

# Technology-driven innovation for plant breeding in PPPs

Access to diversity through access to information

PPP Workshop Bonn, June 7-9, 2017, Sander Peters, WUR- Applied Bioinformatics, Plant Sciences Group, in coop with CGN, WU-Biosys, WU-Genetics, WU-PB and breeding companies.



# Outline

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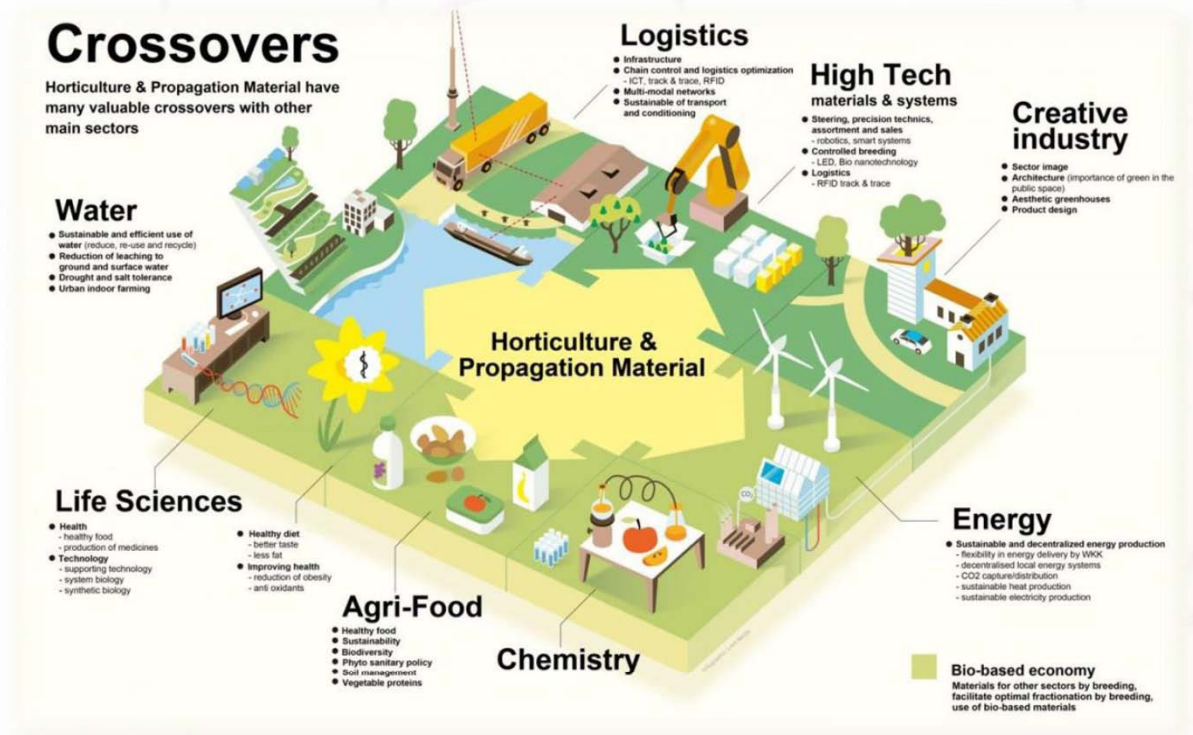
- **PPPs in Topsectors**
  - Context
  - Theme's
  - Types of projects, rules and regulations
- **Examples of PPP projects**
  - Companies and knowledge institutes involved
  - Involved technologies and data
  - Phenotype and genotype



# 9 Top sectors in the Netherlands

## Top sector policy

- Promote research & innovation
- Investing in human capital
- Providing a regulatory framework
- Stimulating international dimension





## Agenda 2012-2016 Topsector T&U

Five key innovation themes and two cross-cutting themes T&U:

- **More with less**  
(innovation for high quality food with less resources)
- **Food safety and Food security**  
(sufficient and varied food, reducing pests and diseases)
- **Health and well being**  
(promote healthy food and production environment in horticulture)
- **Colaborating value chain**  
(innovation for sustainable and economically viable horticulture supply chains)
- **Internationalization**
- **Human Capital Agenda**



*Aim: to double the added value compared to 2000-2010 (1,3 billion extra in 2020)*



# PPP: Private Public Partnerships in innovation programmes and projects

## PPP programme 'Better Plants for new demands'

- 2013-2021
- Projects apply to 5 innovation themes
- Open calls for proposals
- Bottom-up calls and selection procedures

### Programme's

#### Running PPPs

Better plants 4 new demands  
New approaches in Plant health  
Energy & CO<sub>2</sub>  
Horticulture waterproof

#### New PPPs

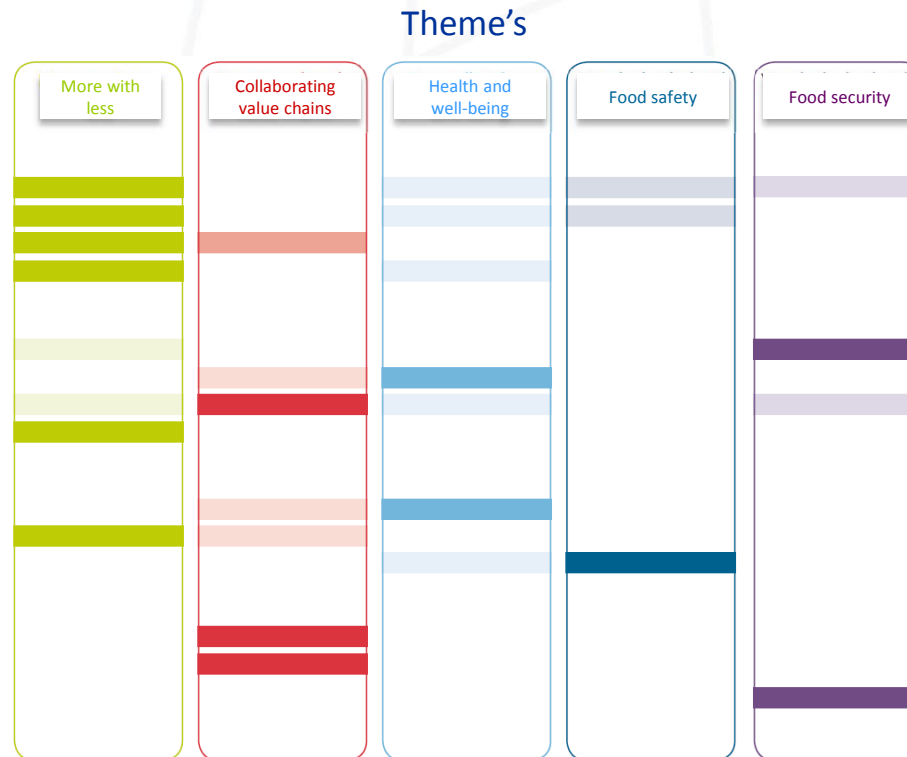
Robust phytosanitary chains  
Green healthy environment  
New business with plant resources  
New Agricultural technologies

#### PPPs in formation

Consumer and health  
Horticulture logistics  
Food safety

#### Platform PPPs

Digital horticulture  
Consumer, market and chains  
Internationalization



# Public private Partnerships

## types and characteristics

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Type	Funding	Intellectual Property	Funding Agency	Expected TTM
Bilateral	>80% private	Industry		variable
Applied Research project	50% private 50% public	Industry, TKI rules & regulations	TKI	< 5 yrs
Strategic Research project	60% public 40% private	Industry, based on economic value	TKI, STW	5-10 yrs
Fundamental (core) research project	25% public 75% private	Knowledge institute, industrial licence	TKI, NWO, TTW	>10 yrs
Technology platform (Enabling Technologies)	90% public 10% private	Knowledge institutes, industrial licence, DTL rules	DTL (NWO, ZonMW)	direct

# PPP projects

## Consortium partners

PPP projects				
150 Tomato	100 Melon	ILGC	STW-RZ	COMREC
TTI-GG	Better Plants 4 new demands	Better Plants 4 new demands	STW Partnership	FP7-People-2013
TTI-GG	TKI-U	TKI-U	STW	EU
EVD				
Nunhems/Bayer	Nunhems/Bayer	Nunhems/Bayer		KWS UK
Rijk Zwaan	Rijk Zwaan	Rijk Zwaan	Rijk Zwaan	Rijk Zwaan
Bejo		Agrisemen		SESVanderHave
Keygene	Keygene	Enza Zaden		Limagrain UK
Syngenta		Syngenta		NIAB
Monsanto		Pinnacle Seeds		Nikon UK
East West Seeds	East West Seeds	Takii		
Ninsar Agro		Ramiro Arnedo		
Semillas Fito		Sakata		
Gautier Semences		Gautier Semences		
BHN Seeds	Vco	Vco		
Rasi Seeds		Mission Raches		
BGI		CVS		UoB
BGI-Hong Kong		Tanimura		JH Inst
Gargiulo Inc.		Vanguard Seed Inc.		UoV
		Tozer		IPK
		Progeny Inc.		INRA
WUR-PRI	WUR-PRI	WUR-PRI	WUR-PRI	WUR-PRI
WU-PB	WU-PB	WU-PB	UvA	UvA
NCB Naturalis	CGN	CGN		UCM
UvA		UC Davis		KIT

- Programme/Call
- Government
- Company
- Knowledge Institute

# Exploring genetic diversity

Many genome initiatives



150 Tomato Genome Project 2012

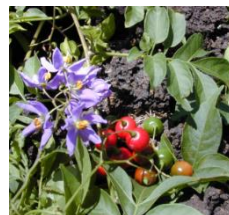


Capsicum

PGSC 2011



*S. etuberosum*



*S. commersonii*



*Botryococcus braunii*



Dandelion



*Ginkgo biloba*



*A. bisporus*



ILGC – 2015



*Malus*



*Rosa L.*

100 Melon  
Genome Project  
2014

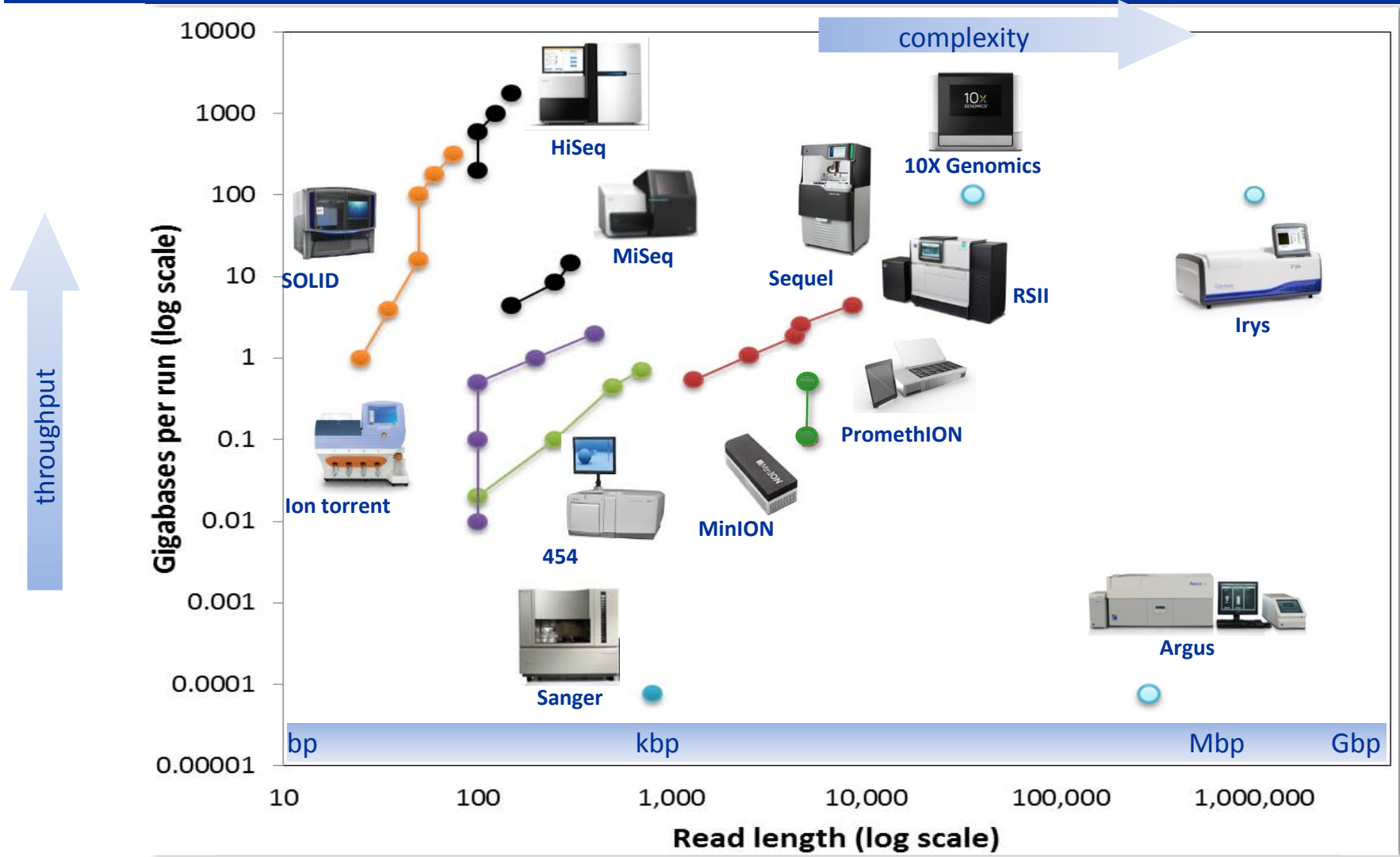


*Medicago S.*



# Assessing genetic and structural diversity

Technology-driven innovation for plant breeding - sequencing, genome mapping & phasing technology



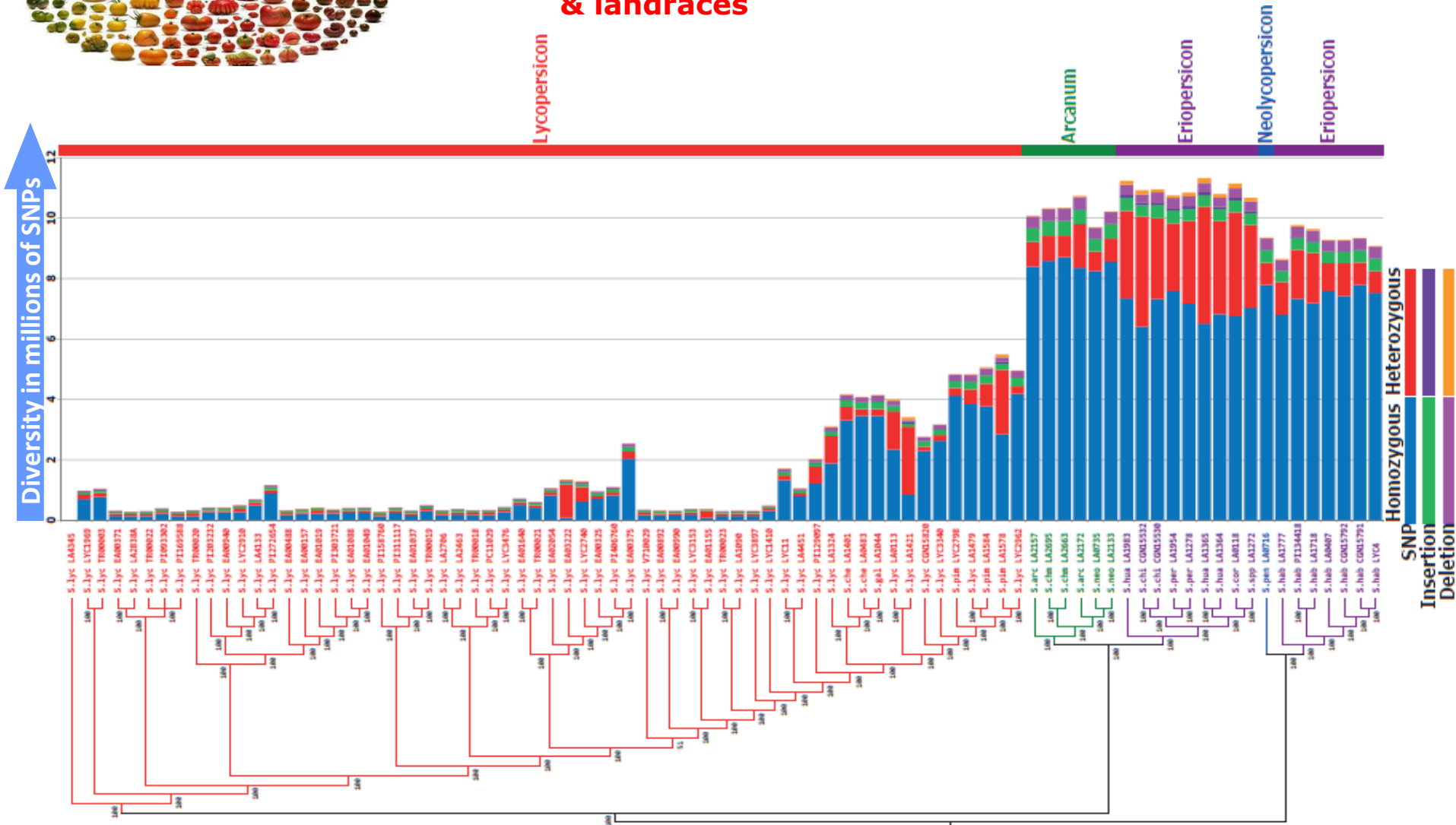
# Genetic diversity

Crossable *Solanum* species, a diverse genetic resource









## Tomato crop accessions & landraces

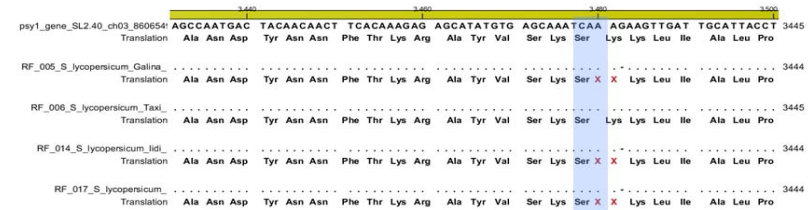
## Wild species



# Connecting Phenotype to Genotype

## SNPs related to fruit color and fruit shape

Accession	color	allele	chr	gene id	mutation	effect
 Heinz 1706	red	<i>r</i>	3	<i>Psy1</i>	wt	Lys <sub>389</sub>
 Galina	yellow	<i>r<sup>y</sup></i>	3	<i>psy1</i>	G>del	Lys <sub>389</sub> >Ser, stop
 Taxi	orange	<i>r</i>	3	<i>Psy1</i>	wt	Lys <sub>389</sub>
 Iidi	yellow	<i>r<sup>y</sup></i>	3	<i>psy1</i>	G>del	Lys <sub>389</sub> >Ser, stop
 RF17	yellow	<i>r<sup>y</sup></i>	3	<i>psy1</i>	G>del	Lys <sub>389</sub> >Ser, stop
 Black Cherry	purple	<i>og<sup>c</sup></i>	6	<i>b</i>	A>del	Lys <sub>35</sub> >Asn, fs



Fray and Grierson (1993): AAG(K<sub>389</sub>)AAG(K<sub>390</sub>)TTG(L<sub>391</sub>) → AAA(S<sub>389</sub>)AGT(S<sub>390</sub>)TGA(Stop) → 23aa deletion

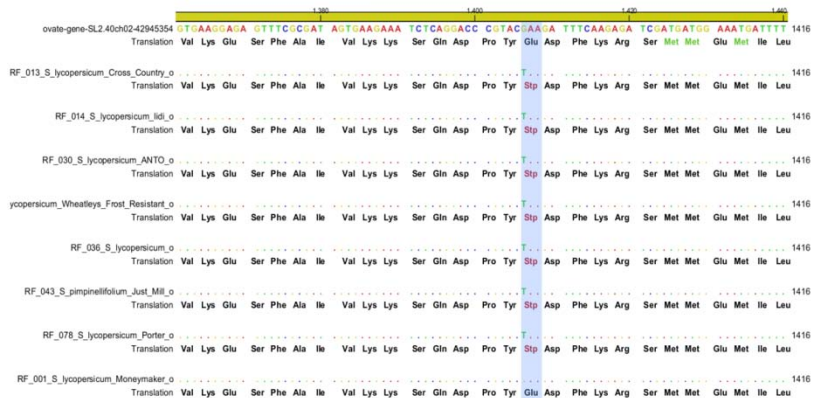
in *Psy1* → yellow phenotype (phytoene↓)



Ronen *et al.*, (2000);

AAA(K<sub>39</sub>) → AAT(Asn<sub>39</sub>) → FS in *B* → dark purple phenotype (lycopene↑)

Accession	shape	allele	chr	gene id	mutation	effect
 Heinz 1706	round	<i>Ovate</i>	2	459212746	wt	Glu <sub>279</sub>
 Cross Country	pear, ovate	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop
 Iidi	pear	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop
 Anto	pear, ox	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop
 WFR	pear	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop
 RF36	pear	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop
 RF43	pear	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop
 Porter	ovate	<i>ovate</i>	2	459212746	G>T	Glu <sub>279</sub> >stop



Liu *et al.*, (2002); GAA(Q<sub>279</sub>) → TAA(Stop) → 75aa deletion in *OVATE* → ovate phenotype

# I Browser

Detecting characteristic introgressions in cherry tomato – chr 5 sequence distance heat map



*S. lycopersicum*  
'round/ovate'

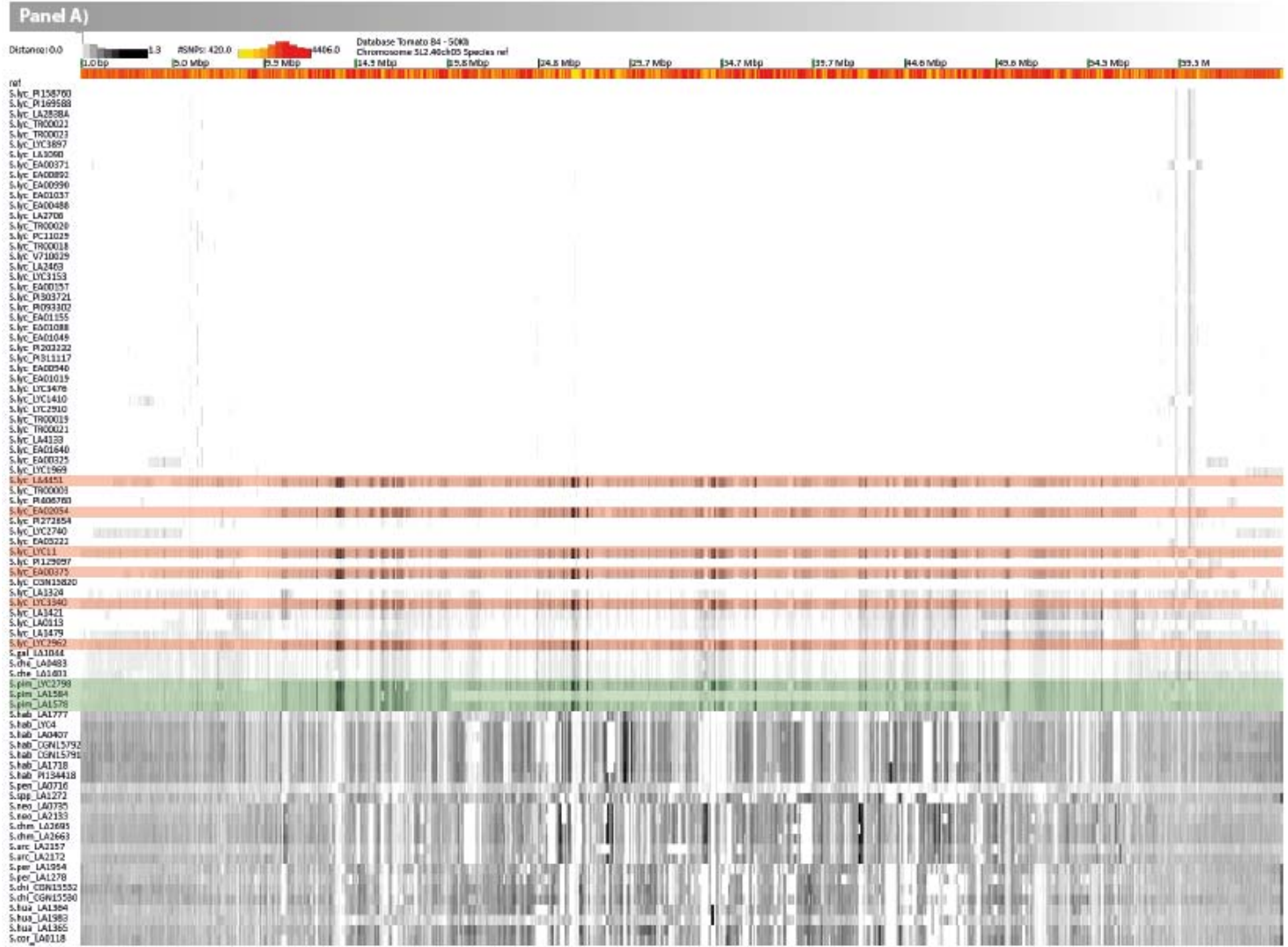


*S. lycopersicum*  
'cherry' size

*S. pimpinellifolium*



wild species



# Tomato collection database

## Access to phenotype data



Welcome, guest

- Home
- Search >
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### Welcome to the EU-SOL BreeDB database

Search by Accession name -sets collected within the framework of the European project EU-SOL. This site is roughly divided into two main sections: data on the tomato core collection and data on experimental populations:

Search by Accession number

Search by phenotype data

Search by

Passport data

Show Accessions on Google map

Well-known experimental IL, RIL, F<sub>2</sub>, and Advanced backcross populations of tomato and potato are maintained and curated by the group of Dani Zamir (The Hebrew university of Jerusalem) and Wageningen UR Plant Breeding).

populations

well-known experimental IL, RIL, F<sub>2</sub>, and Advanced backcross populations of tomato and potato are maintained and curated by the group of Dani Zamir (The Hebrew university of Jerusalem) and Wageningen UR Plant Breeding).

populations. Trait data, marker data and QTL data can be visualised for each of these populations.



Accession EA00027



### Funding

This Integrated Project is supported by the European Commission through the 6th framework program. Contract number: FOOD-CT-2006-016214

Last update: RF/2015-05-15 - version 1.8.0b



# Tomato collection database

## Access to phenotype data



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Accession EA00027



### Search collection by Phenotype

Please correct the following errors:

- Your selection did not return any results

Search the database for a phenotype (combination). The numbers behind the observation gives the total times that an observation exists within the database.

#### Plant habit

Plant habit

Fruit colour

Fruit cracking

Epidermis

Fruit fasciated

Fruit size

Fruit shape

Shoulders

#### Inflorescence morphology

Inflorescence type

#### Leaf morphology

Leaf shape

Leaf veins



# Tomato collection database

Access to phenotype data



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Like Page 26



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Accession EA00027

BreeDB  
Pagina leu



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Pagina leuk vi

Welcome, guest

Welcome, guest

## Accession Summary List

### Accession List

66 items found, displaying 1 to 50.

[First/Prev] 1, 2 [Next/Last]

Accession	Accession Name	Origin	Genebank	MTA
EA00041	CLUJ	Unknown	C. Male	Zamir
EA00223	YELLOW RIESENTRAUBE	Unknown	C. Male	Zamir
EA00325	GALINA	Unknown	C. LeHoullier	Zamir
EA00602	L. esculentum var. cerasiforme	Mexico	Tomato Genetics Resource Center	NULL
EA00760	L. esculentum	Bolivia	Tomato Genetics Resource Center	NULL
EA00920	ESTHER HESS YELLOW CHERRY	Unknown	Sand Hill Preservation Center	Zamir
EA00922	GOLDEN EGG	Unknown	Sand Hill Preservation Center	Zamir
EA00933	MIRABELL	Unknown	Sand Hill Preservation Center	Zamir
EA00948	SNOW WHITE CHERRY	Unknown	Sand Hill Preservation Center	Zamir

# Tomato collection database

Access to phenotype data



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Welcome, guest



Accession EA00027



Accession EA00027



Accession EA00027



Accession EA00325



## Accession Report

### Passport data

Accession number: EA00325  
Accession name: GALINA  
Origin: unknown  
Population: Tomato Core Collection  
Collection / Panel: Color panel, Firmness panel, Infinium 200 core collection, WUR Re-Seq project  
Genebank: [Heirloom tomato expert Craig Lehoullier](#)  
Accession ID:  
Collection date:

### Experiment list

GALINA has been tested in the following experiments:

- 2007 Core Collection Field trial - HUJ, Akko, Israel
- 2008 Core Collection Field trial - HUJ, Akko, Israel
- 2009 Core Collection Field trial - HUJ, Akko, Israel
- 2008 Core Collection Field trial - Hazera Genetics
- 2009 Core Collection Field trial - Semillas Fitó, Spain

### Observations (qualitative)

Trait name	Observations
Corolla color	yellow (1)
Cross sectional shape	symmetric (1)
Epidermis	not transparent (1), yellow (5)
Estimated yield	less than control (1)
Fruit color	yellow (5)
Fruit cracking	no (1)
Fruit fasciated	not fasciated (5)
Fruit firmness	medium (3), firm (1), ultra firm (1)
Fruit shape	round (5), ovate (1)
Fruit shoulders	green (1), light green (1), uniform (3)



# Questions

