FR	French National Research Institute INRAE	2014	F, FN, PR, Ps	OA, RA, SS
Maize (*Zea mays*)	OB, A	PT	Polytechnical Institute of Coimbra IPC, University of Lisbon ITQB NOVA	1984	F, PR, Cu	AB, CQ, SS
	OB, A	US	University of Wisconsin-Madison	2012	F, PR, NR	OA, RA, CQ
	OB, A	FR	Organic Food and Farming Institute ITAB	2017	F, FN, PR	RA, AB
Oat (*Avena sativa*)	IB, A	CA	University of Manitoba	2011	F, PR, NR,	OA, RA, UC
Onion (*Allium cepa*)	OB, B	IT	Italian Research Institute CREA	2012	F, PR	OA, RA
Peas (*Pisum sativum*)	IB, A	IT	Italian Research Institute CREA	2013	F, PR	OA, RA
	IB, A	US	United States Department of Agriculture/ Agricultural Research Service USDA-ARS	2016	F, FN, PR, NR	OA, RA, UC
Pepper (*Capsicum annuum*)	OB, A	US/CA	Cornell University/SeedChange	2016	F, PR	OA, RA, SS
Potato (*Solanum tuberosum*)	V	CA	University of Manitoba	2013	F, PR	OA, RA, UC
	V	NL	Wageningen University, Louis Bolk Institute	2009	F, PR, NR, SC	OA
	V	US	University of Wisconsin-Madison	2014	F, PR	OA
	V	DE	State Research Institute of Bavaria	2012	F, PR	OA
Quinoa (*Chenopodium quinoa*)	OB, A	US	Washington State University	2014	F, PR	OA, RA, SS, DM, UC
	OB, A	US	Organic Seed Alliance	2014	F, NR	OA, RA, SS, DM, UC
Spinach (*Spinacea oleracea*)	OB, A	US	Organic Seed Alliance	2003	F, NR	OA, RA, SS
Sweet potato (*Ipomoea batatas*)	V	US	North Carolina State University	1997	F, PR	RA
Tomato (*Solanum lycopersicum*)	IB, A	IT	Italian Research Institute CREA	2012	F, PR	OA, RA
	IB, A	ES	Miquel Agustí Foundation/Polytechnic University of Catalonia	2011	F, PR	AB, RA, DM, CQ
	IB, A	IT	Rete Semi Rurali	2018	F, NR, SC	OA, RA
	IB, A	IT	Italian Research Institute CRA	2017	F, PR, SC	OA, RA
Wheat (*Triticum aestivum*)	IB, A	IT	Rete Semi Rurali	2006	F, NR, CU, PS	OA, SS, CQ, AB
	IB, A	US	University of Nebraska Lincoln, Northern Plains Sustainable Agriculture Society Famer Breeder Club	1999	FN, PR	OA, RA, BM, SS, CQ, AB
	IB, A	UK	Organic Research Centre	2005	F, NR	OA, RA, AB
	IB, A	US	Washington State University	2002	F, PR	OA, RA
	IB, A	US	University of Vermont, University of New England, Cornell University	2008	F, FN, PR, CU, PS	OA, RA, DM, CQ
	IB, A	CA	University of Manitoba	2011	F, PR, NR	OA, RA, SS, AB
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Colley et al, 2021

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Global North, PPB

Evidence that PPB has expanded crop diversity and farmer's access to improved varieties

Obstacles to PPB challenges in sustained funding as well as addressing regulatory barriers to the commercial distribution of PPB varieties.

Agronomic improvements were only one lens motivating PPB, with many projects identifying goals of conservation of crop genetic diversity, farmers' seed sovereignty and avoidance of certain breeding techniques.

Case studies included maize (*Zea mays*), tomato (*Solanum lycopersicum*), Brassica crops (*Brassica oleracea*), wheat (*Triticum aestivum*) and potato (*Solanum tuberosum*).

Colley et al, 2021

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What is Participatory plant breeding for organic agriculture?

All actors committed in the value chain and working together to from seed to plate to create locally (mainly on-farm) diversified, adapted and evolutionary cultivars to increase resilience of the organic agrofood systems

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Why PPB for Organic agriculture?

The origin of the question appeared 25 years ago:

1. A European regulation for organic farming, including seed issues
2. Evolution of breeding methods, more and more incompatible with organic principles
3. Empowerment of farmers and collective organisations

About seed and organic pioneers

An Agricultural Testament *by* Sir Albert Howard, 1943

Oxford University Press New York and London

"… It was observed in the course of these studies that the **maintenance of soil fertility is the real basis of health and of resistance to disease**.

The various parasites were found to be only secondary matters: their activities resulted from the **breakdown of a complex biological system**

=> the soil in its relation to the plant and to the animal -- ***due to improper methods of agriculture, an impoverished soil, or to a combination of both, and unsuitable seed.***"

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1992: Organic regulation which included the use of organic seed

Through the introduction of EC Regulation, No. 2092/91, which came into force on January 1st, 1992, the use of **organic seed (if available) was made mandatory for organic farmers across the EU**.

LIVESEED – booklet 1, November 2018
How to implement the organic regulation to increase production & use of organic seed policy recommendations for national and regional authorities

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Organic seeds, but what about organic varieties?

The situation in the 2000s

All varieties on the markets have been bred for **industrial agriculture**

No organic varieties and very few organic seeds

- 1st organic varieties in Europe (The first biodynamic carrot varieties selected by flavour, Rodelika and Robila in 1998)
- **1st initiatives of Participatory Plant Breeding to answer to the needs in Europe**

Now, since 2022

The European regulation for Organic agriculture recognized the heterogenous varieties (OHM=Organic heterogenous material) for Organic agriculture

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Evolution of breeding methods
Incompatibility with organic principles

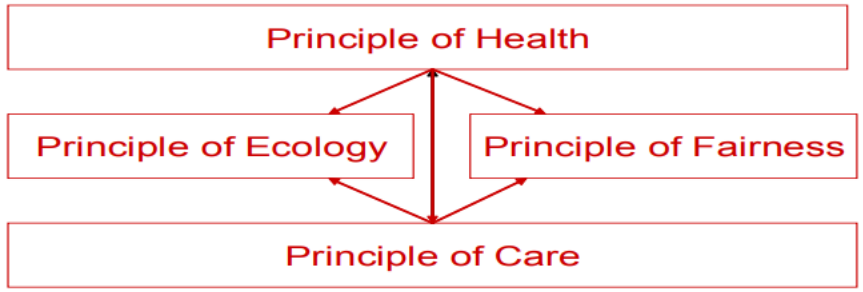
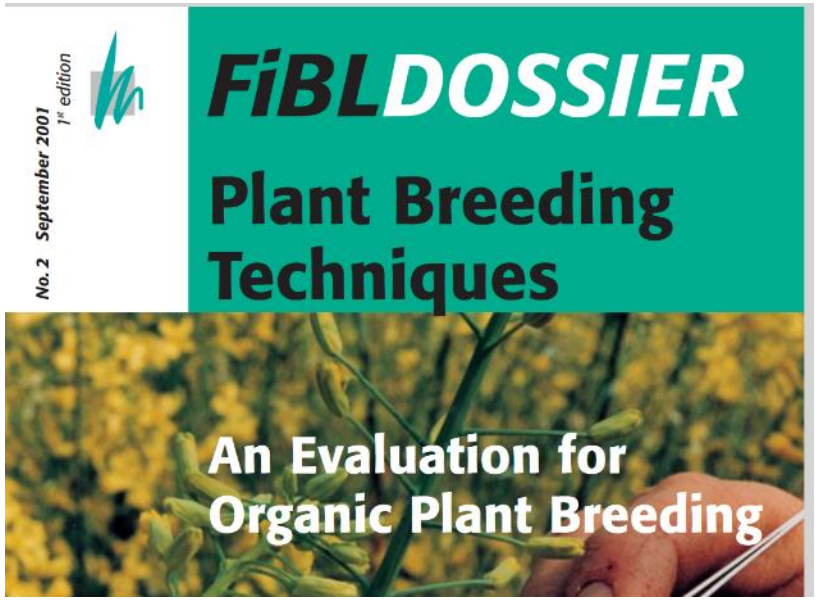


Figure 1: The four IFOAM principles (see www.ifoam.org)

https://research.wur.nl/en/publications/ethics-of-plant-breeding-the-ifoam-basic-principles-as-a-guide-fo



https://www.eco-pb.org/fileadmin/eco-pb/documents/concept_paper/plant_breeding.pdf

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Empowerment of farmers and collective organisation

DIVERSIFOOD INNOVATION FACTSHEET #16, November 2018

DIVERSIFOOD

This project has received funding from the European Union's H2020 Programme under grant agreement no 633571

www.diversifood.eu

A PARADIGM SHIFT

AT FIRST GLANCE

A paradigm shift refers to a radical change in beliefs or theory. DIVERSIFOOD has established diversity as the foundation of resilient food systems working with the hypothesis "the whole is greater than the sum of the parts".

Embedding crop diversity and networking for local high quality food systems

A new paradigm is called for after one century of standardisation in the agro-food system

"From uniformity to diversity: a paradigm shift from industrial agriculture to diversified agroecological systems" is the title of the report of the International Panel of Experts on Sustainable Food systems (IPS-Food 2016). DIVERSIFOOD witnesses experiences from the ground to design more precisely this paradigm shift and to provide elements to involve a large community - from research to market – in redefining food chain organisations based on a holistic knowledge of living processes involved in resilience.

Diversity and living processes

Uniformity invading all levels of modern societies has covered the overall food production and has broken the intrinsic link of agriculture with the living systems. At the other end of the food chain, most of consumers have no more idea of the farming realities, of the needs of their own body and of the quality of their food.

DIVERSIFOOD is deeply influenced by the messages of pioneers of organic agriculture as Howard (An agricultural testament, 1943) who pointed out the close connexions between health of soil, plants, animals and humans, meaning all living beings are interdependent. According to this vision, alternative food systems should be conceived through the holistic approach. Indeed, the new paradigm addresses all the practices from farming to food processing, distribution and consumption.

DIVERSIFOOD promotes organic farming and agroecological farming systems based on diversity and respect of biological processes and societal needs (or, in other words, based on living systems). To do that, DIVERSIFOOD engages in recovering and enriching crop diversity by reintroducing underutilised and forgotten species, adopts multi-actor and participatory plant breeding methods to increase diversity and the capacity to manage it, promotes community agrobiodiversity management to empower local farming systems and collective approaches, and explores the conditions to create sustainable local markets able to appreciate diverse products.

From a market-oriented approach to a life-oriented approach

Boosting participatory and multi-actor research

The sovereign peasant

Peasant research for farmer autonomy

http://www.diversifood.eu/wp-content/uploads/2018/05/Diversifood_IF16_Paradigm_shift-1.pdf

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Module 3 – Unit 4 Historical benchmarks

Crop domestication

Diversification

10,000 years ago, the birth of agriculture and cultivated plants

Uniform crops

Genetic resources conservation

A little over a century ago, the emergence of industrial agriculture and professional selection

Renewal of cultivated diversity

30 years ago, Renewal of peasant seeds and emergence of PBB

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Some historical benchmarks: our heritage

Crop domestication

Diversification

10,000 years ago, the birth of agriculture and cultivated plants

From Teosinte to Maize

https://mots-agronomie.inrae.fr/index.php/Fichier:Photo1_epi_teosinte.jpg

https://www.histoire-pour-tous.fr/dossiers/5732-naissance-de-l-agriculture-11-000-avant-notre-ere.html

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Some historical benchmarks: the industrialization

Crop domestication

Diversification

Uniform crops

Genetic resources conservation

10,000 years ago,
the birth of agriculture and cultivated plants

A little over a century ago, the emergence of industrial agriculture and professional selection

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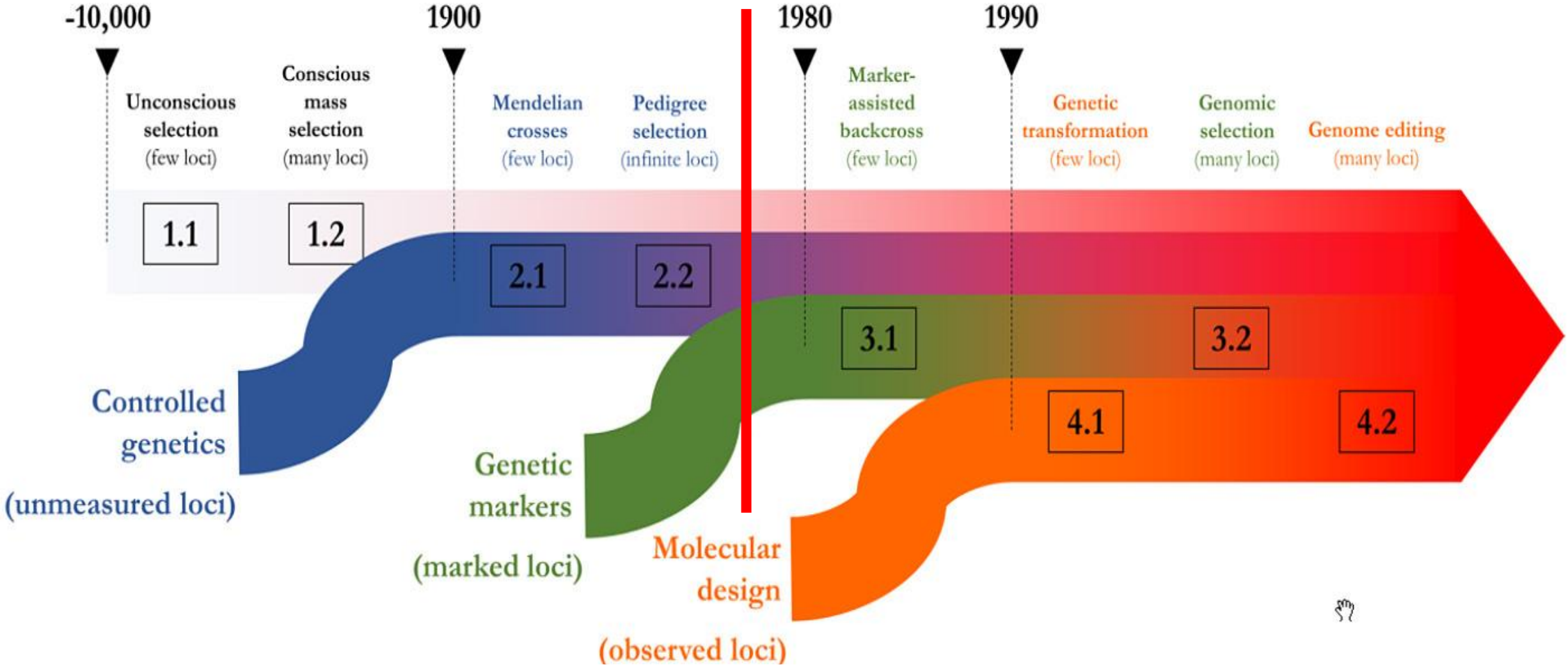
From 1980, biotechnologies are dominating plant breeding strategies, incompatible with organic values



Four periods in plant breeding history (Ramstein et al., 2019) in Carole Caranta, Mathilde Causse, Fabien Nogué, Annabelle Déjardin, Emilie Gentilini, et al.. État des connaissances sur la contribution des technologies d'édition du génome à l'amélioration des plantes pour la transition agroécologique et l'adaptation au changement climatique. INRAE. 2022. ffhal03943821f

Some historical benchmarks: PPB emergence

Crop domestication

Diversification

Uniform crops

Genetic resources conservation

Renewal of cultivated diversity

10,000 years ago, the birth of agriculture and cultivated plants

A little over a century ago, the emergence of industrial agriculture and professional selection

25 years ago, Renewal of peasant seeds and emergence of PBB

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Looking at the cultural context of agriculture and seeds

The history of seeds from the emergence of agriculture to the 21st century

- Broken links with the "living“ concepts/peasant agriculture at the beginning of the 20th century with the industrialization of agriculture
- Notion of stable and uniform varieties has reduced the plant dimension to **an input**, "an isolable and standardized production factor"*

AB needs have been defined in the early 2000s

- **Reconciling with the “living”** and taking care of ecosystems
- **Rediscovering diversity and the evolutionary nature** of cultivated populations for better adaptation to the territories

*Bonneuil, C. ,Thomas, F. (2009) Gènes, pouvoir et profits, Edition Quae et FPH

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Creation of peasant seed associations/community seed banks and their networks

Creation of

- Réseau Semences Paysannes (French Seed Network) in 2003, in France
- Rete Semi Rurali (2007) in Italy,
- Red de Semillas (2002) in Spain …

Then EC-LLD (European Coordination for Let's Liberate Diversity) in 2012

Involvement of all these actors
in European research since 2007

With on-farm/peasant selection => emergence of a participatory organization of research, then a multi-actor and transdisciplinary approach.

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Concepts evolution through 3 European projects

FarmSeedOpportunities

(FP6 2007-2010)

Situation Europe of « non conventional varieties »

Observation and testing diversified crop populations

On farm research

Seed regulation recommendations

4 species

Solibam

(FP7 2010-2014)

Strategies for performance and quality

Working on key-concepts

Participatory research

Policy recommendations on seed, research and food system

7 species

DIVERSIFOOD

(H2020 2015-2019)

Broadening crop diversity and enhance food quality

Multi-actor and transdisciplinarity

Social organisation

Economic impact

Culture about food

15 species

Common hypothesis : DIVERSITY

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Seeds for organic farming: two parallel groups of initiatives

Peasant cultivars and seeds

- On-farm plant breeding
- Participatory research
- Renewal of seeds and know-how

Organic cultivar and seeds

- Developing the framework for organic plant breeding and appropriate regulations
- New business model for diversified cultivars

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One French (Breton) example: buckwheat

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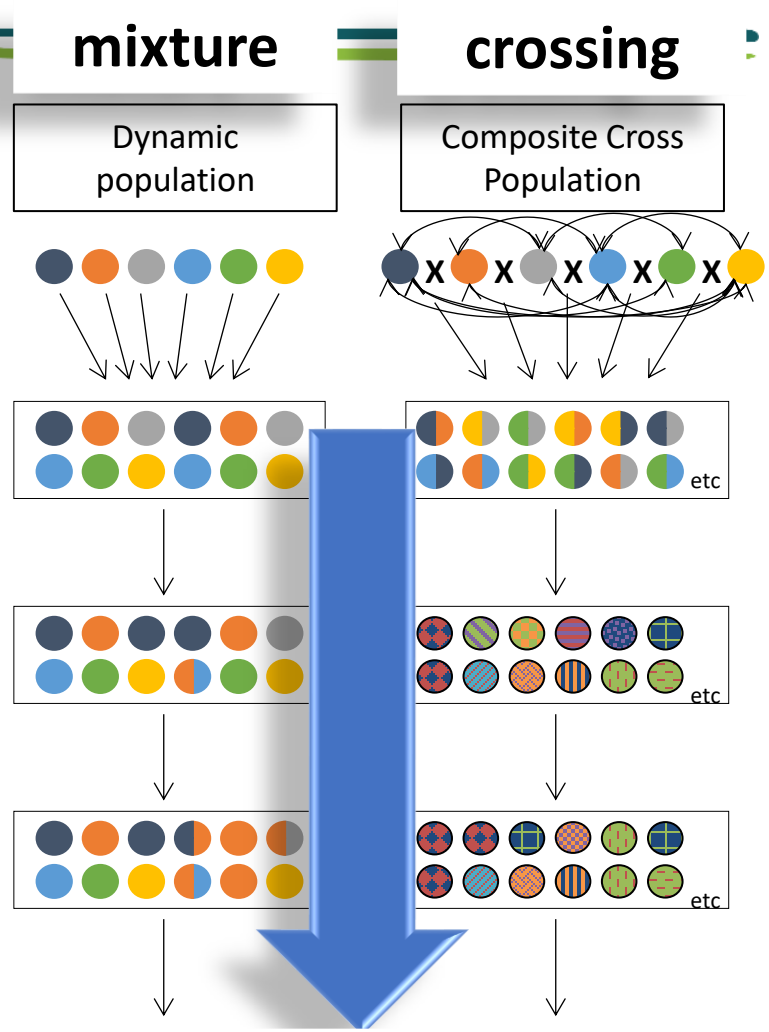
Buckwheat, objectives

For ten years in Brittany, the objectives:

- Create new diversified populations from Breton and European collections
- Create new populations with new traits: deshulled grain, stable yield, variable cycles, keeping also traditional recipes
- Develop a organic value chain in Brittany for new products

Exploring on-farm 2 plant breeding methods to recover crop diversity



EVOLUTION and ADAPTATION year after year

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Solibam

Coordinating Organic Plant Breeding Activities for Diversity
C O B R A

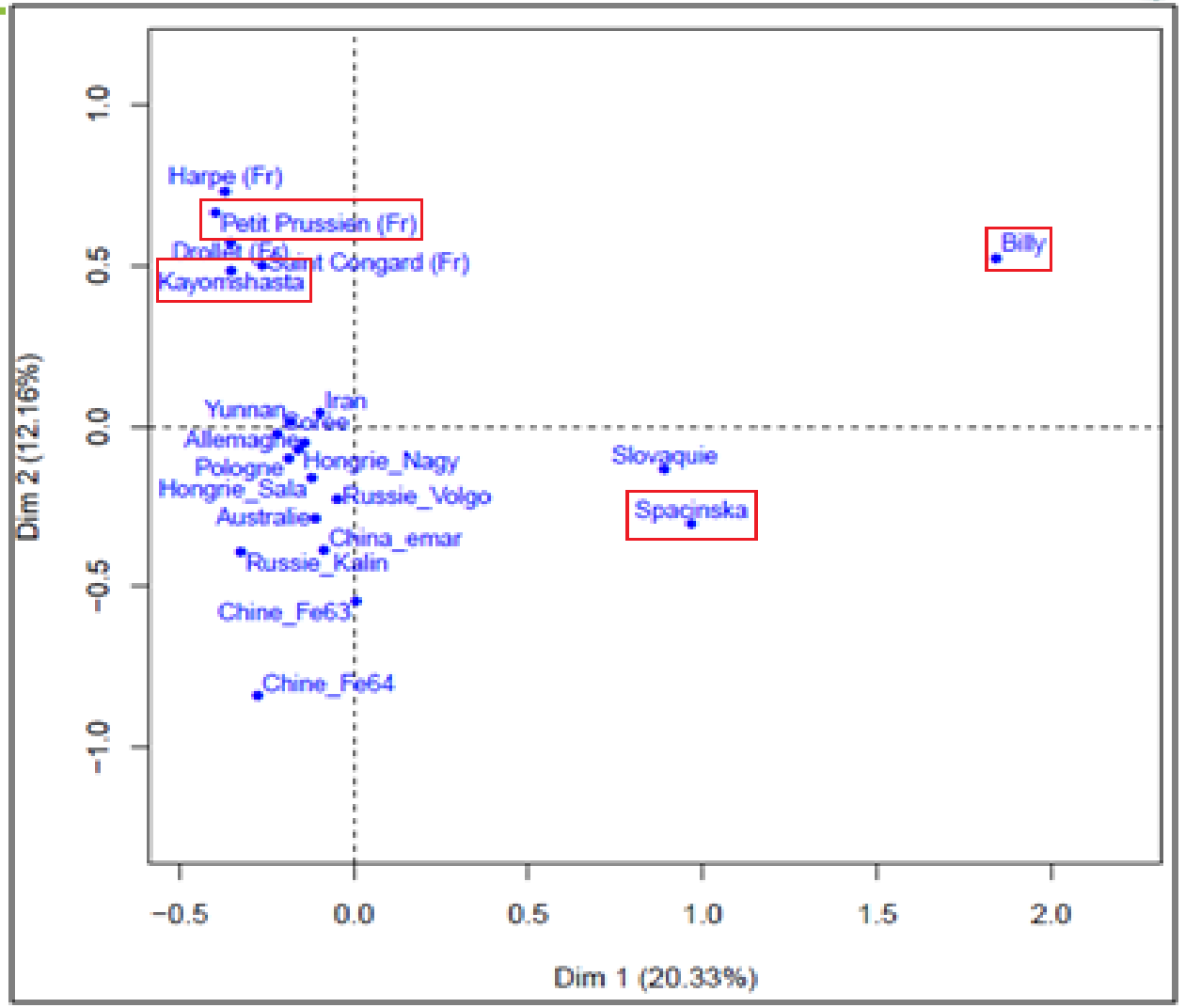
DIVERSIFOOD

LIVESEED

Evaluating and studying the evolution of the genetic diversity

Two populations obtained with 5 cultivars: mixture (dynamic population) and CCP during several generations

- **Billy,** Austria**,** late, very large grain
- **Spacinska**, Slovakia, early, large grain
- **Petit gris**, Breton, local, adapted, small grain
- **Petit prussien**, Breton, local, early, adapted, small grain
- **Kaiomtchasta,** Russia, diversified, rusticity



Genetic diversity of selected populations – microsatellite markers

multiple correspondence analysis (*MCA*)

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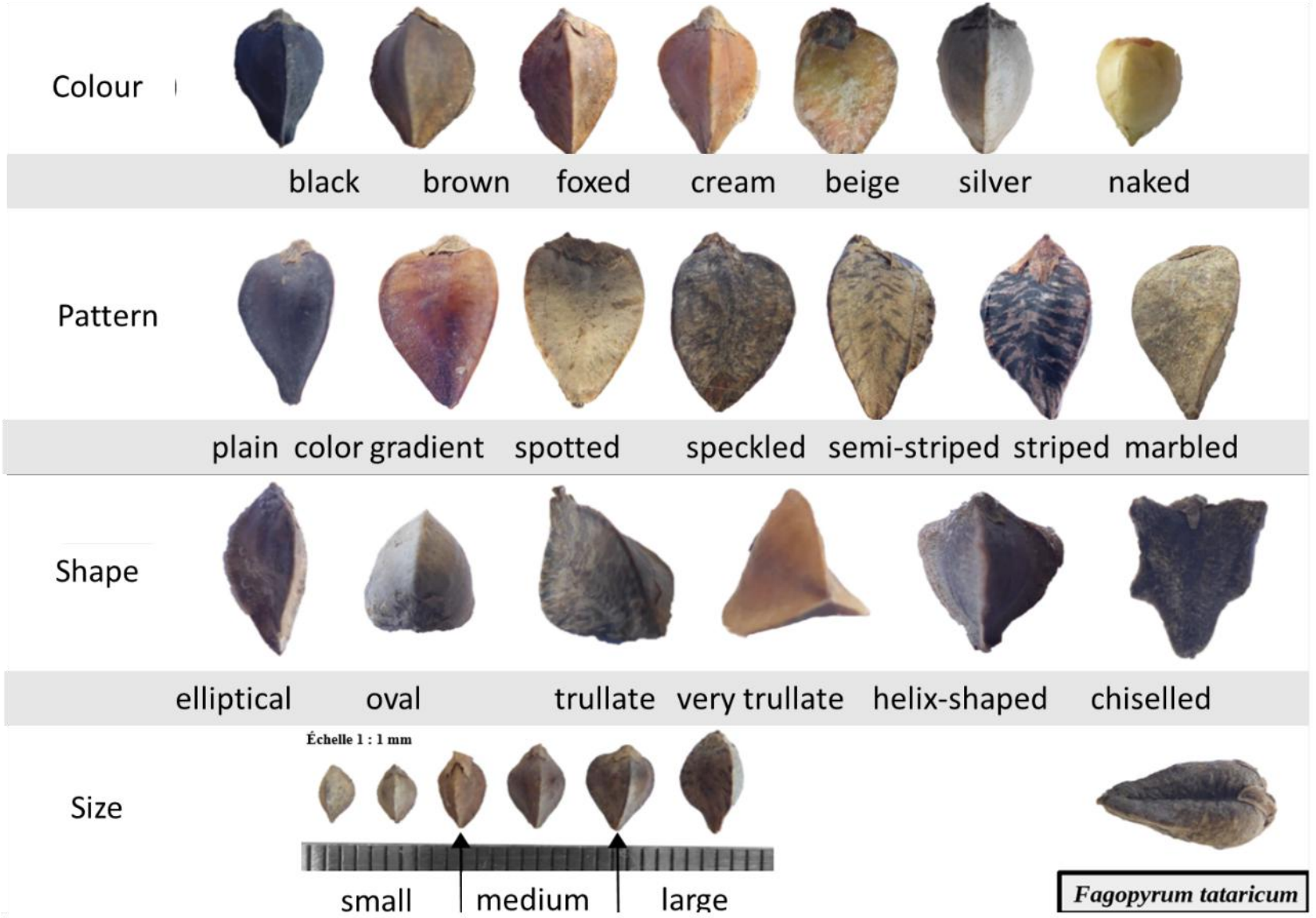
After evolution on 5 sites

The strategy of creation of the populations ('CCP' and 'Dynamic population') does not seem to directly influence the genotype of the populations except for certain rare alleles.

The selection for one trait (grain size) applied to the 'Dynamic Population' with 5 parents do not lead to a significant loss of genetic diversity.

Farmers have mixed the seeds from the both strategies and make evolved the population on their own farm.

Then, diversity measured by the grain morphologies



LiveSeeding

Improving buckwheat dehulling ability and creation of the adapted equipment for on-farm process

Several multi-actor projects funding by the Region (Brittany, OutilSem), Foundation (Fondation de France) and Europe LIVESEEDING

1) Selection of populations and mixtures of populations that are more easily dehulled from 2021

Select the large grains by a very selective calibration, by multiplication and successive calibrations

Dehull the sample before sowing, sow the dehulled grains to select only easily dehulled grains

60%: rate of germination after dehulling

Observation of the evolution of the trait in the following years

LiveSeeding

Région Bretagne

Projet soutenu Fondation de France

FRAB

INRAE

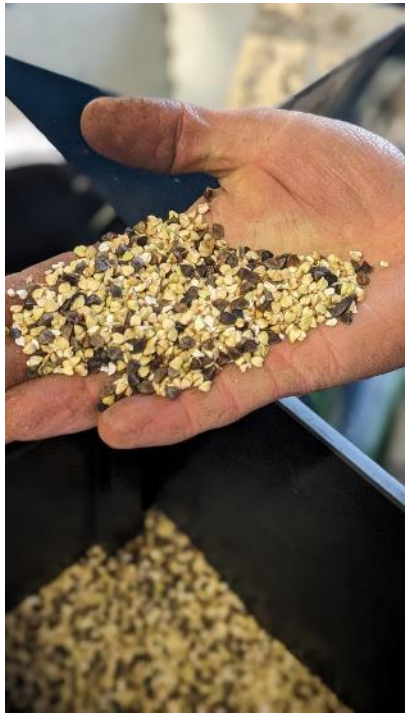
D'une graine aux autres Cultivez la biodiversité !

Triptolème

Improving buckwheat deshulling ability

2) Creation of adapted machines for on-farm transformation

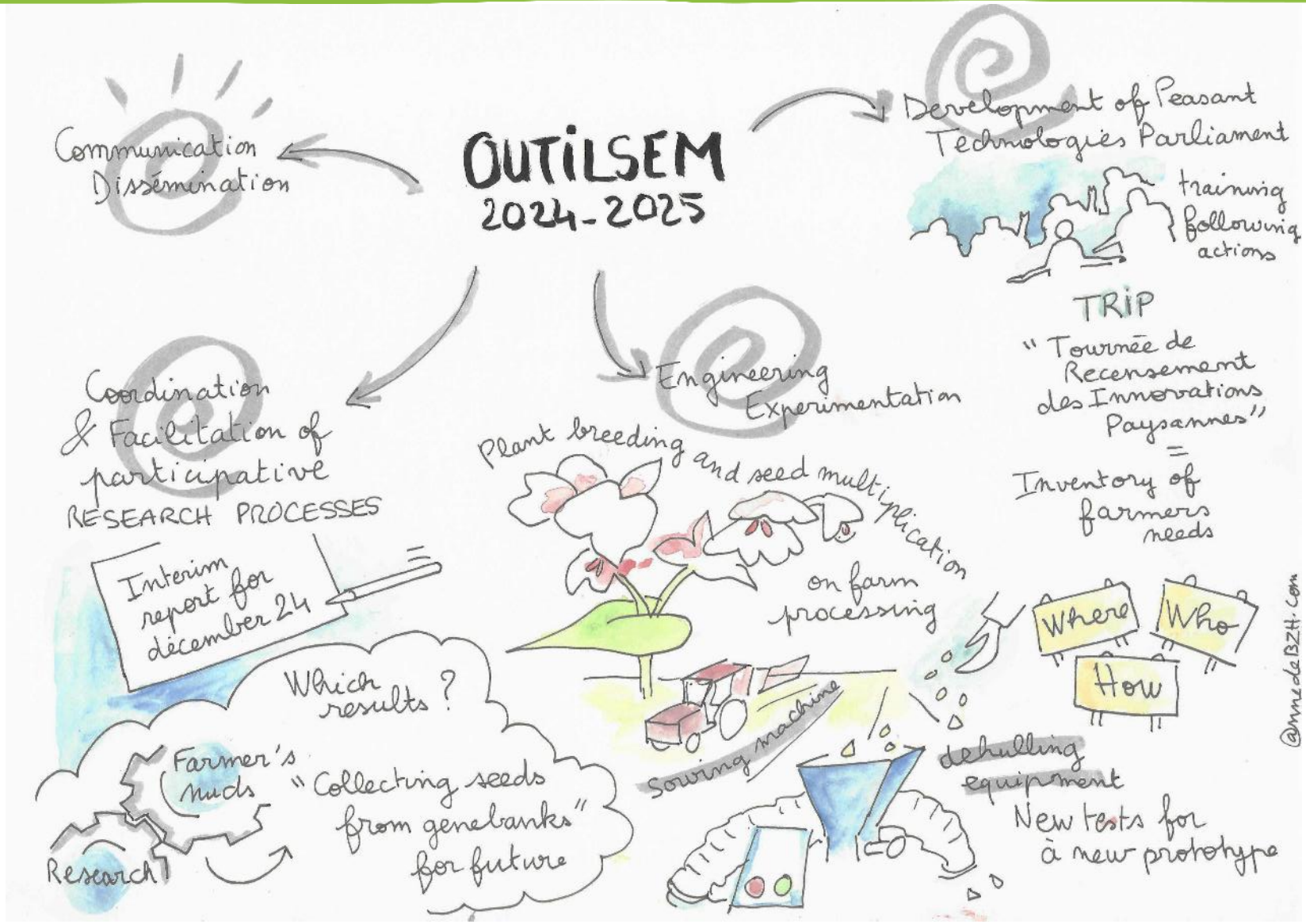
Building with an association “L’atelier paysan” and testing the new machines together
Evolution and improvement of the machine with the farmers, to increase the rate of dehulled grains



L'atelier paysan

LiveSeeding

Project organisation



LiveSeeding

VASO 1.0

The pioneers and their motivations

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Hybrids Program

Early1940s

Genetic Resources

1975-76 First collection missions

Silas Pêgo

Participatory Plant Breeding since **1984**

NUMI
BRAGA
PORTUGAL
NÚCLEO DE MELHORAMENTO DE MILHO

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We asked the farmers to exemplify the selection

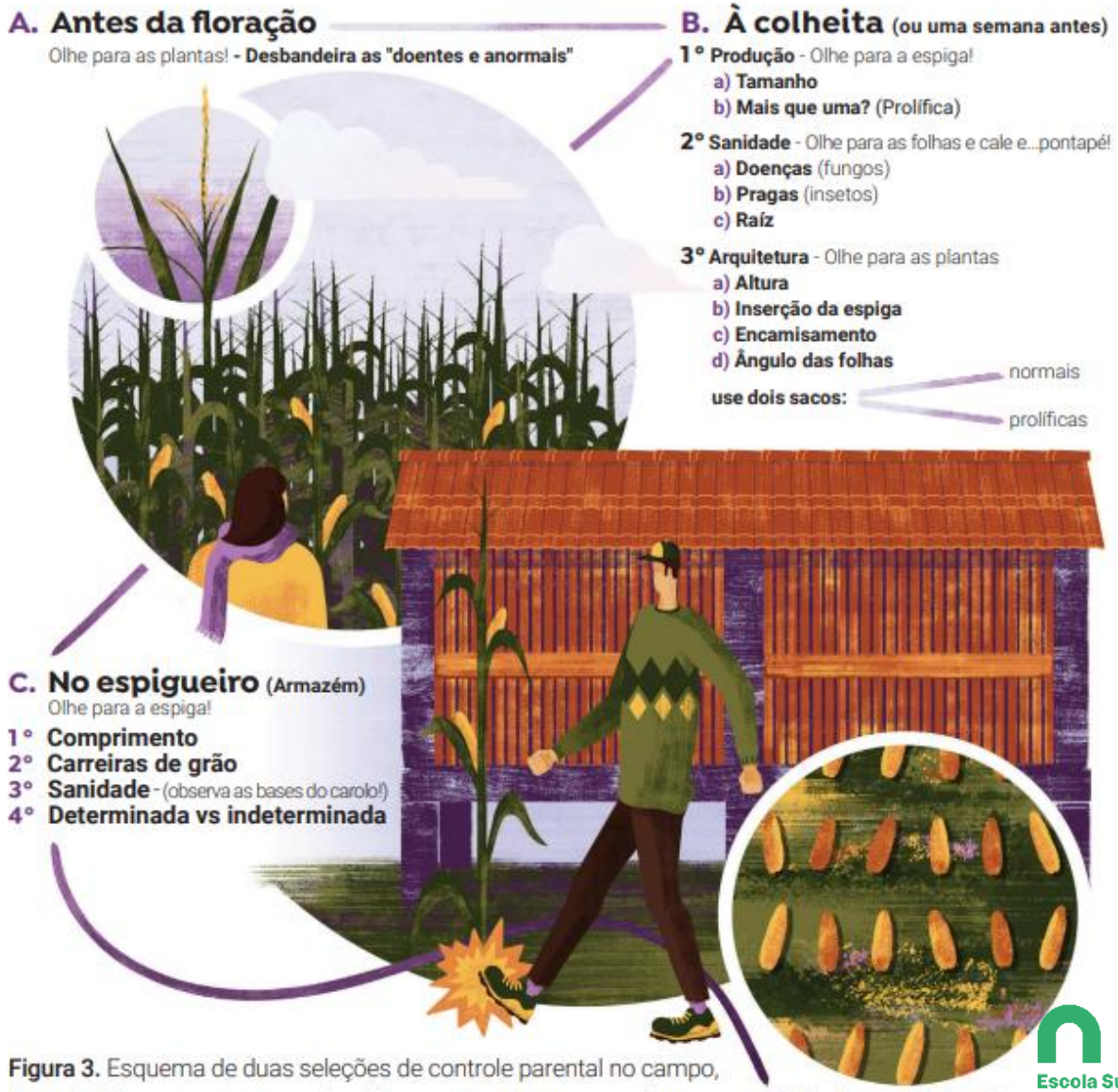

Figura 3. Esquema de duas seleções de controle parental no campo, Fase A e B ao que se segue a Fase C no espigueiro ou armazém.

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VASO 1.0 - Genesis reasons in 1984

André Barata

- Solving the problem of small Portuguese farmers where there is a scarcity of land and a high population density, where the productivist model does not respond
- To have an opportunity to respect the local culture and **recover the genetic resources** in a way that can be used, i.e. maintaining **quality** and increasing the **production**
- **Keep germplasm evolving on time!**

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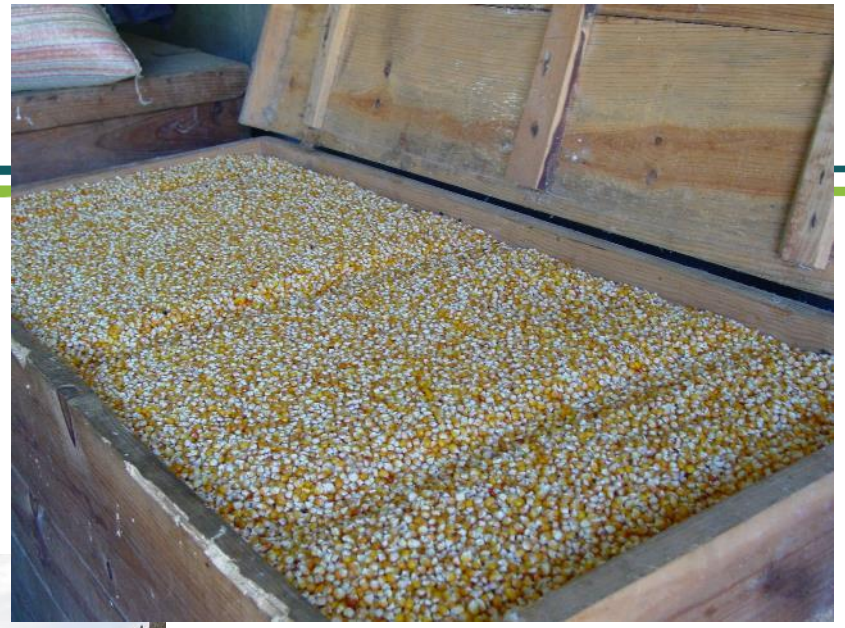
AMÍUDO - early maturing flint yellow (FAO 200) adapted to stress conditions (aluminum toxicity and water limitations)

Photo: André Pereira

PIGARRO - medium Cycle, flint white (FAO 300) with strong expression of fasciation

FANDANGO -YELLOW dent FAO 500



Motivation – Not Forget and replace, Evolve and Valorise.

How to keep seeds… sown!

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2. Vaso 2.0

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Conecting

Transdisciplinarity, multi-actor

Valuing genetic resources and beyond

Issues and challenges

Plate

Seed

Who provides the seed

Selling the Production

Selling processed food

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But NEVER Forget The backbone of the project!

IPC

- Populations
  - Selection
  - New populations
  - Recurrent Selection, S1 or S2
- Knowledge
  - Stat tools
  - Tasting
  - Willing to pay
- Co-organization
- Trials (On-station)
  - Monitoring selection
  - Show varieties

ADERSOUSA

- Farmers' support
- Co-Organization

Farmers contributions

- Seeds
- Empirical knowledge
- Selection
  - Own populations
  - Provided Populations
- Trials (On-farm)
  - Monitoring selection
  - Show varieties

Millers

Bakers

LL - VASO

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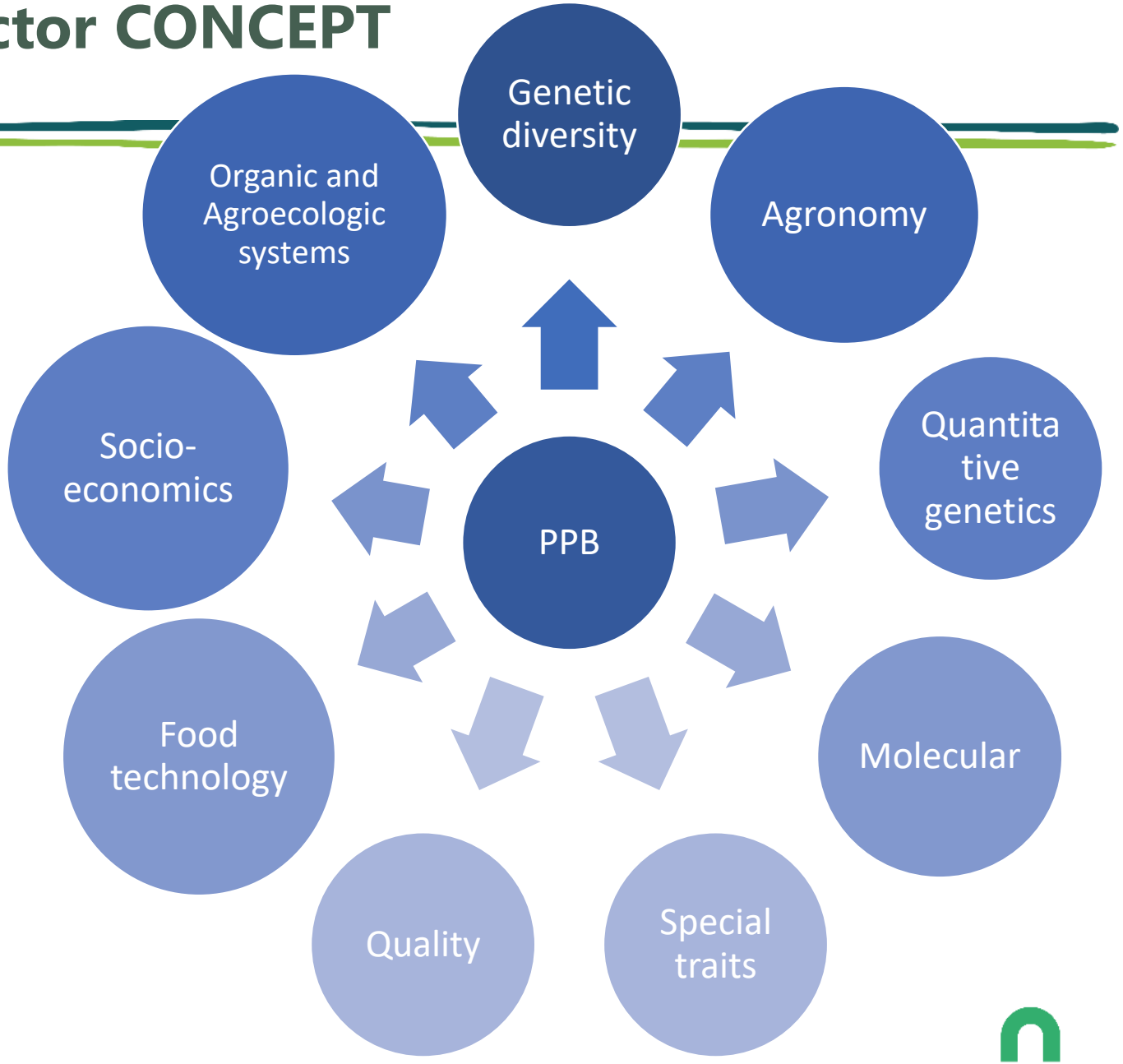
Transdisciplinarity, multi-actor CONCEPT

- When resources are available many other tasks can be done!



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Genetic Resources

CERTRA
Cereais Tradicionais
Cadeia de Valor

Desenvolvimento de Cadeias de Valor de Cereais Tradicionais
para uma Alimentação Sustentável em Portugal

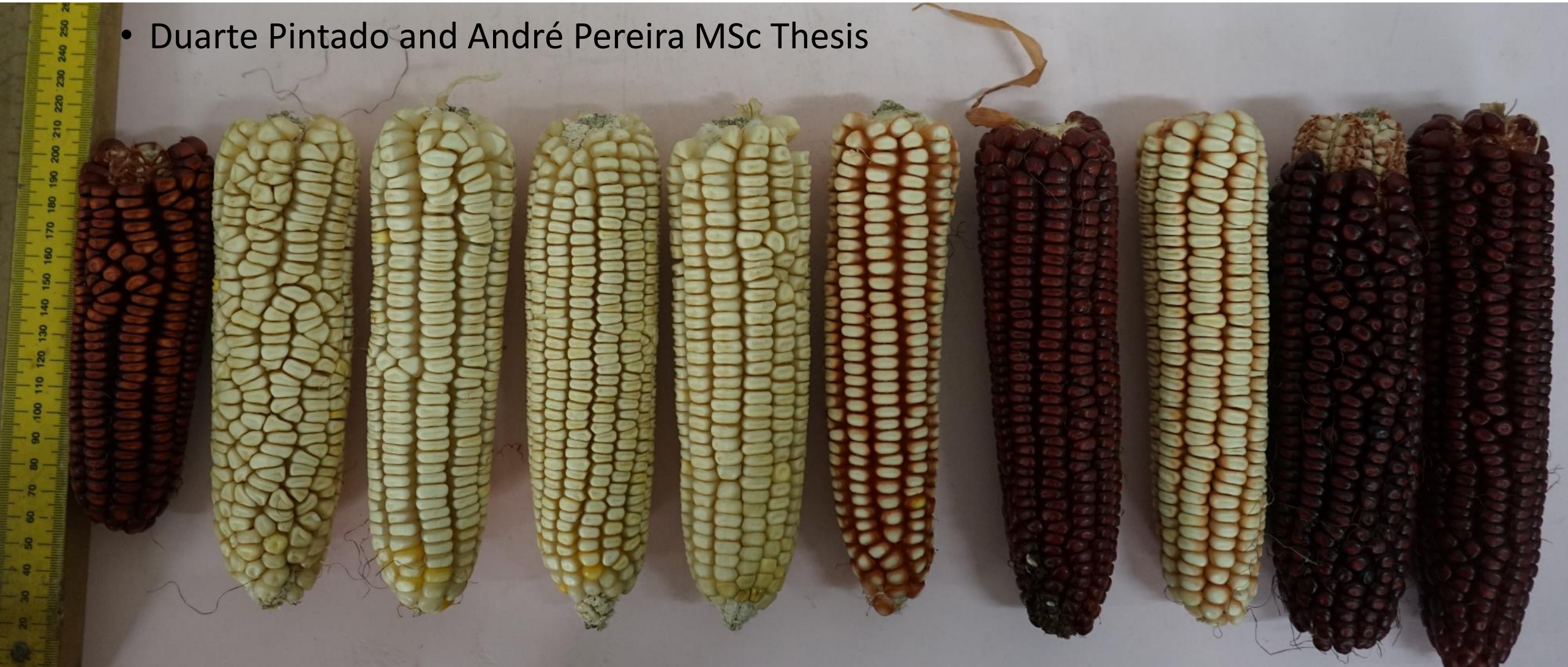
- Continue to collect and characterize
- Study and characterize collections
- Create dynamic populations

Study and characterize collections that were collected in the 80's

Azores Germplasm characterization – Multiply, Characterize and why not a OHM

PROGRAMA DE DESENVOLVIMENTO RURAL 2014·2020

- Duarte Pintado and André Pereira MSc Thesis



Story of a synthetic population, I will get it back in our UNIT 5.2

Maydica 54 (2009): 269-285

76 yellow elite inbred lines (dent and flint; 20% Portuguese and 80% North American

1	2		76
76	…	2	1

“NUTICA” – 1975-78

1983 - North Carolina Design 1 matting design (1 male crossed with 5 females)

‘Fandango’- on farm introduction and mass selection until today

And other Populations

‘FANDANGO’: LONG TERM ADAPTATION OF EXOTIC GERMPLASM TO A PORTUGUESE ON-FARM-CONSERVATION AND BREEDING PROJECT

P.M.M. Mendes-Moreira[1,2,9,*], M.C. Vaz Patto[2,9], M. Mota[3], J. Mendes-Moreira[4,5], J.P.N. Santos[1], J.P.P. Santos[1], E. Andrade[6], A.R. Hallauer[7], S.E. Pego[8,9]

[1] Escola Superior Agrária de Coimbra, Departamento de Fitotecnia, Sector de Protecção Vegetal, Portugal
[2] Instituto de Tecnologia Química e Biológica, Universidade Nova de Lisboa, Portugal
[3] Estação Agronómica Nacional, Instituto Nacional de Recursos Biológicos, Portugal
[4] Faculdade de Engenharia da Universidade do Porto, DEI, Portugal
[5] LIAAD-INESC Porto L.A., Portugal
[6] Banco Português de Germoplasma Vegetal, Instituto Nacional de Recursos Biológicos, Portugal
[7] Faculty of Agronomy, Iowa State University, Ames, IA 50010, USA
[8] Fundação Bomfim. Rua da Boavista, 152-154, 4700-416 Braga, Portugal
[9] Zea+, Portugal

Received July 6, 2009

ABSTRACT - Climatic change emphasize the importance … across cycles was done by the breeder (until cycle 5) and …

Mendes-Moreira, P. M. M., Patto, M. V., Mota, M., Moreira, J. P. C. L. M., Santos, J. P. N., Santos, J. P. P., ... & Pego, S. E. (2009). " Fandango": long term adaptation of exotic germplasm to a Portuguese on-farm-conservation and breeding project.

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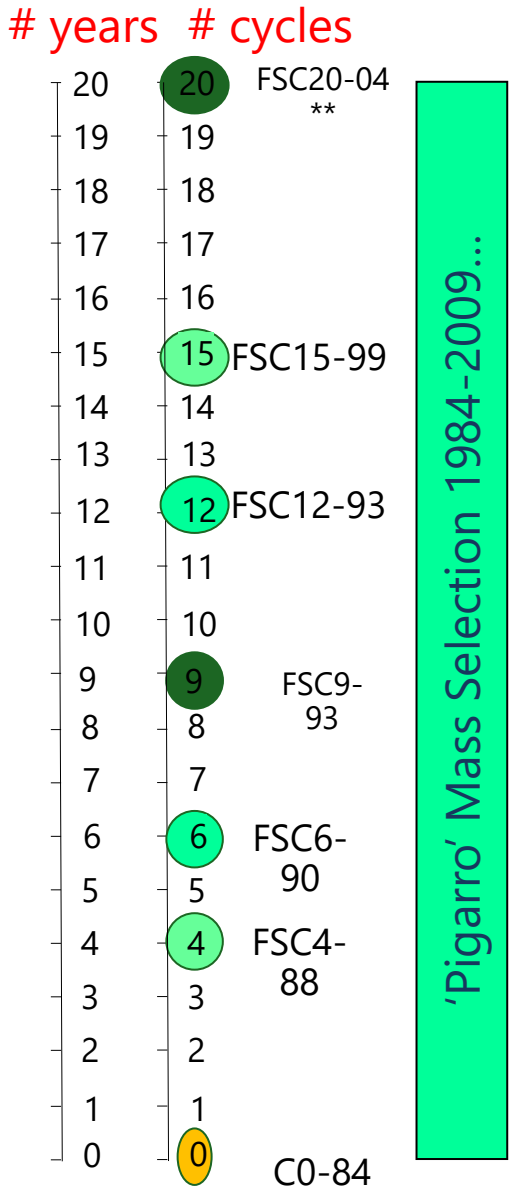
Politécnico de Coimbra

If you want to select you need to track and you need to store!



Farmer selection
(A-B-C mass selection)

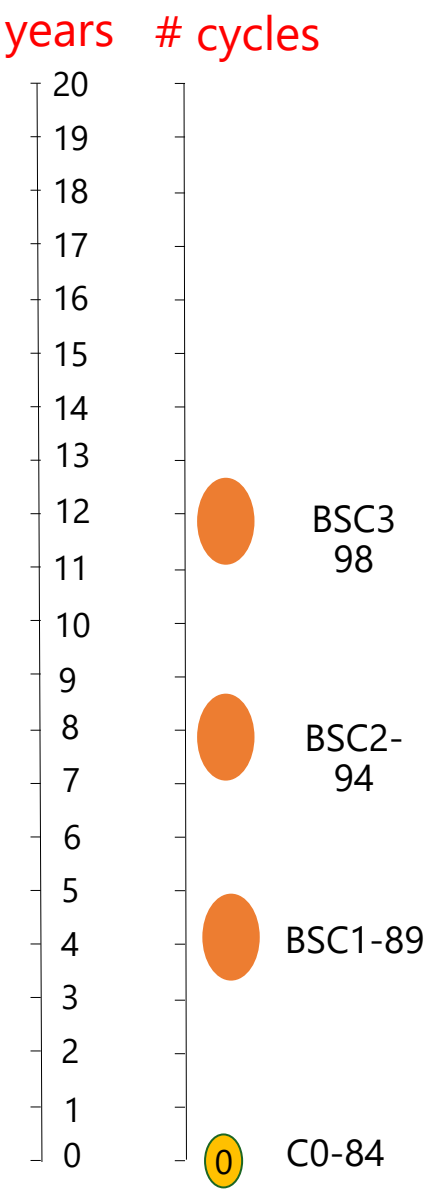
Each cycle of selection was cold stored

Trials

C0-84

7 cycles	3 cycles
FSC20-04 FSC15-99 FSC12-93 FSC9-93 FSC6-90 FSC4-88	BSC1-89, BSC2-94, BSC3 98

'Pigarro' S2RS 1984-1998



Breeder selection
S2 Recurrent Selection

Mendes-Moreira P; Satovic Z; Mendes-Moreira J; Santos JPP, Santos JPNS, Pêgo S Vaz Patto MC, (2017) Maize participatory breeding in Portugal. Comparison of farmer's and breeder's on-farm selection. Plant Breeding. doi:10.1111/pbr.12551 (in press)

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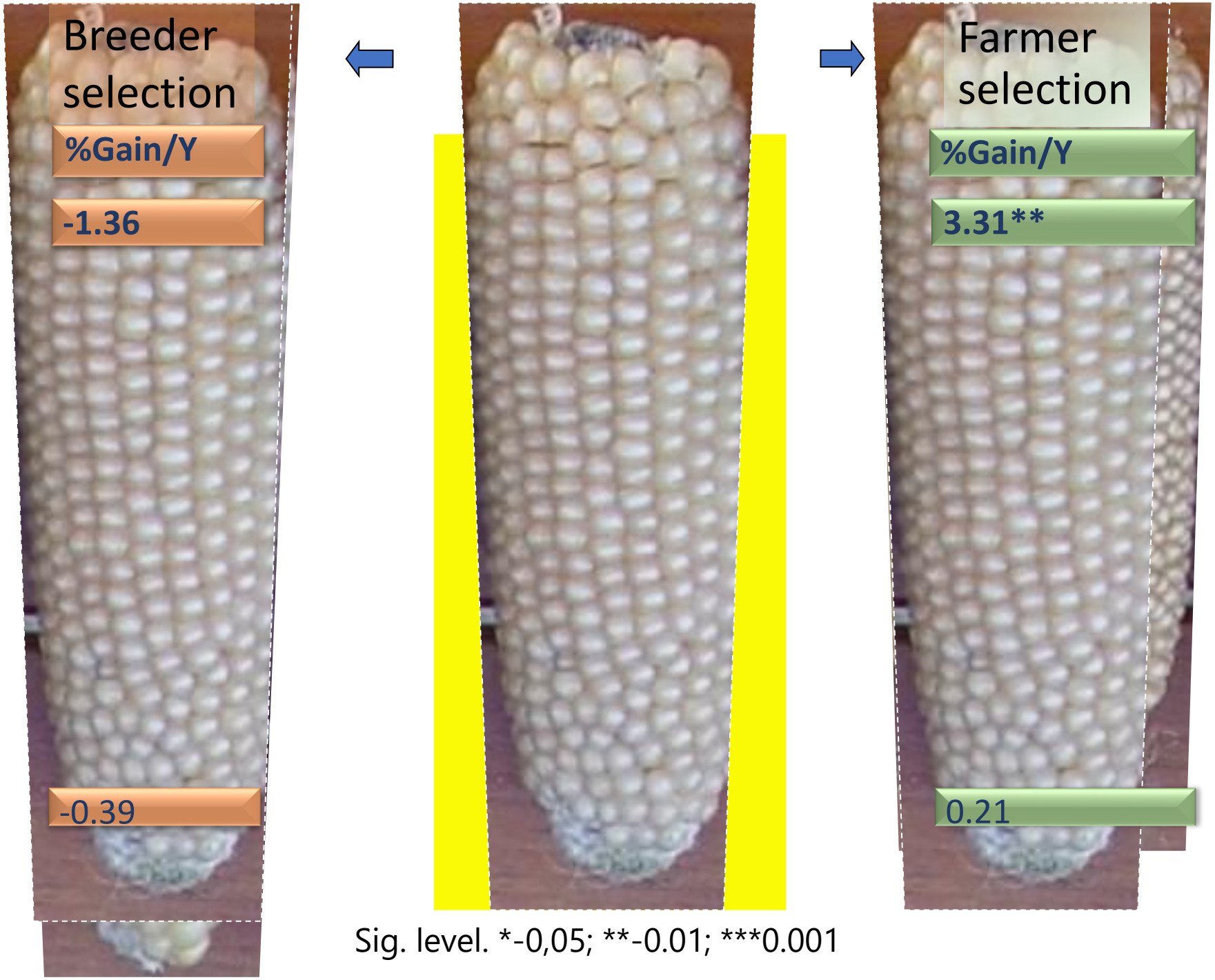
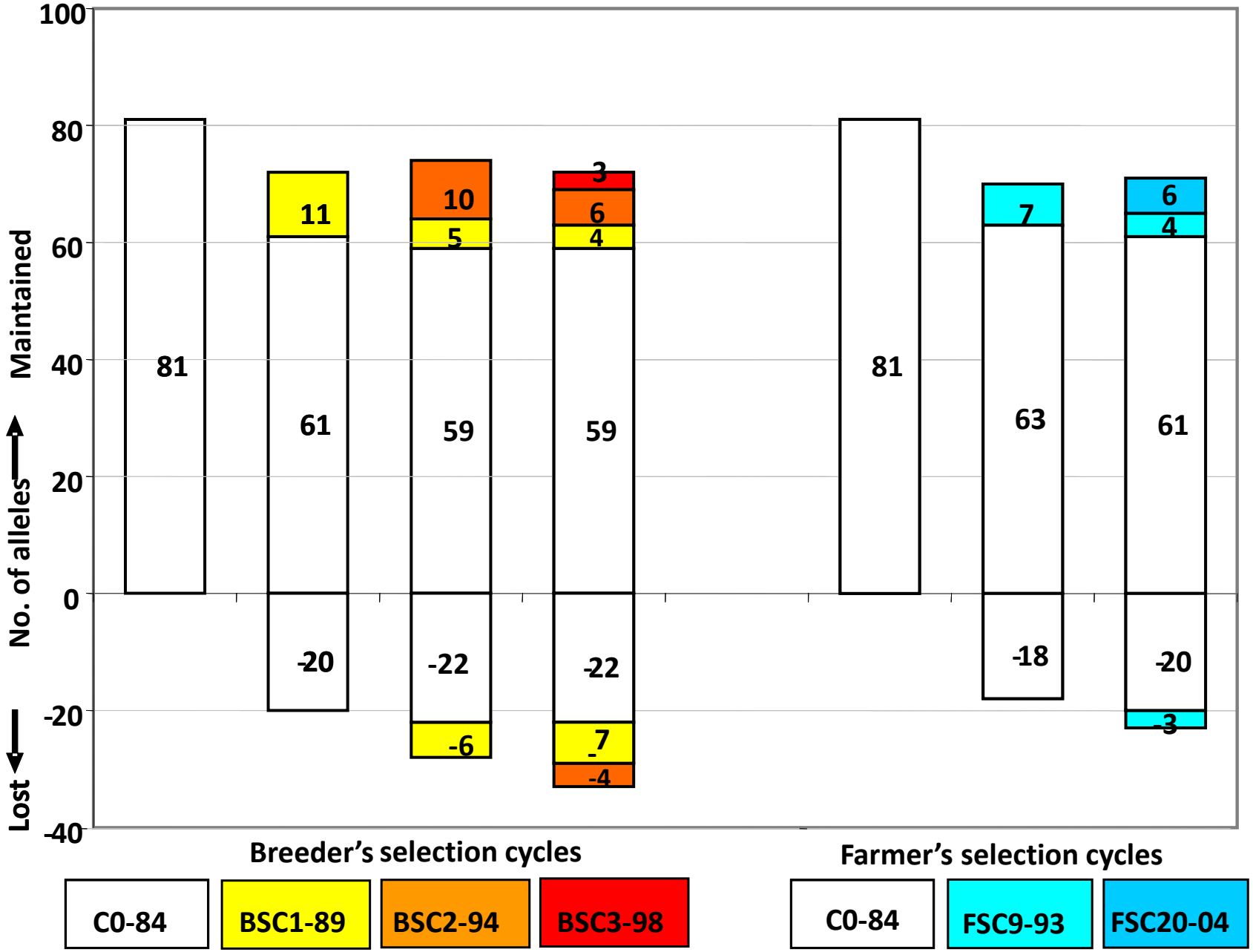
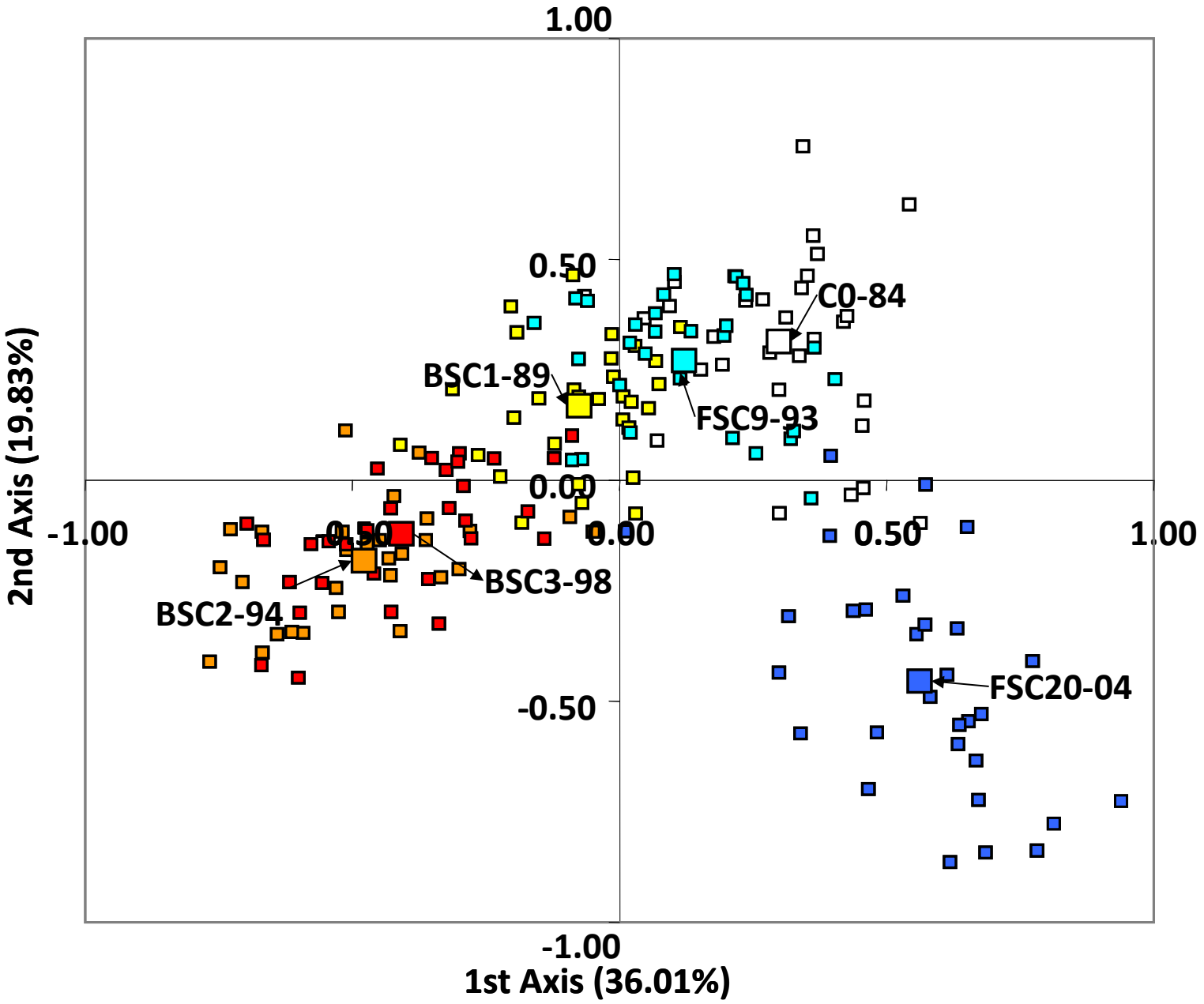


Sig. level. *-0,05; **-0.01; ***0.001

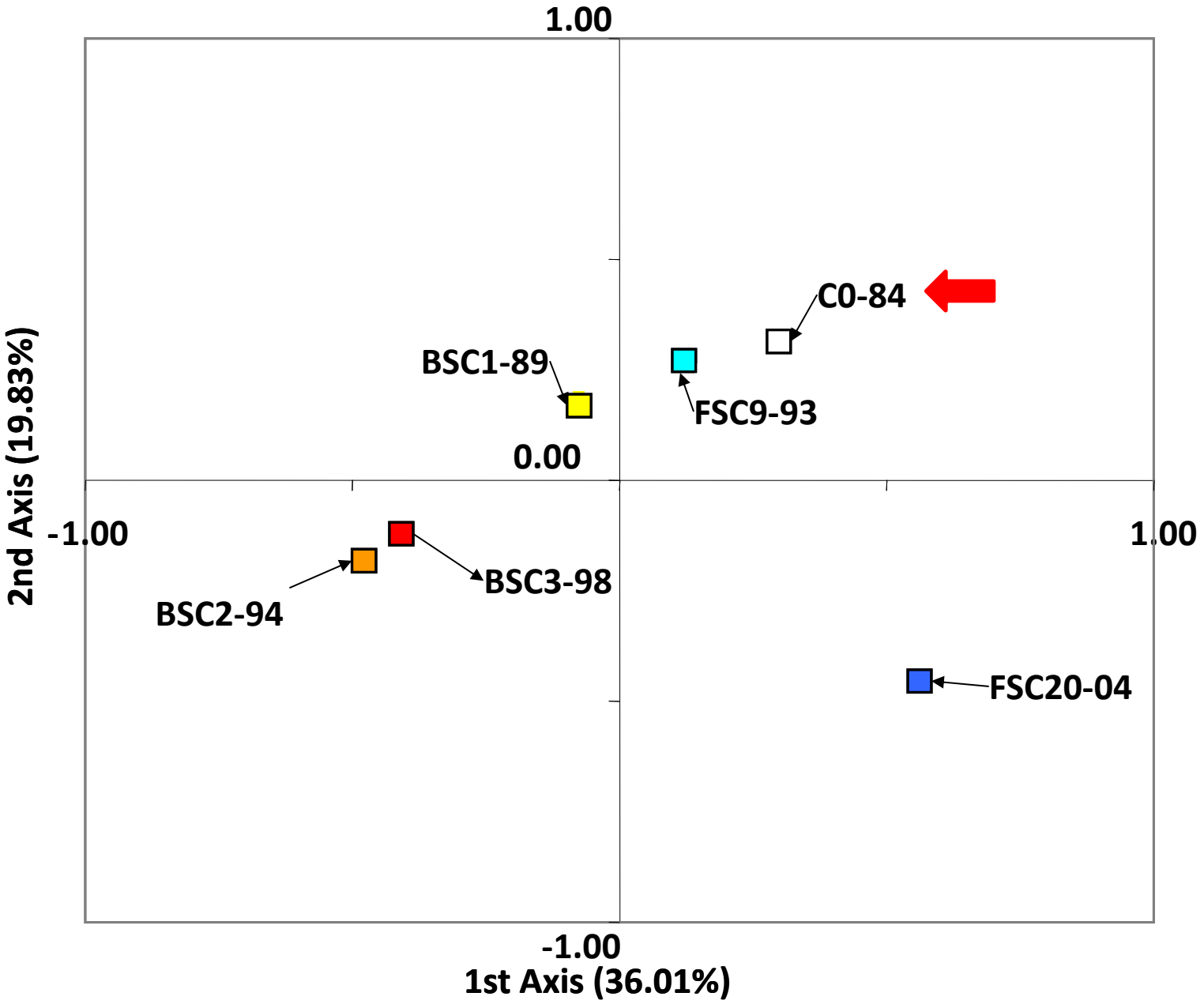
Number of alleles in each selection cycle (represented by different colour) lost or maintained from previous cycles

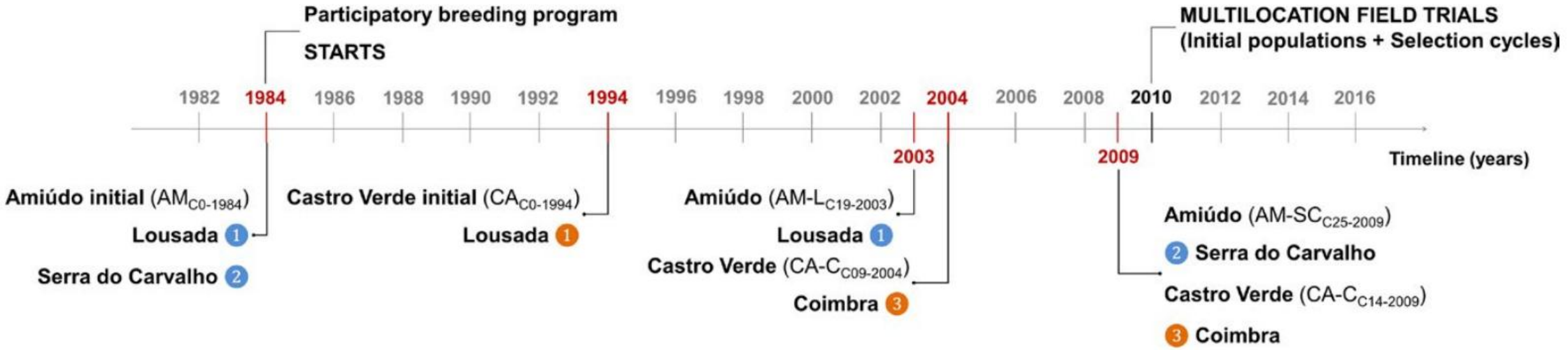


Factorial correspondence analysis (FCA) of 179 maize genotypes belonging to the initial population, farmer and breeders cycles



Factorial correspondence analysis (FCA) of the average maize genotypes belonging to the initial population, farmer and breeders cycles





Breeding objectives and breeding sites for Amiúdo and Castro Verde populations:

Amiúdo

1 Lousada – increase grain yield

2 Serra do Carvalho – increase grain yield

Castro Verde

1 Lousada (until 2000) – bigger ears (ear length, kernel weight, number of rows, and number of kernels/ear)

3 Coimbra (after 2001) – bigger ears (ear length, kernel weight, number of rows, and number of kernels/ear), and additionally, maintenance of an orange flint grain, decrease height of ear insertion in the plant and increase stalk resistance

FIGURE 1 Breeding objectives, timeline, and selection sites for the analyzed Amiúdo cycles (initial population—AM$_{C0-1984}$; AM-L$_{C19-2003}$

Evolutionary Applications
Open Access
Evolutionary approaches to environmental, biomedical and socio-economic issues

ORIGINAL ARTICLE | Open Access

Long-term on-farm participatory maize breeding by stratified mass selection retains molecular diversity while improving agronomic performance

Mara Lisa Alves, Maria Belo, Bruna Carbas, Cláudia Brites, Manuel Paulo, Pedro Mendes-Moreira, Carla Brites, Maria do Rosário Bronze, Zlatko Šatović, Maria Carlota Vaz Patto

First published: 10 September 2017 | https://doi.org/10.1111/eva.12549 | Cited by: 3

Plant Breeding

ORIGINAL ARTICLE

Plant Breeding homepage

Maize participatory breeding in Portugal: Comparison of farmer's and breeder's on-farm selection

Pedro Mendes-Moreira, Zlatko Satovic, João Mendes-Moreira, João Pedro Santos, João Pedro Nina Santos, Silas Pêgo, Maria Carlota Vaz Patto

First published: 17 December 2017 | https://doi.org/10.1111/pbr.12551 | Cited by: 1

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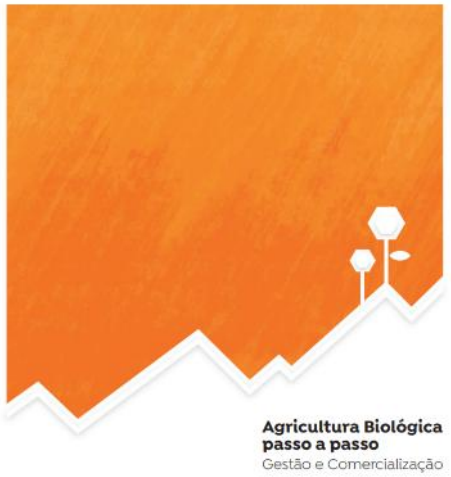
Organic

How can we move faster to organic?

- How bakers and consumers better valorize traditional organic varieties?



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Socio-economics

Not forgeting to feed local iniciatives that can help on PPB recognition

“Best Ear of Sousa Valley competition” can provide adequate measurements, indicate best traits for selection and prediction

$$EVA = \text{mlr.varsEV} = -7.030877 + 0.031605 \times KW + 0.387825 \times L + 0.337015 \times R12 - 0.008875 \times KN \quad (13 \text{ and } 14)$$

Mendes-Moreira, P. M., Mendes-Moreira, J., Fernandes, A., Andrade, E., Hallauer, A. R., Pêgo, S. E., & Vaz Patto, M. (2014). Is ear value an effective indicator for maize yield evaluation? Field Crops Research, 161, 75-86. doi:10.1016/j.fcr.2014.02.015

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PENHA

15 de Março de 2022. Auditório da COPAGRI

COPAGRI, ADER-SOUSA, and ESAC, and counted with the presence of 17 participants, including municipal technicians, local producers, and milling industry representatives.

The evolution of corn production and prices in Portugal and the region were mentioned. Key trends in corn grain production and consumption in the region were discussed, particularly focusing on:

Defining appropriate **marketing strategies** to increase profitability at the best price.
Identifying distribution channels that best adapt to specific production systems.

LiveSeeding

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September 2023, ESAC, Lousada

LiveSeeding

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CERTRA

Desenvolvimento de Cadeias de Valor de Cereais Tradicionais
para uma Alimentação Sustentável em Portugal

https://esa.ipb.pt/certra/divulgacao.html

CERTRA

Desenvolvimento de Cadeias de Valor de Cereais Tradicionais
para uma Alimentação Sustentável em Portugal

Encouraging the production of traditional cereals

Activities to be carried out

1. identify producers with traditional cereals
2. Identify traditional CEREALS: wheat, rye and maize
3. Promote and valorize the Mediterranean diet based on traditional cereals;
4. Introduce technologies and measures for product traceability and authenticity;
5. Encouraging access to safe, diversified, seasonal and quality food;
6. Informing, training and educating about healthy and sustainable eating, and combating food waste.

- Developing the value chain for traditional cereals, involving producers, processors (milling and baking), traders and consumers in the process.

LiveSeeding

CERTRA

Desenvolvimento de Cadeias de Valor de Cereais Tradicionais para uma Alimentação Sustentável em Portugal

What is expected from this project?

- To **valorise** the production of traditional cereals (greater knowledge of their nutritional and organoleptic value);
- Promote added-value food products based on the Mediterranean diet;
- Create new market opportunities, Select products with commercial potential;
- Increase visibility and consumer appreciation;
- Participate in a network of producers committed to preserving Portuguese biodiversity;
- Sharing knowledge and good practices for the continuous improvement of production;
- Contribute to the promotion of sustainable, quality agriculture


LiveSeeding

Materiais e Métodos

SeedLinked

Coimbra – 19/09/2023 BBCH 80
15 dias após a emergência das sedas

47 Avaliações

Lousada – 03/10/2023 BBCH 99
Maturação fisiológica

11 Avaliações

Funded by the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or REA, nor SERI or UKRI.

PRR Plano de Recuperação e Resiliência · REPÚBLICA PORTUGUESA · Financiado pela União Europeia NextGenerationEU

Unlocking the Potential of Portuguese Traditional Maize Varieties for Sustainable Agriculture: A Path to Collective Empowerment

Pereira, André[1*]; Neves, Rafaela[1]; Peninchelro, Alexandre[1]; Matos, André[1]; Dinis, Isabel[1,2]; Mendes-Moreira, Pedro[1,2]
[1] Polytechnic University of Coimbra, Coimbra Agriculture School, Coimbra, Portugal; [2]CERNAS- Research Centre for Natural Resources, Environment and Society
*Corresponding author: andre.pereira@esac.pt

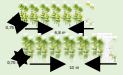
Unlocking the Potential of Portuguese Traditional Maize Varieties for Sustainable Agriculture: A Path to Collective Empowerment

Introduction

In 2024, the VASO (Sousa Valley) project will have 40 years of participatory maize breeding for sustainable and agroecological farming in the Sousa Valley. With an increasing focus on organic production, VASO collaborates with farmers to develop flint maize varieties suited for bread-making, addressing concerns about climate change, food security, and preservation of traditional knowledge and genetic resources diversity. Partnering with the European LIVESEEDING project, VASO has integrated the SEEDLINKED platform to enhance collaboration and data sharing among farmers, researchers, and technicians. The objective is to compare digital platform stakeholders' evaluations with phenotyping and agronomic assessment. This can be very useful, especially in PPB, where the number of varieties should have local and long adaptation to farmers' needs.

Materials and Methods

Environmen
Coimbra 9,6 m²
Lousada 15 m²



Evaluated populations:

- MPM – Milho Branco Meireles
- MBP – Milho Branco Pinto
- Pg – Pigarro
- Ver – Verdeal
- VA – Verdeal Aperrela*

* Evaluated in Lousada

Evaluated triadic traits:

- Plant Height
- Biomass
- Uniformity
- Vigor
- Lodging Resistence
- Evaluated_Yield

Scale:
1 to 5 (1= poor, 2 = fair, 3 = average, 4 = good, 5 = excellent)

Agronomic data:

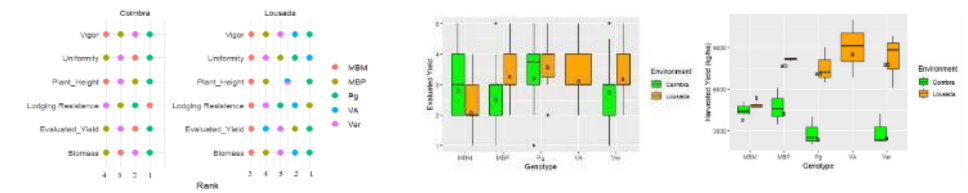
- Yield (15% Moisture)

Randomized Complete Block Design with 2 replications per environment

Triadic evaluations were performed with SeedLinked

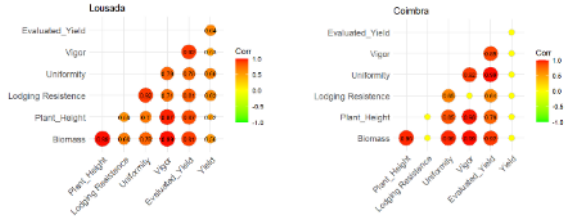
ANOVA, Tuckey test, Simple Rank and Spearman correlations were performed

Results and Discussion



Lousada yielded significantly higher than Coimbra. 'Ver' and 'MBP' showed contrasting estimated yield differences across environments, observed in the participatory evaluation. Although the 'Pg' exhibited significantly higher evaluated yield scores in Coimbra, measured yields revealed no significant differences among populations. MBM yielded significantly lower in Lousada, as reflected in the significantly lower evaluated yield scores.

The correlogram indicates a significant positive correlation among measured yield and all evaluated traits exclusively in Lousada whereas, no significant correlations were observed in Coimbra. This disparity can be attributed to the early evaluation before harvest time compared to Lousada and, the number of evaluations done.
Across environments, significantly higher correlations were observed among Vigor, Biomass, and Plant height.
Traits that are perceived by the SEEDLINKED evaluators as similar ones, which indicates the need to search for more discriminant traits.



*Correlations without a coefficient or marked with a symbol are non-significant (p<0,05).

Conclusion

Despite potential disparities by stakeholders, the analysis of estimated yield and yield revealed a correlation between SEEDLINKED scores and agronomical evaluations in Lousada, even without trained participants. This finding underscores the potential of user-friendly digital platforms like SEEDLINKED to engage communities and provide preliminary visualizations of data, that could help farmers and breeders to take their decisions.

X Congresso Internacional de Agroecologia
Agroecologias do Mundo: Unidas para enfrentar as crises globais
2 a 6 de setembro de 2024- Vilaxu – Portugal

LiveSeeding
CERTRA
Ader-Sousa

MICROBIOME IN MAIZE

Escola Superior
Agrária
Politécnico de Coimbra

frontiers in Microbiology | Microbe and Virus Interactions with Plants

Impact Factor 5.640 | CiteScore 7.3
More on impact ›

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The editor and reviewers' affiliations are the latest provided on their Loop research profiles and may not reflect their situation at the time of review.

TABLE OF CONTENTS

ORIGINAL RESEARCH article

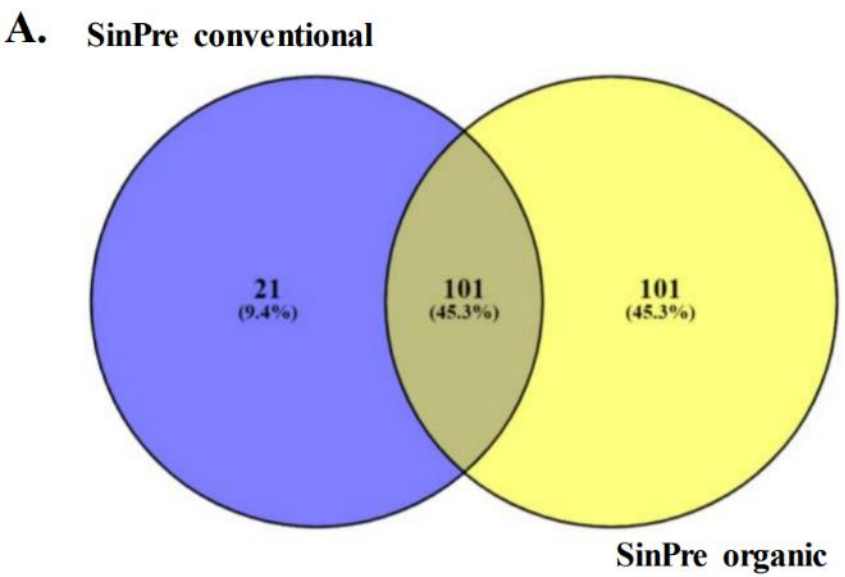
Front. Microbiol., 26 February 2021 | https://doi.org/10.3389/fmicb.2021.636009

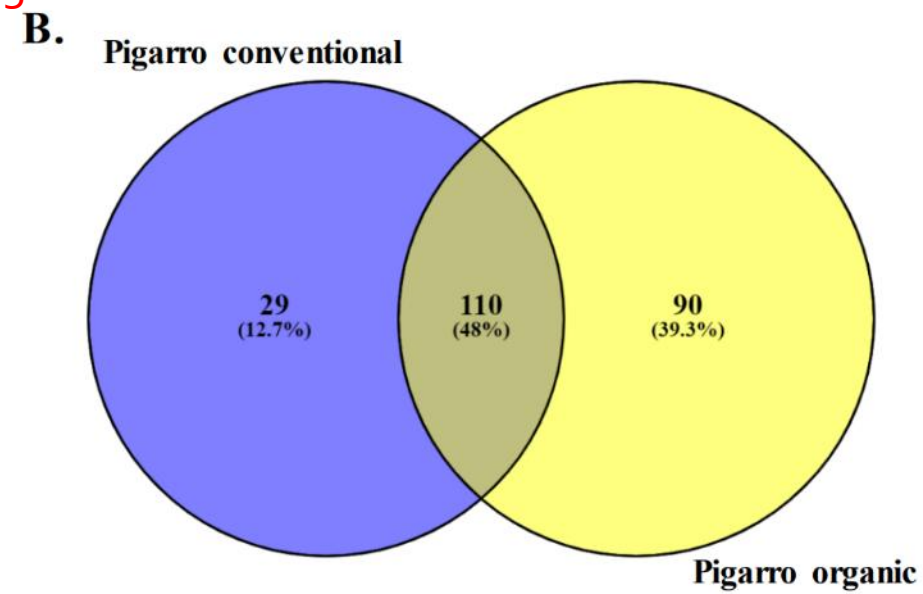
Effect of Low-Input Organic and Conventional Farming Systems on Maize Rhizosphere in Two Portuguese Open-Pollinated Varieties (OPV), "Pigarro" (Improved Landrace) and "SinPre" (a Composite Cross Population)

Aitana Ares[1,2], Joana Costa[1,2*], Carolina Joaquim[3], Duarte Pintado[3], Daniela Santos[3], Monika M. Messmer[4] and Pedro M. Mendes-Moreira[5]

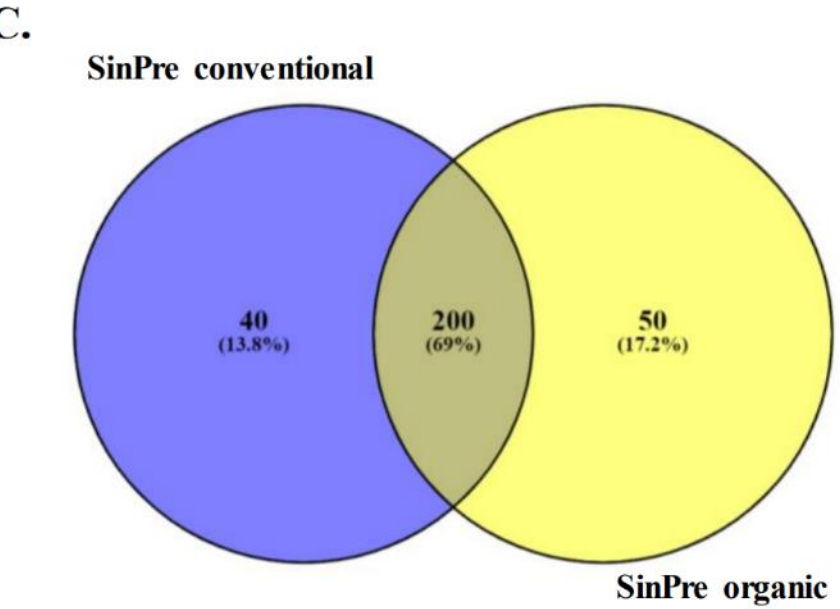
[1]Department of Life Sciences, Centre for Functional Ecology, University of Coimbra, Coimbra, Portugal
[2]Laboratory for Phytopathology, Instituto Pedro Nunes, Coimbra, Portugal
[3]Centro de Recursos Naturais, Ambiente e Sociedade (CERNAS), Coimbra, Portugal
[4]Research Institute of Organic Agriculture (FiBL), Frick, Switzerland
[5]Instituto Politécnico de Coimbra, Escola Superior Agrária de Coimbra, Coimbra, Portugal

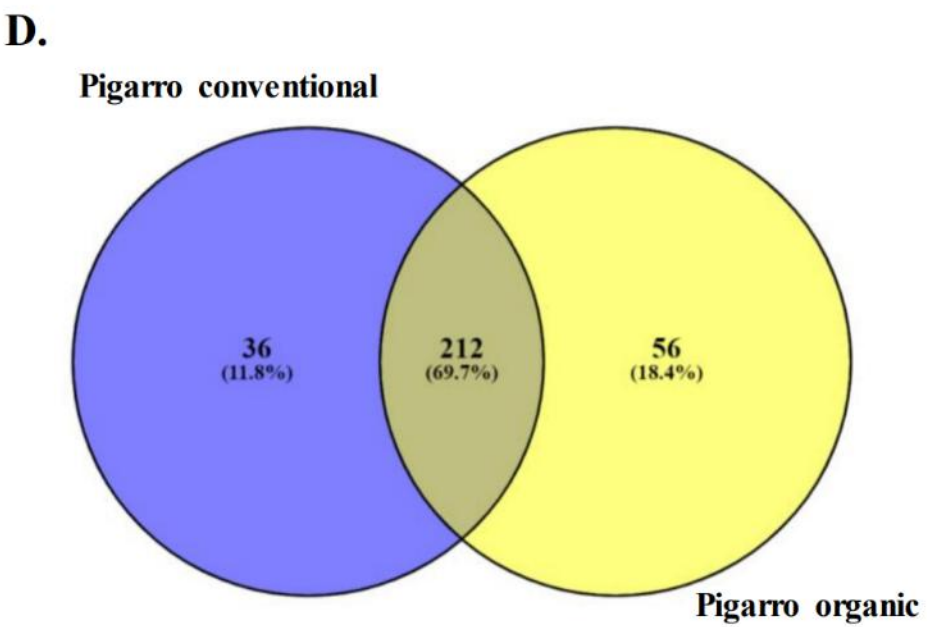
Fungi





Bacteria





Genera of the rhizosphere of the maize populations

SinPre and Pigarro under conventional and organic farming system

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Politécnico de Coimbra

Culinary breeding.

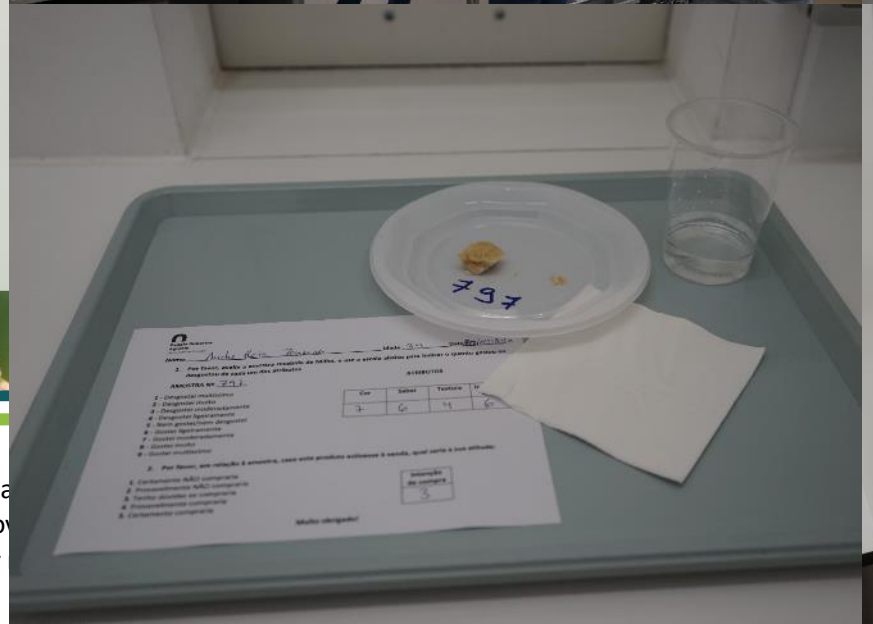
International Conference on

BREEDING AND SEED SECTOR INNOVATIONS FOR ORGANIC FOOD SYSTEMS

Online from Latvia
08-10 March 2021

EUCARPIA

P25 Exploring Portuguese Maize Landraces as Fresh Maize
Felipe HANOWER, Rosa GUILHERME, João NORONHA, André PEREIRA, Walkiria SPRING, Sara CORREIA, Ana NERI, Pedro MENDES-MOREIRA 76



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Exploring Portuguese maizes landrace as fresh maize

Felipe HANOWER, Rosa GUILHERME, João NORONHA, André PEREIRA, Walkiria SPRING, Sara CORREIA, Ana NERI, Pedro MENDES-MOREIRA

Objective

- HIGHLIGHT: Is landrace maize grown in Portugal, organically, ready to be sold and served to consumers? What are the attributes that most attract consumers' attention?

Methods

- HIGHLIGHT: The use of sensory analysis among thirty participants of different profiles to discover the characteristics of the maize that most attracted they attention.

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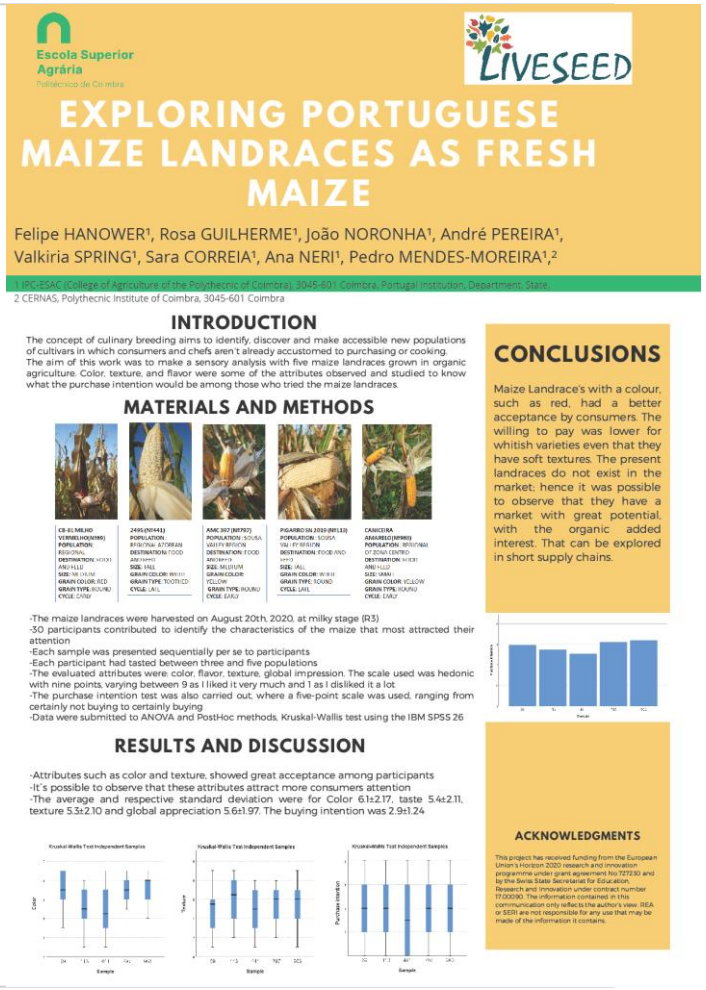
EXPLORING PORTUGUESE LANDRACE MAIZE AS FRESH MAIZE

Main result

Attributes such as color, showed great acceptance among participants.

Texture was also another approved characteristic among consumers.



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LIVESEED

EXPLORING PORTUGUESE MAIZE LANDRACES AS FRESH MAIZE

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INTRODUCTION

The concept of culinary breeding aims to identify, discover and make accessible new populations of cultivars in which consumers and chefs aren't already accustomed to purchasing or cooking. The aim of this work was to make a sensory analysis with five maize landraces grown in organic agriculture. Color, texture, and flavor were some of the attributes observed and studied to know what the purchase intention would be among those who tried the maize landraces.

MATERIALS AND METHODS

-The maize landraces were harvested on August 20th, 2020, at milky stage (R3)
-30 participants contributed to identify the characteristics of the maize that most attracted their attention
-Each sample was presented sequentially per se to participants
-Each participant had tasted between three and five populations
-The evaluated attributes were: color, flavor, texture, global impression. The scale used was hedonic with nine points, varying between 9 as I liked it very much and 1 as I disliked it a lot
-The purchase intention test was also carried out, where a five-point scale was used, ranging from certainly not buying to certainly buying
-Data were submitted to ANOVA and PostHoc methods, Kruskal-Wallis test using the IBM SPSS 26

RESULTS AND DISCUSSION

-Attributes such as color and texture, showed great acceptance among participants
-It's possible to observe that these attributes attract more consumers attention
-The average and respective standard deviation were for Color 6.1±2.17, taste 5.4±2.11, texture 5.3±2.10 and global appreciation 5.6±1.97. The buying intention was 2.9±1.24

CONCLUSIONS

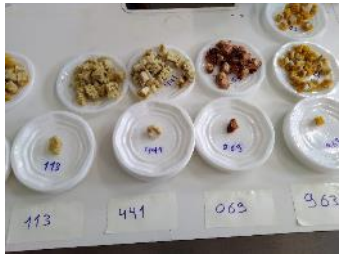
Maize Landrace's with a colour, such as red, had a better acceptance by consumers. The willing to pay was lower for whitish varieties even that they have soft textures. The present landraces do not exist in the market; hence it was possible to observe that they have a market with great potential, with the organic added interest. That can be explored in short supply chains.

ACKNOWLEDGMENTS

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727230 and by the Swiss State Secretariat for Education, Research and Innovation under contract number 17.00090. The information contained in this communication only reflects the author's view. IREA or SERI are not responsible for any use that may be made of the information it contains.

The measures related to the color and texture attributes were the ones that most showed significant differences. It´s possible to observe that these attributes attract more consumers attention

- It was possible to observe in this study that landrace maize have a market with great potential. And, as they have an organic origin, this factor generates even more customer loyalty and benefits for producers.



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Module 3 – Unit 4

FAST QUIZ https://forms.office.com/e/vuNj1tbQCs?origin=lprLink

- *Question 1: How many PPB projects exist in the world according Ceccarelli and Grando (2019)?*
  - *>25, >50, >75, >10*
- *Question 2: Indicate by alphabetic order, the initials of the four principles of organic agriculture defined by IFOAM*
  - *4 letters*
- *Question 3: Why on-farm activities are part of PPB strategy?*
  - *Local adaptation; Farmers' engagement; Participation of several actors; all the refered options above*
- *Question 4: PPB projects in Europe are in general adapted to organic farming systems*
  - *Yes/No*
- *Question 5: PPB modern technologies such as the use of data platforms (e.g. SEEDLINKED are not allowed)*
  - *Yes/No*

Send to :

pmm@esac.pt and petra.jelincic@ips-konzalting.hr

In 10 min

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Module 3 – Unit 4

DEBATE

- ❑ *Revise the quiz in common*
- ❑ *What I know about PPB?*
- ❑ *What I know about transdisciplinary?*
- ❑ *Other questions and doubts*

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WRAP UP

- *What we have learned today?*
- *Proposed homework: What is the nearest PPB project from your home. Characterize the chosen project in a brief paragraph (Start?, Responsible?, Crops?, What is the production system used?)*

Send to :

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By next Monday 17th february

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Additional available materials

Video casts (In English or French):

https://www.youtube.com/watch?v=DLEYIUQC3ZU

In France

Video of the field tour on organic seed. Faire revivre la biodiversité cultivée : un projet participatif (INRAE)

https://dynaversity.eu/2020/04/04/cereal-reinassance-in-the-field-documentary/

In Europe

https://eorganic.org/node/35654

In USA

MARCH 29, 2023

Practical Training for On-Farm and Collaborative Plant Breeding Webinar Series

https://www.youtube.com/watch?v=Nud4EbqUNQo

In Belgium

Les semences paysannes et la sélection participative

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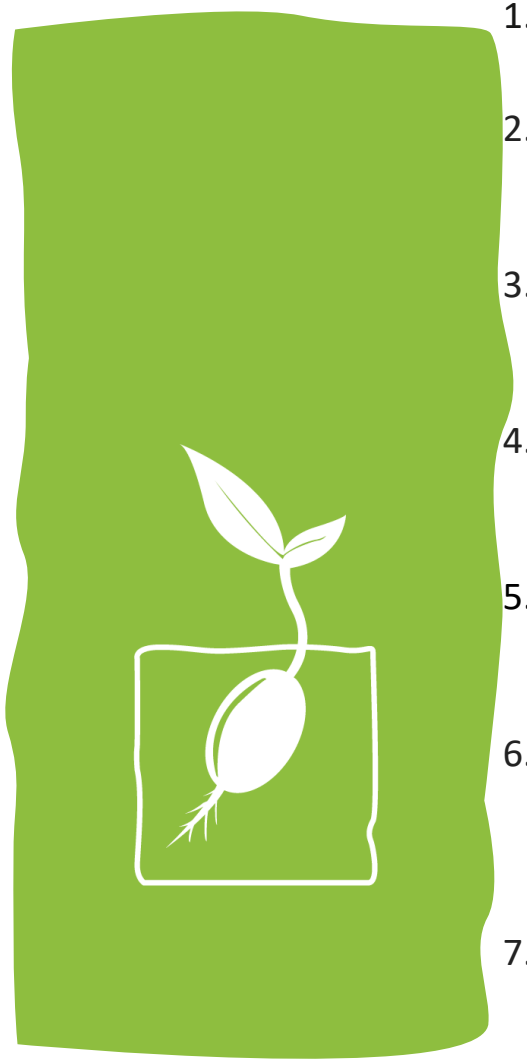
Additional available materials



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Acnowledgements

H2020 LIVESEEDING, H2020 LIVESEED GA number: 727230; **H2020-SFS-2014-2 project DIVERSIFOOD** 633571, FP7 SOLIBAM, FP6 FarmSeedOpportunities

PRR CERTRA

H2020 LIVESEED GA number: 727230; **H2020-SFS-2014-2 project DIVERSIFOOD** 633571

FCT and PDR2020Projets

Farmers that have helped us since the beginning of the project

ADERSOUSA, COPAGRI, CMLousada

Researchers : Silas Pêgo, Carlota Vaz Patto (ITQB), Rosário Bronze (ITQB), Carla Brites (INIAV), Daniela Santos, Isabel Dinis, Rui Costa (ESAC), João Mendes Moreira (FEUP)

Technicians : Luis Valério, João Vaz Pato

Collaborators: André Pereira, Ana Neri, Joanne Hovenkamp, Cláudia Brites, Daniel Gaspar, Manuel Paulo, Emanuel Amaral, Duarte Pintado, Mara Alves, Elsa Mecha, Andreia Bento da Silva, Catarina Bicho, Beatriz Oliveira, Bruna Carbas

And many others

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Funded by the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or REA, nor SERI or UKRI.

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Thanks for your attention!

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