

# Participatory research for organic agriculture: the case of Brassica plant breeding in Brittany

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**INRAE**  
30 November 2020

Online Postgraduate course

**Participatory Plant Breeding & Resilient  
Seed Systems:**

**Options for Stakeholder Engagement and Benefit  
Sharing**

30 November – 4 December 2020



This project received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement n. 773814



DYNAVERSITY

# Content

1. General context and objectives
2. One example: creation of the « bricoli »
3. Evolution of the collective organisation, emergence of the Community Seed banks of Kaol kozh
4. Activities of Kaol kozh, the seed association which had emerged from participatory researches

# Some words about Brittany in France

- North of Brittany, specialized in vegetable production and mainly cauliflowers.
- The oceanic climate allows cauliflower/cabbage production in autumn, winter and spring.
- Since the end of the 19th century, Brittany has developed this production
  - which increased mainly since 1960
  - and then, at the end of the eighties, when the F1 hybrid types were generalized.



# Brittany and organic farming

- Even if Brittany underwent a great intensification of its agriculture in the second half of the 20th century, this region of France was involved in organic agriculture very early.
- With 2,730 farms involved in organic production, **8% of Breton farms are organic**
- Main activity of Breton organic farms (on 01.01.18): dairy cattle: 771 (28%), **vegetables: 655 (24%)**

# The beginnings in the years 2000

In Europe, when the EU Regulation 1452/2003 requiring the use of organic seed for planting went into force, organic seed professionals were not ready to fulfil the demand.

- In Brittany, a group of organic farmers and their organisations started to meet with researchers and to build Participatory Plant Breeding projects.
- for the Brassica species, most modern varieties did not fit to the principles of Organic Agriculture.





# Modern Brassica varieties: for uniformity and stability



- Most seed companies have based the creation of F1 hybrid varieties of Brassicas (cauliflower, cabbage, broccoli...)
- The seed companies are mostly using the cytoplasmic male sterility (CMS) obtained from *Ogura radish*.

# The recent selection of cauliflowers in Brittany

## Before 1980

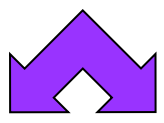
Step 1 "Population improvement"  
• mass selection and on farm seed production

## After 1980

Step 2 "Creation of homogeneous varieties"  
• creation of F1 hybrid varieties

## 21st century

Step 3 : two opposite trends



« modern varieties with biotechnologies »

Professional selection - mostly large international groups

« open pollinated populations »

Farmer and professional selection - local or independent structures

# Genetic resources evaluation

Breton Brassica landraces stored in 1983 at INRA, thanks to an European program supported by ECP-GR (*European Cooperative Program for Crop Genetic and Resources Networks*).



Evaluation of landraces of autumn and winter cauliflowers, and some local cabbages

- from Genebanks INRA Rennes
- from HRI Wellesbourne (UK), CGN Wageningen (NL), GEVES (France), and breeders



# 2000 – 2020 : All Brassica actions

## Evaluation of local genetic resources

- Re-Discovering of our patrimony
- Exploring other forms/landraces of Brassica

## Selection and adaption of landraces from genebanks

- Modifying few characters (colors, size, earliness, homogeneity)

## Creation of new types

- The “bricoli” of Kaol kozh

White breton cauliflower



Cabbage of Lorient



Di Jesi Cauliflower



Cape broccoli



Bricoli



# The “bricoli”

The idea: a good broccoli easily recognizable for organic farmers and consumers

Should associate:

- ✓ Good taste of sprouting broccoli
- ✓ Easy to harvest
- ✓ Good local adaptation
- ✓ And specific color

Ten years selection

Begun with SOLIBAM (EU project)

And was finalized by one farmer of Kaol kozh during DIVERSIFOOD



# LES PARENTS



Brocoli à jets  
'Di Cicco'

For the good  
taste

Pomme ronde et verte  
'Marathon'  
'Samson'



For the shape

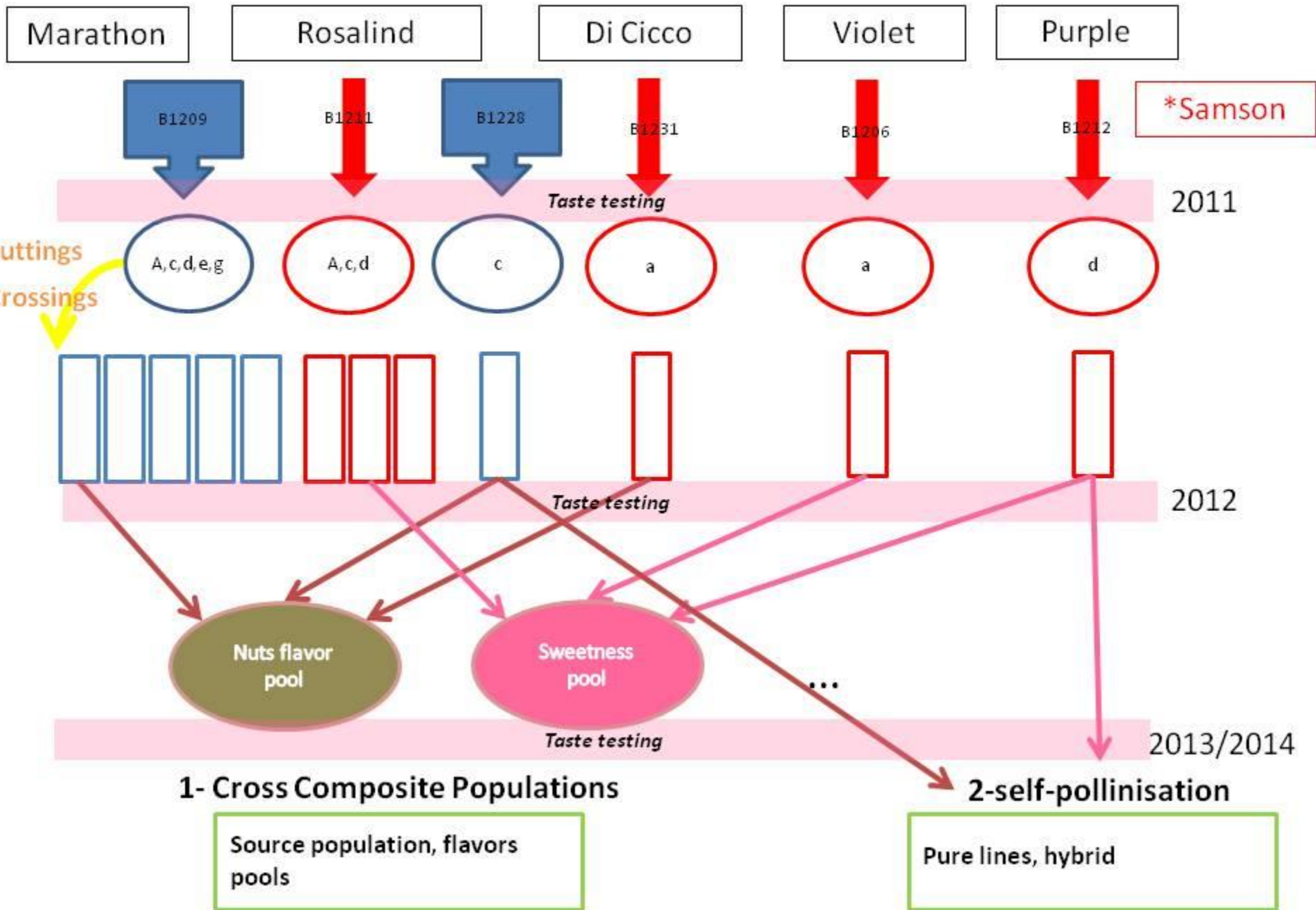


Pomme ronde et violette  
'Purple cape'  
'Rosalind'  
'Viola'



For the nice  
colour



# SOLIBAM Breeding strategy: Broccoli



# PhD Camille Vindras

N° ordre :2014-34  
N° Série : C-116

**THESE / AGROCAMPUS OUEST**  
Sous le label de l'Université Européenne de Bretagne  
pour obtenir le diplôme de :

**DOCTEUR DE L'INSTITUT SUPERIEUR DES SCIENCES AGRONOMIQUES, AGRO-ALIMENTAIRES, HORTICOLES ET DU PAYSAGE**

Spécialité : « Nom de la spécialité »  
Ecole Doctorale : « **VIE AGRO SANTE** »

présentée par :


« **CAMILLE VINDRAS-FOUILLET** »

**EVALUATION DE LA QUALITE SENSORIELLE DE PRODUITS POUR LA SELECTION PARTICIPATIVE EN AGRICULTURE BIOLOGIQUE : CAS DU BLE ET DU BROCOLI**

soutenue le 17 décembre 2014 devant la commission d'Examen

Composition du jury :

Directrice de thèse	Véronique CHABLE	Ingénieur de recherche (INRA)
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	Giovanni DINELLI	Professeur (Université de Bologne)
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	François HUSSON	Professeur (AGROCAMPUS OUEST)
	Estelle MASSON	Maître de conférences (UBO)
	Bruno TAUPIER-LETAGE	Ingénieur agronome (ITAB)



11  
TECHNICAL  
BOOKLETS

Recommended tests


How to prepare the samples

How to analyze the results


TASTING GUIDE :


Tools to integrate organoleptic quality criteria in breeding programs

Authors :	Camille VINDRAS Nicolas SINOIR
Reviewers :	Aude COULOMBEL Sally HOWLETT Frédéric REY Bruno TAUPIER-LETAGE
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Institut Technique de l'Agriculture Biologique





Ministère de l'Agriculture, de la Pêche et de l'Alimentation



Taste testing

2013/2014

### 1- Cross Composite Populations

### 2-self-pollinisation

Source population, flavors pools

Pure lines, hybrid

Plouescat – West Brittany

Chavagne – East Brittany

Eyragues – South of France



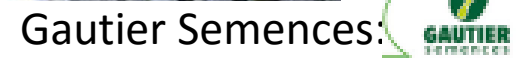
2015 and 16



2014

On-farm breeding

Mass selection



Gautier Semences: trials with 4 lines and 15 F1 Hybrids

No more news for the seed company



2019

Creation of the "bricoli" at René Léa' s farm Sold on farm and for restaurants

# DIVERSIFOOD - New approaches of plant breeding for diversified farming system

➔ Experimenting tools from fields to products





# New approaches of plant breeding for diversity and sustainable farming system

Objectives	Information type	Type of data	Experimental constraints	Experimental constraints	Experimental design	Method	
Study network of see circulation	Network topology	Bipart network for germplasm location	M8 - Network analysis				
		Unipart network for location	M8 - Network analysis				
		Unipart network for seed lots	M8 - Network analysis				
Study the response of populations under selection over several environments	Agronomic / Nutritional traits traits	Quantitative traits, single-trait approach	Number of plots per location: large	At least two locations and one year or more	M6a - AMMI M6b - GGE		
		Quantitative traits, multi-trait approach	Number of plots per location: low	At least 25 environments (i.e. number location x number year ≥ 25)	All locations share one control or more; entries are not replicated within and among locations	M7b - Bayesian hierarchical model GxE	
Improve the prediction of a target variable for selection.	Agronomic / Nutritional traits traits	Quantitative or qualitative traits, multi-trait approach	Number of plots per location: large	At least two locations and one year or more (i.e. number location x number year ≥ 2)	Same entries in all locations, all entries are replicated at least twice in each location	M1 - Non parametric; multivariate regressions; classification & regression trees, random forest	
Compare different populations evaluated for selection in different locations	Sensory	Napping test product sensory	Number of product < 12	Number of tasters > 10	M9a - Multiple factors analysis; Projection word frequency		
		Hedonic test	Number of product < 7	Number of tasters > 60	M9b - ANOVA; Hierarchical cluster analysis; Correspondence analysis on additional sensory descriptors		
		Agreeability test	Number of product < 6	Number of tasters > 12	M9c - Non parametric test on rank sums; Friedman's Test		
Study diversity structure and identify parents to cross based on either good complementarity or similarity for some traits	Agronomic / Nutritional traits traits	Individual genetic data	M3 - Genetic distances; trees				
		Quantitative or qualitative traits, multi-trait approach	Number of plots per location: large	At least one environment (i.e. number location x number year ≥ 1)	Same entries in all locations, all entries are replicated at least twice in each location	M2 - Multivariate analysis (PCA, clustering, discriminant analysis)	
		Quantitative traits, single-trait approach	Number of plots per location: large	One or several locations and one or several years	All entries are replicated at least twice	D1 - fully replicated	M4a - Anova
		Quantitative traits, single-trait approach	Number of plots per location: low	At least 25 environments (i.e. number location x number year ≥ 25)	All locations share one replicated control or more; entries are not replicated within and among locations	D1 - stallite and regional farms	M7a - Bayesian hierarchical model intra-location
			At least one environment (i.e. number location x number year ≥ 1)	Entries are replicated at least twice and distributed among environments	D2 - incomplete block design	M5 - Mixed models for incomplete block design	

## Experimental designs and statistical methods for PPB

Decision tree for statistical tools according to objectives/types of information/types of data/experiments/experimental constraints/

### METHODS AND TOOLS FOR DECENTRALIZED ON-FARM BREEDING




Booklet #3

This technical booklet describes experimental designs and statistical methods and tools that are relevant for decentralized on-farm breeding.



Isabelle Cloiringer (INRA) and Pierre Rivière (RSF), with the contribution of DIVERSIFOOD partners

**DIVERSIFOOD**

DIVERSIFOOD is a European Horizon 2020 project funded by the European Union under grant agreement no 633571. The project has received funding from the European Union's Horizon 2020 Programme under grant agreement no 633571.



# Collective organisation

- From the PAIS (Plateforme Agrobiologique d'Initiative Bio Bretagne à Suscinio)
- to the Maisons de Semences Paysannes (Community seed banks)



Une maison pour les semences à Roscoff



Roscoff, au printemps et Marie, vice-présidente de l'association KAOL KOZH (association pour la création de la Maison des Semences Paysannes à Roscoff).

L'association KAOL KOZH (vieux chou en breton et bien commun en russe) porte un de légumes méconnus du grand public : choux de Lorien, de Plompon ou Racalos de Rennes, véritable trésor pour Kaol Koth mais aussi pour la ville de Roscoff. Ainsi, en 2019, la première

# The PAIS

Plateforme Agrobiologique  
d'Initiative Bio Bretagne à Suscinio



- Created in 2000
- First PBB program in 2001 for organic cabbages and cauliflowers in 2001.
- The aim was to include all concerned actors (farmers, processors, traders, trainers, researchers...) in defining the objectives and the means to reach them.



6 hectares of open field  
and 800 m<sup>2</sup> of plastic greenhouse





# Creation of Kaol kozh in 2007



# Maison des semences in Roscoff (Community seed banks)



- A **professional** meeting point (access to seeds and technical equipments, etc.)
- A **training center** on seeds production and organic practices (for gardeners and professionals) with meeting room, practical work room, practical workshops
- A **varietal trials** and **seed production** area
- A **showcase garden** for the large public (with production of vegetables and their se aromatic plants, flowers, and sensory testing)
- A shop to buy peasant seeds for gardeners
- A **documentary center**, with access to various resources (books, DVDs, etc.) on peasant seeds
- Events throughout the year:
  - plant fair, farmers market,
  - art exhibitions,
  - open houses, seed barter,
  - Peasant Seeds festival ...
- A simple restaurant with local products from farmers' seeds



<https://www.roscoff-tourisme.com/fr/a-voir-a-faire/visites-et-decouvertes/a-visiter/la-maison-des-semences-kaol-kozh/>



# Kaol kozh, the association that cultivates as formerly



ouest  
france



Recherche : ville, actualité, fait divers...

Abonnez-vous



Se connecter



Réservé  
aux abonnés

## Roscoff. Kaol Kozh, l'association qui cultive comme avant

Kaol Kozh a obtenu un emplacement à Roscoff (Finistère) en juin 2019. Depuis, le jardin s'épanouit à vue d'œil, et abrite des légumes de tous les horizons.



**COMMUNITY SEED BANKS IN EUROPE**

COMUNITÀCHY  
RED DE WILKIAS  
RED LARIBAY  
MAISON DE  
SCIENCE  
SOCIETY COOP  
SAMENBLOTTRE  
PUB LIETEN  
MAATGEVAST  
BIOLOGISCHENLIST  
POPUSSEMERA  
CAMPO CONSERVAT EDU  
CASE DELLE SEMENTI

**REPORT**  
FROM A STAKEHOLDER  
WORKSHOP IN THE  
FRAMEWORK OF THE  
DIVERSIFOOD PROJECT,  
HELD IN ROME ON  
21 SEPTEMBER 2017

Edited by Beate Koller, Bele Bartha,  
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Petricer, Gerrit Roubien, David Martin Polo,  
Eira Roco, Aurora Sánchez, Simon von  
Südenhof, Kallisa Tsingou, Ronnie Vermooij

**CONTENTS**

- CDBs in Europe: Results
- The way to SMART analysis
- Presentation of initiatives
- Outlook with a global perspective

**COMMUNITY BIODIVERSITY MANAGEMENT:**

DIALOGUE BETWEEN REPRESENTATIVES OF COMMUNITY SEED BANKS AND INTERNATIONAL INSTITUTIONS

**REPORT**  
FROM THE WORKSHOP  
HELD ON THE  
22 OF SEPTEMBER 2017  
IN ROME AT FAO HQ

Authors: Riccardo Bocci, Veronique Chabli, Ronnie Vermooij, Mario Marino, Rodica Leahu, Beate Koller, Ximena Cadima, Sergio Romeo Alonso, Yiching Song, Regassa Feyissa, Mariam Sy, Maria Carrascosa, Pierre Rivière, Christian Damasso, Carina Fantoni, Ragnie Andersen

Edited with the contribution of Liviu Ortolan, Tara Dourian



# DIVERSIFOOD and DYNNAVERSITY



**Technical manual series on Community Seed Banks**

**Manual 1**  
**Community Seed Banks**  
Establishment, management and governance





# 2020: the PAIS has been recently closed

pressreader

Se connecter

Résultats de recherche

Le Télégramme - Morlaix

## Initiative Bio Bretagne ferme sa station de Suscinio

Initiative Bio Bretagne (IBB) a voté la fermeture de la plateforme agrobiologique de Suscinio au 31 décembre 2020.

18 sept. 2020 [+5 plus](#)

Créée il y a 20 ans, la plateforme agrobiologique d'Initiative Bio Bretagne (IBB) de Suscinio (PAIS), à Morlaix, a été initiée par la volonté politique d'indépendance des producteurs de légumes bretons en matière d'expérimentation 100 % biologique. Au fil des ans, la PAIS a été reconnue au niveau national, sans toutefois parvenir à trouver sa place technique au niveau régional. Ces deux dernières années, la fragilité de ses financements s'est accentuée, et en particulier suite au redressement judiciaire de l'Institut technique de l'agriculture biologique, partenaire pilote sur plusieurs projets. De plus, malgré les sollicitations d'IBB, les organisations de producteurs se sont éloignées de leur outil, ce qui a fini de cristalliser la situation.

Une décision unanime, prise avec « beaucoup de regrets » Lors de la journée « Goûtez la recherche en bio

Langue et région  
France (Français) >

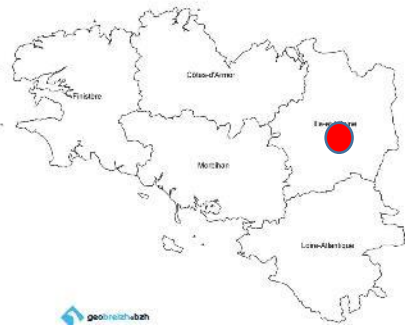
Pour Vous

Fil d'actualités

- En Manchette
- Conseillé
- Politique
- Économie
- Technologie
- Santé
- Sport
- Sciences



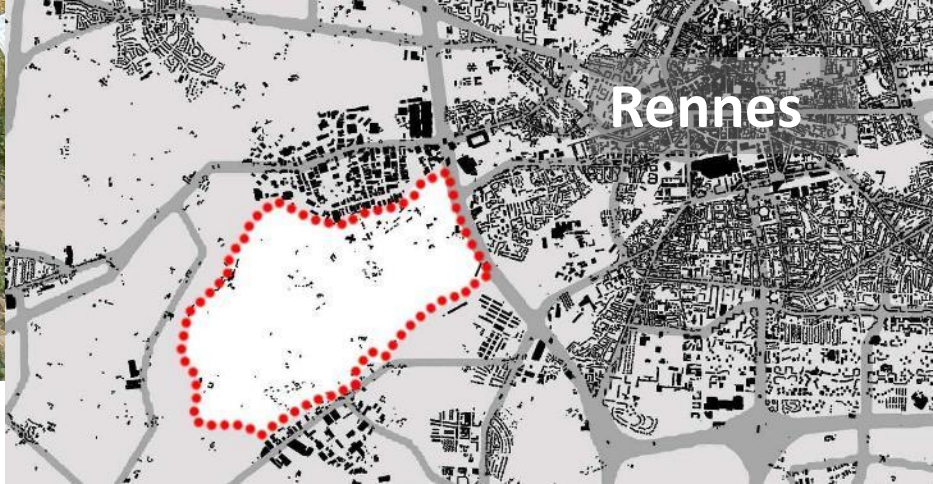
# Second Maison des semences in Rennes



An ancient farm in the Prevalaye in Rennes (South West)



There in  
2021



# And then at the same place, a « Maison du vivant »

- **For our INRAE team** (cultivated biodiversity and participatory research)
- Local link between the projects: “Prévalaye”, Kaol kozh and other initiatives
- Actions from local to international, to support the enlargement of cultivated diversity stored in genebanks
- Scientific and cultural animation for a holistic approach to organic food systems
- An anchoring in a territory of sciences renewed by the citizens for a collective project



# Brassica breeding in a network of Kaol Kozh





# In Brittany (France) since 2007

## Kaol Kozh

Association KAOL KOZH

Un patrimoine vivant, les semences en héritage

A living patrimony,  
seeds as a heritage



# The members

Gardeners,  
Citizens  
associations...

**Kaol  
Kozh**



COOP BIOBREIZH  
– long supply chain

Vegetable growers selling on-  
farm, in CSA, or local shop

**About 200 members**  
**All forms of marketing are represented**



# What are doing Kaol Kozh ?

- Management of the mention/label « Légume issu de Semence Paysanne » (*Vegetable from peasant seed*)
- Experimentation
- Multiplication and dissemination of seeds
- Looking for adapted machinery and sharing equipment
- Training and communication
- Setting of collective places for our « Community Seed Banks »



Kaol Kozh is managing a mention « Légume issu de Semence Paysanne »



**Vegetable grown from  
peasant seed**

30 candidate farms in 2020

Committee of evaluation

Attribution of the mention « Légume issu de Semence Paysanne »



COOP BIOBREIZH

Direct selling CSA/Amap

Local stores

Local marketing

Biocoop

Organic chains

Long distribution channels

Carrefour BioBreizh





# Experimentation, plant breeding and seed production on several species over whole Brittany



“ZAD” (in memory of the farmers and activists who have defended the place of Notre Dame des Landes also named ZAD (Area to defend) as the peasant seeds.



# An increasing network of farms/gardens for experimentation

- 13 farmers who hosted trials in 2018
- About ten species tested
- From simple characterization to "comparative" testing
- Cabbage, beans, tomatoes, parsnip, zucchini, turnip
- 150 populations observed





# Brassica, example 1: Exploring a collection at Chavagne

- From INRA genebank: a collection of best open pollinated varieties from the 70's stored in 1983
- A collection of 65 cultivars, very diverse and original







Pointed head  
Savoy cabbage



Large stalks  
kale (similar  
to chard)



Chou de Pontoise



Baccalan cabbage of Rennes



- Choice of original 7 cultivars adapted to local production
- Collective organization for the first multiplication before mass selection
- Multiplication based on 30 to 50 plants on 7 farms,
- Then mass selection to adapt to new environments and for quality



### Now, two exploitation channels:

- Pontoise cabbage sold by Agrosemens, a small scale seed company (Artisan semencier)
- And circulation within KK members and other vegetable growers



Early cabbages  
(bacalans, douarnenez...)

# Brassica, example 2: Chou de Lorient (Lorient cabbage)



- Plant breeding to modify the size of a traditional cabbage “Chou de Lorient”
- formerly used to supply, in winter, the sauerkraut manufacturers of Alsace: it is a large cabbage
- some farmers succeeded to reduce its size to be sold to families to be cooked or in salads,
- it is softer and sweeter than many other cabbages on the markets.
- To reach these aims, farmers use mass selection, directly in traditional cultivars



# A mass selection

- 15 to 30 plants
- Seed production in plastic greenhouses
- Re-plantation from field to greenhouse after selection OR production of cuttings on mother plants

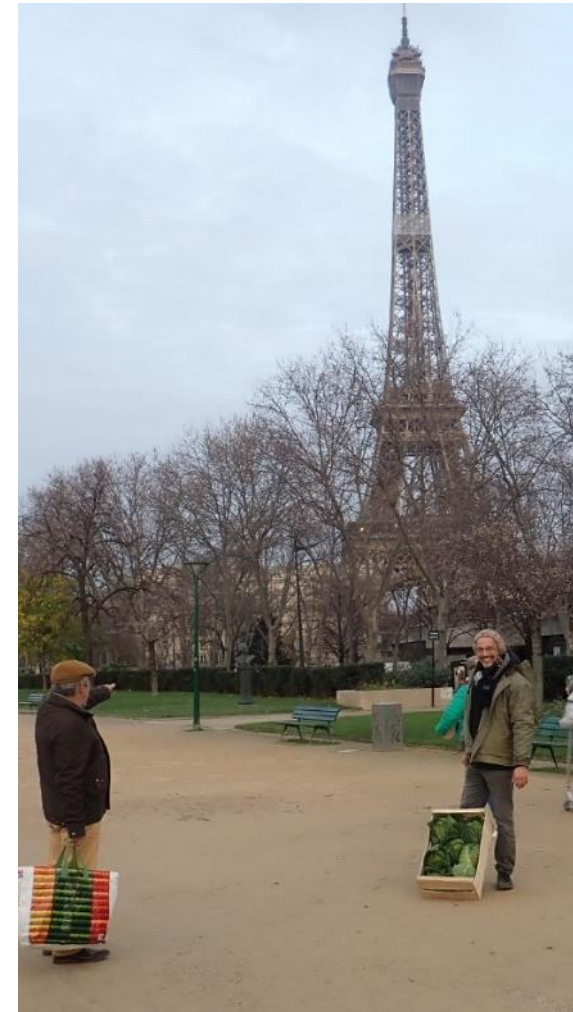


Distribution within Kaol kozh members or by small-scale seed companies such as Germinance, Graines del Pais

# Our participatory research: plants farmers and researchers together



sharing objectives, actions and making  
evolve our respective organisations  
since 2000







**Thank you.**



DYNAVERSITY