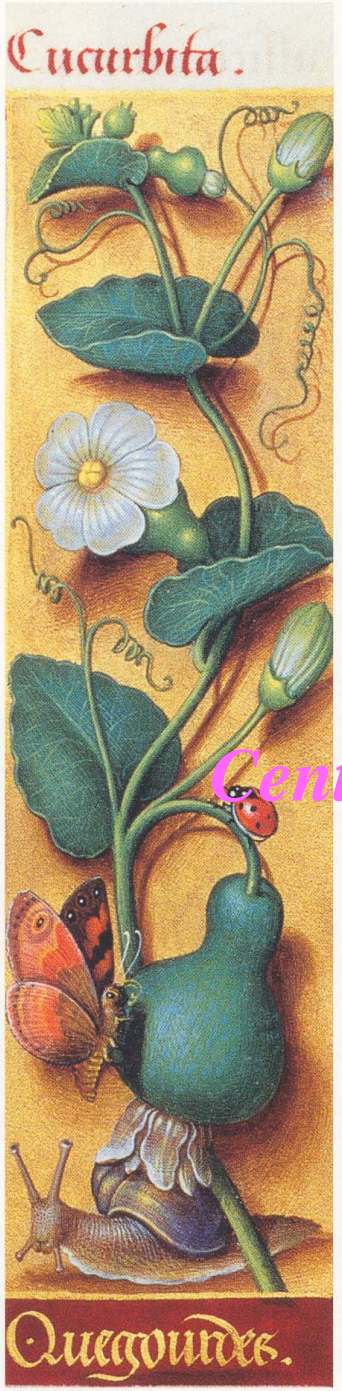


Roundtable. The Future of Food

Venezia 2008

Pere Puigdomènech

Centre for Research in Agricultural Genomics

CSIC-IRTA-UAB

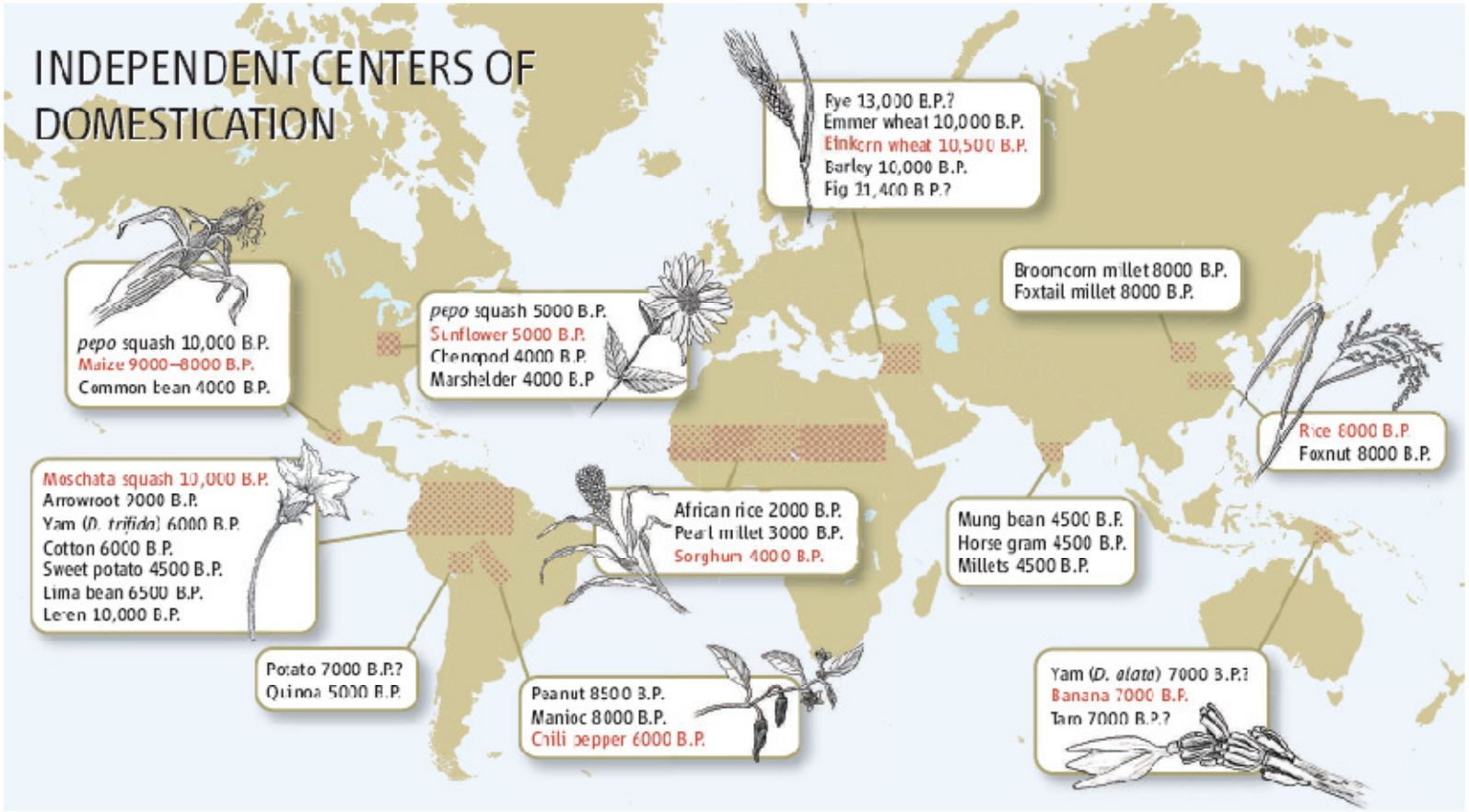
What do we eat?

- We eat what is nutritious
- We eat what we choose as a function of our needs, our possibilities, our believes and our tastes

But also:

- We eat what we can cultivate
- We eat now what a complex industrial chain provides to us

Plant domestication centres



Multiple birth. People in many different parts of the world independently began to cultivate and eventually domesticate plants.

Maize, the gift of gods

All in the family. Maize and its wild ancestor teosinte (*left*) are closely related despite their differences.

fw2.2: A Quantitative Trait Locus Key to the Evolution of Tomato Fruit Size

Anne Frary,[1*] T. Clint Nesbitt,[1*] Amy Frary,[1†]
Silvana Grandillo,[1‡] Esther van der Knaap,[1] Bin Cong,[1]
Jiping Liu,[1] Jaroslaw Meller,[2] Ron Elber,[2] Kevin B. Alpert,[1]
Steven D. Tanksley[1§]

L. pimpinellifolium *L. esculentum*

Science 289, 85-88. (2000)

Plant domestication

Rice domestication

Rice Domestication by Reducing Shattering

Changbao Li, Ailing Zhou, Tao Sang*

Crop domestication frequently began with the selection of plants that did not naturally shed ripe fruits or seeds. The reduction in grain shattering that led to cereal domestication involved genetic loci of large effect. The molecular basis of this key domestication transition, however, remains unknown. Here we show that human selection of an amino acid substitution in the predicted DNA binding domain encoded by a gene of previously unknown function was primarily responsible for the reduction of grain shattering in rice domestication. The substitution undermined the gene function necessary for the normal development of an abscission layer that controls the separation of a grain from the pedicel.

Melon as a vegetable

var *tibish*

var *flexuosus*

var *chate*

Domestication

1. Plants cultivated in new habitats
   (less adpated – more variability)

2. Absence of natural selection pressure

3. Selection by man of characters non-beneficial to plants in natural situations

XXth century contradicts Malthus

- The birth of Genetics
- Fertilizers, pesticides, fungicides and herbicides
- Agronomic techniques (including mechanization, irrigation, etc.)
- Green revolution

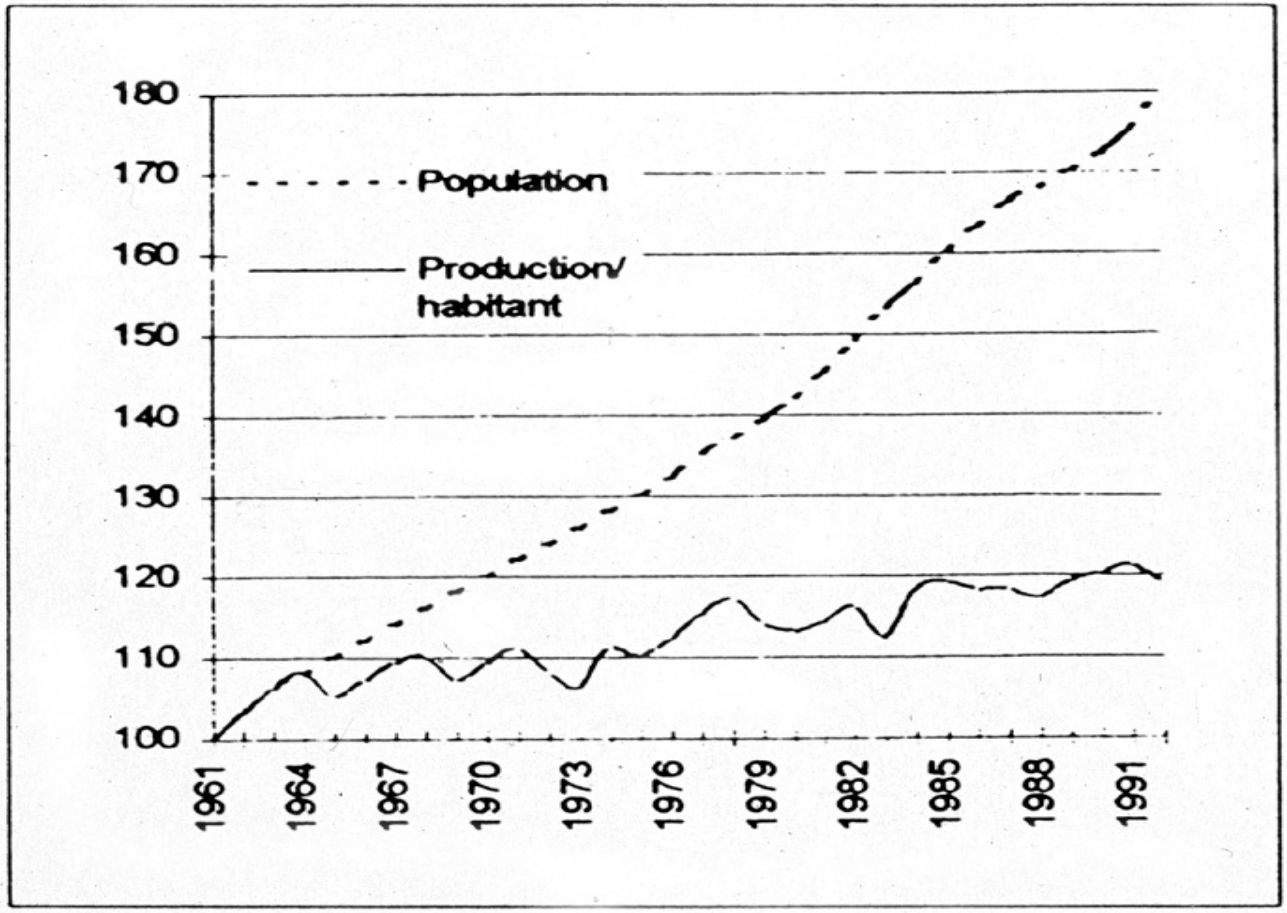


Figure 4. Évolution globale de la production agricole et de la population de 1961 à 1992 (indice 100 en 1961) [11].

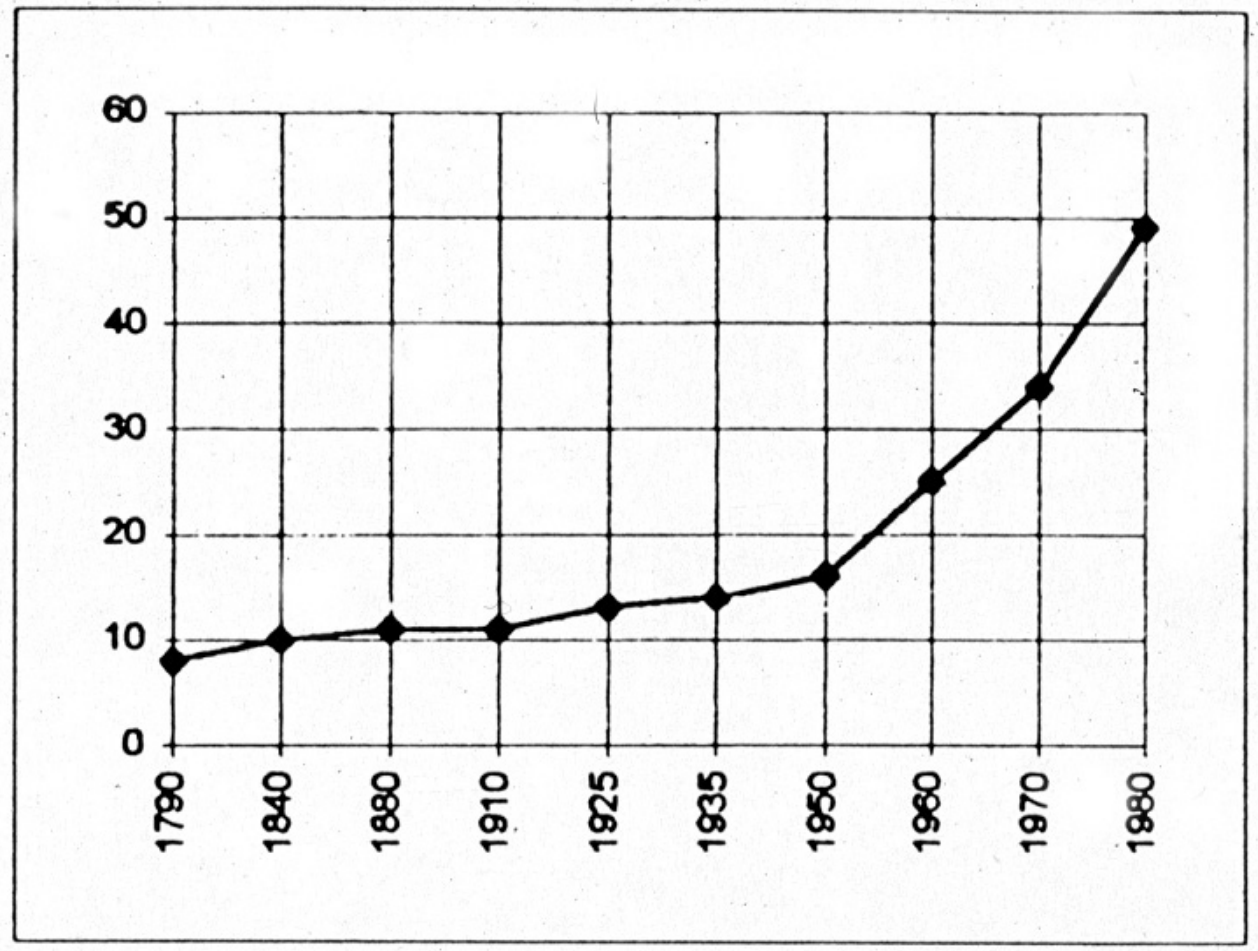


Figure 5. Évolution des rendements moyens en céréales en France de 1790 à 1980 (Rdt. q/ha) [12].

History of plant modification

		Wild species	
-10000 years	Domestication	↓	Beginning of agriculture
		Cultivated plants	
1859	Darwin: Evolution of species	↓	1. Conscient introduction of characters
1865	Mendel: Laws of Genetics		2. Selection
		Enhanced plants	
1953	Watson/Crick: DNA structure	↓	Directed introduction of characters
1960-1970	In vitro cell culture techniques		
1983	Plant transformation		Transgenic plants
2001	Arabidopsis genome		
		Plant design	

Genetics appears in decssive moments

- In plant and animal domestication
- In the applications of Mendel's laws during XXth century
- When Molecular Biology is applied since 1970
- Genomics appears at the end of XXth century

Arabidopsis thaliana

Chromosomes	5
DNA molecules lenght	115 Mb
Genes	25.498
Genes with EST	60 %
Gene density	4,5 Kb/g
Gene length	2 Kb

Phylogenetic relations in multicelular organisms

(J. Bennetzen, (2002) Science **296,** 60-3)

Vol 436|11 August 2005|doi:10.1038/nature03895 nature

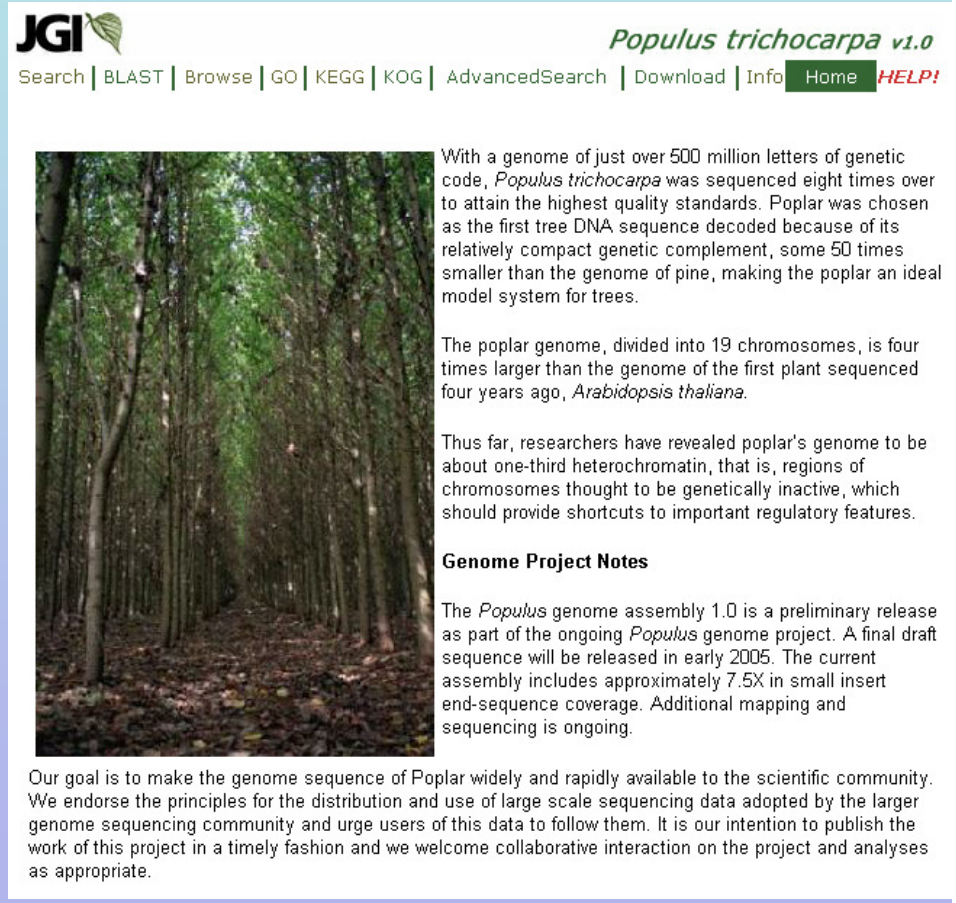
ARTICLES

The map-based sequence of the rice genome

International Rice Genome Sequencing Project*

Rice, one of the world's most important food plants, has important syntenic relationships with the other cereal species and is a model plant for the grasses. Here we present a map-based, finished quality sequence that covers 95% of the 389 Mb genome, including virtually all of the euchromatin and two complete centromeres. A total of 37,544 non-transposable-element-related protein-coding genes were identified, of which 71% had a putative homologue in *Arabidopsis*. In a reciprocal analysis, 90% of the *Arabidopsis* proteins had a putative homologue in the predicted rice proteome. Twenty-nine per cent of the 37,544 predicted genes appear in clustered gene families. The number and classes of transposable elements found in the rice genome are consistent with the expansion of syntenic regions in the maize and sorghum genomes. We find evidence for widespread and recurrent gene transfer from the organelles to the nuclear chromosomes. The map-based sequence has proven useful for the identification of genes underlying agronomic traits. The additional single-nucleotide polymorphisms and simple sequence repeats identified in our study should accelerate improvements in rice production.

Populus genome



The grapevine genome sequence suggests ancestral hexaploidization in major angiosperm phyla

The French–Italian Public Consortium for Grapevine Genome Characterization*

Nature advance online publication 26 August 2007 | doi:10.1038/nature06148; Received 5 April 2007; Accepted 7 August 2007; Published online 26 August 2007

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The European Group on Ethics in Science and New Technologies

to the European Commission

The group is an independent, pluralist and multidisciplinary body which advises the European Commission on ethical aspects of science and new technologies.

Web site address:
http://ec.europa.eu/european_group_ethics/index_en.htm

Questions addressed to the Group (2005-2009)

- Ethical aspects of Nanomedicine (December 2006)
- Ethical criteria for the approval of european research projects using embryo stem cells of human origin (June 2007)
- Ethical aspects of consumption of meat from cloned animals (January 2008)
- Ethical aspects of new developments in agriculture (December 2008?)

Concerns at the beginning of XXIst century

- Concerns related to food production: hunger divide, safe and healthy food
- Concerns related to the effects of agriculture on the environment:Biodiversity loss. Degradation of the environment. Habitat loss, deforestation, water use and water pollution, contribution to climate change

Concerns at the beginning of the XXIst century

- Concerns related to social and political conditions: Political instability. Disruption of social structures and massive urbanisation. Control over food supply. Conflicts around food in the international trade
- Concerns related to the changing global situation: Population growth, globalisation of threats (pests, etc.), climate change, reducing oil reserves

General criteria

- **Food security.** The right to food, distributive and social justice, beneficience and non-malificience
- **Sustainability.** Antropo- and ecocentric approaches: human beings, environment and future generations

- We have to use all the tools available to secure suficient, safe and healthy food for people in all places and in the future and, as we have done in the past, science will be a key factor in the future.