

Practical innovation in the food and farming sector

# On farm research for cultivated diversity

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"Innovation in the agri-food sector: for and by the people"

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# for and by the people ...

➔ **From uniformity to diversity**

## Objectives:

**To boost and to renew cultivated diversity aiming resilience of organic food chains/system and high quality food**

**And then to revive a culture about living processes thanks to a collective approach of agriculture and research in Europe**

At the beginning of the 2000's, the question was:

“What kind of seeds and research organisation for organic agriculture? “



# About F1 hybrid, the most prevailing modern variety

## PERSPECTIVES

### TIMELINE

#### Biotechnology in the 1930s: the development of hybrid maize

Donald N. Duvick

Hybrid maize was one of the first examples of genetic theory successfully applied to food production. When first introduced, it seemed almost miraculous; starchy hybrids convinced sceptical farmers that 'the professors' and their arcane science could do them some good. Strangely, the genetic basis of heterosis (hybrid vigour) was and still is unknown. But to this day, newer hybrids continue to outyield their predecessors; they do so because they are tougher and healthier.

Hybrid maize (*Zea mays*) is not new, but the biological and sociological bases on which it was built are now considered as new — and disturbing — by some segments of the public.

When hybrid maize was invented and presented to US farmers in the first decades of the twentieth century, it was based on two new operations, one biological and the other socio-economic. First, strange manipulations (forced inbreeding and controlled hybridization) produced biological products that had never before existed in nature. Second, farmers gave up their time-honoured practice of saving their own varieties of seed in favour of annual purchases of hybrid maize seed.

These two actions are deplored today by some elements of society as the undesired and potentially dangerous consequences of the application of biotechnology (especially, of genetic transformation) to plant breeding<sup>1,2</sup>. ('The term 'biotechnology' has many definitions, but is used here to refer to the branch of molecular biology that uses recombinant DNA technology to study, categorize and

manipulate genetic materials. Genetic transformation, also called genetic engineering, is one kind of biotechnology.)

Why were similar concerns not expressed 70 years ago when maize hybrids were bred and released rapidly and on a large scale in the heart of the United States 'Corn Belt'? I will consider these questions in the light of the following account of the origins and development of hybrid maize.

#### Darwin, maize and hybrid vigour

Charles Darwin did many experiments to test his theory on the 'origin of species'. One of them involved a comparison of inbred and cross-pollinated maize. He noted that the progeny of cross-pollinated maize plants were 25% taller than the progeny of self-pollinated plants and had greater tolerance to cooler growing conditions. From these experiments, he concluded in 1876 that, as a general rule, cross-pollinated (hybrid) plants have "greater height, weight, and fertility" as compared with their self-pollinated counterparts because of their "greater innate constitutional vigour"<sup>3</sup>.

In the United States, William Beal at Michigan State College was encouraged by Darwin's observations on hybrid vigour and hybridized pairs of open-pollinated varieties of maize. Beal observed increased vigour and grain yield in the hybrids of different varieties and, in 1880, he encouraged the use of this method<sup>4-7</sup>. However, because the results of further experiments were unpredictable, hybridization seemed to have no future as a way to improve maize yields and general per-

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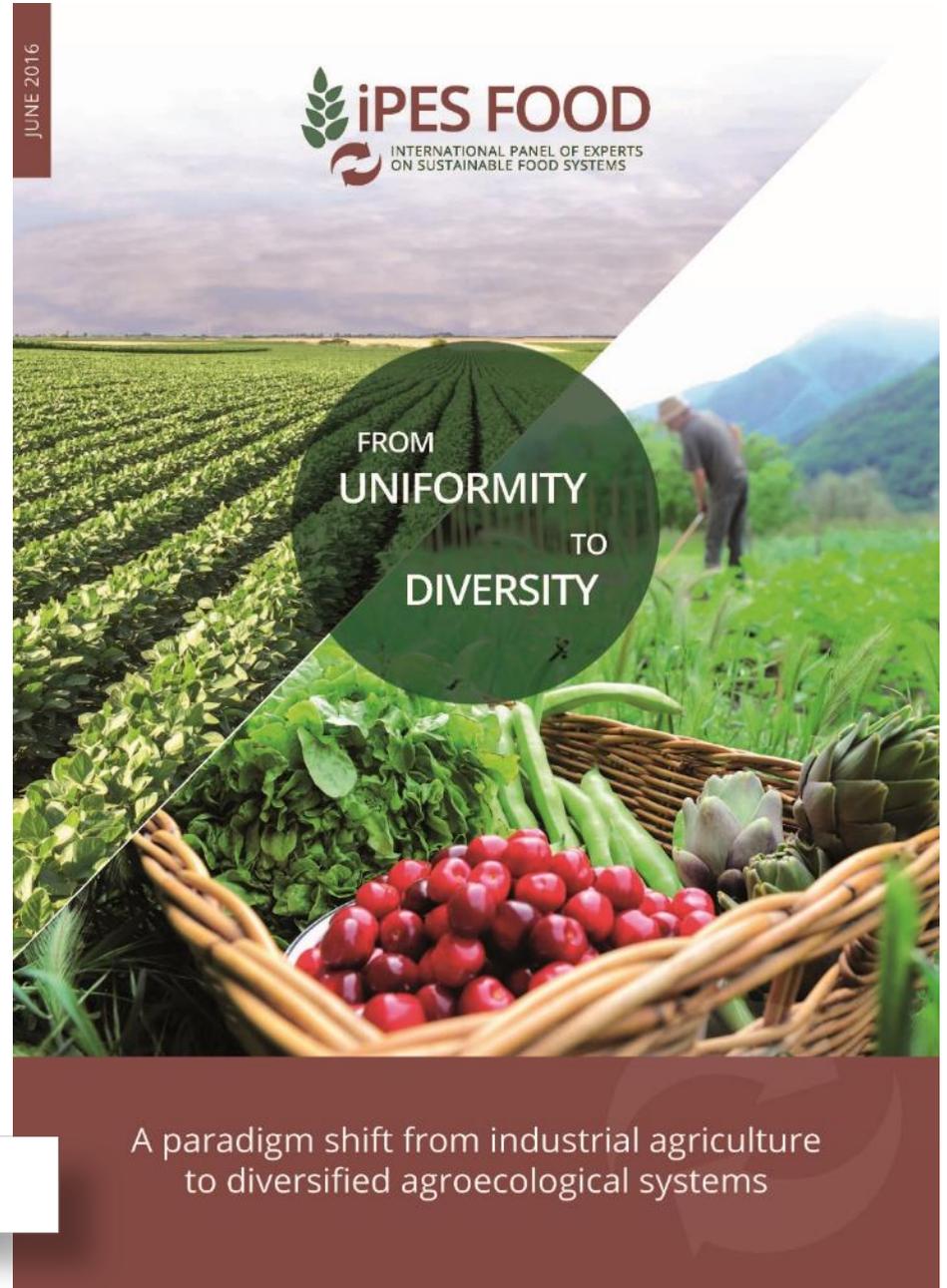
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Corn Belt at two separate institutions on the Atlantic seaboard (East worked in Connecticut, Shull on Long Island in New York), independently rediscovered the phenomenon of inbreeding depression and hybrid vigour in maize, and reported their results independently in 1908 (REFS. 11,12). They went further than Darwin did, by self-pollinating several generations to produce essentially homozygous (pure-breeding)

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# From uniformity to diversity

2016



**Our hypothesis : Life is DIVERSITY**

# DIVERSITY for living agroecosystems and human organisations

- **Sharing a conception of research with a participative, multi-actor and transdisciplinary approach**
- **To shape an agriculture which respects and boosts living processes for resilience**

# Innovation in European farms from diversified « varieties »

Seeds from centre of genetic resources

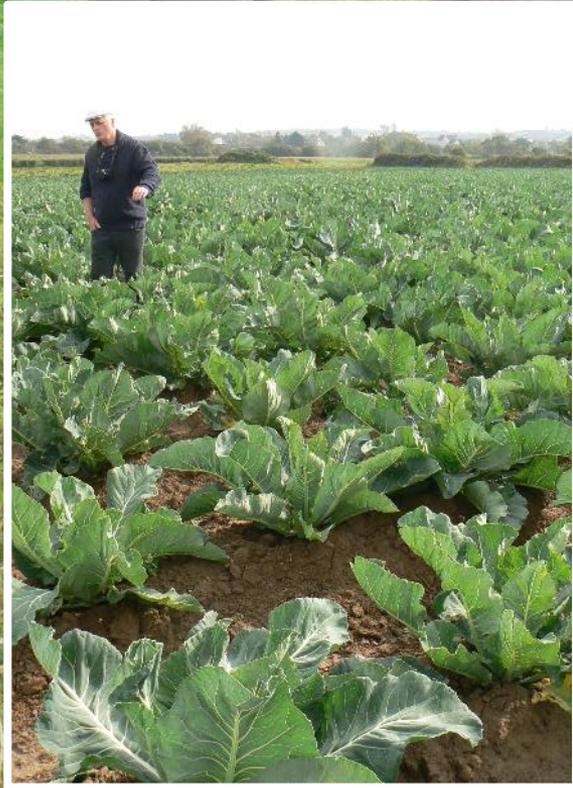
Seeds from gardeners



Putting back in the field forgotten diversity and creating new diversity



Farmers'/peasant seeds









# Triptolème



One seed association association, created 12 years ago.

With about 120 members in 2018, in three French regions: Brittany, Normandy and Pays de Loire, in France





# European Coordination for Let's Liberate Diversity!

At the moment the members of EC-LLD are the following organizations:

- the Scottish Crofting Federation (Scotland)
- Pro Specie Rara (Switzerland)
- Réseau Semences Paysannes (France)
- BEDE (France)
- Red de Semillas “ Resembrando e Intercambiando” (Spain)
- Centro Internazionale Crocevia - CIC (Italy)
- Rete Semi Rurali (Italy)
- Dachverband Kulturpflanzen- und Nutztiervielfalt e. V. Dachverband (Germany)
- Ecoruralis (Roumanie)
- SEED(Luxembourg)



# Our overall context of our European research

building resilient and high quality food systems



- Networks of researchers, farmers and other actors involved in organic agriculture

- Funding, since 2007, by 3 consecutive European Framework Programmes for Research and Technological Development



The EU Framework Programme  
for Research and Innovation

**HORIZON 2020**



*9. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy*

## General objective

- “ to contribute to securing sufficient supplies of safe, healthy and **high quality food** and other bio-based products, by developing productive, sustainable and resource-efficient primary production systems, fostering related ecosystem services **and the recovery of biological diversity, alongside competitive and low carbon supply chains.**”

# Progresses through EU 3 projects

Common hypothesis : DIVERSITY



Situation Europe of « non conventional varieties »

Observation and testing diversified crop populations

On farm research

Seed regulation recommendations

Strategies for performance and quality

Working on key-concepts

Participatory research

Policy recommendations on seed, research and food system

Broadening crop diversity

Multi-actor and transdisciplinarity

Social organisation

Economic impact

Culture about food

4 species

7 species

15 species



# Broadening and reviving diversity

Seed from genebanks  
gardeners or farmers



Local or heritage  
landraces/varieties

Discovering our  
heritage and

And creating new  
diversity for a  
coherent organic  
agriculture

New populations  
and locally adapted  
varieties varieties  
bred on farm



Evaluation from **soil** to  
products



DIVERSIFOOD

# On farm research

Example: to manage quality of bread for farmer-baker



# The multi-actor concept

Common objective embedded in the food chain reality



# Now, current trends



- Organic agriculture development in Europe
- Success of “seed network and “Community seed banks” and on-farm plant breeding
- Willingness to **rediscover a large panel of forgotten species and underutilised species**, strengthening authenticity and quality of organic products
- Aims **to fit better to organic principles** (ecology, health, fairness and care)
- **“Sustainability” of multi-actor research** mainly supported by foundations and European commission



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www.diversifood.eu

**FINAL**  
*congress*

**RENNES - FRANCE**  
**10-12 DECEMBER**  
**2018**

Cultivating  
diversity and  
food quality



Enabling crop diversity and  
resilience for local high quality  
food systems



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**Registration:**

<https://symposium.inra.fr/diversifood2018>

[www.diversifood.eu](http://www.diversifood.eu)



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organic agriculture  
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