Development and evaluation of tomato and pepper genetic resources in the framework of public-private partnerships

Teodoro Cardi

CREA Research Centre for Vegetable and Ornamental Crops

Pontecagnano Faiano (SA), Italy

Council for Agricultural Research and Economics

Research Centre for Vegetables and Ornamental Crops

Research with integrated and multidisciplinary approaches on:

- ***enhancement and use of plant genetic resources***
- ***plant breeding***
- ***agronomic innovation***
- ***eco friendly plant protection***

vegetables

ornamental plants

aromatic crops

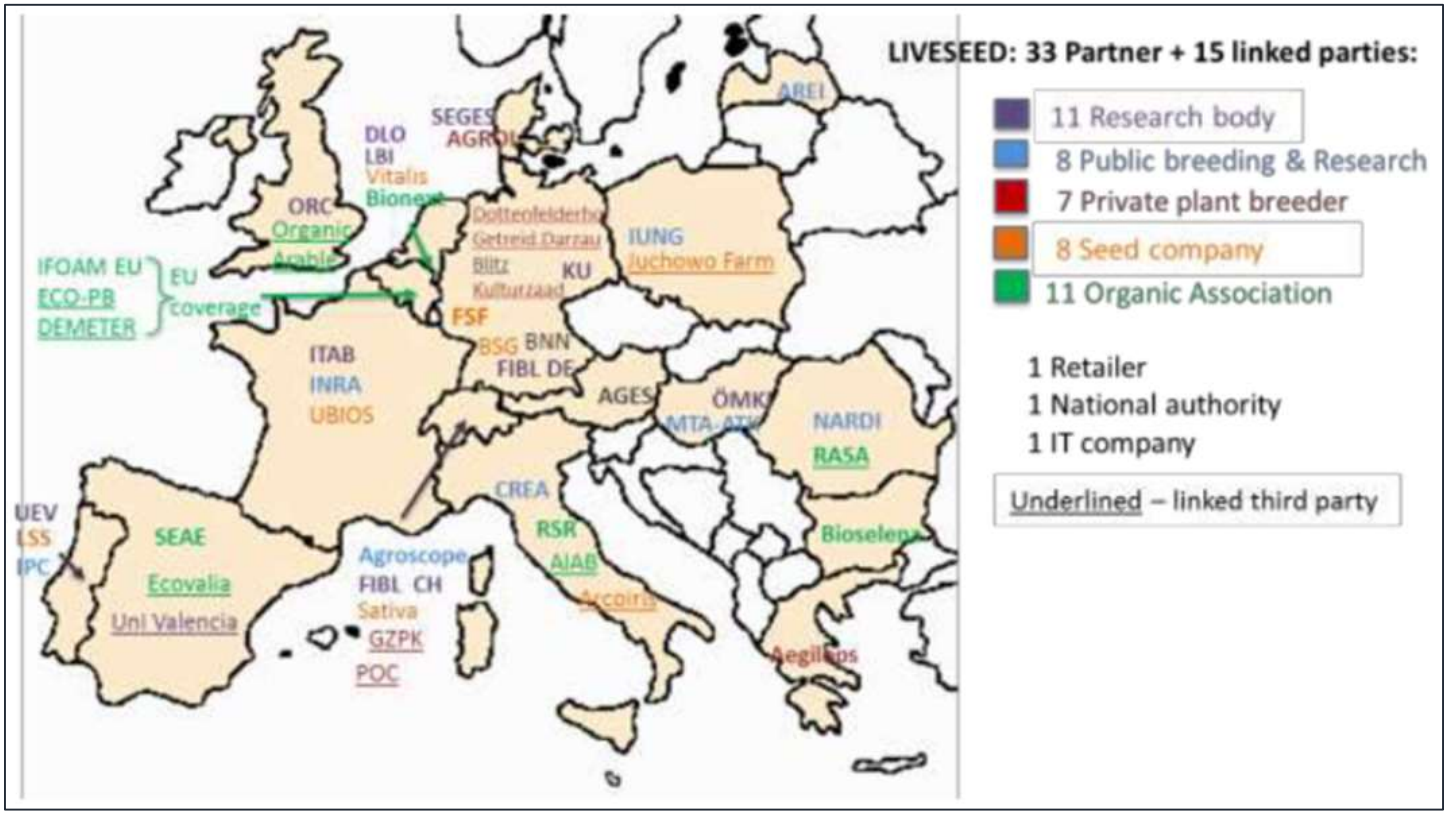
nursery productions

In partnership with:

- **Universities and other public research councils**
- **Seed companies and other private entities**
- **National and regional governments**

"Improve performance of organic agriculture by boosting organic seed and plant breeding efforts across Europe" - LIVESEED

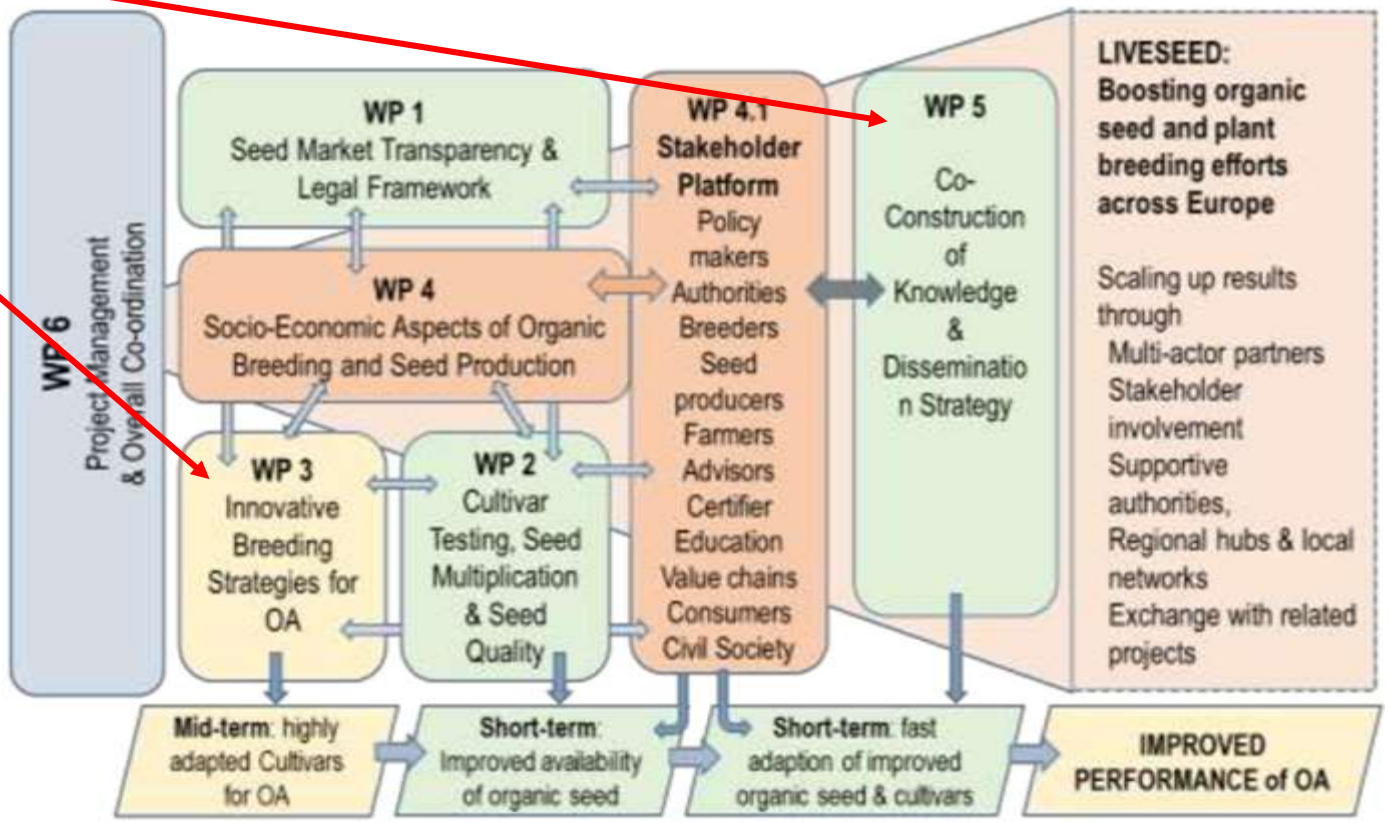
H2020 SFS-07-2016: Organic breeding – Increasing the competitiveness of the organic breeding and farming sectors



Support participatory tomato breeding in Italy and Spain

CREA-OF
Monsampolo del Tronto

Partners
ISI Sementi
ARCOIRIS
Rete Semi Rurali
University of Valencia

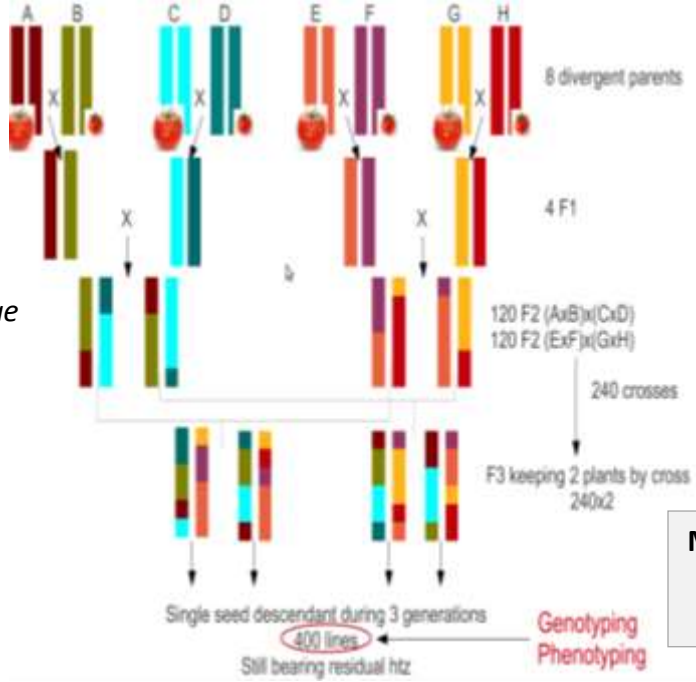


"Breeding tomato for organic farming"

- **Development of new varieties adapted to organic system**
- **Exploring new interesting traits needed for research, breeding and markets**

Tomato Multi-parent Advanced Generation Inter-Cross (MAGIC)

7 lines, with interesting agronomic traits (ISI Sementi)
1 wild accession of *Solanum cheesmaniae* (LA 1407), TGRC



Molecular characterization by GBS (Genotype By Sequencing)

20k new **SNPs** (Single Nucleotide Polymorphisms) anchored on tomato genome and evenly distributed across all chromosomes

100 crosses cultivated at CREA-OF on MOVE-LTE (Monsampolo del Tronto)

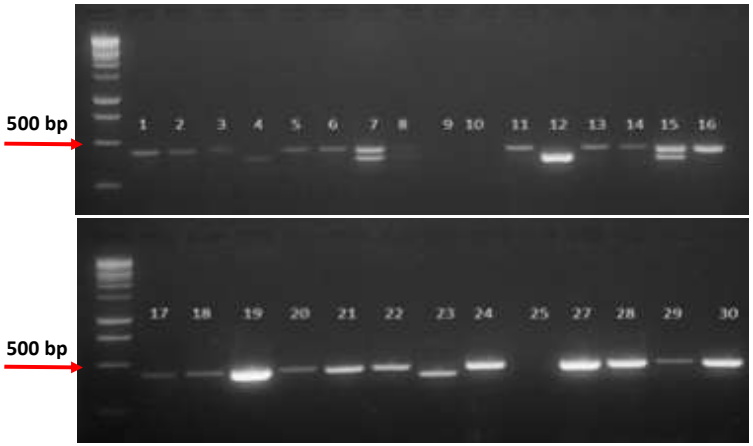
Molecular association with important agronomic traits to follow the allelic frequencies evolution in different environments

Italy	**NORTH** Padova	**CENTRE** Fermo	**SOUTH** Metaponto	**CREA-OF** MOVE-LTE
Spain	**Valencia**	**Murcia**	**Andalucia**	

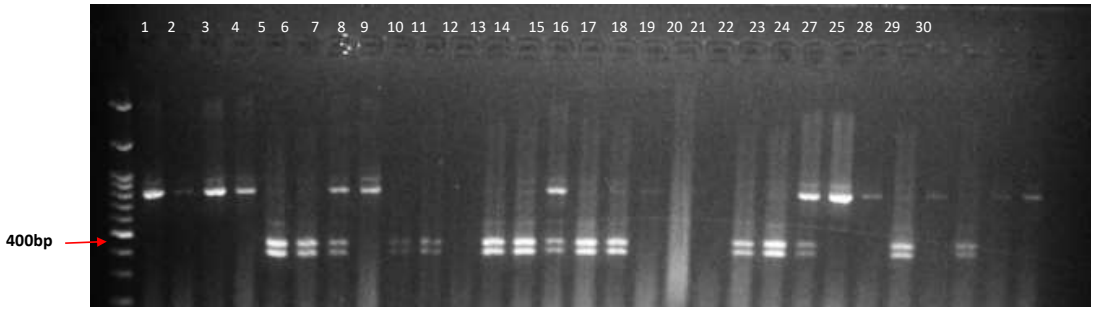
+ local varieties

- ✓ **Fruit quality**: pulp softness, shelf life, yellow and orange-coloured pulp, increase of red colour/lycopene content, uniform green shoulder, Brix
- ✓ **Bio-morphological traits**: self-pruning, leaf transparency
- ✓ **Abiotic stress tolerance**: salt, drought and cold
- ✓ **Resistance to pests and diseases**: Verticillium, Fusarium 1 e 2, Alternaria, TSWV, Phytophtora, white flies
- ✓ **Organoleptic traits**

Resistance to *Meloidogyne* spp. (*Mi-1* gene)

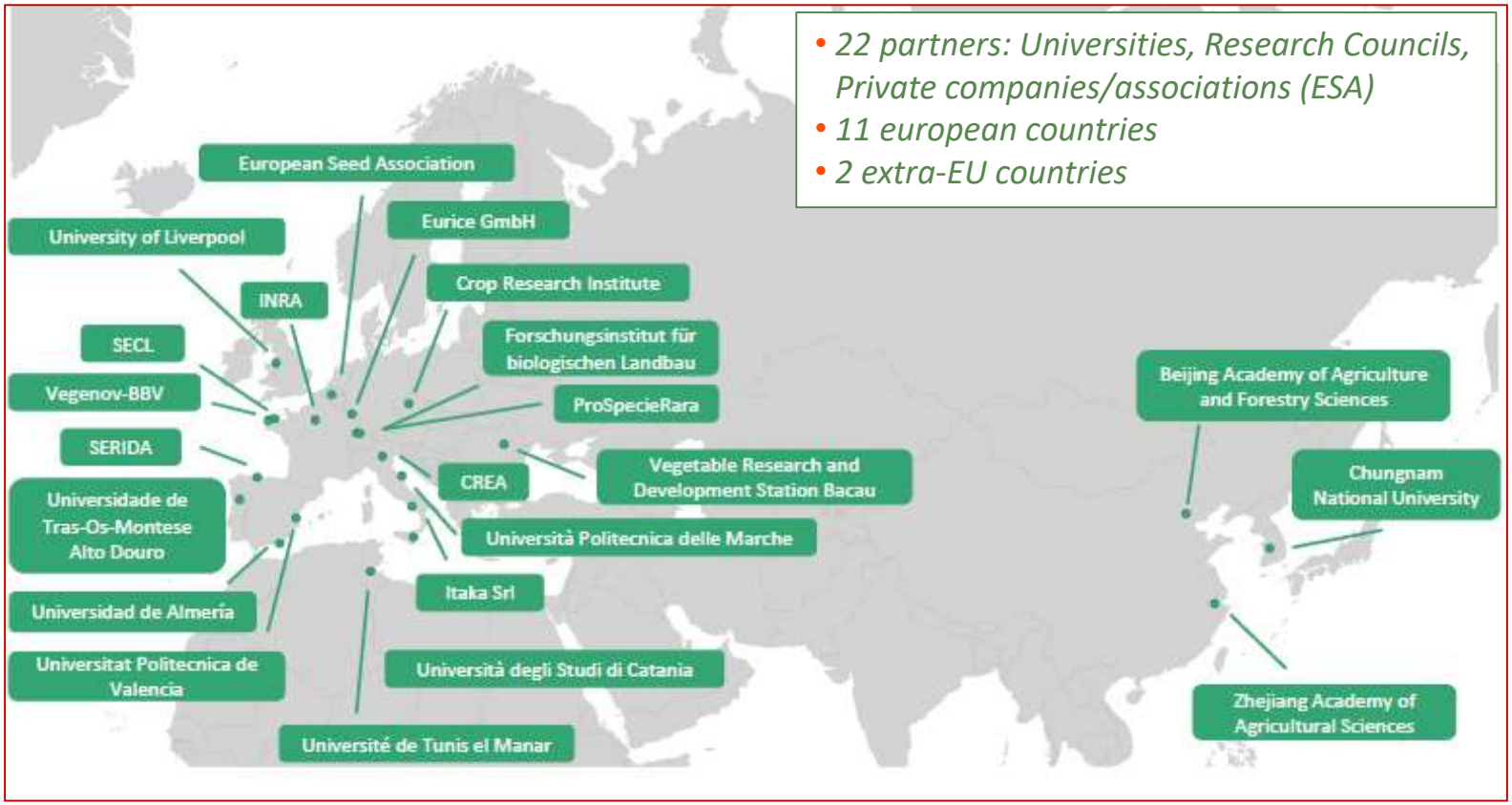


Resistance to *Fusarium oxysporum* f. sp. *lycopersici* (*I-2* gene)

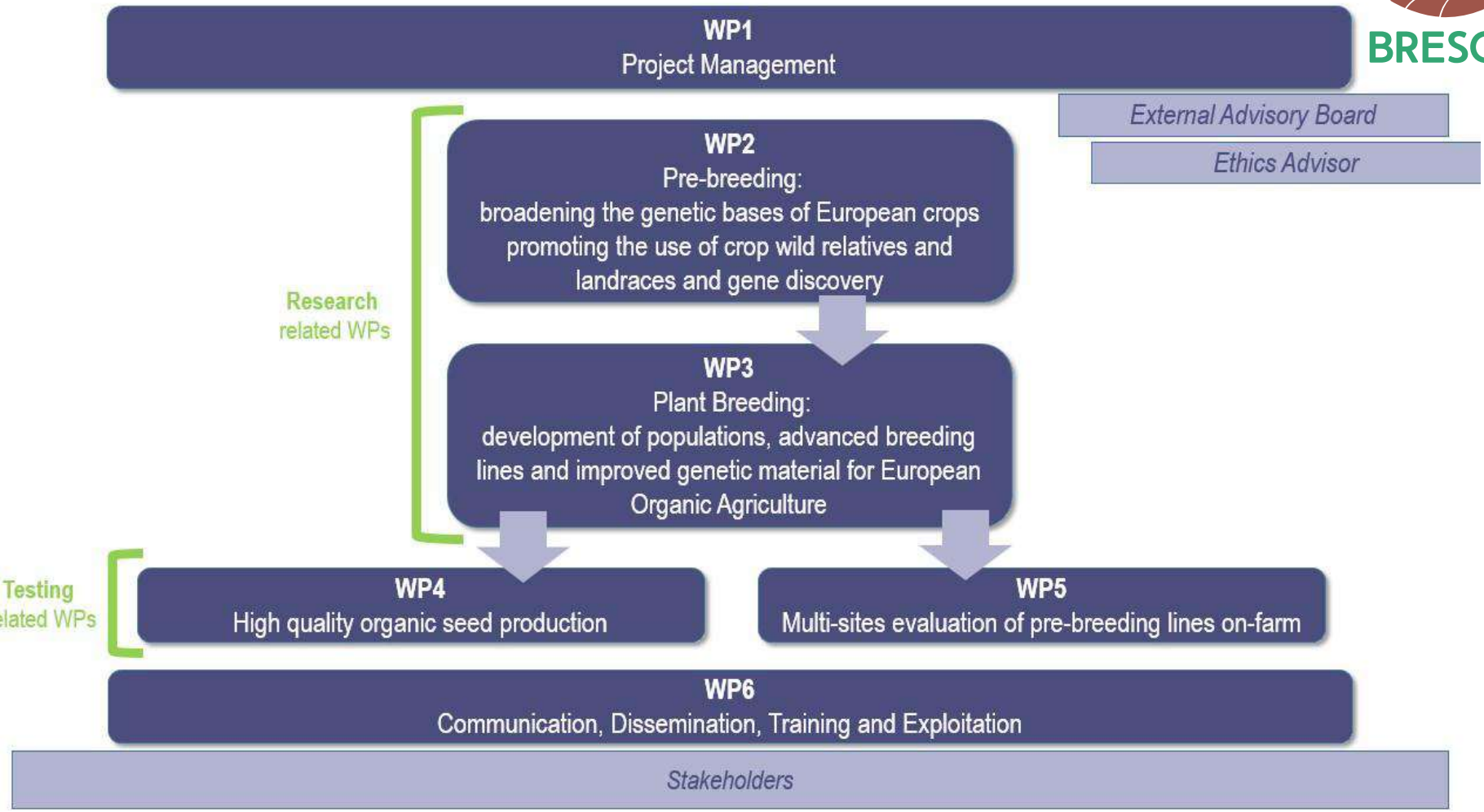


"Breeding for Resilient, Efficient and Sustainable Organic Vegetable Production" - BRESOV

H2020 SFS-07-2017: Organic breeding – Increasing the competitiveness of the organic breeding and farming sectors



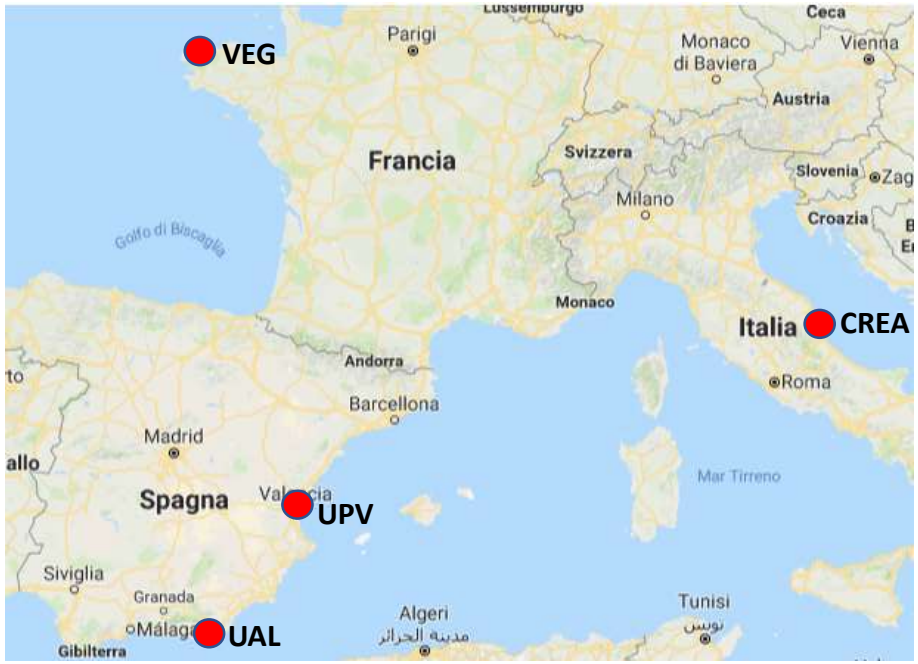
BRESOV



Broccoli and Cauliflower, Snap bean, Tomato

BRESOV

- ***A core collection and a breeding set of about 300 tomato genotypes, including italian and spanish cvs for fresh market and «da serbo», landraces and wild accessions are being genotypized and phenotypized in growth chambers, greenhouses and organic fields (agronomic, nutritional and organoleptic traits, biotic and abiotic stress tolerance)***



"Linking genetics resources, genomes and phenotypes of solanaceous crops" - G2P-SOL

H2020 SFS-07b-2015: Management and sustainable use of genetic resources

G2P-SOL

The G2P-SOL consortium

PARTNERS

Acronym	Organisation name
ENEA	Agenzia Nazionale Per Le Nuove Tecnologie, L'Energia e lo Sviluppo
WUR	**Wageningen University***
JHI	**The James Hutton Institute**
HUJI	**The Hebrew University of Jerusalem**
IPK	**Leibniz Institut fuer Pflanzengenetik und Kulturpflanzenzuchtung**
UPV	**Universidad Politécnica de Valencia**
UniTO	**Università degli Studi di Torino**
INRA	**Institut National de la Recherche Agronomique**
CREA	**Consiglio per la ricerca e la sperimentazione in agricoltura**
ARO	**The Volcani Centre**
Eurice	European Research and Project Office GmbH
IHAR	**Instytut Hodowli i Aklimatyzacji Roślin**
CIP	**Centro Internacional de la Papa**
PHEN	Phenome Networks Ltd.
BATEM	**Bati Akdeniz Agricultural Research Institute**
MVCRI	**Maritsa Vegetable Crops Research Institute**
AVRDC	**AVRDC – The World Vegetable Center**
BLUMEN	Blumen Group Spa
SATIVA	Consorzio Sativa

COLLABORATORS

Organisation name
Chinese Academy of Agricultural Sciences
Seoul National University
Boyce Thompson Institute
Tomato Genetics Resource Center
Michigan State University
Limagrain Vegetable Seeds
Association de créateurs de variétés nouvelles de pommes de terre
Enza Zaden
Hodowla Ziemniaka Zamarte
Top Seeds International
Esasem S.p.A.
Semillas Fito
Ramiro Arnedo Semillas
Benson Hill Ltd

G2P-SOL

WP1 Project management and scientific coordination

Work Block I: Input

WP2 Genotype and phenotype inventory and harmonization, exchange of materials

Work Block II: Characterization

WP3 Genotyping and resequencing

WP4 Phenotyping

Work Block III: Output

WP5 Pre-breeding

WP6 Data management, analysis and integration

WP7 Dissemination, valorisation and training

Sol Genomics Network

Genesys

eurisco
Finding seeds for the future

WP4 -> Phenotyping

PhenOme NETWORKS

Core collection

400

~ 10.300 accessions low density GBS
> available phenotyping data

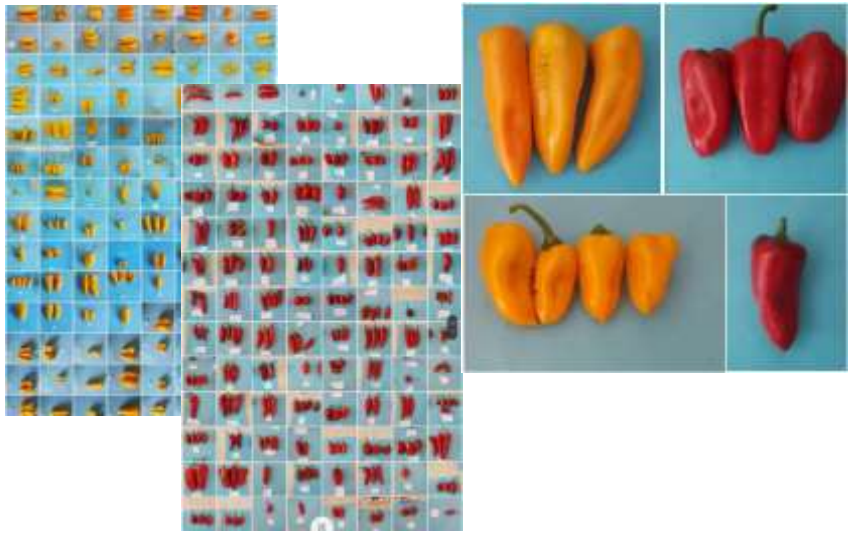
- Agronomic and metabolic traits
- Abiotic and biotic stress tolerance

WP5 -> Pre-breeding

- BIL 140 *C. annuum* x *C. frutescens*

- BIL 120 *C. annuum* x *C. chacoense*

- MAGIC 650 lines *C. annuum*



"Harmonization of resistance tests to diseases for DUS testing - 3" - HARMORES 3

→ official variety description in the framework of the DUS (Distinguibility, Uniformity, Stability) tests for national listing and plants breeder's rights

CPVO
Community Plant Variety Office

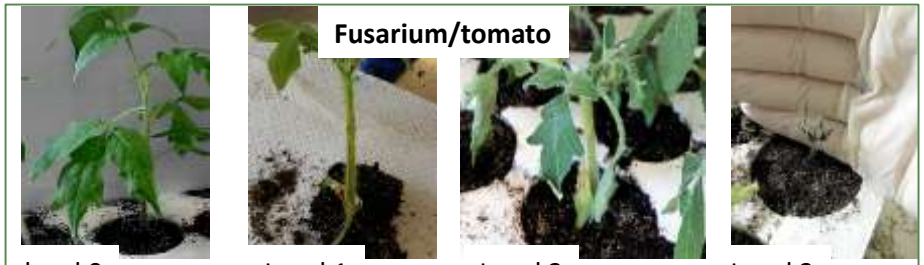
Partners

- Geves - Groupe d'Etude et de contrôle des Variétés Et des Semences (FR) – coordinator
- Naktuinbouw - the Netherlands Inspection Service for Horticulture (NL)
- INIA - Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (SP)
- CISTA - Central Institute for Supervising and Testing in Agriculture, National Plant Variety Office (CZ)
- SASA - Science and Advice for Scottish Agriculture (UK)
- NEBIH – National Food Chain Safety Office (HU)
- CREA - Consiglio per la Ricerca in agricoltura e l'analisi dell'economia agraria (IT)
- CTIFL – French Technical Institute for Fruit and vegetables (FR)
- Seed Companies belonging to ESA - European Seed Association (Bayer, Monsanto, HM Clause, Enza Zaden, Gautier, Ramiro, Sakata, Rijk Zwaan)

✓*harmonization of the resistance tests in terms of:*

- reference material (isolates and varieties)
- test conditions (temperature, light, humidity, stage of inoculation, ...)
- notation scales

Fusarium/tomato



level 0 | Level 1 | Level 2 | Level 3

Fusarium/melon

1: no symptoms | 2: slightly wilted yellow cotyledons (with brown vessels under the cotyledons) | 3: internal vessel browing, wilted plant | 4: appearance of aerial mycelium on dying plants | 5: death of plant

CPVO · OCVV

PROTOCOL FOR TESTS ON DISTINCTNESS, UNIFORMITY AND STABILITY

Solanum lycopersicum L.

TOMATO

UPOV Code: SOLAN_LYC

Adopted on 21/03/2018

Entry into force on 01/01/2018

✓*proposal of new harmonized and robust protocols to CPVO*

Seven host/race/pathogen combinations are being studied:

1. *Meloidogyne incognita* / tomato
2. *Erysiphe sp* /pea
3. Powdery mildew / melon

4. *F. oxysporum* f. sp. *lycopersici* race 0 and 1 / tomato
5. *F. oxysporum* f. sp. *melonis* race 1.2 / melon
6. *F. oxysporum* f. sp. *melonis* race 2 / melon
7. *F. oxysporum* f. sp. *melonis* race 0 and 1 / melon

CREA

Future perspectives and follow-up

- *a database that could be used by examination officers and breeders*
- *a collection of reference materials (pathogens/plant genotypes) to be used in resistance tests*

Collection, characterization, multiplication and conservation of local PGRFA

- ✓ **National Ministry of Agriculture → Implementation of the *International Treaty (RGV-FAO)***
- ✓ **Regional government Marche Region → Collection, characterization, support for registration to regional/national variety lists, seed distribution to farmers (BanGe5, CARBIO)**
- ✓ **Regional government Campania Region → same as above (ABC)**

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- ✓ *BRESOV[b] → Pasquale Tripodi[2], Gabriele Campanelli, Sara Sestili, Nazzareno Acciarri[1]*
- ✓ *G2P-SOL[c] → Pasquale Tripodi*
- ✓ *HARMORES 3[d] → Loredana Sigillo[2]*
- ✓ *RGV-FAO[e] → Pasquale Tripodi, Nadia Ficcadenti[1]*
- ✓ *BanGe5[f], CARBIO[f] → Sara Sestili, Nazzareno Acciarri*
- ✓ *ABC[g] → Massimo Zaccardelli[2], Pasquale Tripodi*

[a] EU H2020 grant agreement No 727230
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[c] EU H2020 grant agreement No 677379
[d] CPVO
[e] FAO - Italian Ministry of Agriculture
[f] Marche Region
[g] Campania Region

[1] CREA OF Monsampolo
[2] CREA OF Pontecagnano
[3] ISI Sementi

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