



International Conference on Biodiversity and Molecular Plant Breeding

02.- 06.10.2022.



Maize Research Institute

ZEMUN POLJE

Serbia, Belgrade

Utilisation of Maize Genetic Resources for Agro-Biodiversity Enhancement

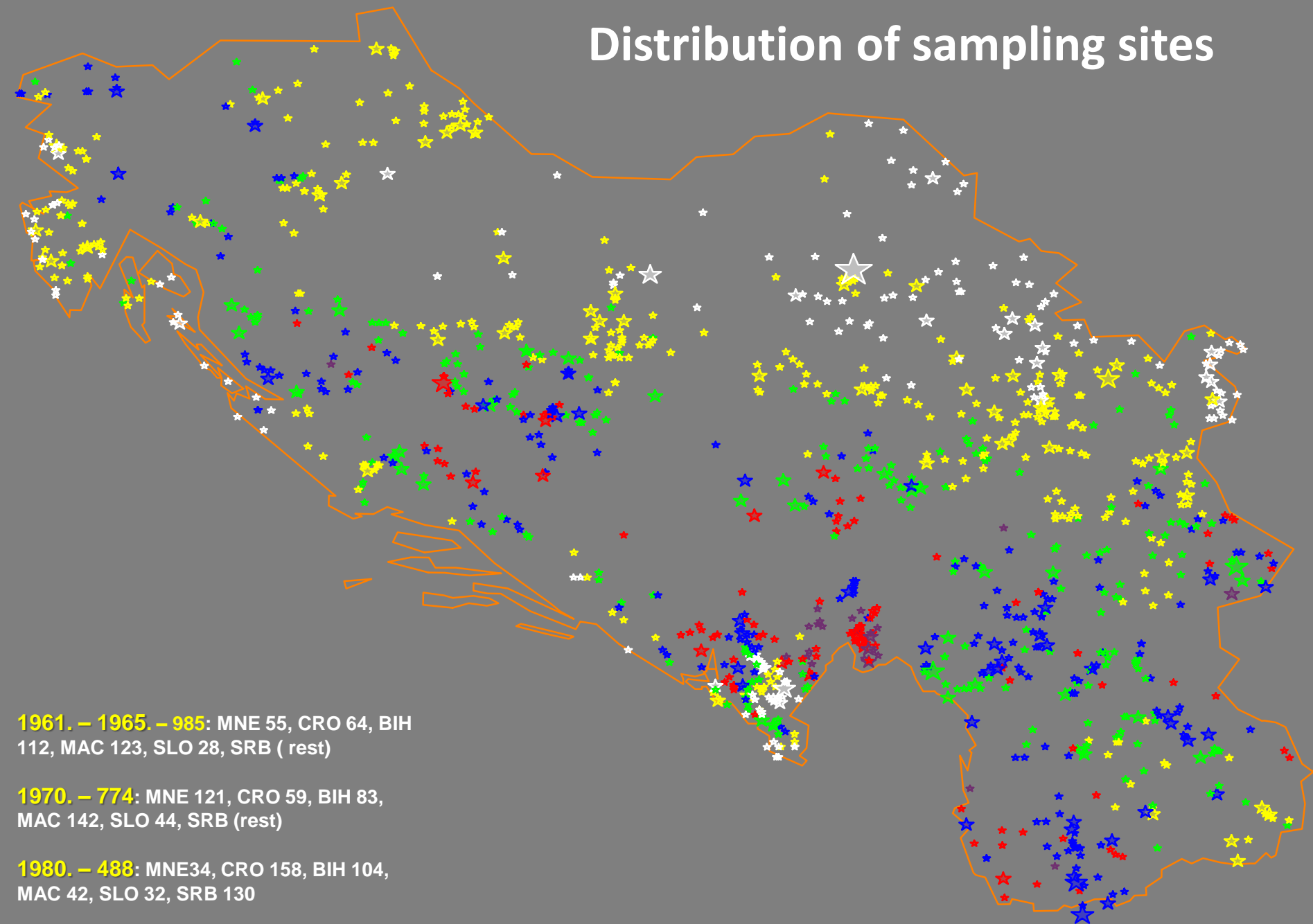
**Violeta Andjelkovic, Vojka Babic,
Natalija Kravic**



The largest maize collections

■	Ukraine	9050
■	Romania	6813
■	Portugal	5942
■	Serbia-MRIZP	5806
■	Italy	5640
■	Bulgaria	4824
■	Spain	3035
■	Hungary	2907
■	Germany	1408
■	Poland	1102

Distribution of sampling sites



1961. – 1965. – 985: MNE 55, CRO 64, BIH 112, MAC 123, SLO 28, SRB (rest)

1970. – 774: MNE 121, CRO 59, BIH 83, MAC 142, SLO 44, SRB (rest)

1980. – 488: MNE34, CRO 158, BIH 104, MAC 42, SLO 32, SRB 130

1990. – 42: BIH 10, SRB 32

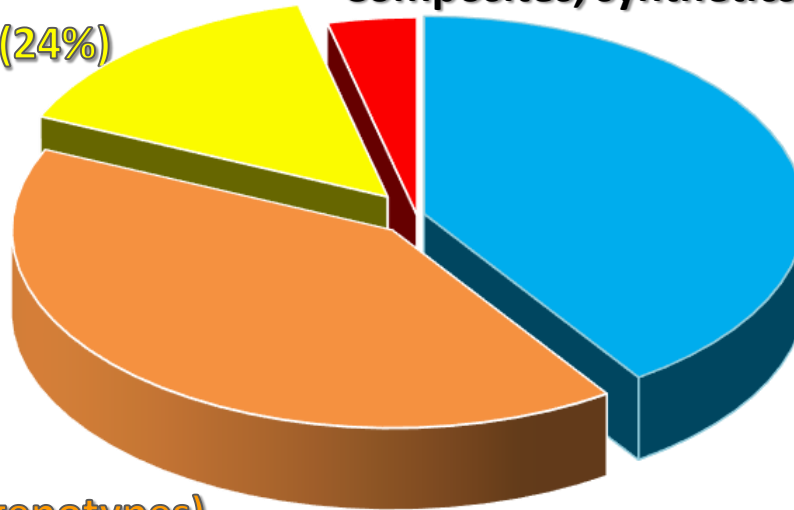


Maize gene bank collection

1 335 heterozygous accessions

Composites, synthetics (9%)

Introduced populations (24%)



Local landraces (2 217 genotypes)

**Introduced inbred lines
(2 254)**



Maize gene bank collection

- Active (working) collection
- Medium-term storage
- Sample size
- Regeneration and multiplication
- Exchange and distribution (seed shipment packets)





Documentation level

The collection of local landraces has been fully characterized in line with the Descriptor for Maize (CIMMYT/IBPGR, 1991)

The Maize Descriptor list includes:

- passport data (accession identifiers and information recorded by collectors)
- characterization (recording of highly heritable and easily observed characteristics, expressed in all environments)
- preliminary evaluation (recording of a limited number of additional agronomic traits important to breeders)

Selected Passport Data Stored in Database

Accession Number	Donor name	Acquisition date	Number of registrations	Photo
1	Mirošević Matrona	10 December 1982	7	
2	Petrović Vlado	10 December 1982	5	
2a	Panković Čarpan	10 December 1982	5	
2b	Panković Čarpan	10 December 1982	5	
4	Čirbačić Savo	10 December 1982	5	
6	Čirbačić Matrona	10 December 1982	7	
7	Buković Radica	10 December 1982	7	
16		10 January 1983	5	
1811	Križević Jozica	23 March 1977	3	
2217	Petrović Stojan	11 December 1989	2	
2297	Trubić Otoka	20 January 1992		



MRIZP gene bank collection of local landraces was classified into 16 main and two derived agro-ecological groups, using natural classification based on morphological traits, origin and evolution

Agro-ecological groups

- 1. Montenegrin flints**
- 2. Bosnian early dents**
- 3. Kosmet flinty dents**
- 4. Macedonian flints**
- 5. Eight-rowed maize type of Ne Am.**
- 6. Derived flints**
- 7. Mediterranean flints**
- 8. Small-kernelled flints**
- 9. Eight-rowed soft dents**
- 10. Romanian flints**
- 11. Large-eared flints**
- 12. White flinty dents - Moravac**
- 13. Dents type of USA Corn belt dents**
- 14. Derived dents**
- 15. Dents type of southern areas of USA**
- 16. Serbian dents**
- 17. Flinty dents**
- 18. Denty flints**





Use and valorization

(till 2000)

- high diversity of maize eco-types represent a good potential for improvement of elite breeding material
- maize landraces are not directly used in breeding
- they are used for the development of synthetic populations or core collections for the traits of interest
- development of core collection allows the integration of the most valuable traits (adaptability, variability, divergence and heterotic potential) of underutilized gene bank germplasm



Eco core collection – Flints

(till 2000)



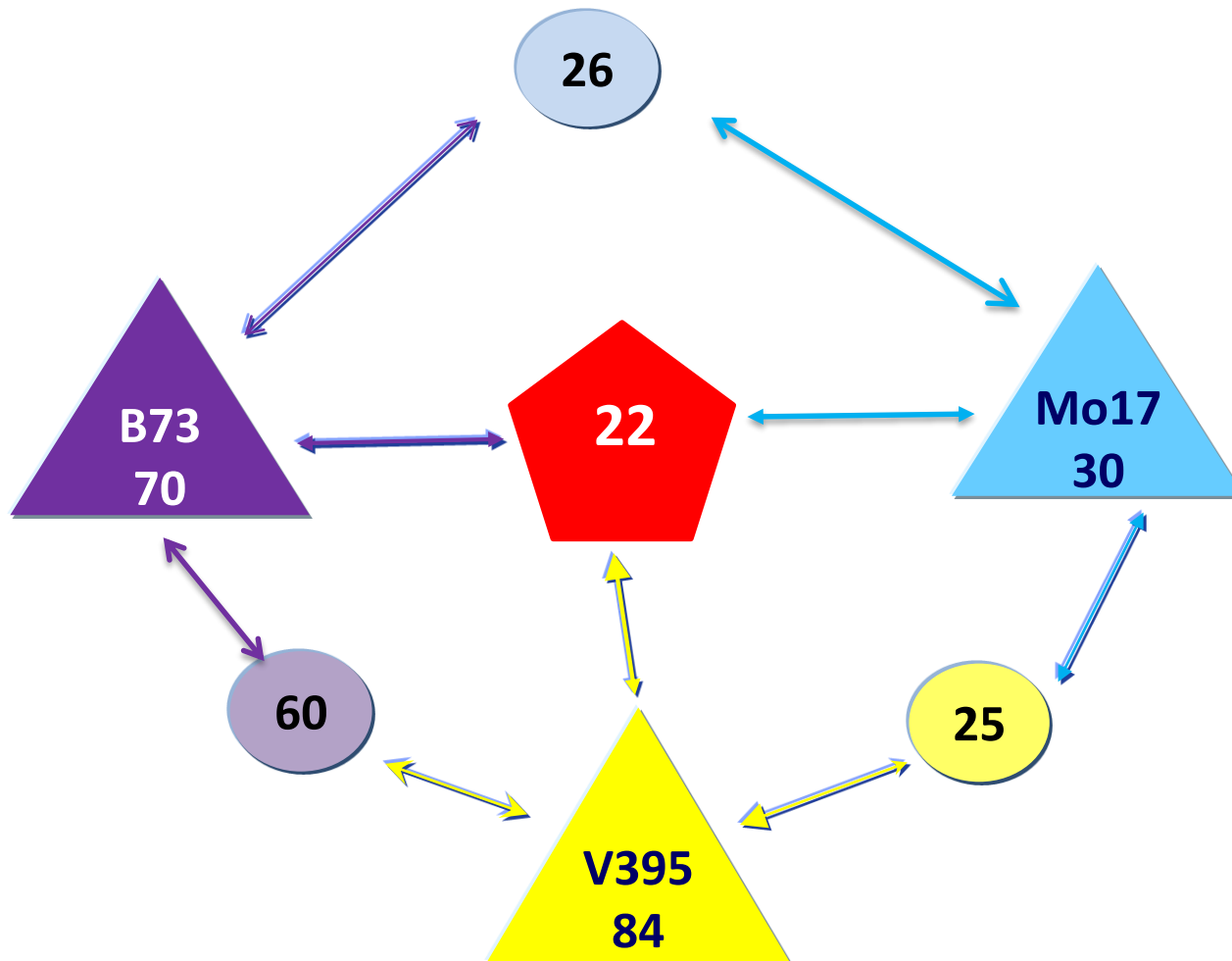


Eco core collection - Dents





Elite core collection



900 populations

FAO 500-700 were crossed to testers



Existing use and its valorization

Identification of new sources in gene bank

(After 2000)

- Cytoplasmatic male sterility - Cms
- Herbicide tolerance
- Drought tolerance
- Grain quality





National projects

- **Identification of drought tolerant sources in maize gene bank (TR 20014)**, Ministry of Education, Science and Technological development, Republic of Serbia, 2008–2011
- **Exploitation of maize diversity to improve grain quality and drought tolerance (TR 31028)**, Ministry of Education, Science and Technological development, Republic of Serbia, 2011–2019



IDENTIFICATION OF DROUGHT TOLERANT SOURCES AMONG ENTIRE MAIZE GENE BANK COLLECTION

Controlled drought in Egypt (5806 genotypes)

Survived \approx 769 genotypes

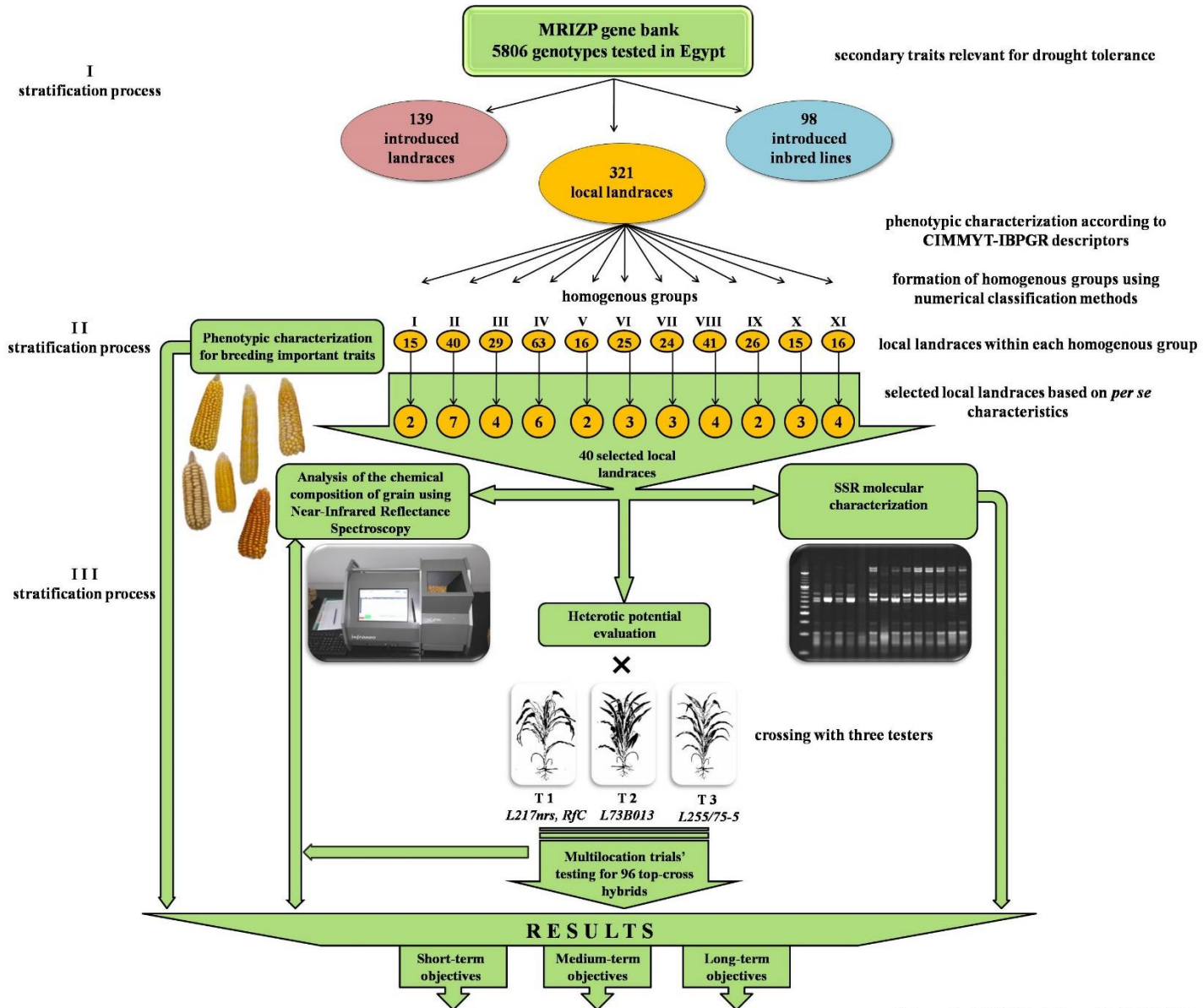
selected \approx 571 genotype

*321 local landraces
(long-term breeding)*

*41 accessions
(mini-core collection)*

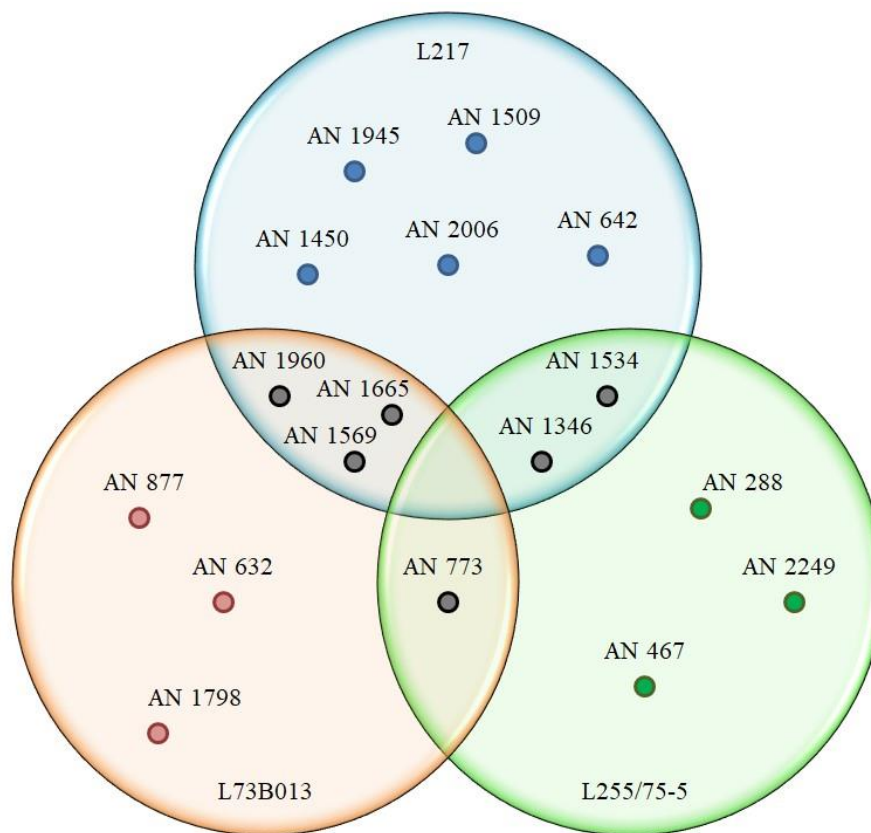
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Long-term pre-breeding program for improvement of local maize populations





Development of broad-base synthetic populations, in accordance with short, medium and long-term goals of MRIZP commercial breeding program



Heterotic effect of the maize landraces in crosses with testers used



Ongoing projects

- **Biodiversity and Molecular Plant Breeding (KK.01.1.1.01.0005)**, Centre of Excellence for Biodiversity and Molecular Plant Breeding (CoE CroP-BioDiv), Republic of Croatia, 2018–2023

OBJECTIVES - to improve maize breeding based on:

- (1) to increase profits from sustainable use of maize genetic resources for food and agriculture
- (2) introduction and optimization of modern high yield phenotyping techniques
- 3) introduction and optimization of modern genotyping with the application of new approaches in the statistical analysis

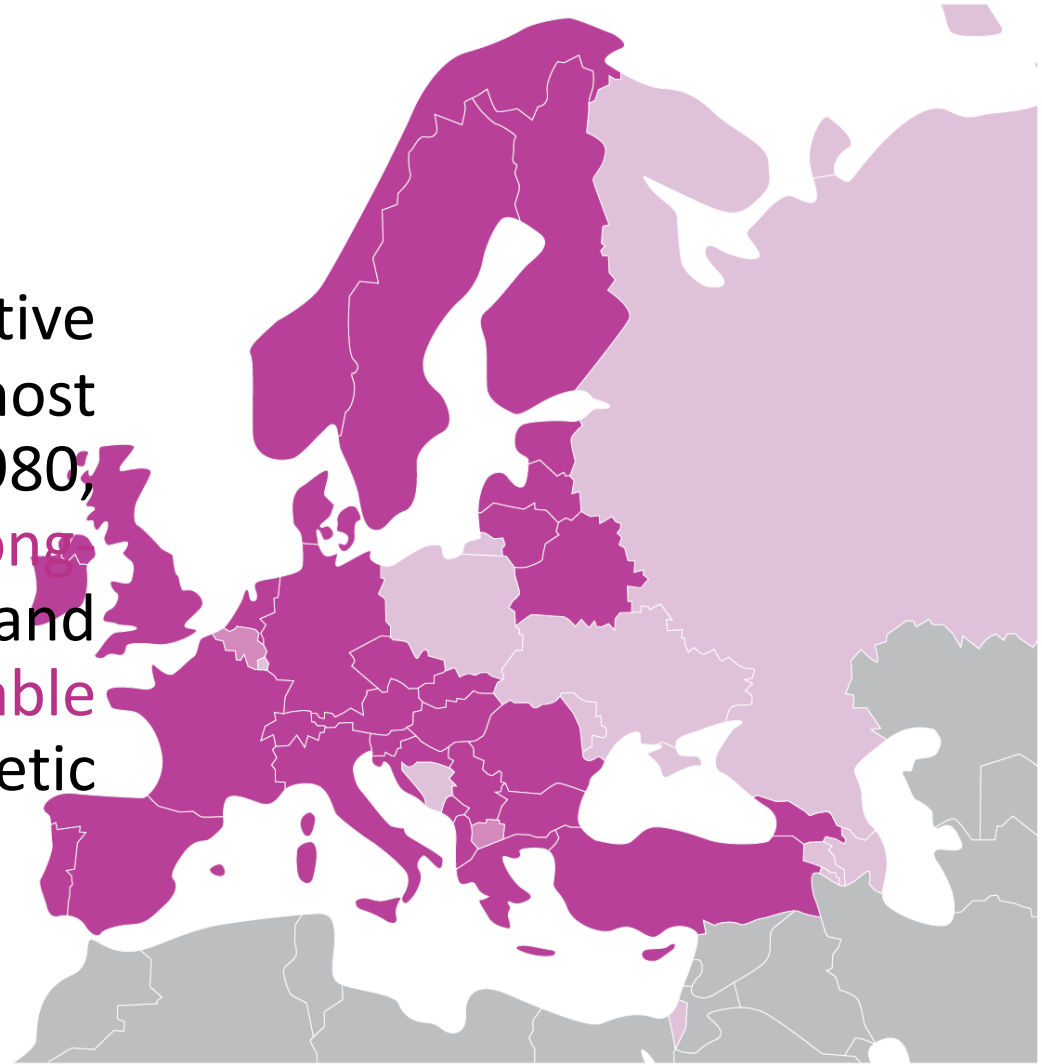
- **Harmonization of methods for phenotyping, genotyping and management of genetic resources in maize**, Bilateral Project with Republic of Croatia, 2019–2022)

European
Cooperative
Programme
for Plant
Genetic
Resources

ECP/GR



ECPGR is a collaborative Programme among most European countries since 1980, aiming at ensuring the long term conservation and facilitating the sustainable utilization of plant genetic resources in Europe



- ECPGR Membership in Phase X (Letter of agreement signed)
- ECPGR Membership in Phase X (Country did not sign Letter of Agreement, but is paying contributions)
- Countries eligible to join Phase X

The European Cooperative Programme for Plant Genetic Resources (ECPGR) is a collaborative programme among most European countries aimed at ensuring the long-term conservation and facilitating the increased utilization of plant genetic resources in Europe

[Read More](#)

Pisum sativum (Photo: LMaggioni)



40 YEARS OF COOPERATION IN EUROPE FOR DIVERSITY AND FOOD SECURITY!

In this 4 min video **'Saving European plant and food diversity: together, we are stronger!'**, Marc Lateur tells a story about apple diversity, with a happy ending (*Marc Lateur is the ECPGR National coordinator from Belgium*).

[WATCH VIDEO](#)

ECPGR Maize Working Group

ECPGR Homepage / ECPGR Working Groups / ECPGR Maize Working Group



Maize diversity. Photo: V. Babic, Maize Research Institute, Serbia

CHAIR

Violeta Andjelkovic

✉ violeta@mrizp.rs

Nominated as Chair for Phase X in February 2019



Expectations from maize working group

- **Netting of gene bank managers, researchers, breeders and different kind of users (small farmers, organic farmers, food industry)**
- **Enhancing the value of underestimated and underutilised maize gene bank collections**
- **Rising public awareness about the importance for preservation and sustainable use of maize genetic resources**



Crop-specific public-private partnerships

Joint phenotyping and genotyping

Evaluations in different European environments

Identification of climate-resilient breeding material

Enriched genebank inventories

EVA

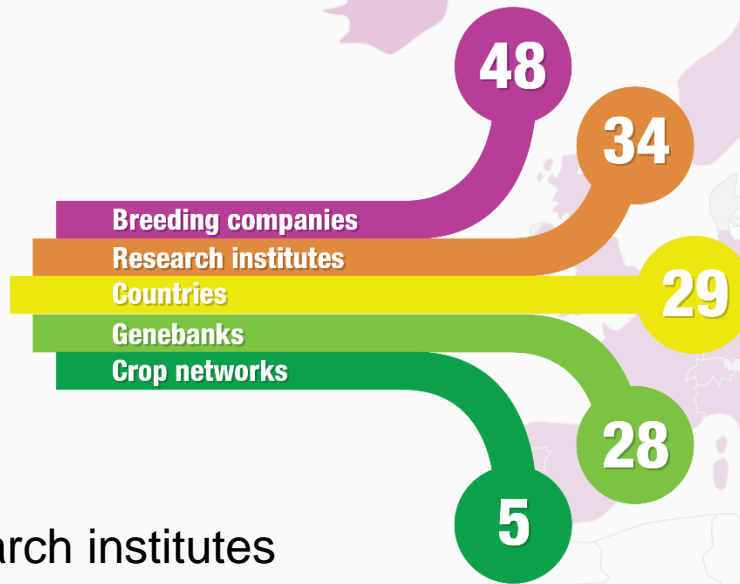
European Evaluation Network

Joint work provides benefits to all partners:

- Shared expertise and knowledge
- Large phenotypic datasets from multilocation trials
- Data embargo
- Results and materials will be publicly available (through EURISCO and SMTA)

More than 90 EVA partners

EVA IN NUMBERS



- **Public partners:**
 - Genebanks
 - Universities and research institutes
- **Private partners**
 - Multinational breeding companies
 - SME breeding companies
 - Organic breeding companies
 - Breeding and farming cooperatives

→ **Networks are open to new partners**

→ **ECPGR can facilitate establishment of new networks**

Five crop-specific EVA networks

**EVA
Carrot**



**EVA
Lettuce**



**EVA
Wheat & Barley**

**EVA
Pepper**

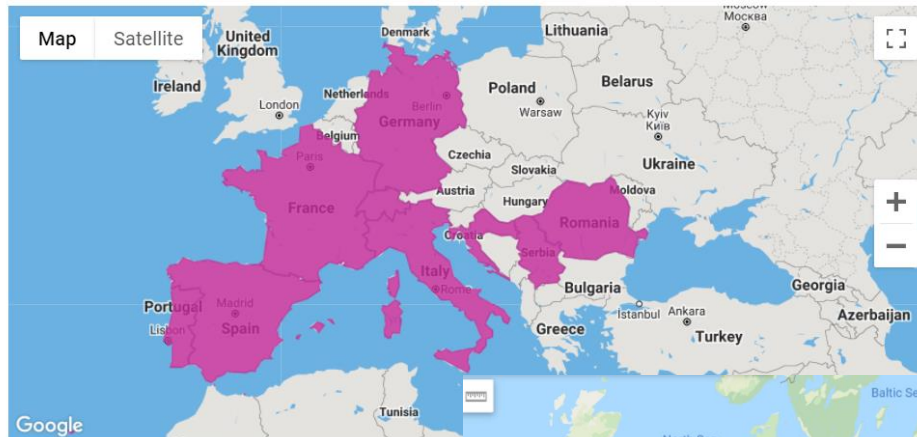


**EVA
Maize**

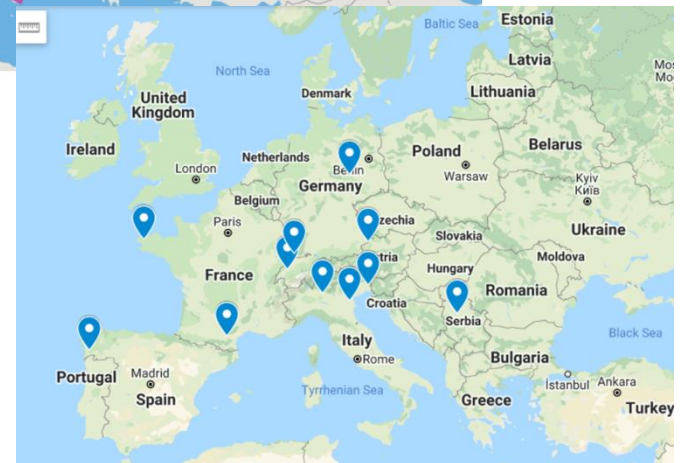


The EVA Maize network

- 18 partners from 9 countries
 - 11 genebanks and/or research institutes
 - 8 breeding companies

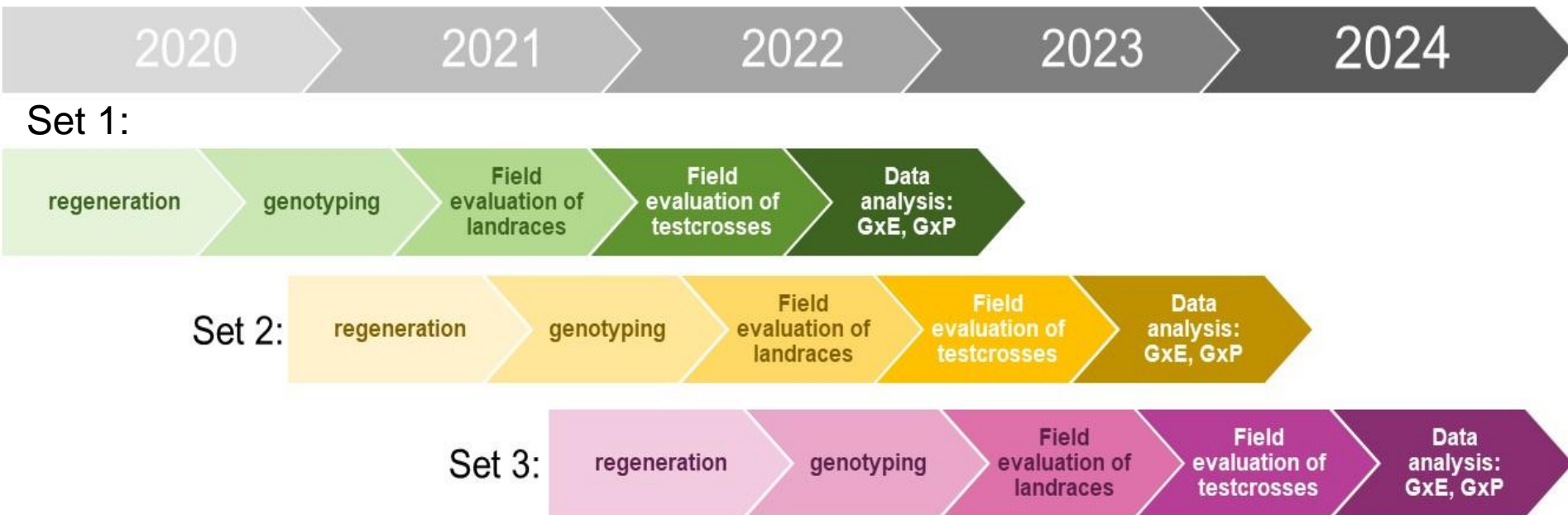


EVA Maize countries involved



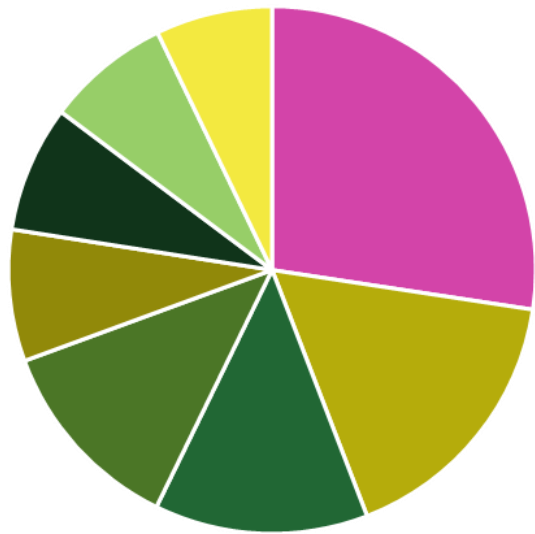
EVA Maize trial sites 2021

Workplan of EVA Maize network



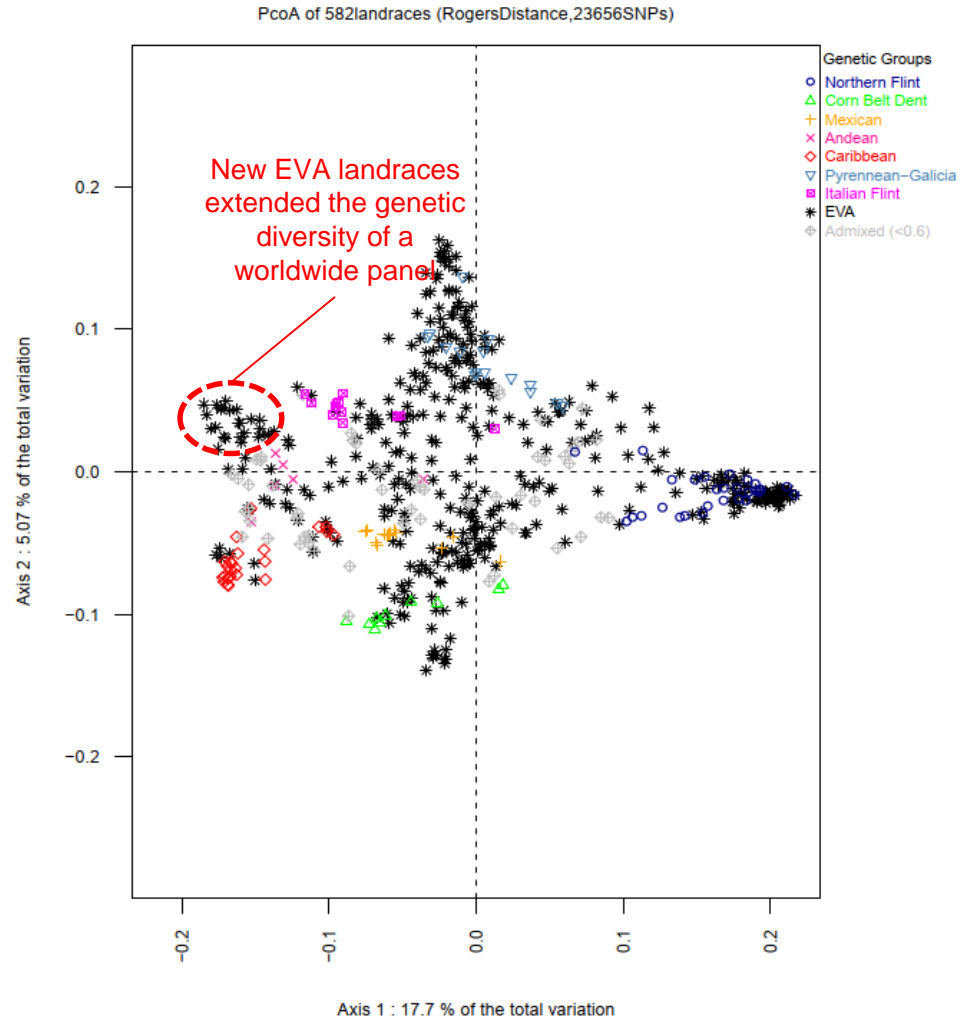
- 3 sets of ~250 maize genebank accessions genotyped and evaluated in multilocation field trials → total of ~750 accessions
- Data collected and stored in EURISCO-EVA project database during embargo period

European genebanks providing EVA Maize accessions



- Spain
- Switzerland
- Serbia
- France
- Italy
- Romania
- Croatia
- Portugal

Material includes landraces, first generation inbred lines and more advanced breeding lines



PcoA on Modified Roger's Distance matrix of 416 EVA landraces and 156 landraces from worlwide panel (Arca et al., 2021b).

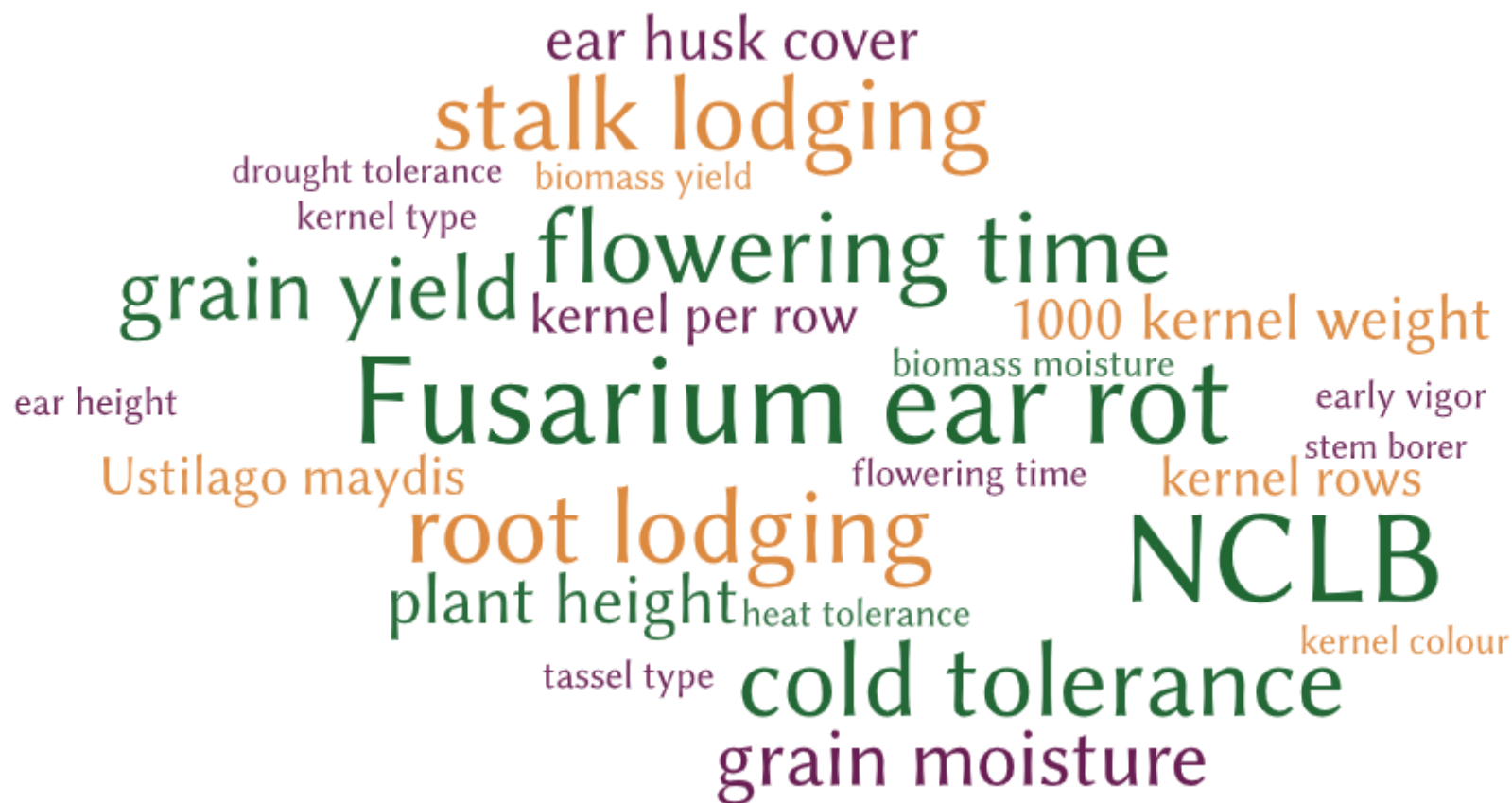
D. Madur, INRAE

Phenotypic evaluations

Standard scoring protocols
Standard experimental protocols
Standard data collection templates



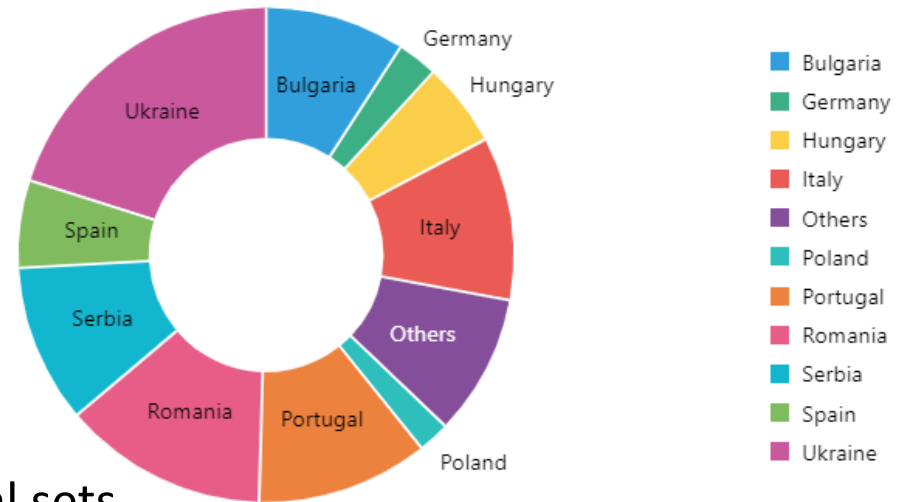
**Standardized
comparable data**



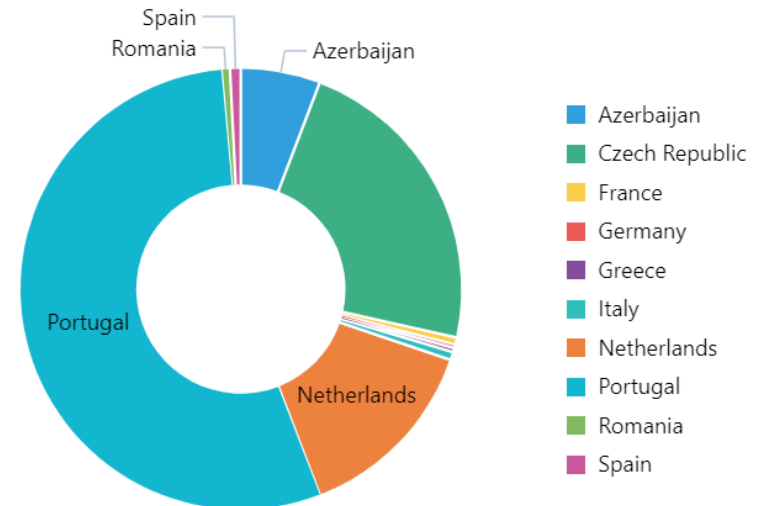
>50,000 Maize accessions in EURISCO

Outlook

- 43 field trials in 2022:
 - Finalize evaluations of first set of accessions
 - Ongoing evaluations of additional sets
- Optimization of protocols and logistics
- Data analysis
- Explore the remaining diversity of European maize accessions



~3,000 Maize accessions with C&E data



EVA Maize partners:

LIDEA Seeds
CREA-CI Bergamo
Agroscope MRIZP BPGV-INIAV
Instituto Politécnico de Coimbra
Delley Seeds and Plants Limagrain CSIC
BAYER Seeds INRAE Montpellier
INRAE GQE MAS Seeds RAGT 2n KWS
Suceava Genebank IPK
University of Zagreb



Funding:





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Thank you for your attention!

