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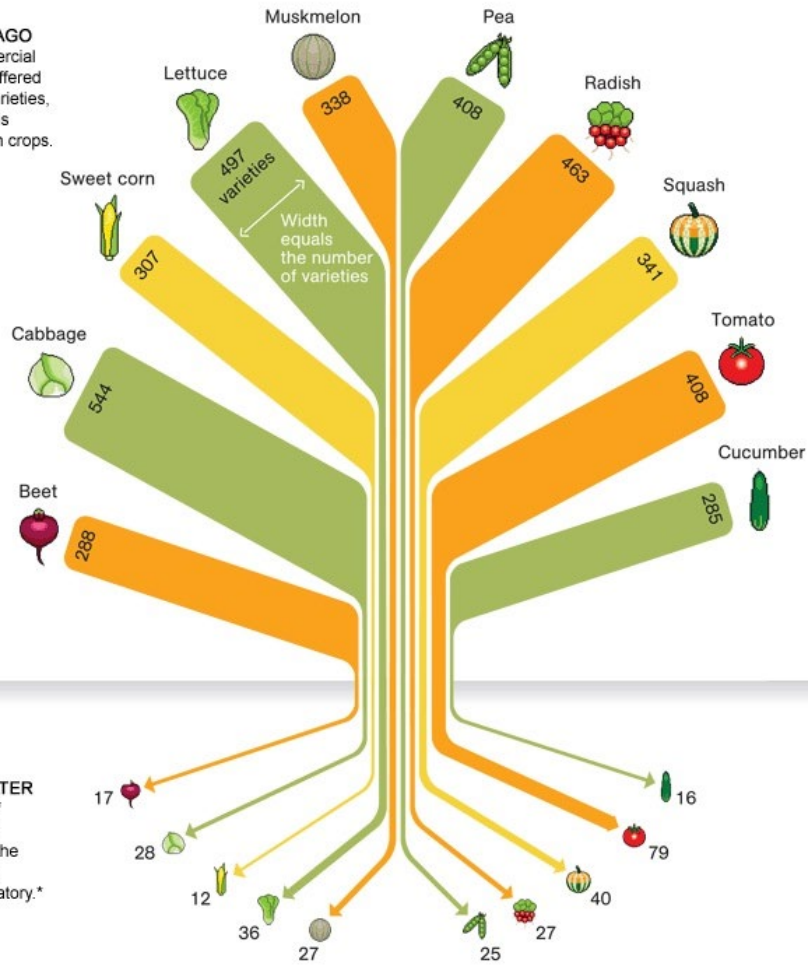
European projects improving genebank inventories: AGENT and EVA

Sandra Goritschnig

PRO-GRACE Workshop on Genetic Resources and
Phenotyping

Brussels, 28.06.2024

A CENTURY AGO
In 1903 commercial seed houses offered hundreds of varieties, as shown in this sampling of ten crops.



80 YEARS LATER
By 1983 few of those varieties were found in the National Seed Storage Laboratory.*

* CHANGED ITS NAME IN 2001 TO THE NATIONAL CENTER FOR GENETIC RESOURCES PRESERVATION

JOHN TOMANIO, NGM STAFF. FOOD ICONS: QUICKHONEY
SOURCE: RURAL ADVANCEMENT FOUNDATION INTERNATIONAL

Since ~1920, crop varieties, landraces and wild relatives have been collected in genebanks



Maize conserved at the Portuguese genebank.
Credit: L. Maggioni

Loss of crop varieties in active use by farmers over the past century – genetic erosion

Need to make genebank accessions available to farmers and breeders!

How do you know which genebank accessions may be interesting for your breeding project?

- **Passport data on PGR** conserved in genebanks is not consistently complete
 - Collecting location and habitat
 - Morphological descriptors
 - Species identification (taxonomy)
- **Characterization data** collected during regenerations are not homogeneous, not fully digitized or available, especially for old records

Connecting conservation and use of PGR through high quality documentation

Projects creating and managing data on PGR to improve genebank inventories and access to PGR



An **Activated Genebank Network** – creating a network of genebanks to build capacity and create bioresource centres

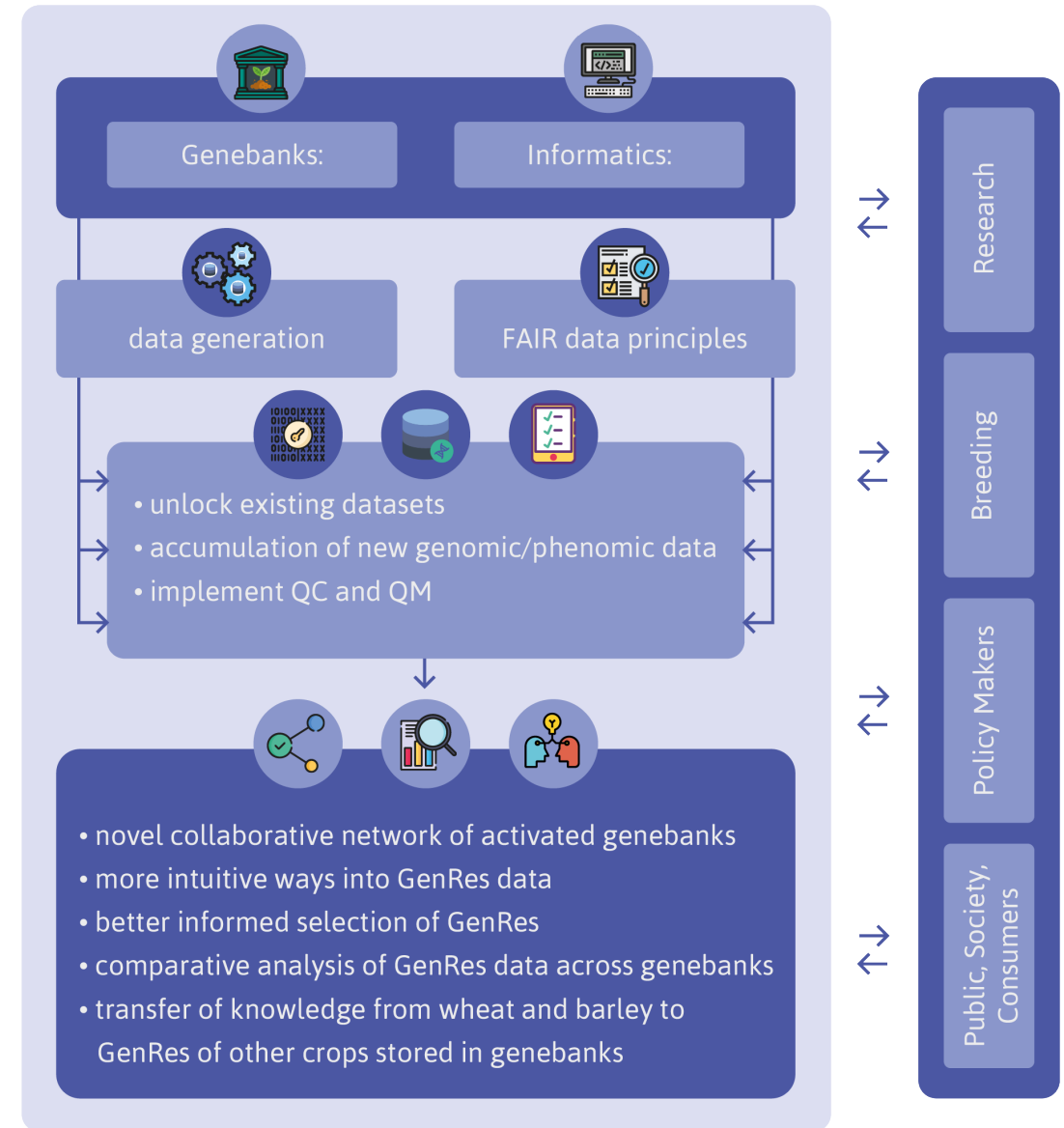


ECPGR **European Evaluation Network:** Public-private partnerships to evaluate genebank material in multilocation trials

AGENT Facts and Goals



AGENT - Activated GENEbank NeTwork



AGENT genebanks create wheat and barley collections for phenotyping and genotyping

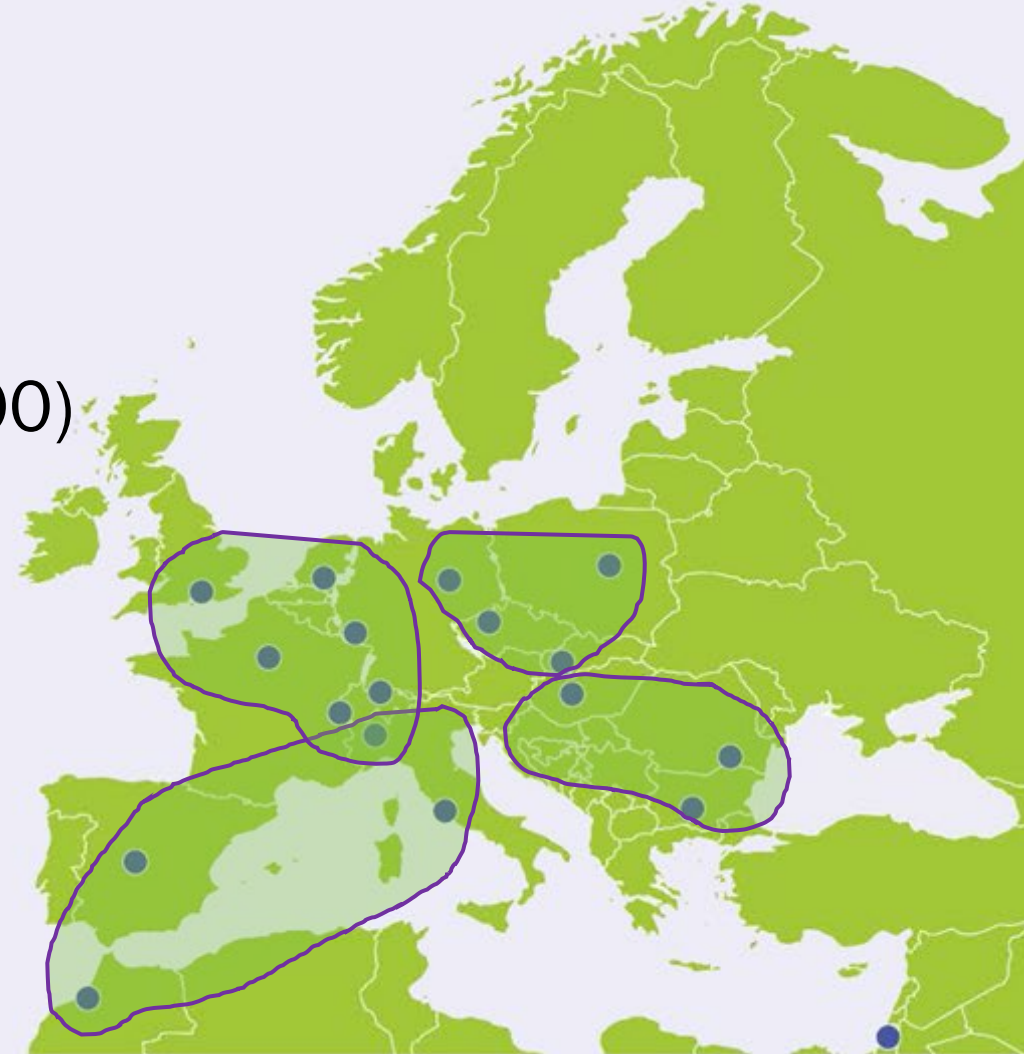


AGENT collections:

- **Precision:** unique accessions (~12,000)
- **Bridging:** potential duplicates (~2,000)
- **Standard checks:** commercial varieties (200)

Agronomic traits phenotyped:

- Plant height
- Flowering time
- Thousand-kernel-weight (TKW)

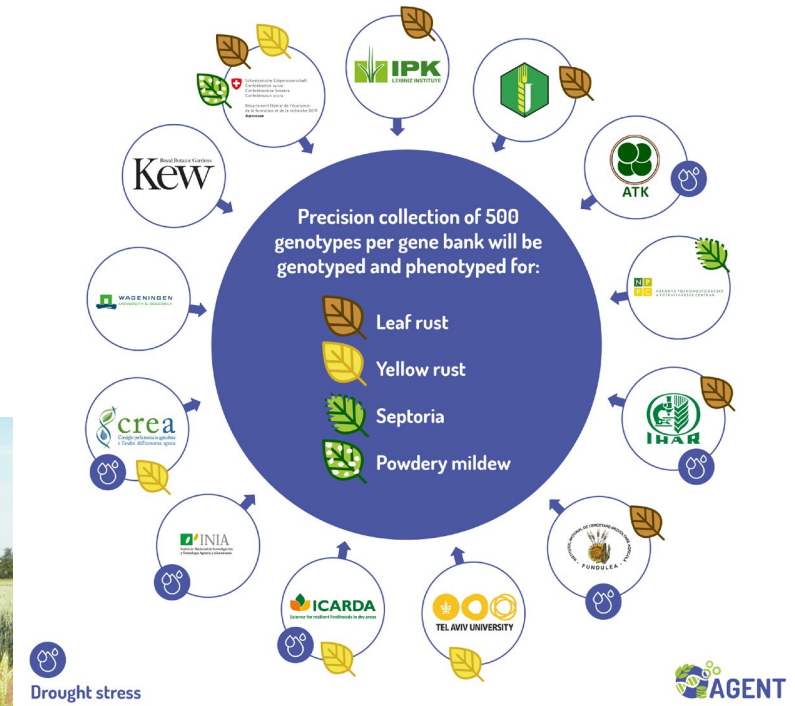


AGENT genebanks collecting phenotypic data for genomic association and prediction



Biotic stress:

- Various fungal diseases



Abiotic stress:

- Drought – in select locations



NPPC



CRI



ICARDA

Historic data from genebank collections collected over multiple decades



- Data collected since the 1940s:
 - Plant height
 - Flowering time
 - 1000 kernel weight
 - others

- Analysis:
 - Heritability,
 - Genomic association,
 - Genomic prediction,
 - Effect of climate change

Data													
Wheat	acn	40s	50s	60s	70s	80s	90s	00s	10s	20s	years	decades	
CREA	1707	-	-	-	-	-	-	+	+	+	14	3	
CRI	4534	-	+	+	+	+	+	+	+	-	40	7	
ICARDA	1654	-	-	-	-	-	-	-	+	+	4	2	
IHAR	7607	-	-	+	+	+	+	+	+	+	27	6	
INIA	1260	-	-	-	-	-	+	+	+	-	22	3	
IPGR-Sadovo	504	-	-	-	-	+	+	+	+	+	30	5	
IPK	12754	+	+	+	+	+	+	+	+	-	70	8	
NARDI	86	-	-	-	-	+	+	+	+	+	29	5	
NPPC	5764	-	-	-	+	+	+	+	+	+	38	6	
WBF	699	+	+	+	+	+	+	+	+	+	55	9	
WR	2239	-	-	-	-	+	+	+	+	+	17	5	

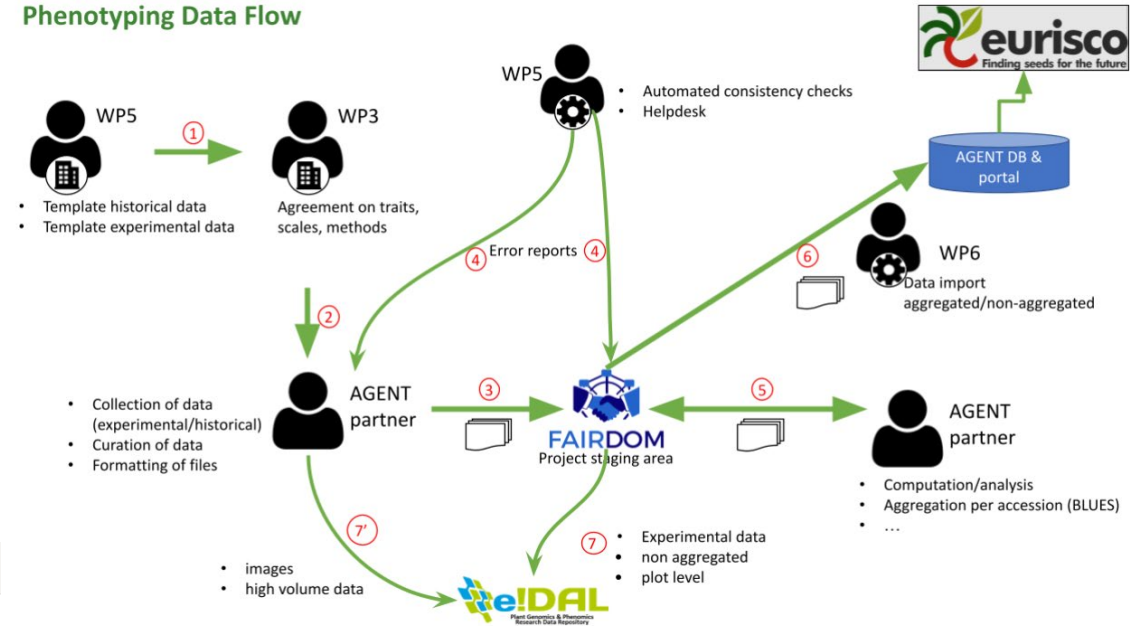
Data													
Barley	acn	40s	50s	60s	70s	80s	90s	00s	10s	20s	years	decades	
CRI	515	-	+	+	+	+	+	+	+	+	65	8	
ICARDA	3	-	-	-	-	-	-	-	+	-	3	1	
IHAR	2626	-	-	-	+	+	+	+	+	-	18	5	
IPGR-Sadovo	610	-	-	-	-	-	+	+	+	-	11	3	
IPK	12876	+	+	+	+	+	+	+	+	-	70	8	
NARDI	944	-	+	+	+	+	+	+	+	+	52	8	
NPPC	1569	-	-	-	+	+	+	+	+	-	28	5	
WR	2047	-	-	-	-	+	+	+	+	+	15	5	

AGENT tools for genebank management



- Data management **guidelines** for phenotypic and genotypic data
- **Standard templates** for data collection
- Data **curation** guides and **validation** tools
- AGENT **data portal**
- Data **analysis** tools and pipelines

Phenotyping Data Flow



Home

About the AGENT portal		
The AGENT portal provides the central entry point to all data collected in the frame of the AGENT project.		
Material providers	Accessions total	Original genebank accessions
14	77560	63770
SSD lines	AGENT IDs	Collections
13574	63846	17

Stakeholder engagement: Evaluations of AGENT accession by EVA Wheat and Barley



European Evaluation Network for PGRFA aims to:

EVA

European Evaluation Network



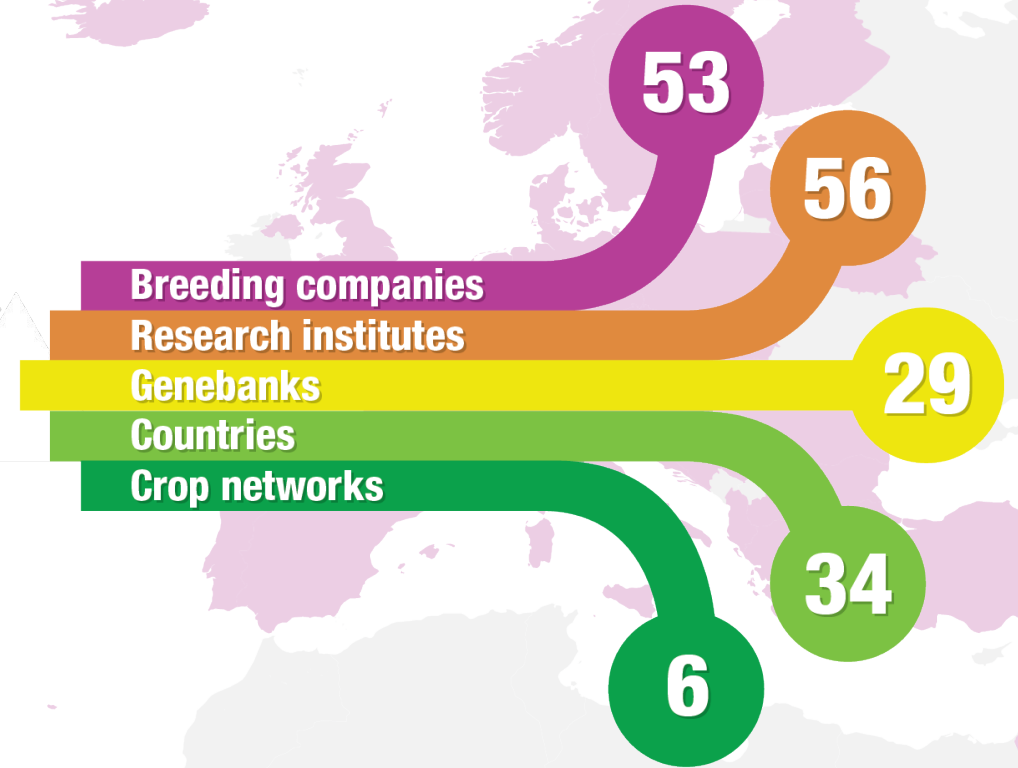
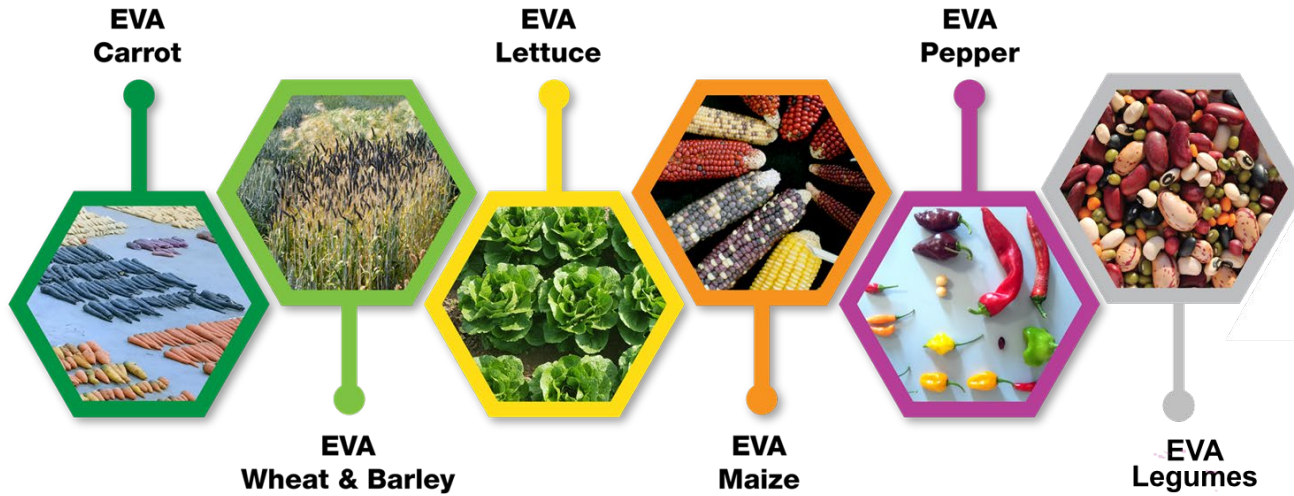
<https://www.ecpgr.org/eva>

- Promote the **use of germplasm diversity** held in European genebanks in research, breeding and cultivation
- Promote exchange of PGR material with **SMTA**
- Foster cooperation between **public and private** sector, involving wider groups of stakeholders in using PGRFA
- Generate **standardized** multilocation evaluation data to identify **climate-resilient** breeding material
- Increase **knowledge**, improve passport information and add C&E data in **EURISCO**
- Create **self-sustaining networks** that evaluate available PGRFA in continuous evaluation cycles

Collaborative crop-specific Public-Private Partnerships

EVA

European Evaluation Network



Standard protocols for traits of interest



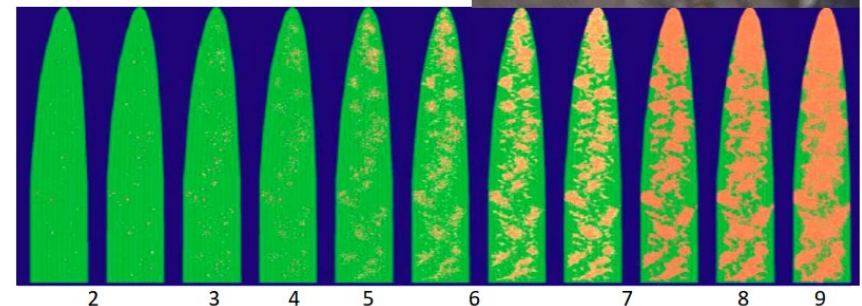
- Morphological traits
 - Shape, color, height,
- Agronomical traits
 - Vigor, yield, development time
- Quality traits
 - Biochemical, processing, storage
- Biotic stress traits
 - Fungal, bacterial or viral diseases
- Abiotic stress traits
 - Drought, heat, cold stresses

Standard protocols combine:

- IPGRI descriptors
- Published protocols
- Partners' expertise



Bread Wheat (*Triticum aestivum*) Illustration by Lizzie Harper



2 3 4 5 6 7 8 9

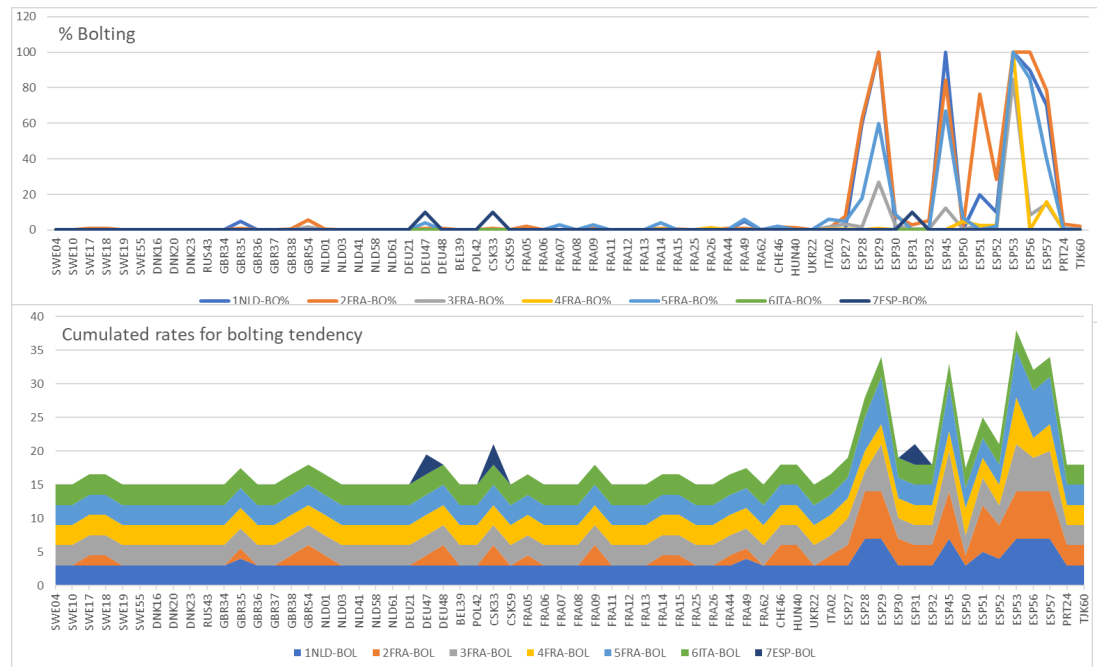
Multilocation trials in field, greenhouse and lab



EVA

European Evaluation Network

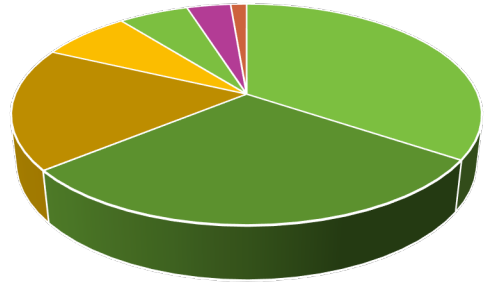
Behaviour of crops in different environments allows identification of locally adapted accessions



Phenotypic data output of EVA networks (2020-2024)

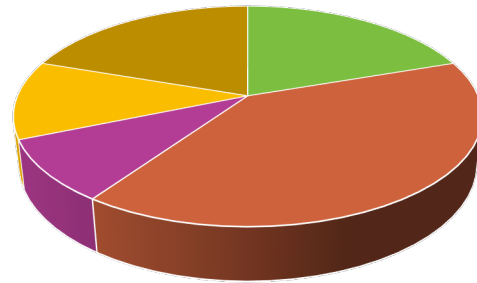


>5000 accessions



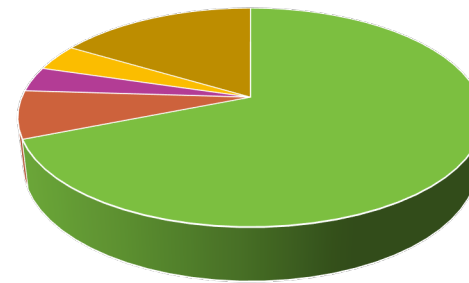
- barley
- wheat
- maize
- durum wheat
- lettuce
- pepper

> 230 Traits evaluated



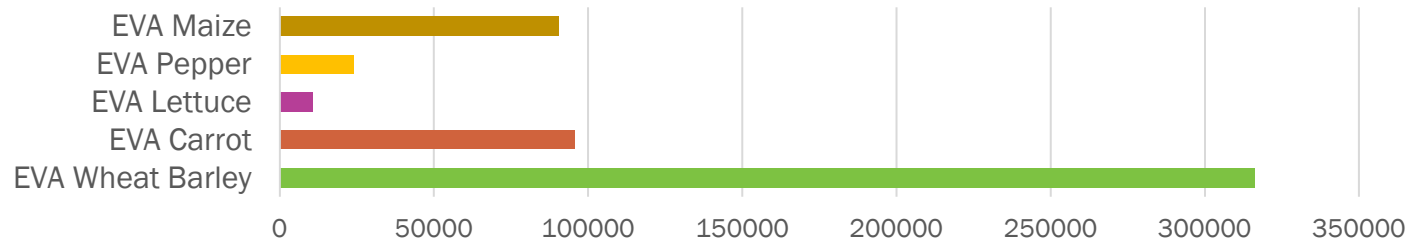
- EVA Wheat Barley
- EVA Carrot
- EVA Pepper
- EVA Maize

383 EVA trials



- EVA Lettuce
- EVA Wheat Barley
- EVA Carrot
- EVA Pepper
- EVA Maize

> 530.000 evaluation data points



Phenotypic data stored in project-specific **EURISCO-EVA** intranet

Genome-wide association in lettuce

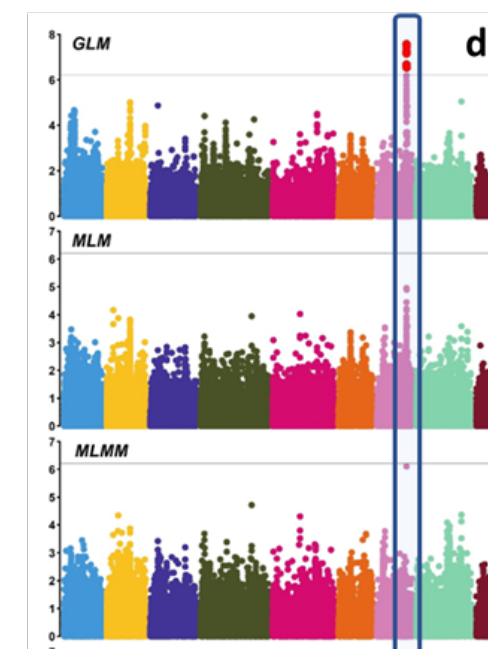
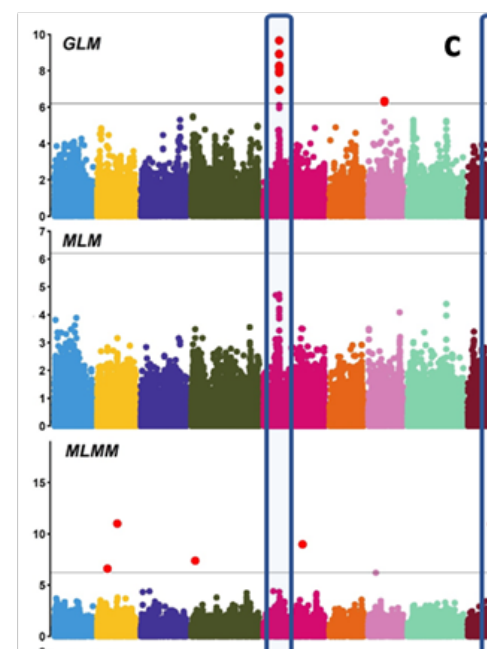
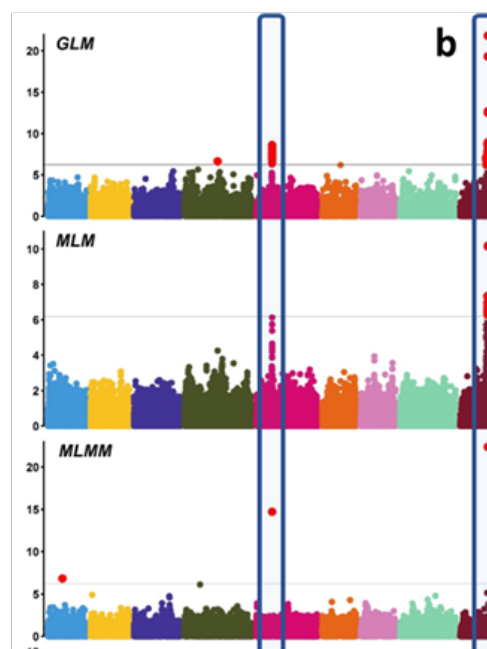
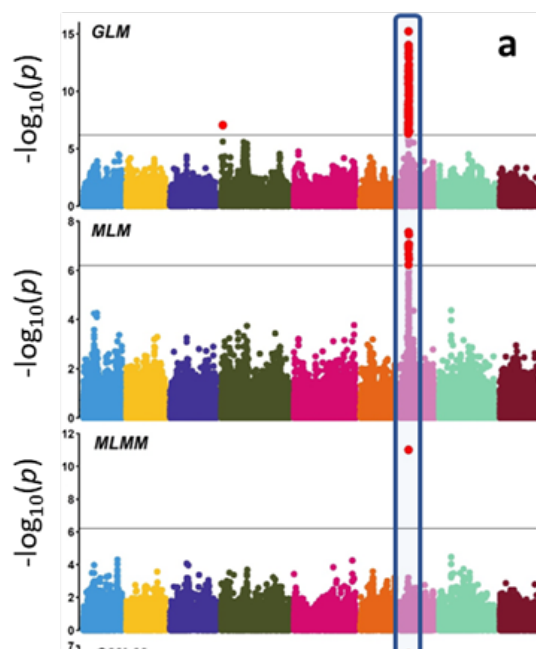
a) Seed colour

b) Leaf anthocyanin

c) Outer leaf colour

d) Bolting time

GLM
MLM
MLMM



Tripodi et al (2023), FIPS

Enable access to PGR through improved documentation

- Harmonize documentation of **passport data on PGR** conserved in genebanks
- Standardize **characterization data** through use of MIAPPE compliant metadata
- Mobilize **existing datasets**, from previous projects and regenerations, to enable exploitation and reuse

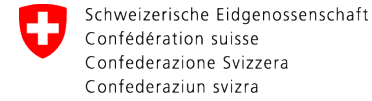
A path to implementing results and approaches from projects like AGENT and EVA through coordinated actions in a GRACE-RI



Acknowledgements

EVA

European Evaluation Network



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THANK YOU

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<https://www.ecpgr.org/eva>

Sandra Goritschnig
s.Goritschnig@cgiar.org



<https://www.agent-project.eu/>