



Genebank perspective – how to make genebank materials attractive for users?

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1. Introduction

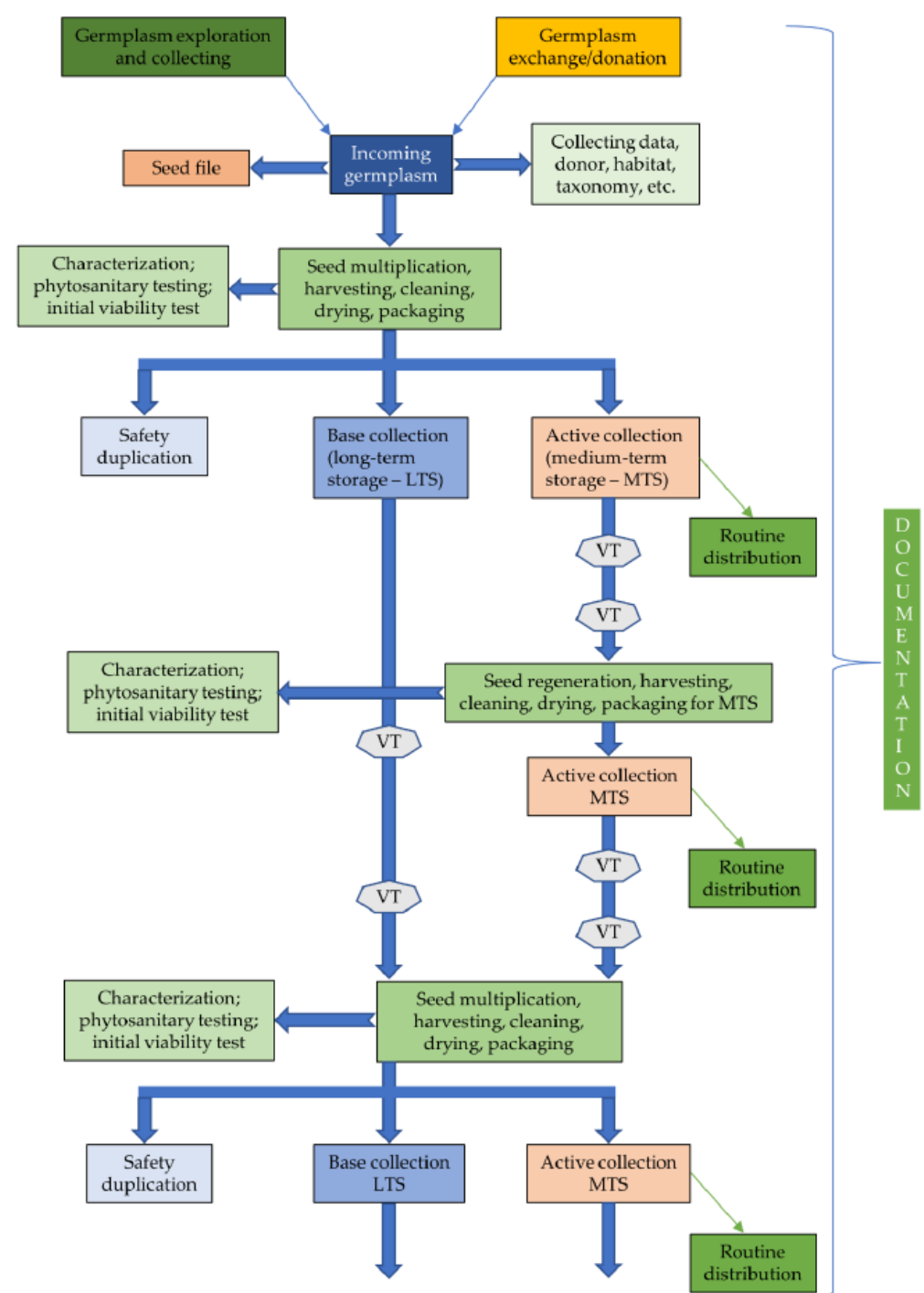
- I'm on both sides of the table:
 - Researcher and breeder (>30 y)
 - Director of Institute holding UPV germplasm bank (8,5 y) + Director of the UPV germplasm bank (9 m)
- The germplasm bank of UPV is small (13,901 accessions)
- We are one of around 2,000 germplasm banks at World level (>400 in Europe)



2. Importance of genebanks

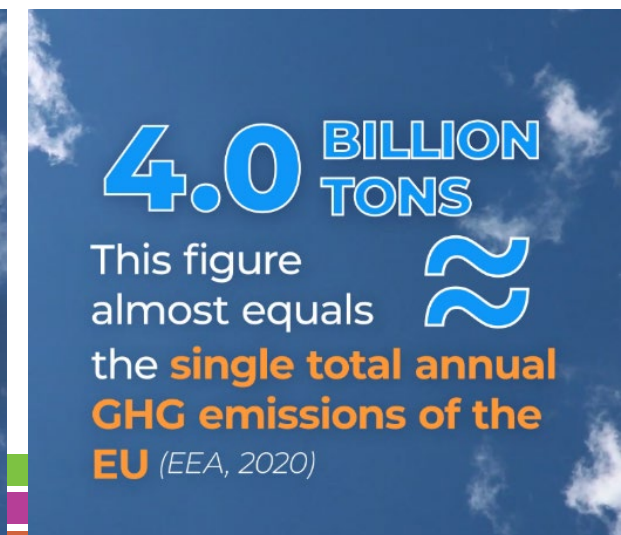
- Essential in maintaining food security, yield increases and a more sustainable agriculture
- Long time conservation of genetic resources of crops
- Characterize the genetic resources, at different layers: basic characterization, evaluation, phenomic data, genotyping

Image taken from Engels et al., 2021



2. Importance of genebanks

- Properly document the information of genetic resources and make it available
- Providing genetic diversity for users. This information must be of the highest quality possible and abiding to the applicable laws and regulations
- Raw material for genetic advances in yield and sustainable agriculture



3. Challenges faced by genebanks

- Funding is a crucial issue. There is a disparity in availability of funds for the genebank operations
- Deficient funding often results in inappropriate germplasm management leading to poor quality germplasm and associated information
- Funding of genebanks depends from the national level, resulting in disparities of strategies and irregular funding, difficulting efficient coordination at the European level



3. Challenges faced by genebanks

- Genetic resources went from “heritage of mankind” (pre-1992) to resources “under national sovereignty” (1992 onwards)
- Access to genetic diversity has become more complicated and bureaucratic (seed companies make more emphasis in their own private genebanks...)
- Multilateral system of ITPGRFA is restricted to 35 crops and genepools and 29 forage species

Table 1. Salient statistical features of information in EURISCO.

	Number
Number of accessions	2,056,983
part of MLS:	430,597
part of AEGIS:	65,286
with a DOI:	228,078
Number of institutes:	401
Number of countries:	43
Number of genera:	6725
Number of species:	45,179

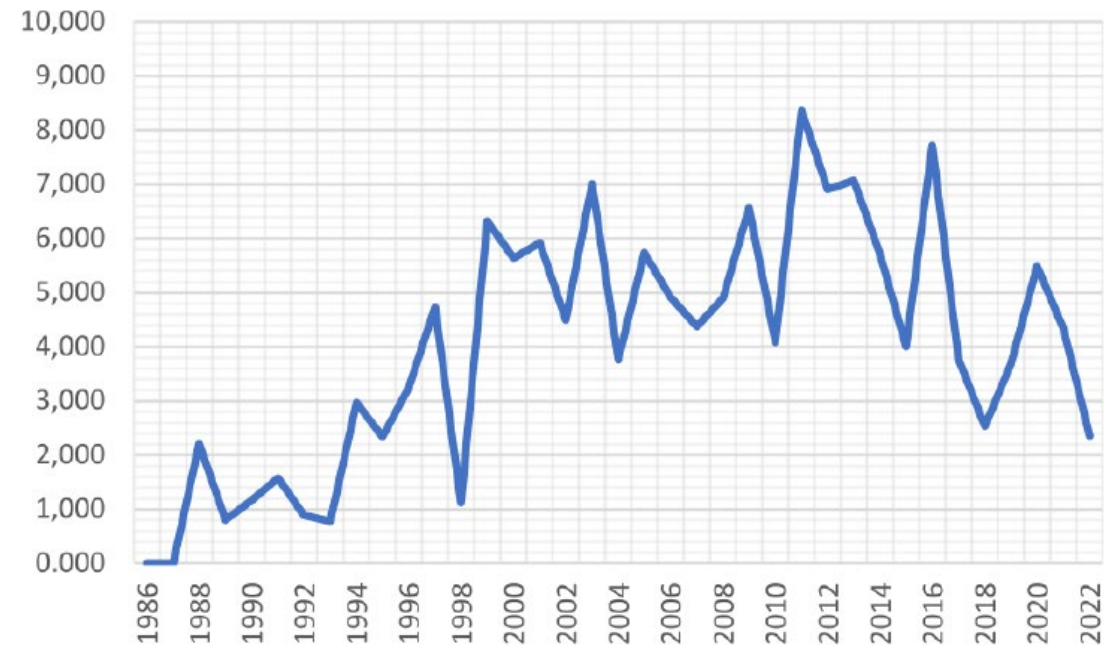
Table taken from van Hintum et al., 2021

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CGN (The Netherlands)

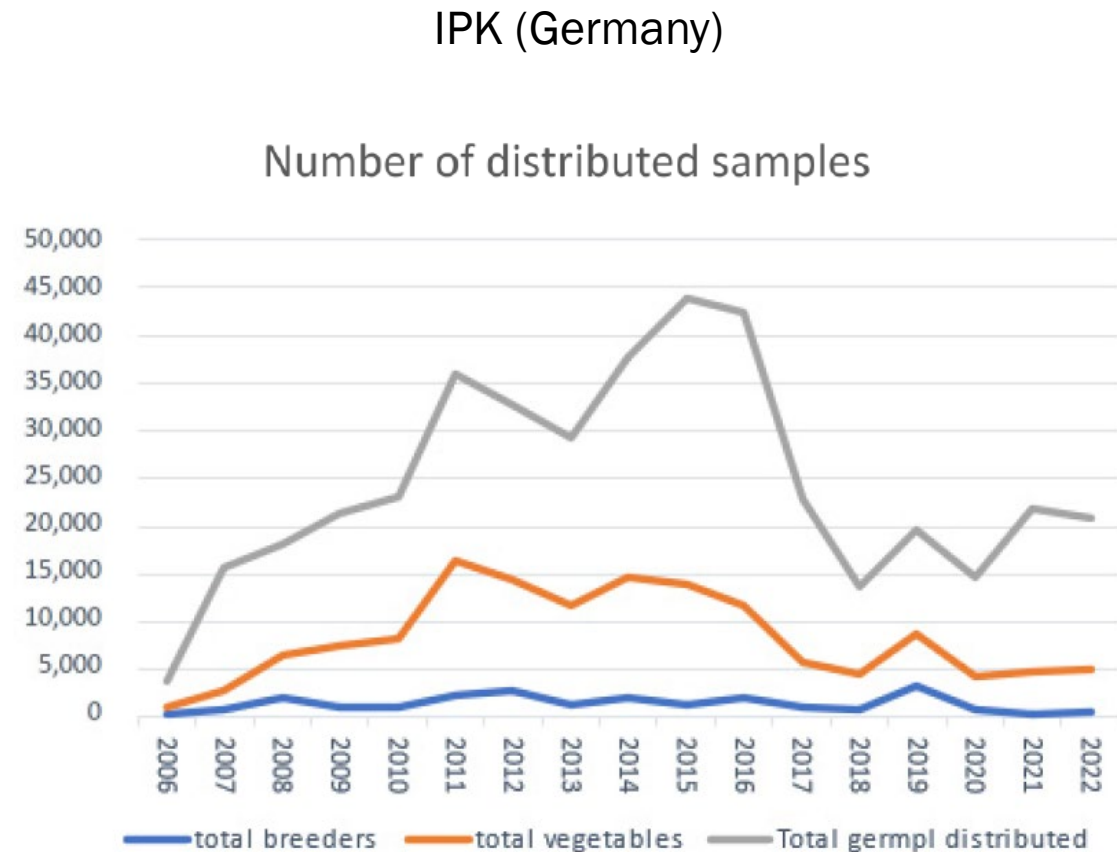
Number of distributed samples



Taken from van Hintum et al., 2021

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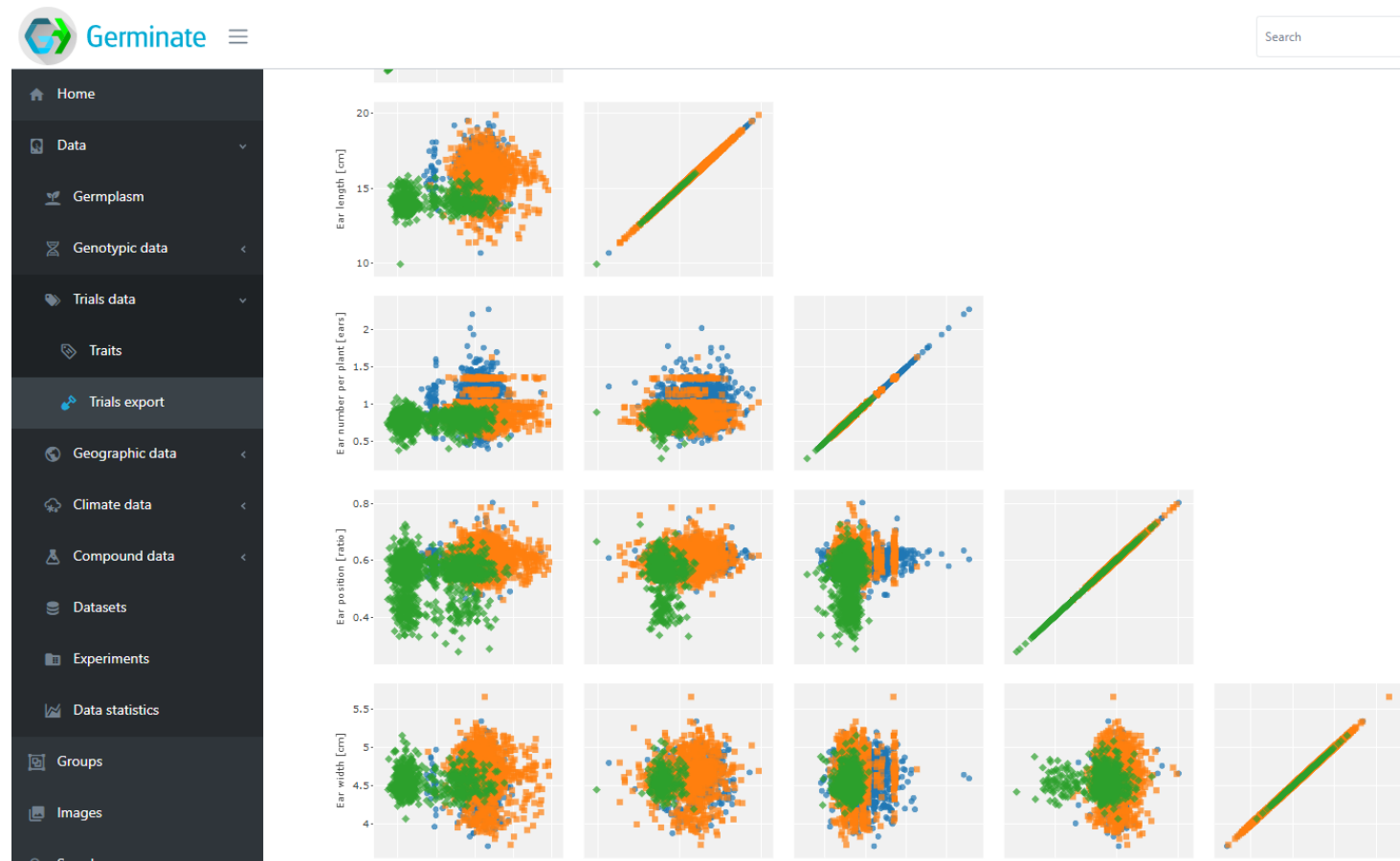
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Taken from van Hintum et al., 2021

4. Strategies to enhance attractiveness

- Improve accessibility:
- Improve access to the germplasm which should be viable, disease-free and with acceptable legal conditions
- Germplasm is most useful when distributed together with relevant information
- Legal certainty and easy and transparent access to genetic resources



4. Strategies to enhance attractiveness

- Improving accessibility:
- Ensuring comprehensive and accurate documentation of genebank materials
- Facilitate the burdensome paperwork, including phytosanitary aspects, to ease providing germplasm
- Fast and straightforward process for supplying germplasm to breeders and seed companies.

The screenshot displays the 'Online SMTA Generation and Reporting' interface. At the top left is the logo for the International Treaty on Plant Genetic Resources for Food and Agriculture. The main content area is a yellow grid of icons representing various SMTA-related actions: 'Generate new SMTA', 'Pending SMTAs', 'SMTAs ready for reporting', 'Reported SMTAs', 'View Profile', 'SMTAs ready for acceptance', 'Change tool', and 'Help'. A left-hand navigation menu includes sections for 'Main menu', 'As Provider', and 'As Recipient'. The footer contains a 'User Manual' link, a copyright notice for 2024, and a 'Terms of Use' link.

4. Strategies to enhance attractiveness

- Designate more accessions as part of AEGIS
- Adopt standards (certification and auditing such as ISO9001 or AQUAS) to ensure quality of the procedures and materials
- Clear rules on providing accessions (i.e., maximum number of accessions, time required for sending the germplasm, etc.)

Responsibilities of AEGIS Associate Members:

Ensure long-term conservation of European Collection according to FAO and [crop-specific agreed standards](#) (as part of the AEGIS quality system - AQUAS)

Ensure safety-duplication in agreed conditions

(under black-box arrangements as appropriate and as appropriate for vegetatively propagated material, at another Associate Member genebank, possibly in a different country, and/or at the Svalbard Global Seed Vault. See [safety duplicate policy](#).)

Record public domain accession-level information through the National Inventory System and EURISCO

(including available non-confidential characterization and evaluation data)

Facilitate access to and availability of European Accessions

(with use of [SMTA](#))

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A genebank quality management system assures the quality and reliability of products and services for customers, partners and funding agencies. It also facilitates cooperation between genebanks in Europe.

Certification

CGN has adopted a Quality Management System (QMS) according to NEN-EN-ISO9001:2015, certified by DNV.

The CGN quality handbook (in Dutch) is available on request. If you have questions or comments, do not hesitate to contact us at cg@wur.nl.

4. Strategies to enhance attractiveness

- Access to germplasm information:
- Include information in databases and online platforms that provide comprehensive information
 - EURISCO
 - Genesys
 - Germinate
 - Specific of crops
 - G2P-SOL
 - HARNESSTOM
 - TGRC, etc.



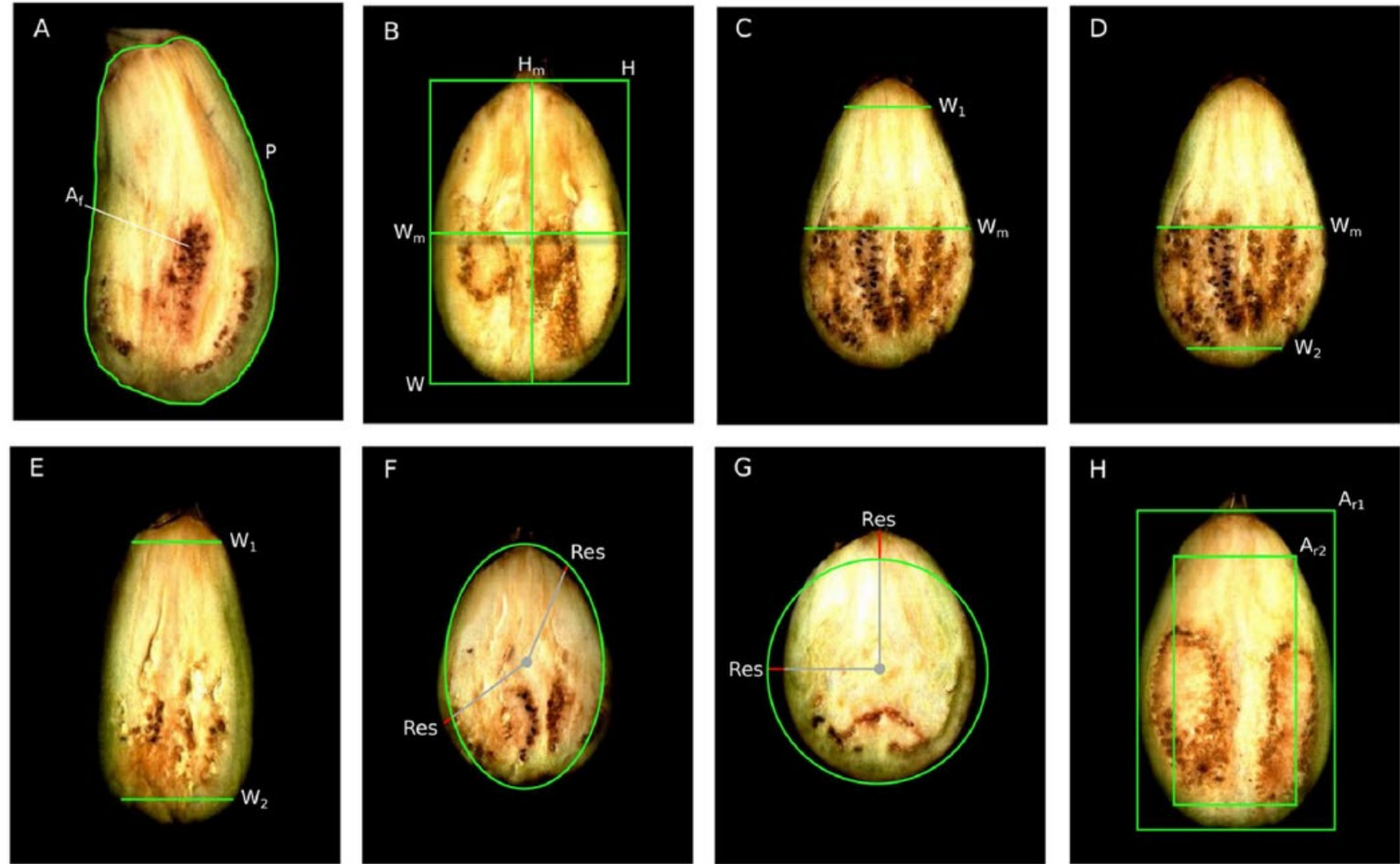
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- Promoting utilization:
- Developing partnerships with researchers, breeders, and farmers to encourage the use of genebank materials
- Collaboration in regeneration and phenotypic/molecular characterization and evaluation of materials with breeding companies. This facilitates selection of germplasm of interest by companies. Information can be public after an embargo (typically 2-3 years)



4. Strategies to enhance attractiveness

- Images and high-throughput phenomic data available in addition to standardized primary characterization



4. Strategies to enhance attractiveness

- Specialization in specific crops



4. Strategies to enhance attractiveness

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

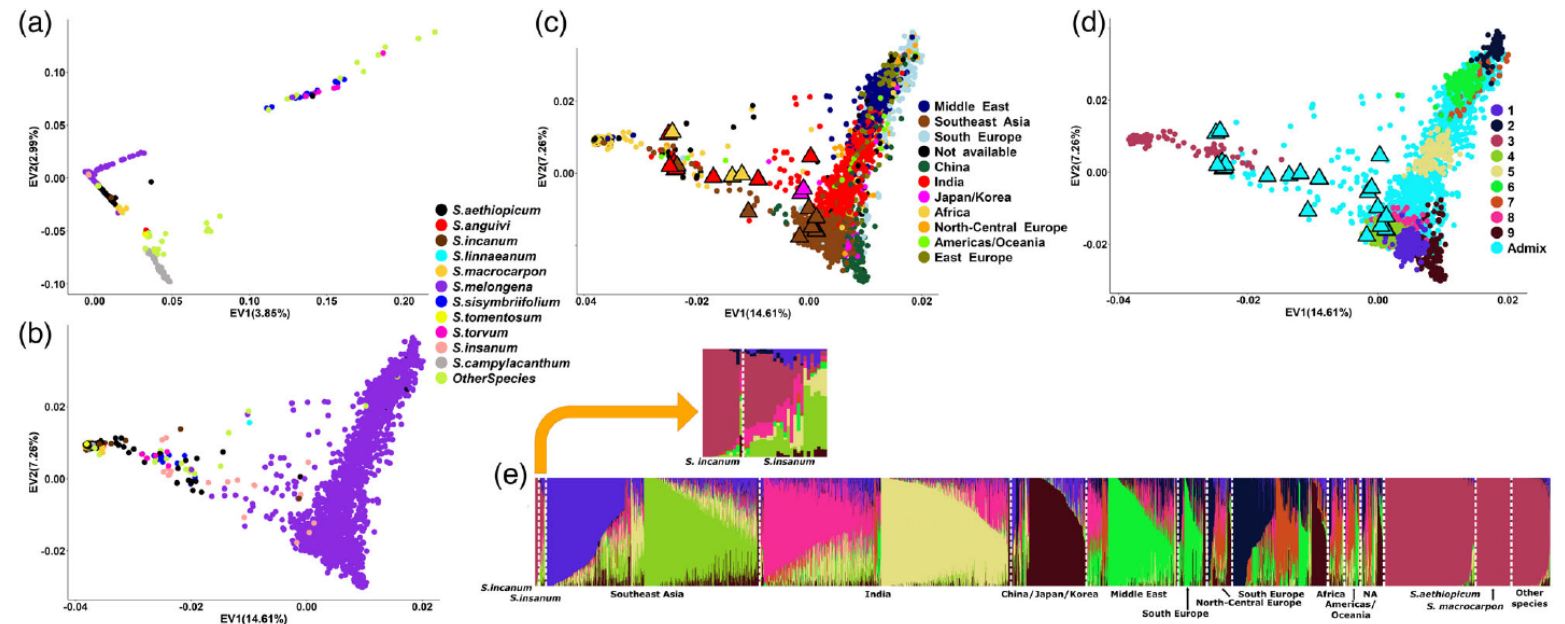


Figure 3. Principal component analysis (PCA) of eggplant genetic diversity in worldwide genebank holdings.

(a) PCA colored by species, whole single nucleotide polymorphisms (SNPs).

(b) PCA colored by species, target SNPs.

(c) PCA colored according to geographic origin, target SNPs.

(d) PCA colored according to Admixture K clusters, target SNPs ($K = 9$).

(e) Admixture clustering analysis, $K = 9$, target SNPs, using the same color scheme of (d). *Solanum insanum* and *S. incanum* admixture assignment are expanded in the panel indicated by the arrow. The full Admixture analyses, with $K = 2-15$, are shown in Figure S4.

Image taken from Barchi et al., 2023

4. Strategies to enhance attractiveness

- Innovative approaches:
- Providing training and support to potential users on how to access and use genebank materials
- Open days and field days for breeders, researchers and farmers



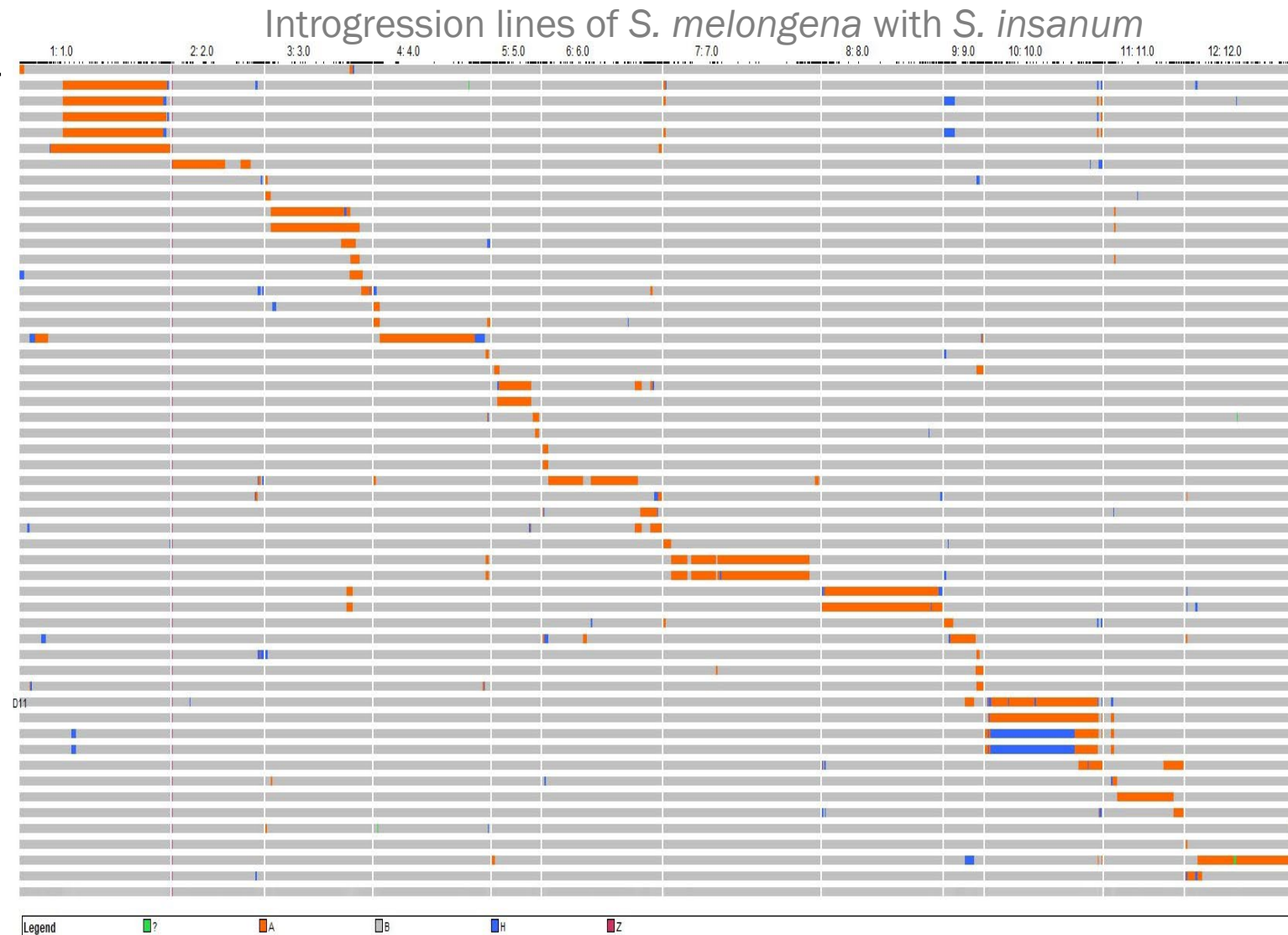
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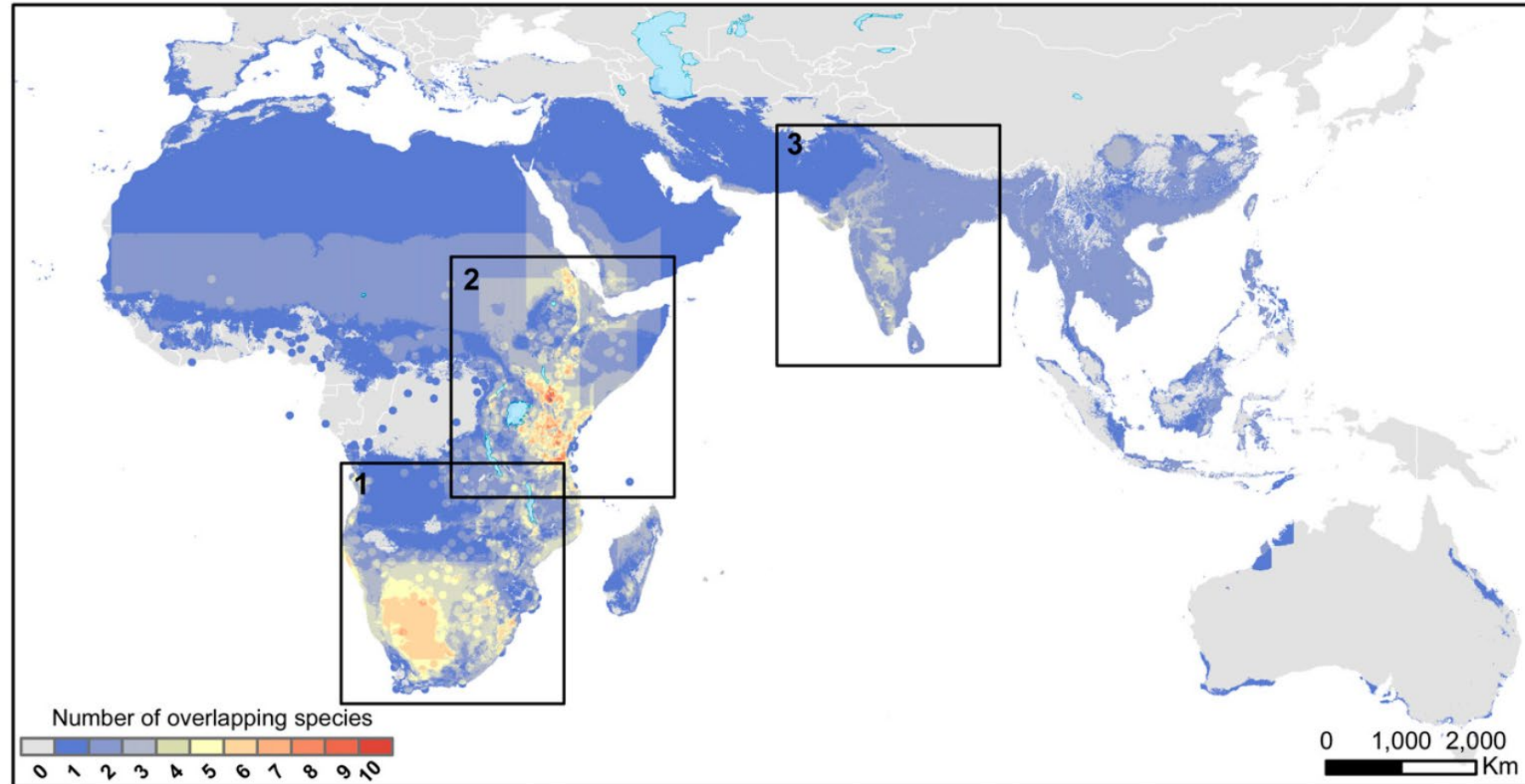
- Source of pre-breeding and experimental populations?
- Contribute to preemptive breeding by acting as repositories of high-added-value pre-breeding and experimental populations? Such as:
 - Introgression lines
 - MAGIC and NAM populations
 - Mutant collections



4. Strategies to enhance attractiveness

- Improve the collections:
- Fill genetic and geographic gaps, underrepresented crops and CWRs
- However, restrictions increasing for collecting new germplasm

Gap analysis of eggplant CWR (Syfert et al., 2016)



4. Strategies to enhance attractiveness

- Policy and advocacy:
- Creating a European Research Infrastructure on Genetic Resources
- Advocating for supportive policies and increased funding for genebanks at national and international levels
- Extending the MLS of the ITPGRFA to all crops



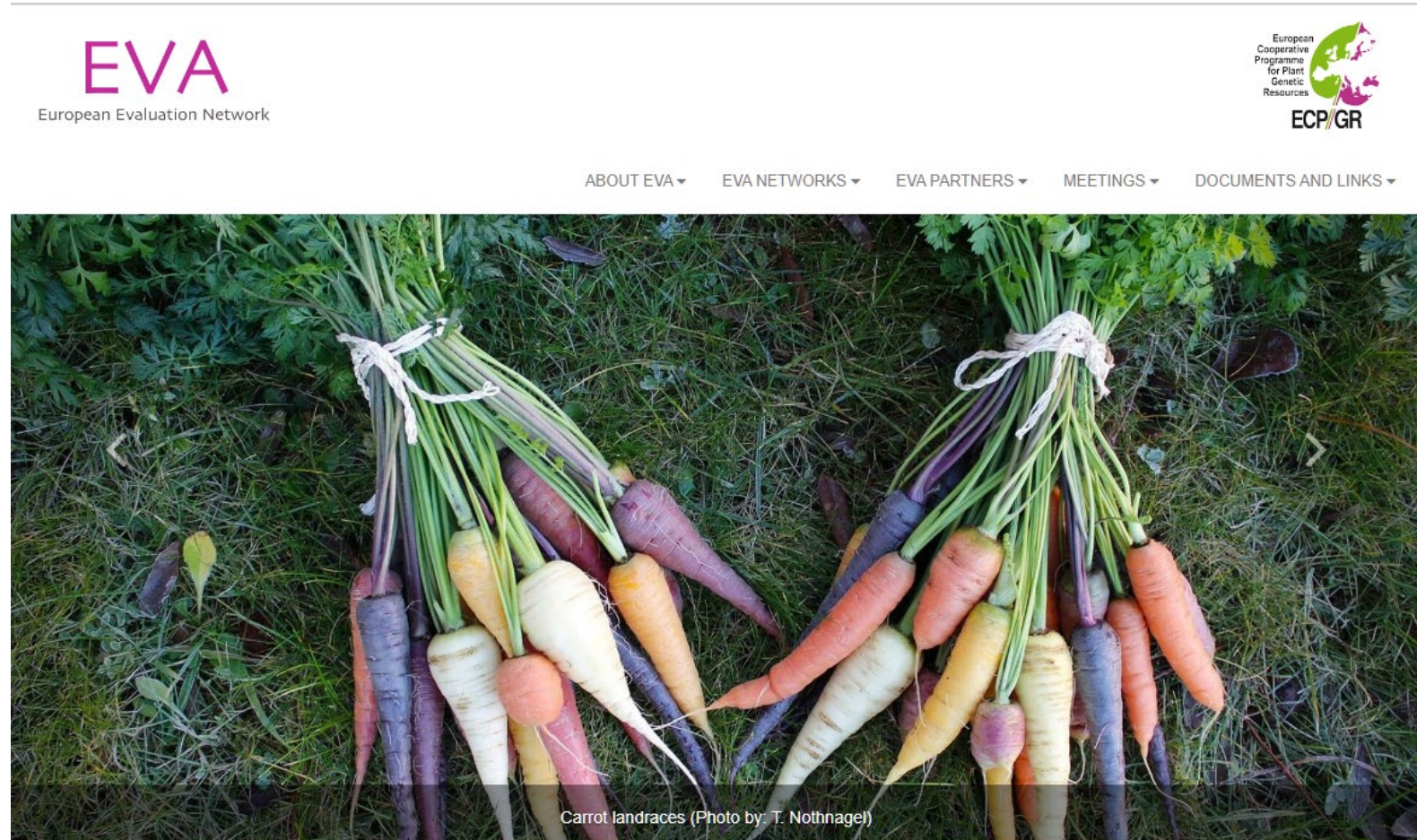
4. Strategies to enhance attractiveness

- Raising public awareness about the importance of genebanks through educational campaigns and outreach programs
- Participation of private sector representatives in genebank advisory committees
- Long-term agreements between genebanks and breeding companies and associations for provision of mutual services



4. Strategies to enhance attractiveness

- Joint participation in the ECPGR EVA network
- Extend the concept of AEGIS (European Genebank Integrated System) to more accessions



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5. What if too attractive?

- In the current situation being “too attractive” may result in too many applications that in quite a number of genebanks can not be managed in a sustainable way without extra resources



5. Summary

- Genebanks are essential for food security and sustainable agriculture
- Funding disparities and bureaucratic hurdles impact genebank effectiveness
- Increased genebank attractiveness for users require improving accessibility and enhancing the information provided on germplasm
- Improving current databases to provide extended information of characterization and phenomic data would increase attractiveness
- Advocating for supporting policies and raising awareness is crucial
- The development of the GRACE-RI will represent a dramatic improvement on attractiveness of germplasm to users

6. Call to action

- Continue with improving the genebanks functioning procedures and standards
- Enhance the capabilities of the databases to include more information accessible to users in a friendly manner
- Facilitate as much as possible the bureaucratic and phytosanitary paperwork
- Engage in raising awareness among the public and among decision makers
- Support actively the establishment of the GRACE Research Infrastructure



THANK YOU

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