BIODIVERSITY GROW.®
Commitment to Sustainable Agriculture

Jornada BioDiversidad y Sistemas Agroalimentarios Sostenibles Valencia.
19 de Mayo de 2026

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Food for Biodiversity

Q&A
QUALITY AND ADVISER
consultoría y formación

Crop biodiversity and germplasm banks for more diverse and resilient food systems

Jaime Prohens

Universitat Politècnica de València (Spain)

1. The generation of domesticated biodiversity

The process of domestication transformed wild species into cultivated species

Domestication

Domestication

1. The generation of domesticated biodiversity

And human and natural selection in different environments and cultures generated a wide diversity, with more than 3000 species having been domesticated, each with multiple landraces

Examples of diversity in major and minor Solanaceae crops

Tomato (*S. lycopersicum*)

Peppers (*Capsicum spp.*)

Common eggplant (*S. melongena*)

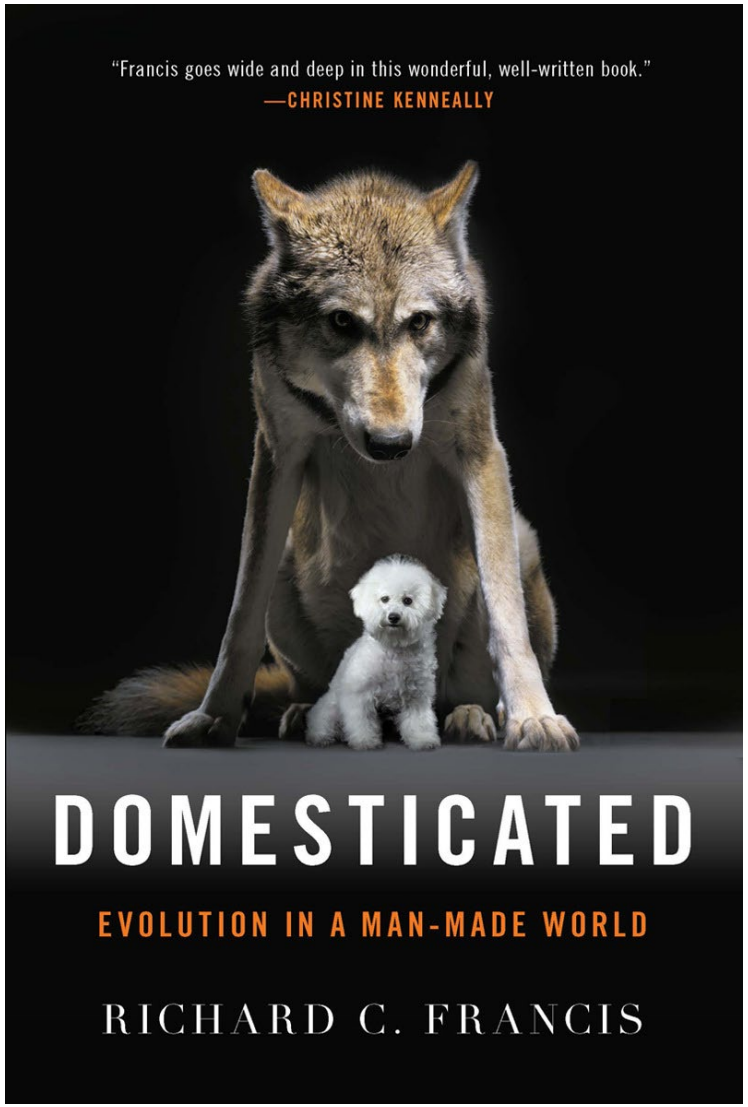
Pepino (*S. muricatum*)

Gboma eggplant (*S. macrocarpon*)

Scarlet eggplant (*S. aethiopicum*)

1. The generation of domesticated biodiversity

In domesticated animals, the same processes resulted in the creation of a high morphological diversity

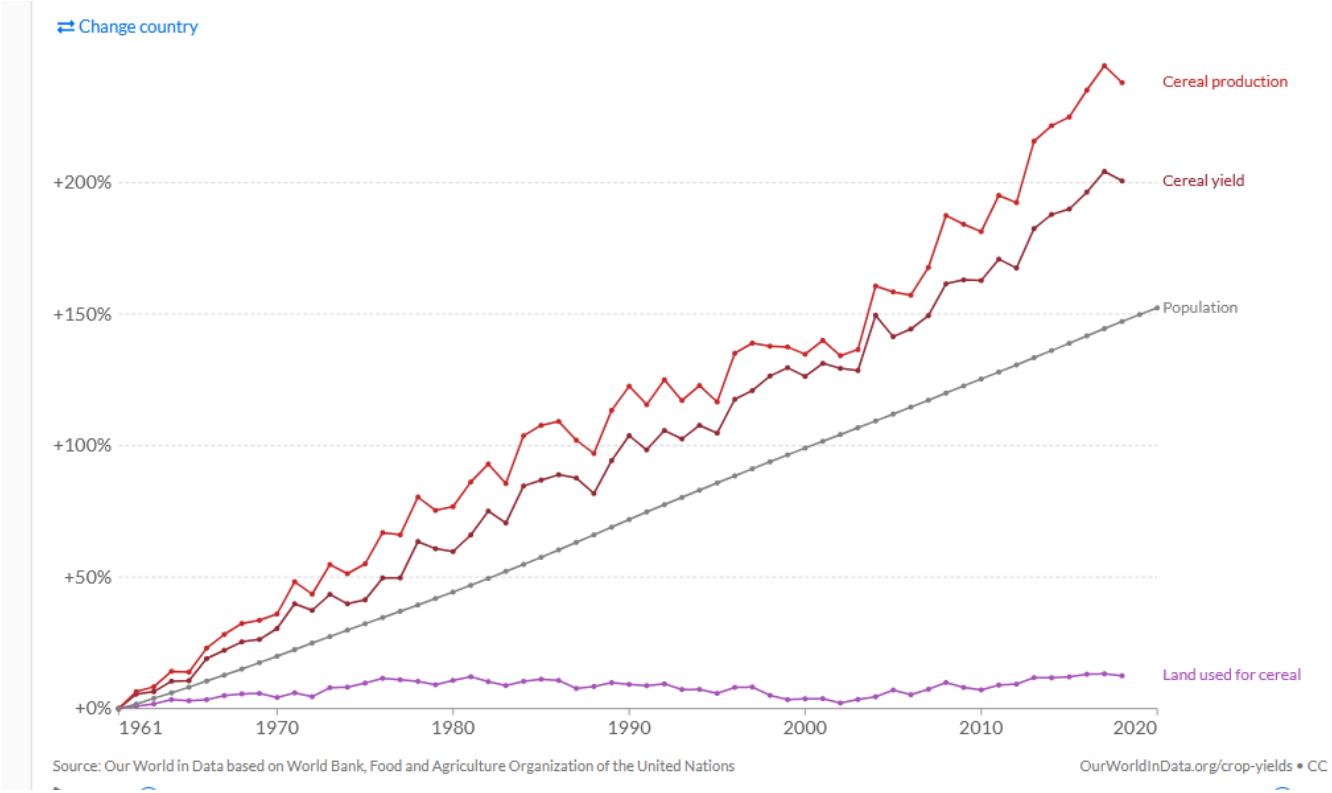


2. Why do we need crop biodiversity?

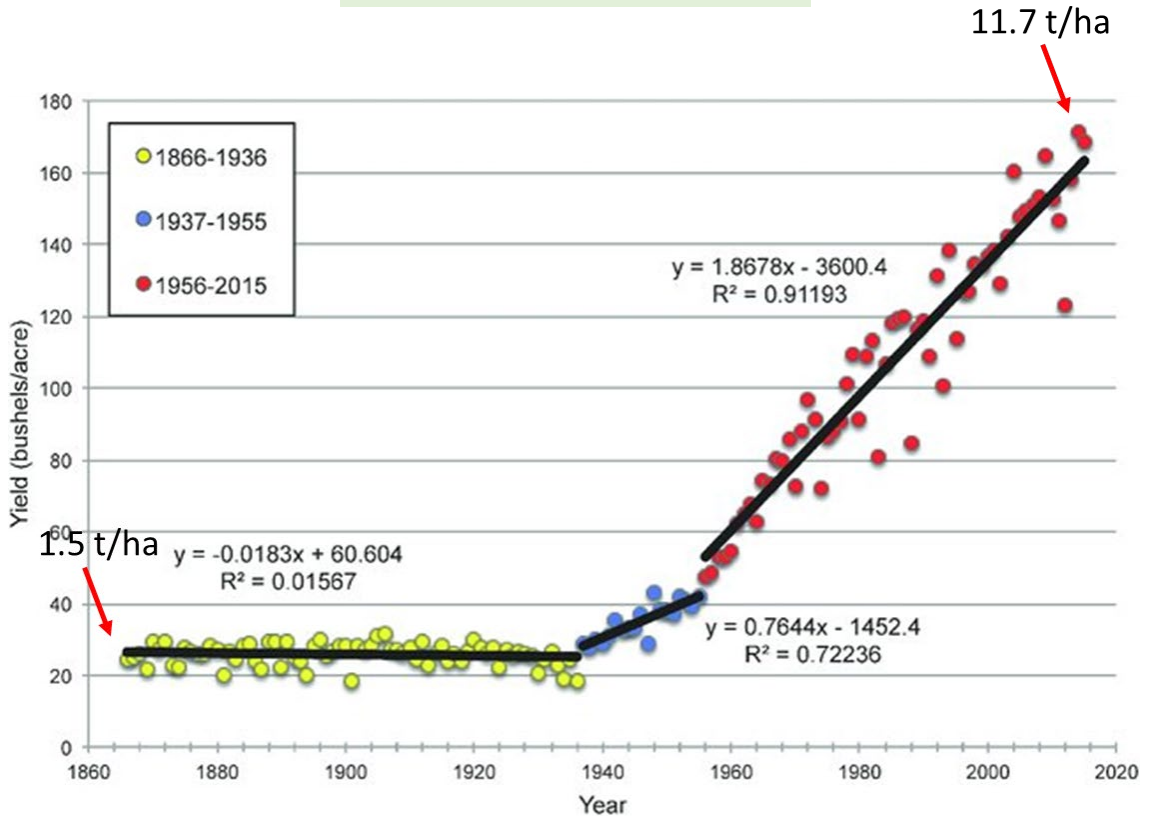
Crop biodiversity (including landraces of cultivated species and their wild relatives) have allowed the development of improved varieties that have allowed impressive increases in productivity

Breeding has contributed around 50% to the increase in crop yields in the last century

Cereals yield and production



Maize yields in the US



2. Why do we need crop biodiversity?

Crop biodiversity allows new genetic combinations and the selection, development and breeding of new varieties with improved yield, quality, resistance to pests and diseases, tolerance to abiotic stresses and with better efficiency in the use of water and nutrients

‘De Penjar’ tomato: able to grow without irrigation and long postharvest

2. Why do we need crop biodiversity?

Breeding has been very efficient in improving yield

However, this has resulted in genetic erosion, in which the local landraces that have been the “raw material” for developing new improved varieties have been replaced by the new varieties

This has resulted in a loss of diversity and the disappearance of many landraces that are no longer available for being used in breeding

Local varieties

Diversity

Genetic erosion

Uniformity

3. Germplasm

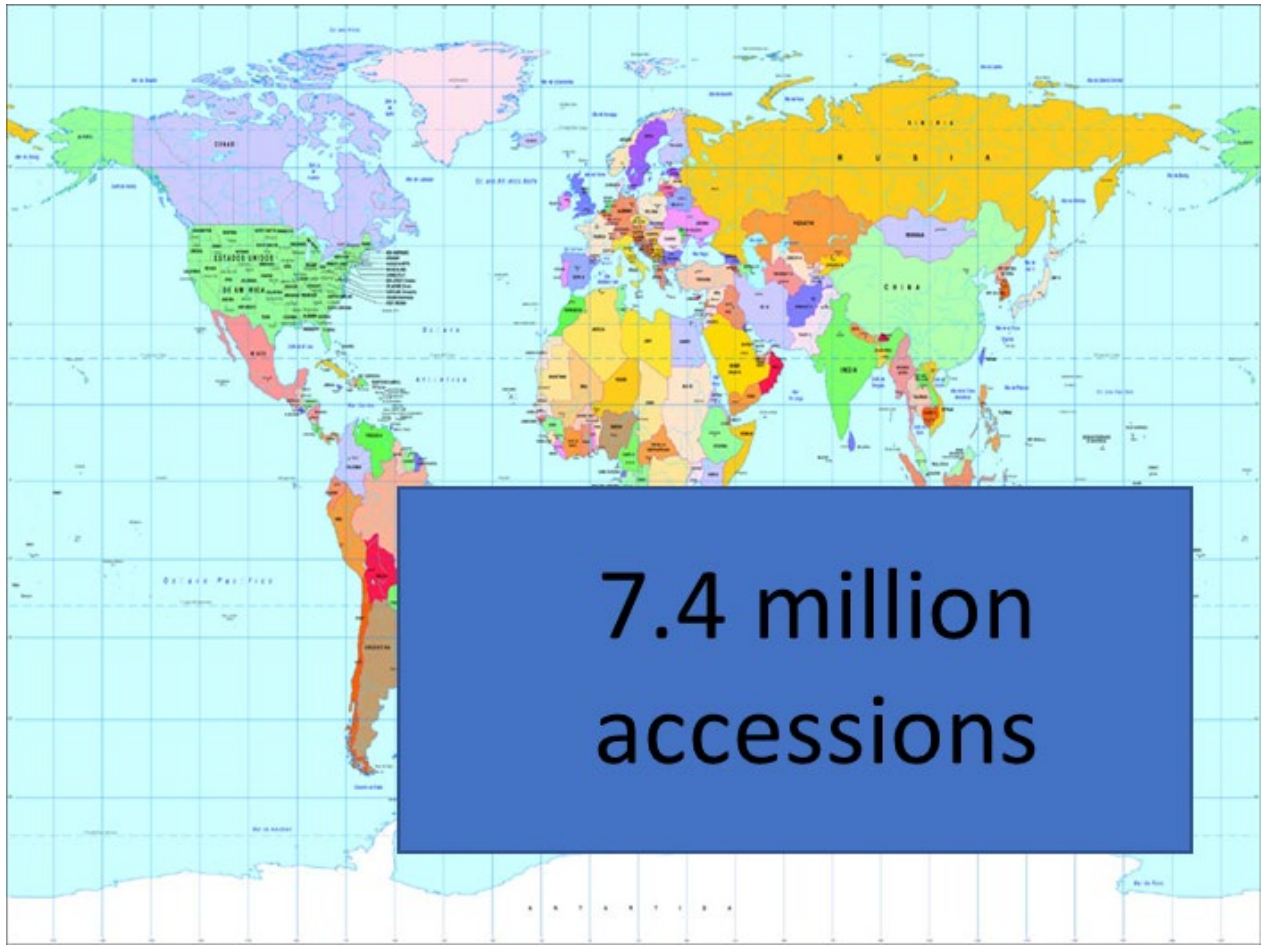
Germplasm consists of living genetic resources such as seeds or tissues that are maintained for the purpose of plant breeding, recovery of diversity, and research

Germplasm materials

- Modern and obsolete varieties
- Breeding materials
- Local, traditional varieties
- Exotic materials
- Wild species

3. Germplasm

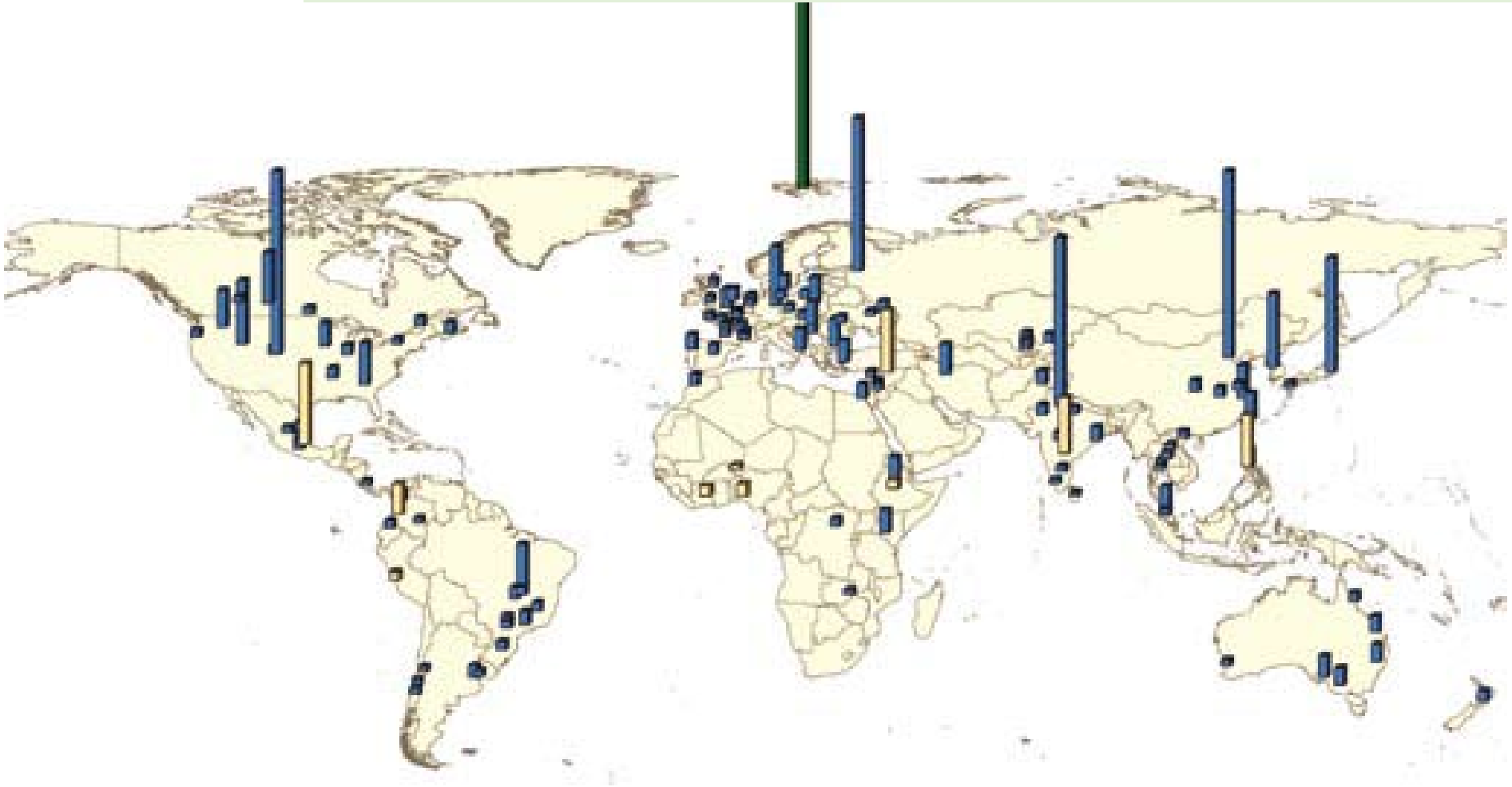
Germplasm of many crops and crop wild relatives has been collected and conserved along the last decades in germplasm banks.



3. Germplasm

Germplasm of many crops and crop wild relatives has been collected and conserved along the last decades in germplam banks

Geographical distribution of the 130 germplasm Banks with over 10.000 accessions



National and regional banks

CGIAR Centers

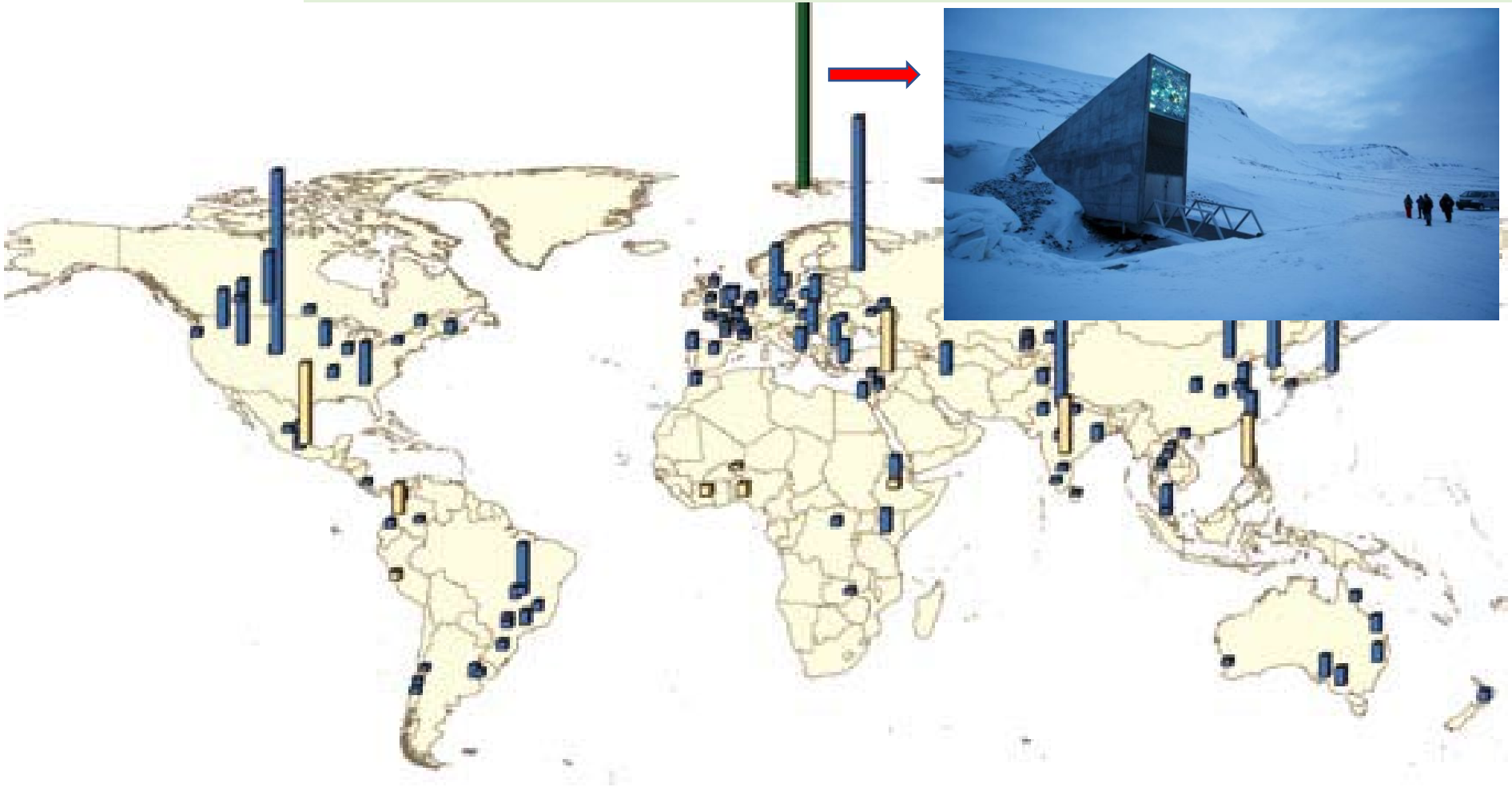
Consultative Group on International Agricultural Research

Svalbard Global Seed Vault

3. Germplasm

Germplasm of many crops and crop wild relatives has been collected and conserved along the last decades in germplam banks.

Geographical distribution of the 130 germplasm Banks with over 10.000 accessions



National and regional banks

CGIAR Centers

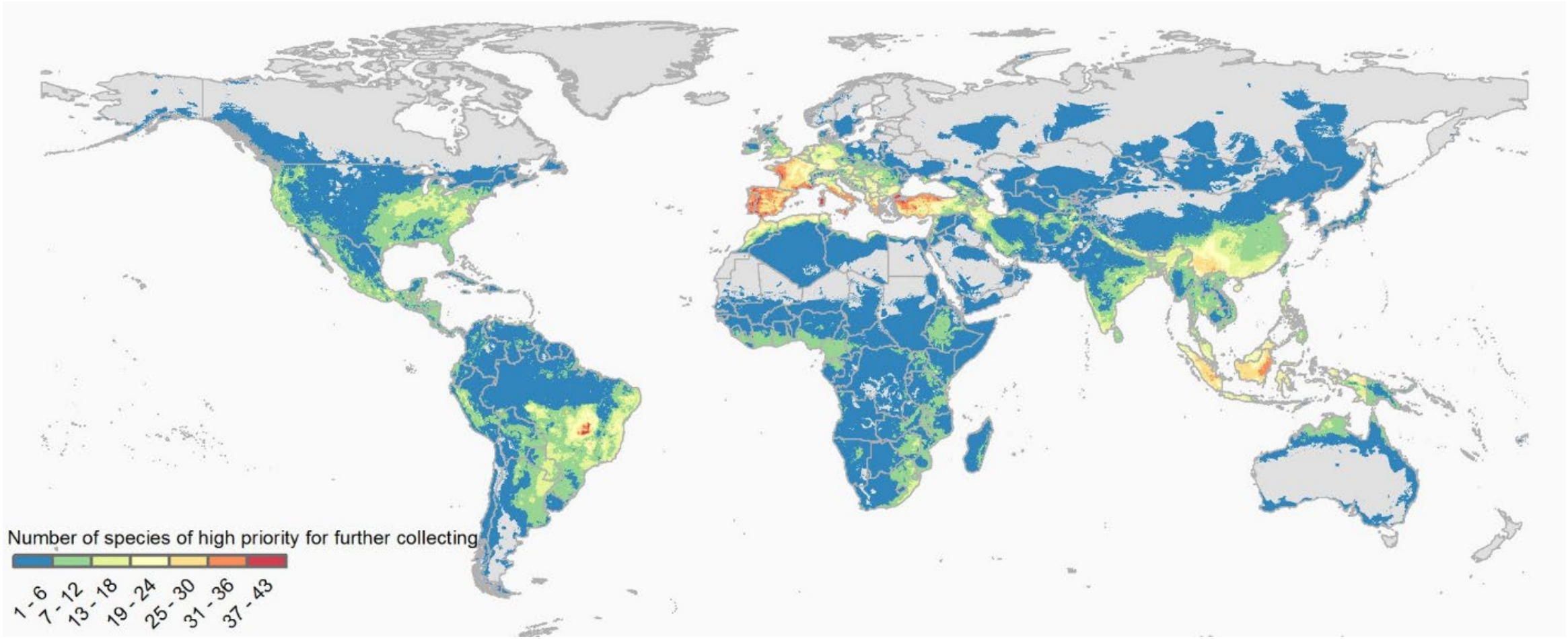
Consultative Group on International Agricultural Research

Svalbard Global Seed Vault

3. Germplasm

For major crops a high percentage of crop diversity is safeguarded in germplasm banks, but the situation is very different for locally important crops and wild species

Geographic hotspots of distributions of crop wild relatives not represented in germplasm banks



4. The UPV germplasm bank

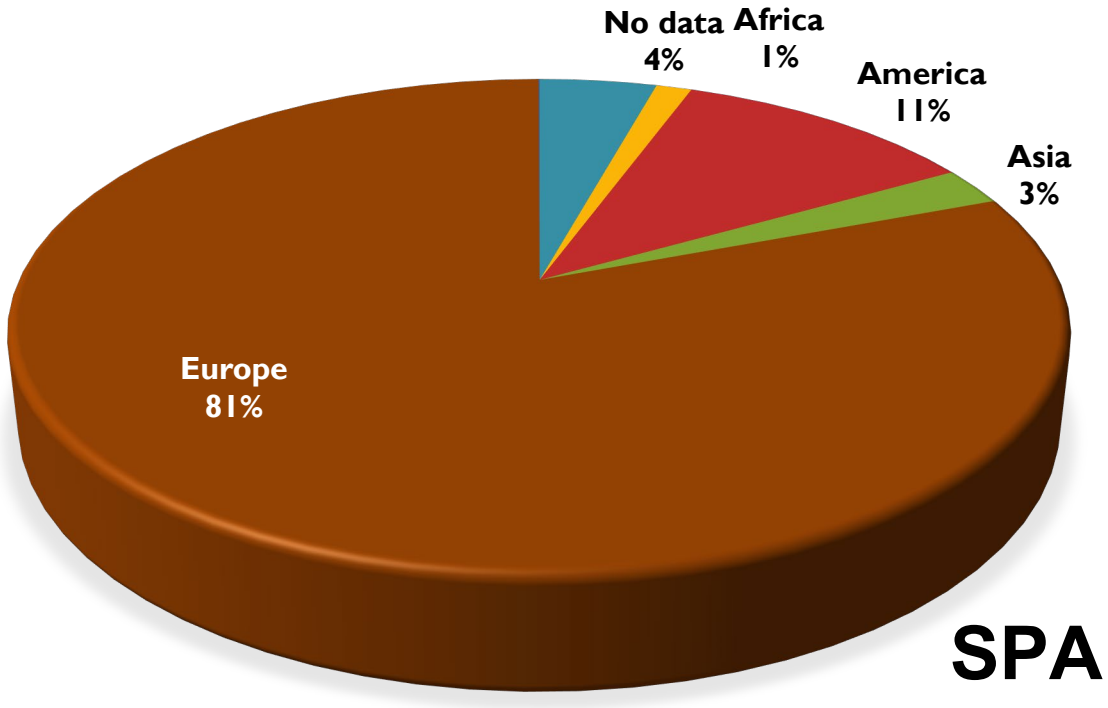
The germplasm bank of UPV is specialized in vegetable crops and stores 13,556 accessions. We are one of the >400 official germplasm banks in Europe (FAO code: ESP026)

Crop	Number of accessions	
Solanum spp (tomato and wild relatives)	3716	6058
Capsicum spp (pepper and wild relatives)	2032	
Solanum spp (eggplant and wild relatives)	310	
Cucumis melo and wild relatives	1249	3107
Cucurbita (*C. maxima, C. moschata, C.pepo, C. ficifolia, C. argyrosperma*)	1225	
Cucumis sativus	232	
Citrullus lanatus and wild relatives	364	
Other cucurbits (*Lagenaria, Cyclanthera, Momordica, Luffa*, etc.)	37	
Lactuca sativa y *Cichorium endivia*	1123	
Pulses (*Phaseolus, Vicia, Pisum, Arachis, Cicer, Lens, Lathyrus*, etc.)	975	
Brassica (*B. oleracea, rapa, carinata, napus*. etc.)	864	
Apiaceae (*Allium* spp., *Daucus, Coriandrum, Petroselinum, Pastinaca, Apium*, etc.)	681	
Chenopodiaceae (*Beta vulgaris, Spinacia oleracea*)	197	
Others	551	
TOTAL	13556	

4. The UPV germplasm bank

The collection of the UPV germplasm bank started in 1982 and contains mostly landraces and wild relatives from Spain and South America

- **Spain**: Local varieties of all crops
- **South America**: Collecting expeditions performed by COMAV and exchange of materials with the Tomato Genetic Resources Center (TGRC, California, Davis) and ARS GRIN (USA)
- **Rest of the world (103 countries)**: Exchange of materials with germplasm banks and researchers (local varieties, improved cultivars, breeding materials)



SPAIN: 77%

4. The UPV germplasm bank

Samples are conserved at 4 ºC in cold chambers and stored in flasks with silica gel.
These conditions allow preserving the germination for over 30 years in most materials

1) Desiccation chambers

2) Flasks with silica gel

3) Storage at 4ºC in cold chamber

5. Utilization of the UPV germplasm collection

Conservation is only the beginning. For an efficient use it is necessary to make a characterization and evaluation of the materials

Characterization is performed using standardized descriptors for each crop

Descriptors for

Tomato

(*Lycopersicon* spp.)

International Plant Genetic Resources Institute
IPGRI

CHARACTERIZATION

7. Plant descriptors

7.1 Vegetative

7.1.1 Seedling
Records should be taken when the seedling primary leaves are fully opened and the terminal bud is around 5 mm in size

7.1.1.1 Hypocotyl colour (4.1)
1 Green
2 1/4 purple from the base
3 1/2 purple from the base
4 Purple

7.1.1.2 Hypocotyl colour intensity
3 Low
5 Intermediate
7 High

7.1.1.3 Hypocotyl pubescence
0 Absent
1 Present

7.1.1.4 Primary leaf length [mm]
Average of 10 cotyledonous leaves

7.1.1.5 Primary leaf width [mm]
Average of 10 cotyledonous leaves

7.1.2 Plant characteristics
Records should be taken when the fruits of the 2nd and 3rd truss are ripened

★ **7.1.2.1 Plant growth type** (4.2)
Observed on the whole plot, after admixtures have been removed
1 Dwarf
2 Determinate
3 Semi-determinate
4 Indeterminate

7.2.2.3 Intensity of greenback (green shoulder) (8.4)
3 Slight
5 Intermediate
7 Strong

7.2.2.4 Fruit pubescence

		Reference variety
3	Sparse	*L. esculentum*
5	Intermediate	*L. pennellii*
7	Dense	*L. hirsutum*

★ **7.2.2.5 Predominant fruit shape** (5.2)
Recorded after the fruits turn colour. (See Fig. 4)
1 Flattened (oblate)
2 Slightly flattened
3 Rounded
4 High rounded
5 Heart-shaped
6 Cylindrical (long oblong)
7 Pyriform
8 Ellipsoid (plum-shaped)
9 Other (specify in descriptor **7.4 Notes**)

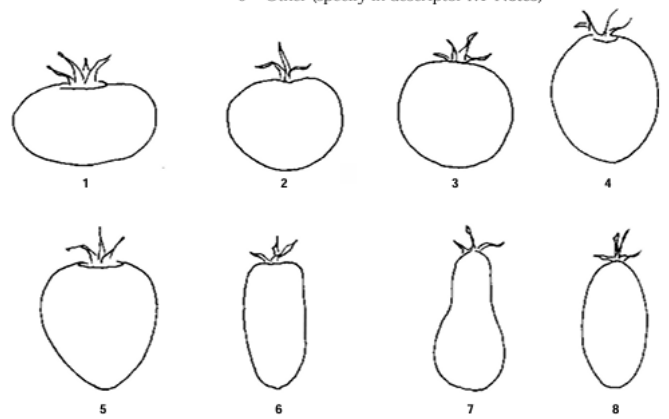


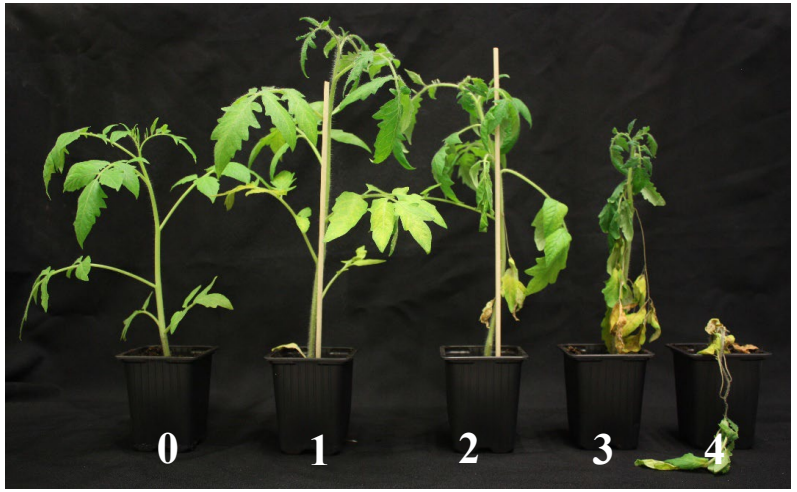
Fig. 4 Predominant fruit shape

5. Utilization of the UPV germplasm collection

Evaluation for traits of interest, such as resistance to diseases, tolerance to abiotic stresses, and complex quality traits

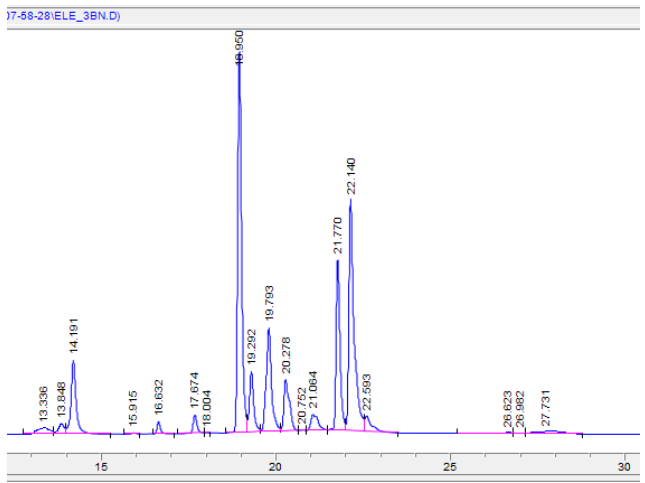
- Evaluation for **resistance to pests and pathogens**
- Evaluation for **quality** traits
- Evaluation for adaptation to **abiotic stresses**
- Enhancement of **traditional varieties**

Fusarium tolerance

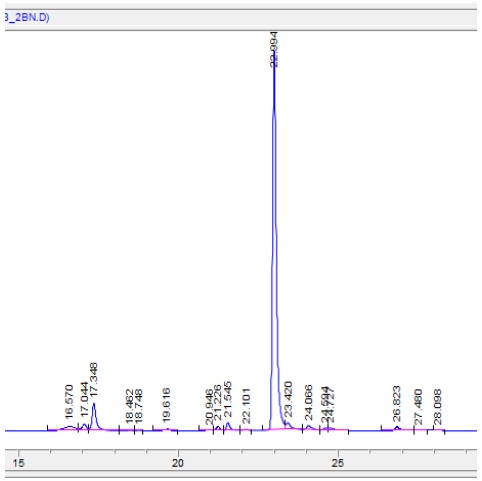


Phenolic acids pattern

S. elaeagnifolium



S. melongena



Drought tolerance

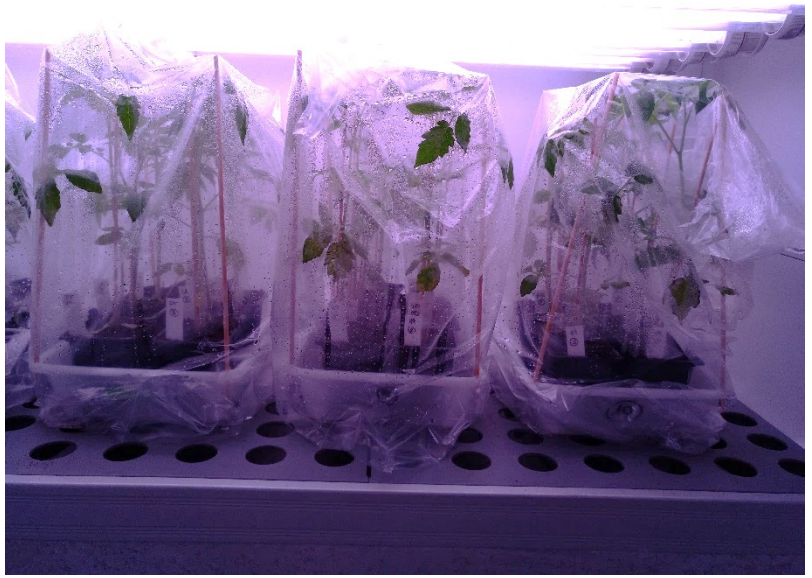
S. melongena

S. elaeagnifolium

5. Utilization of the UPV germplasm collection

A great emphasis is on the evaluation of resistance to diseases, including new ones, which contributes to resilience

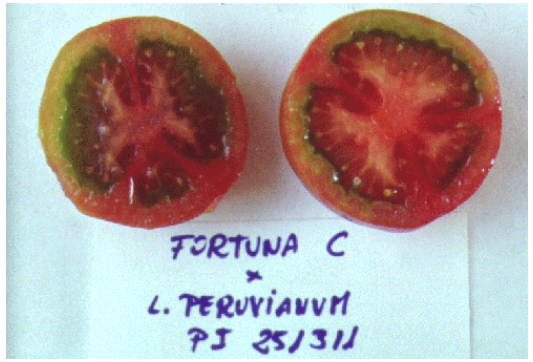
- *Fusarium oxysporum*
- *Pseudomonas syringae*
- Tomato mosaic virus
- Pepino mosaic virus
- Tomato spotted wilt virus
- Tomato yelow leaf curl virus
- Tomato brown rugose fruit virus

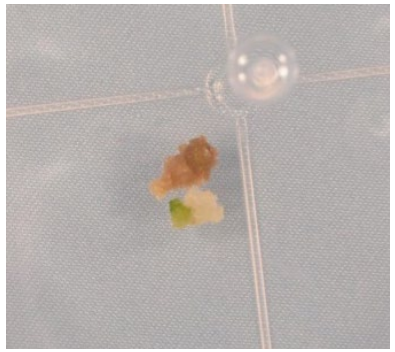


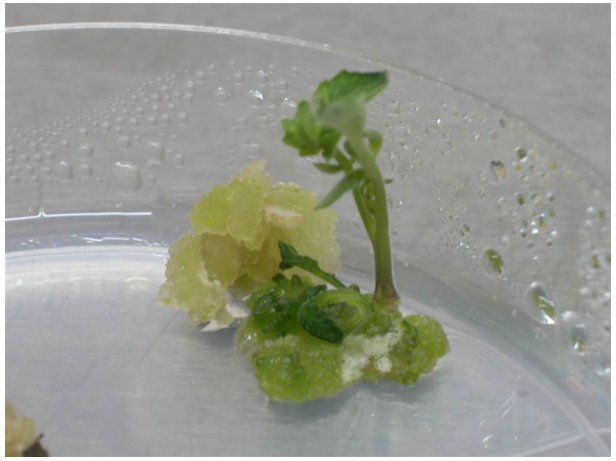
5. Utilization of the UPV germplasm collection

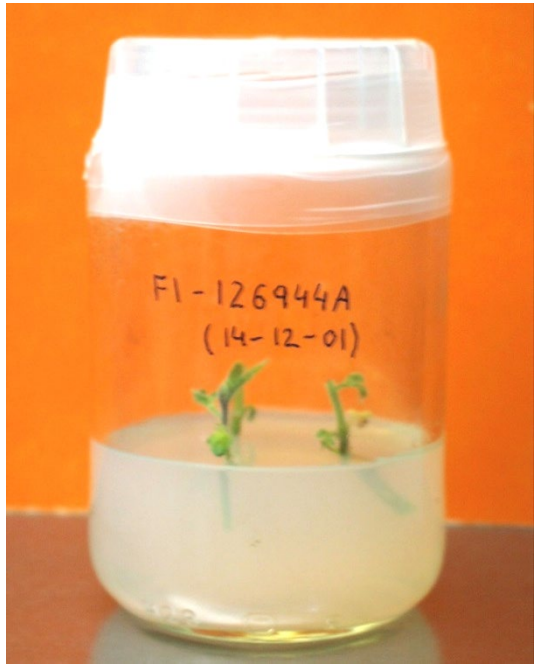
New discovered sources of resistance are used in crosses to introduce the resistance into the genetic background of lines or varieties of interest

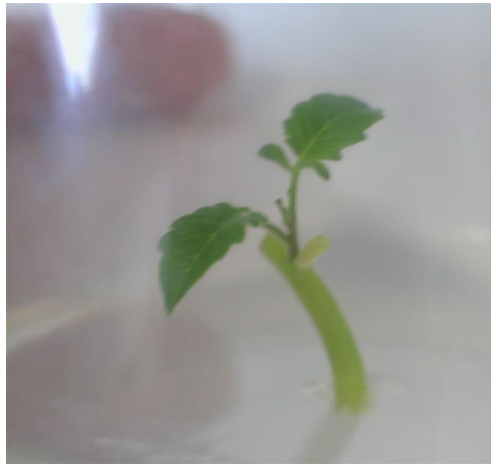
Tomato (recipient) × *S. peruvianum* (donor)











5. Utilization of the UPV germplasm collection

The increasing importance of organic and sustainable agriculture and the interest for diversification has meant a revival of local varieties

- Locally adapted and demanded
- Higher prices obtained by farmers
- Protected by PDO or PGI
- Contribute to a more sustainable and resilient agriculture

Santorini tomato

onion landrace *Laaer Zwiebel*

Italian *Solina* wheat

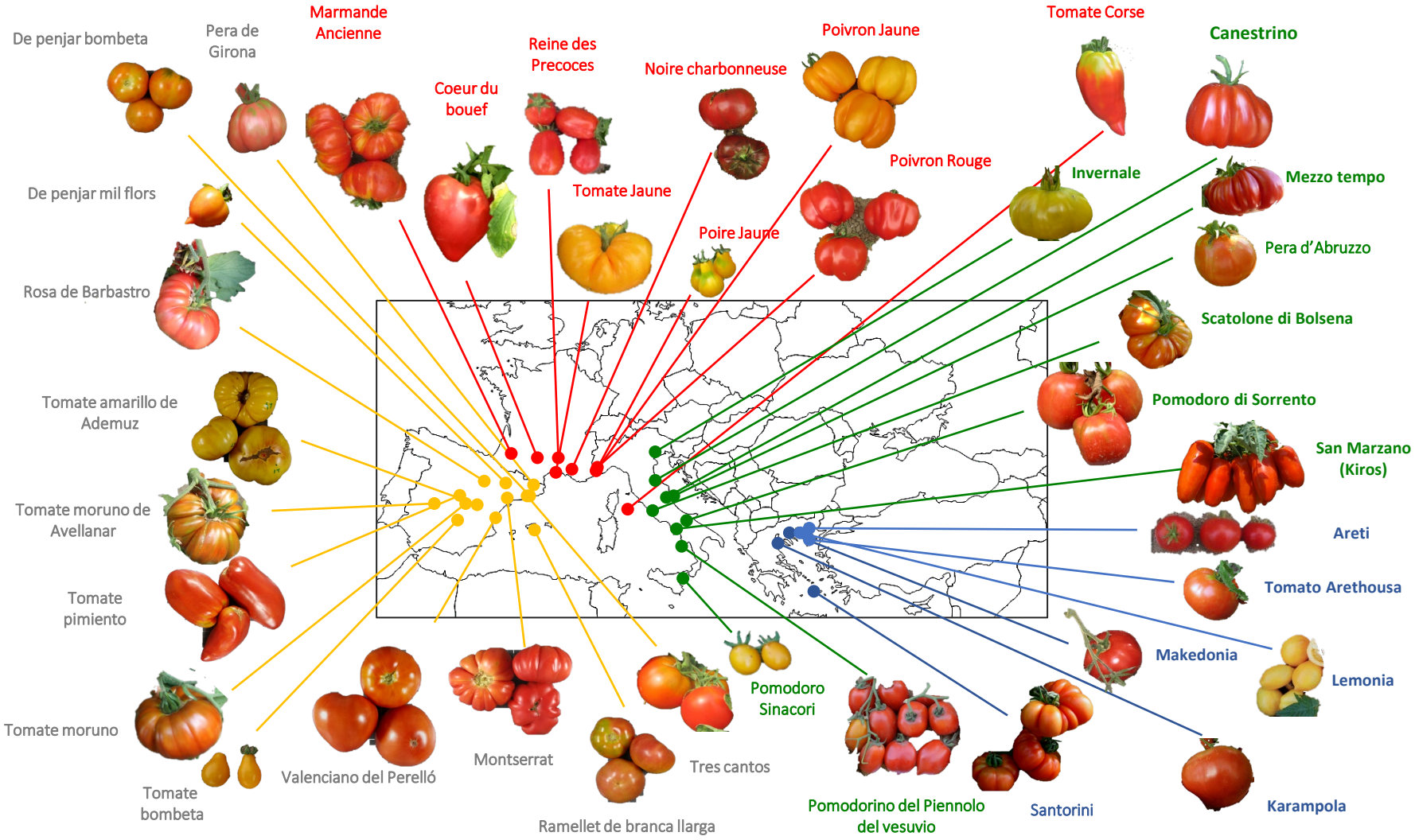
Valencian tomato

Higher prices

5. Utilization of the UPV germplasm collection

The increasing importance of organic and sustainable agriculture and the interest for diversification has meant a revival of local varieties

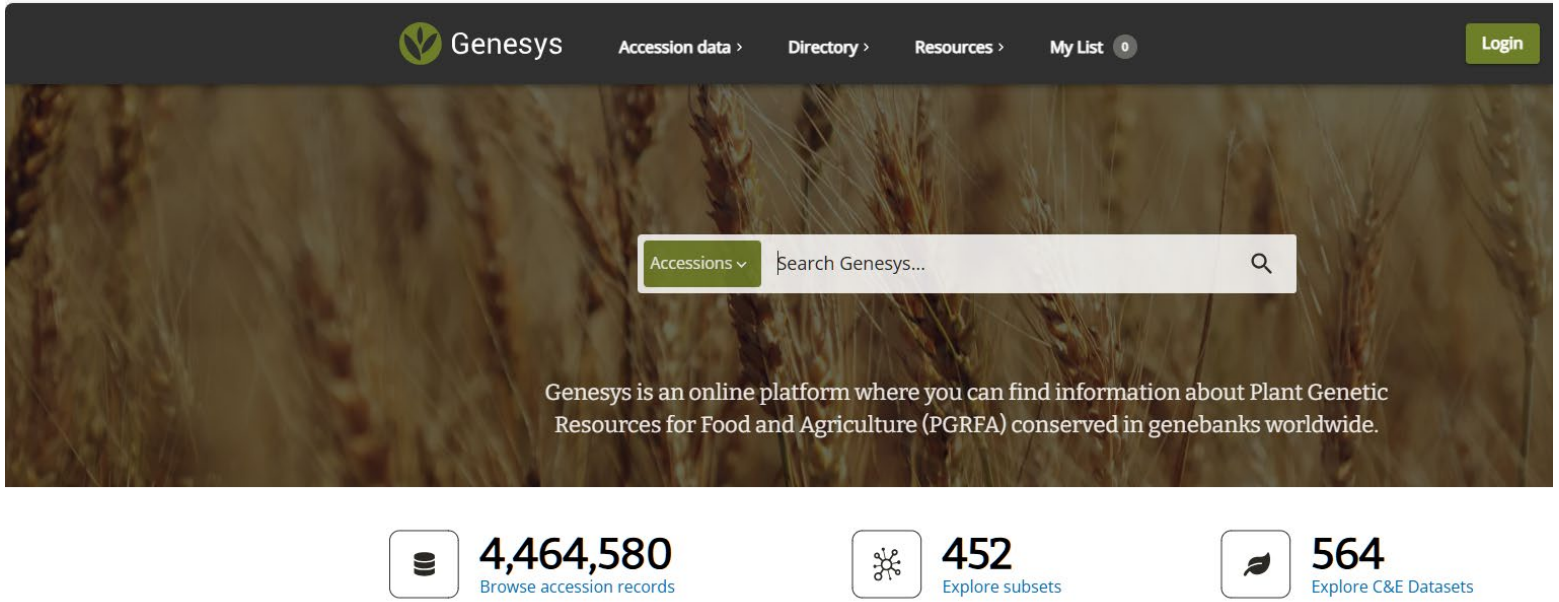
Hundreds of tomato local varieties have been studied in the TRADITOM project. Many were found of interest for enhancement and recovery



6. Access to the information

Information that is not available is not useful. Information on germplasm Passport, characterization, evaluation and genetic data is available in freely accessible databases

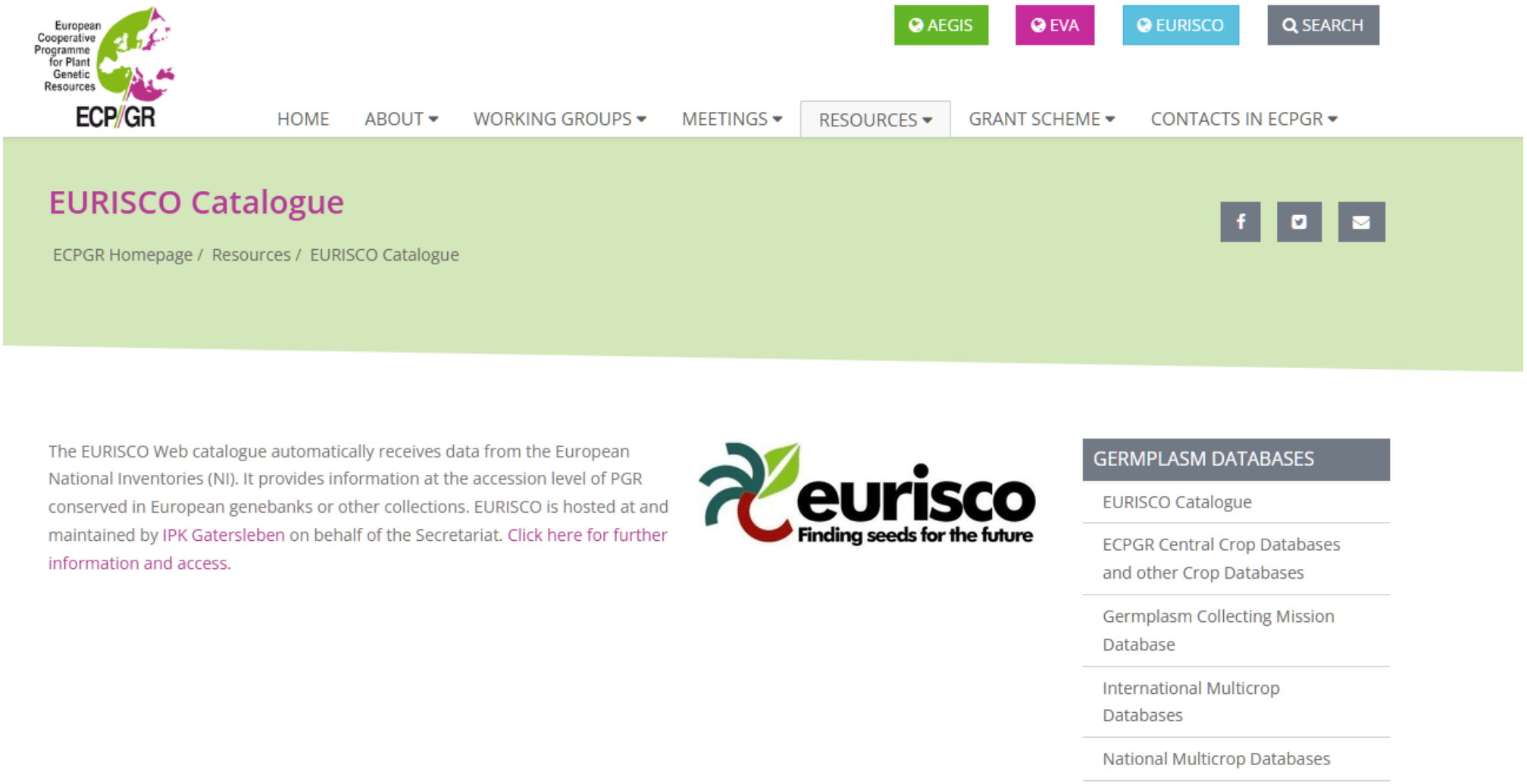
	General ones	
EURISCO	Genesys	Germinate
	Specific of crops	
G2P-SOL	HARNESSTOM	TGRC, etc., etc.



C.M. Rick
TGRC
Tomato Genetics Resource Center

6. Access to the information

Information that is not available is not useful. Information on germplasm passport, characterization, evaluation and genetic data is available in freely accesible databases



7. Genetic information

High-throughput genotyping available for germplasm bank accessions allows fingerprinting, genetic distances, GWAS, duplicates identification, gaps in the collection, heterozygosity, genomic prediction, taxonomic identification, etc.

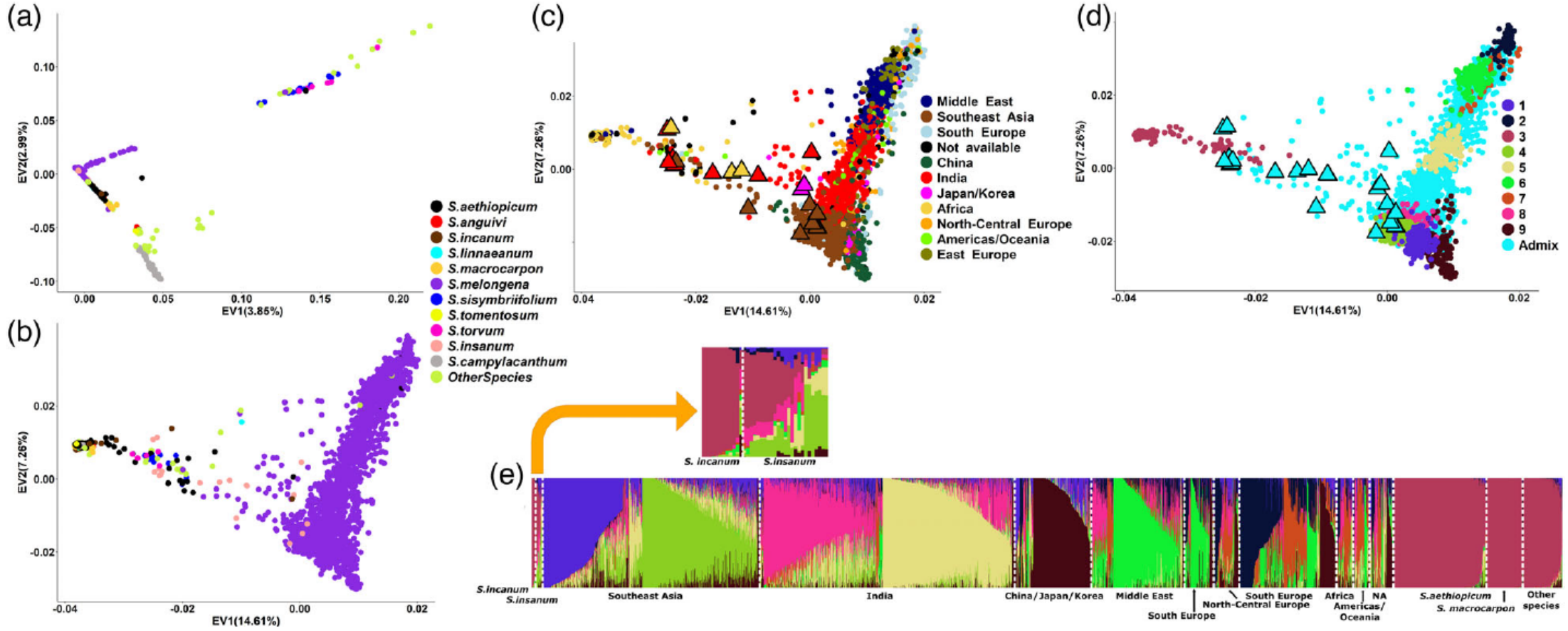


Figure 3. Principal component analysis (PCA) of eggplant genetic diversity in worldwide genebank holdings.

8. Strategies to promote utilization

Promoting the utilization of germplasm accessions is essential for adapting our agriculture to more sustainable and resilient systems

- Developing partnerships with researchers, breeders, and farmers to encourage the use of germplasm bank materials
- Collaboration in regeneration and phenotypic/molecular characterization and evaluation of materials with breeding companies.
- Raising public awareness about the importance of germplasm banks through educational campaigns and outreach programs
- Participation of farmer associations, NGOs and private sector representatives in germplasm bank advisory committees
- Long-term agreements between germplasm banks and breeding companies and farmer associations for provision of mutual services

9. Take home message

- Crop biodiversity is not only heritage from the past, but a strategic resource for the future of agriculture.
- Germplasm banks preserve genetic diversity before it is lost and make it available for research, breeding and innovation.
- The UPV Germplasm Bank conserves a valuable collection of vegetable crops, with a strong focus on local varieties and crop wild relatives.
- Conservation is only the first step: characterization, evaluation and documentation are essential to transform accessions into useful resources.
- Crop biodiversity can provide solutions for disease resistance, adaptation to water deficit, quality improvement and more sustainable production systems.
- The impact of germplasm banks depends on collaboration with farmers, breeders, researchers, companies and public institutions.

BIODIVERSITY GROW.®
Commitment to Sustainable Agriculture

Jornada BioDiversidad y Sistemas Agroalimentarios Sostenibles Valencia.
19 de Mayo de 2026

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Food for Biodiversity

Q&A
QUALITY AND ADVISER
consultoría y formación