European Cooperative Programme for Plant Genetic Resources
ECP/GR

EVA
European Evaluation Network

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Roadmap for the Development and Establishment of the EVA Perennials Network

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Contents

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Introduction

The European Cooperative Programme for Plant Genetic Resources (ECPGR) has long been dedicated to preserving, evaluating and sustainably utilizing plant genetic resources. The ECPGR Evaluation Network EVA represents a key initiative within this framework, focused initially on coordinating the evaluation of seed-propagated crops across Europe. Operating since 2019, the current six crop-specific EVA networks bring together around 130 organizations in public–private partnerships to join their expertise and capacity to generate knowledge and add value to crop accessions conserved in European genebanks and making them more available for further research, direct uses, pre-breeding and breeding. Recognizing the pressing need to extend such collaborative efforts to perennial crops, such as berries, pome fruits, stone fruits, nuts and grapes, an activity was included in the German-funded project EVA Boost (GenR 2024-2) to lay the foundation for a strategic expansion of EVA activities.

Perennial crops present a unique set of challenges compared to annual crops, primarily due to their long life cycles, complex genetic structures, and the extended time required for evaluation and breeding. However, these challenges also offer opportunities: long-term trials and evaluations can yield richer data on traits such as climate resilience, fruit quality and pest and disease resistance over the years, and interactions with environmental abiotic and biotic stresses, providing critical insights that annual crop evaluation cannot capture.

The present roadmap was designed to guide the development of a robust and innovative EVA Perennials Network, ensuring that the network can effectively address the diverse needs of stakeholders, including researchers, genebanks, breeders, nurseries, growers, gardeners and policymakers.

Perennials breeding status quo

Perennial crops represent a cornerstone of European agriculture, contributing not only to food security and rural economies but also to biodiversity, landscape conservation and climate resilience. The perennial crops considered in this context include pome fruits (e.g. apple, pear), stone fruits (e.g. cherry, plum, peach, apricot), nuts (e.g. almond, walnut, hazelnut), and berries (e.g. strawberry, raspberry, blueberry, currants, grape). These crops are propagated clonally or vegetatively, and their genetic resource conservation requires long-term field maintenance and highly specific propagation and phytosanitary protocols. While *ex situ* collections of these species are widespread in Europe, their coverage, quality, and accessibility vary greatly. Core challenges include the lack of regeneration, incomplete or outdated passport data, and a general absence of centralized phenotypic and genotypic characterization and evaluation. As a result, significant portions of the available diversity often remain underutilized in research, direct uses, pre-breeding and breeding or are at risk of being lost.

Based on data and national inventories on the European Catalogue for Plant Genetic Resources (EURISCO), the diversity of perennial fruit and nut crops in Europe is significant but highly variable in terms of documentation, characterization, evaluation and institutional concentration. While certain countries maintain extensive collections for species such as *Malus domestica*, others are notably underrepresented in official databases, despite likely holding valuable local diversity. The EURISCO overview on characterization and evaluation (C&E) data reveals that perennial crops are systematically underrepresented compared to major cereals and grain legumes. Although the EURISCO dataset covers a wide range of crop groups, the availability of data for perennial species such as apple, pear, cherry, plum and nuts (almond, walnut, hazelnut) remains limited. This reinforces the need for targeted investments to improve accession-level documentation, harmonize descriptors, and facilitate visibility of perennial material in national and European platforms.

A closer look at currently available national inventory data for *Malus domestica*, taking it as an illustrative example, shows a highly uneven distribution of holdings among countries (Figure 1):

- Countries such as Switzerland (8,860), the Czech Republic (2,216 accessions), Austria (2,062), Germany (1,553), and Poland (1,510) hold substantial apple collections, suggesting these countries could serve as strategic hubs for future EVA activities related to apple evaluation, characterization, and pre-breeding.
- Other countries, including, inter alia, Albania (99 accessions), Portugal (18), and Cyprus (6), report more modest holdings. However, it is likely that much of the local diversity in these and other countries is either not yet included in EURISCO for variable reasons or not fully documented or digitized, indicating a need for support of developing an updated inventory and data sharing.

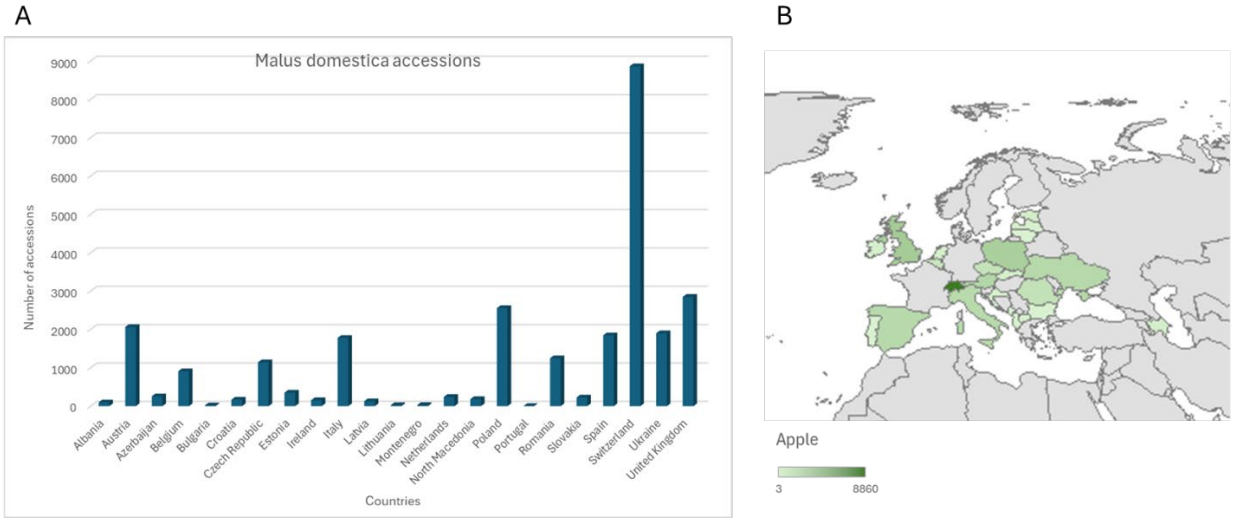


Figure 1: Example of National inventories of Apple (*Malus domestica*) across Europe documented in EURISCO (as of 6 March 2025). Overall, 69 holding institutions in 23 countries have documented apple collections, summing up to 27,039 accessions in total. Notable collections missing in EURISCO are from the Nordic countries, Germany, France, and some Eastern European countries.

In the context of such an example, it could be suggested that institutions in countries identified as having large and well-maintained collections are often also involved in ongoing or past EVA-related and Horizon Europe projects such as InnOBreed, BreedingValue, Shield4Grape, FRUITDIV and other sub-regional or regional genetic resources evaluation, pre-breeding and breeding efforts. After having organized an update of the European collections encoded in EURISCO, institutes fulfilling these requirements will be identified as key nodes in existing ECPGR Working Groups (WGs), which could serve as coordinating platforms for perennial evaluation.

Perennial crop pre-breeding and breeding are inherently slower due to longer generation cycles and the time and space required for field evaluation. The development of a new cultivar may take 10–25 years from initial cross to market release. This delay is further extended by EU regulatory requirements for distinctness, uniformity, stability (DUS) testing, availability of proper healthy propagation material and variety registration, which demand rigorous trials.

ECPGR is a unique network which contributes to the coordination of perennial crop research and conservation across Europe and provides a platform for coordination through its WGs, bringing together experts on crop-specific conservation strategies but also on characterization and evaluation, although activity levels and outputs vary depending on crop, institutes and funding availability. As examples, *Malus*/*Pyrus, Vitis* and *Prunus* WG contributed through EU projects and ECPGR Grant Scheme Activities in defining common and harmonized descriptor lists for evaluation and characterization of fruit genetic resources and in some cases (e.g. FruitBreedomics, InnOBreed, BreedingValue) have collected priority phenotypic traits data on some partners' collections. Molecular markers have been developed for some crops, for example the *Malus* and *Pyrus* UNiQue genotype codes (MUNQ and PUNQ) for variety identification inside

and between genetic resources collections[1], or recommended SSR loci for plum[2]. The European Fruit Research Institutes Network (EUFRIN) is another network which functions as a coordination structure for the evaluation of novel commercial fruit varieties. It supports the exchange of methodologies and sometimes trials, but it mostly lacks conservation principles and strategies.. Between 1999 and 2010, two European Cooperation in Science and Technology (COST) Actions[3] established networks of berry researchers and producers, which contributed to some successful Horizon projects. Recently, a new COST Action has been approved and focuses on improving water use efficiency and irrigation strategies for fruit trees to enhance resilience to drought in European orchards[4].

Genetic resources collections for perennial crops are maintained by a wide range of different kinds of institutions, including national genebanks, agronomic research centres, universities, regional repositories, and non-governmental organizations (NGO) whose coverage and curation capacity vary substantially:

- Apple, pear, cherry, peach, apricot and plum collections are widely held but, in many cases, duplicative and incompletely documented. Nut crops such as almond, walnut and hazelnut are concentrated in Southern Europe, where environmental adaptation is strong, but conservation efforts are typically under-resourced.
- Minor crops (e.g. medlar (*Mespilus germanica*), quince (*Cydonia oblonga*)) are maintained by few institutions and are often missing from databases such as EURISCO.
- Berry germplasm is scattered across public and private entities, with significant collections in Switzerland, Germany, the Nordic countries and Poland. However, a lack of coordination and data integration hampers their accessibility.

It should be noted that even significant collections – such as the strawberry collection in Málaga (Spain), maintained by IFAPA – are at risk due to the lack of stable funding, technical staffing, or institutional mandate. This highlights the fragility of many existing collections.

The phenotypic characterization and evaluation of perennial genetic resources remain highly variable. Genotyping is available for some crops and collections, particularly those linked to national research institutes, and platforms such as SPET or Axiom have been used in apple, cherry and pear. However, in some cases, the lack of coordinated metadata (e.g. on which accessions have been genotyped and how) severely limits reuse. Data may remain unpublished or restricted to specific research groups. These gaps hinder the ability to compare performance across sites or to link genotypic variation with relevant traits (e.g. disease resistance/tolerance, chilling requirements, fruit quality traits).

Perennial germplasm exchange is further complicated by legal uncertainties. The implementation of the Nagoya Protocol and national access and benefit-sharing (ABS) legislation introduces administrative burdens, and many institutions lack clear internal procedures. The standard Material Transfer Agreement (sMTA) under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) is not applicable per se to material outside Annex I, although ECPGR provides and promotes the use of the SMTA with an explanatory note, which enables its use for the exchange of all plant genetic resources, at the same terms and conditions. Despite the possibility of using this option, which is fully compatible with the Nagoya Protocol and has been recommended by the Steering Committee of ECPGR, institutions often avoid sharing

[1] Durel, C-E, Denancé, C., Muranty, H., Lateur, M., Ordidge, M. (2022). MUNQ and PUNQ – a European and international apple and pear germplasm coding system. DOI 10.17660/ActaHortic.2023.1384.59.
[2] Nybom, H., Giovannini, D., Ordidge, M., Hjeltnes, S. H., Grahić, J. and Gaši, F. (2020) "ECPGR recommended SSR loci for analyses of European plum (Prunus domestica) collections", *Genetic Resources*, 1(1), pp. 40–48. DOI 10.46265/genresj.2020.1.40-48.
[3] https://www.cost.eu/actions/836/; https://www.cost.eu/actions/863/
[4] https://www.cost.eu/actions/CA21142/

material due to perceived legal risks, withhold information about material availability or documentation on the origin and legal status of accessions.

Activities towards the creation of the roadmap

The creation of the roadmap for the establishment of the EVA Perennials Network was the result of a structured and participatory process, grounded in the collaborative ethos of the ECPGR. The development journey encompassed a series of targeted activities that ensured broad engagement, scientific relevance, and alignment with both past experiences and future needs. The groundwork was laid through a series of strategic discussions among the Chairs and key members of relevant ECPGR WGs, particularly those focused on Berries, *Malus*/*Pyrus*, *Prunus* and *Vitis*. These early consultations helped to articulate the rationale for expanding the EVA model to include perennial crops. These internal exchanges formed the conceptual and organizational backbone for broader stakeholder engagement and roadmap development.

A mapping of relevant stakeholders followed, covering a wide range of actors involved in the conservation, evaluation and use of perennial genetic resources. The core group – supported by the ECPGR Secretariat – identified and invited representatives from national genebanks and agricultural ministries, academic and research institutions active in perennial crop evaluation, valorization and breeding, private sector actors, including nurseries and small-to-medium enterprises (SMEs), NGOs with conservation or agrobiodiversity mandates, EU-funded and national projects with synergies to the EVA initiative. This inclusive approach was designed to ensure diversity of perspectives and create a robust foundation for future collaboration.

Building on this groundwork, a 2-day stakeholder workshop was organized in Ancona, Italy, to serve as the pivotal moment for co-developing the roadmap. The workshop provided a space for structured dialogue, scenario planning and technical discussion across plenary sessions and specialized subgroups. Key elements of the workshop included:

- Presentation of the EVA framework and its current implementation for seed-propagated crops
- Overview of relevant EU, national and ECPGR projects, which offered insight into multi-site evaluations, data infrastructure, and trait evaluation and characterization standardization
- Subgroup discussions by crop category (Berry; Pome–Stone–Nuts–Grape) to identify the needs of perennial crops, trait priorities, legal obstacles and data challenges
- Plenary debates on funding strategies, legal harmonization, stakeholder engagement and long-term planning.

The presentations given at the workshop and the meeting report are available on the EVA Perennials website.[5]

Complementing the qualitative insights from the workshop, a stakeholder survey was launched to:

- Assess institutional capacities and expertise of interested organizations
- Understand expectations and motivations for participation
- Identify priority crops and traits from a user-centric perspective
- Highlight perceived legal, technical and funding constraints

The survey results (summarized in Annex 1) confirmed a strong interest in a coordinated EVA approach for perennials and offered valuable direction for defining initial crops, engagement models and technical foci.

[5] https://www.ecpgr.org/eva/eva-networks/perennials/eva-perennials-project-meetings

Lessons learned from these initiatives helped to frame both the strategic potential and operational feasibility of establishing a dedicated EVA network for perennials.

EVA Perennials Roadmap

Framework adaptations for EVA Perennials

The current EVA framework, designed for seed-propagated crops, is built on principles that remain fundamentally relevant for perennials (Figure 2). These include stakeholder-driven work planning, standardized phenotyping protocols, streamlined material exchange via SMTA, centralized data management through EURISCO-EVA, and clear agreements outlining partner roles and responsibilities.

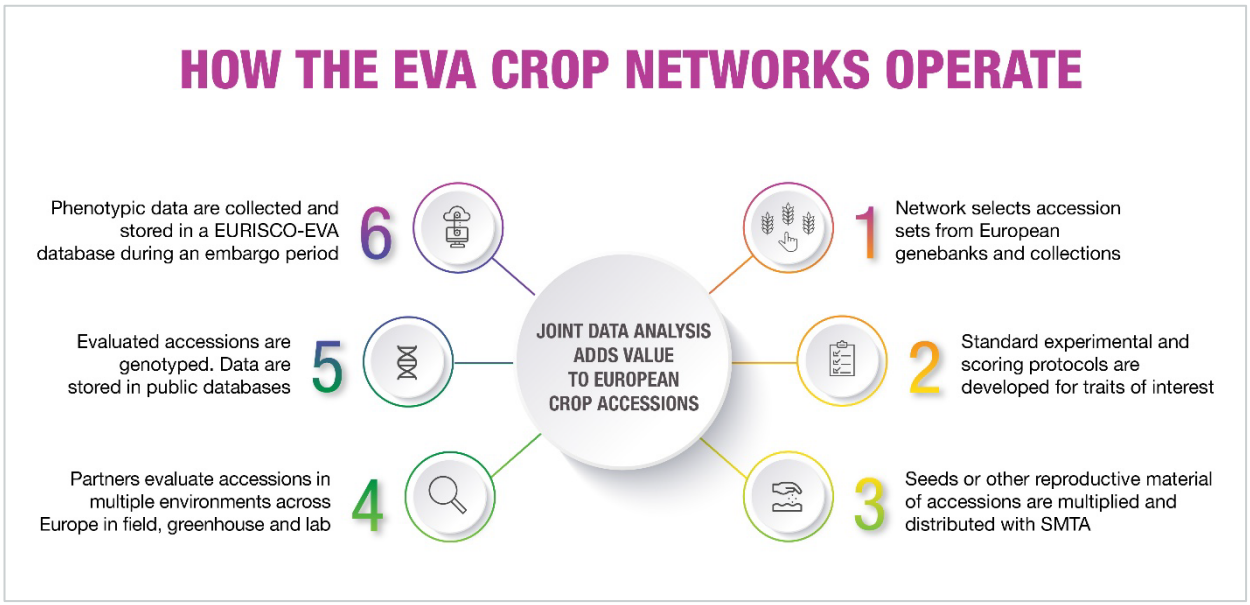


Figure 2: The EVA networks operate in cycles where partners provide their relevant expertise into jointly evaluating crop accessions from European genebanks and collections. Important aspects are the use of standardized protocols for multilocation trials, of the FAO Treaty SMTA for all material exchange, and the application of an embargo period on phenotypic data stored in a project-internal database before public release of data in EURISCO.

However, adapting this framework to perennials requires special considerations:

- **Extended timeframes**: The long developmental cycle of most of the perennials means that trial designs must accommodate multiple growing seasons, sometimes spanning several years before meaningful data can be gathered. Therefore, in a preliminary phase, a first step should take advantage of existing experimental evaluation orchards in developing collaborative and common characterization and evaluation work among partners.
- **Multi-location trials**: To capture environmental variation and ensure robustness, reference populations and/or common reference cultivars should be established across diverse European sites. This necessitates a strategic approach to trial location selection, phenotyping schedules and data harmonization.
- **Health-status of plant reproductive material:** Accessions of perennial crops are often vegetatively propagated. The fresh nursery materials can carry diseases and pests, while the stakeholders interested in phenotypic evaluation (breeders, nurseries, botanical gardens, etc.) have to be cautious to avoid introducing new pests to their local experimental sites and valuable perennial collections. Thus, the EVA network should

ensure that the material it distributes maintains a high phytosanitary status, supported by advanced propagation conditions and pest diagnostics that go beyond the market standards generally applied in nursery trade.

- **Broader stakeholder engagement**: The perennial network should incorporate not only genebanks, public and private research institutes and breeders, but also fruit growers, nurseries, botanical gardens and citizen scientists. Although EVA is already structured as a public–private partnership, the role of producers and nurseries – particularly SMEs – remains underrepresented in many crop sectors, especially for perennial species. Strengthening their involvement is essential to ensure that the evaluation and conservation of genetic resources are directly connected to on-farm needs, market relevance – for fresh and processed products, and regional production systems. Producers, especially those included in a participatory breeding approach, and nurseries play a critical role in identifying locally adapted material, contributing to trait prioritization, and facilitating the downstream use of evaluated accessions. Their engagement will not only improve the practical relevance of EVA outputs but also contribute to the long-term sustainability of the network by anchoring it more firmly in real-world cultivation and innovation contexts.

These adaptations will ensure that the network remains responsive to the complex realities of perennial crop evaluation and breeding.

Key challenges and priorities for an EVA Perennials network

Discussions within the Berry and Pome–Stone–Nuts–Grape subgroups during the workshop brought forward several convergent themes:

- **Defining target crops for the network:** Within the different species groups, stakeholders identified priority crops for which establishing an EVA network would bring the most benefits. For example, breeding germplasm in blueberry or walnut is largely from America, with little knowledge about the genetic diversity in European collections, highlighting the need for a coordinated European activity on these crops.
- **Defining genetic material scope**: Establishing clear definitions for the types of genetic materials considered within the EVA framework – including landraces, wild relatives, obsolete cultivars, pre-breeding lines and improved material – is essential to ensure coherent and meaningful evaluation strategies. For example, various EU-funded projects have created breeding material and experimental orchards for different crops, which could be further exploited by the EVA networks and thus disseminated to users (e.g. InnOBreed project). Furthermore, in berry crops, where commercial breeding has traditionally been more closed and dependent on imported germplasm (e.g. in blueberry), participants highlighted the importance of incorporating local wild relatives and regionally adapted cultivars to broaden the genetic base. In pome and stone fruits, the focus was more on obsolete cultivars and landraces maintained in national and research collections, which often represent valuable sources of resistance and climate adaptation traits. For some participants, also rootstocks should be included in the genetic material to preserve and evaluate. In nut crops, where structured breeding programmes are less developed, some suggested that pre-breeding material and region-specific landraces should be prioritized for joint evaluation. It was also suggested that the network should consider establishing a set of prioritization criteria – including agronomic relevance, conservation status, stakeholder interest and data availability – to identify which crops and material types should be the initial focus of EVA evaluations. The definition and selection of target species should be dynamic, taking into account both existing institutional capacity (e.g. well-documented collections in apple, pear, cherry, peach, apricot, strawberry) and underrepresented diversity with high potential value (e.g. almond, red currant, quince).
- **Data quality and accessibility**: As has been repeatedly observed in other crops within EVA, there is a recognized lack of consistency and interoperability among existing datasets and phenotyping protocols, which impairs the integration and comparison of

results. Coordinated efforts to harmonize data standards and improve database connectivity are imperative.

- **Trait prioritization**: The network should focus on traits with high breeding relevance, conservation importance, and stakeholder demand, specific for each crop - especially those linked to climate resilience, robustness, pest and disease resistance/tolerance, fruit quality and niche market potential (fresh and processed products).
- **Legal and procedural barriers**: Navigating ABS requirements, particularly under the Nagoya Protocol, remains a significant obstacle, highlighting the need for simplified legal tools and advisory services within the EVA framework. This is further complicated by the fact that very few perennial fruit crops are included in Annex I of the ITPGRFA. Of the major fruit crops, only apple (*Malus* spp.) and strawberry (*Fragaria* spp.) are included in the Multilateral System (MLS), although ECPGR promotes the use of the ITPGRFA SMTA for all material exchange as a prerequisite within EVA networks. In addition, the phytosanitary requirements for the international movement of vegetatively propagated material – including field-grown trees and scions – pose further obstacles. The use of *in vitro* or cryopreserved material, while helpful in some cases, remains limited by technical feasibility, species-specific constraints, and limited institutional infrastructure.
- **Geographical inclusivity**: Considering the uneven documentation of European perennial collections in EURISCO, there is a clear need to engage more actively with stakeholders from all regions with important collections and relevant markets for different perennial crops, some of which are currently underrepresented in EURISCO and EVA activities, particularly in Eastern and Northern Europe. This highlights the need for targeted outreach and inclusion strategies to establish a truly pan-European network.

Strategic priorities and innovative directions

Timeframe and Planning

Given the long lifecycle of perennial crops, rigorous and adaptable planning is paramount. Establishment of EVA Perennials networks will require long-term commitments of network partners and relevant stable funding for the establishment and maintenance of evaluation orchards. Examples such as Switzerland's multisite evaluations managed by Pro Specie Rara provide a successful model for locally organizing multi-location trials, which enhance the robustness and relevance of data collected. The ECPGR Grant Scheme Activity FruitTreeData and EU projects such as InnOBreed further exemplify coordinated support for such complex activities.

While the long-term ambitions of the EVA network will require external funding, several meaningful activities can be carried out through in-kind contributions and existing institutional engagement. These include the exchange of knowledge and tools, such as protocols for evaluation, preliminary trait prioritization, or descriptor alignment within crop groups. Similarly, a joint effort to audit and harmonize existing data – particularly across EURISCO, national inventories and project outputs – can be initiated through voluntary collaboration, coordinated by ECPGR. Meanwhile, stakeholder engagement can be strengthened through low-cost mapping exercises at the national level, identifying nurseries, SMEs, NGOs, and other potential actors to be included in future EVA Perennial activities.

Strategic alignment and preparation for funding opportunities can also be collectively pursued, allowing partners to define shared priorities, generate draft proposals, and coordinate participation in upcoming Horizon Europe or national calls. Communication and outreach – through institutional websites, newsletters and conferences – can continue to raise EVA's visibility using existing internal channels.

These foundational efforts will not replace the need for structured funding, but they represent an important intermediate step. They reinforce EVA's collaborative identity and demonstrate the network's capacity to take coordinated action, even in the absence of dedicated external resources. A special emphasis should be placed on developing niche market varieties, including minor crops with unique bioactive compounds. Market research embedded in the network's

activities will identify demand patterns and valorization opportunities, bridging the gap between conservation and economic sustainability.

Legal framework and operational guidance

Navigating the complex landscape of international and national regulations governing genetic resource access and benefit-sharing was widely recognized during the workshop as a persistent challenge for many EVA partners. While the development of comprehensive legal support tools lies beyond the current operational scope of EVA, participants clearly identified the need for a "Legal Toolkit" – not limited to standard templates, but encompassing explanatory guidance, practical examples, and access to advisory services tailored to the genetic resource user community. Such a system, though relevant to EVA's mission, would more appropriately fall under the remit of a broader, long-term plant genetic resource research infrastructure. Within that context, a centralized digital platform for legal support, documentation, and compliance monitoring could provide valuable assistance to national institutions, pre-breeding and breeding programmes, and collaborative networks like EVA. A forward-looking proposal should include the development of a digital platform for real-time legal advice and compliance monitoring, ensuring that partners can efficiently and confidently manage material transfers. Moreover, establishing a centralized registry for material exchange would enhance transparency, facilitate tracking, and ensure adherence to obligations under the Nagoya Protocol and related frameworks.

Adaptive licensing models should also be considered to accommodate the diversity of stakeholders and uses within the network, from fundamental research to commercial breeding and variety deployment.

Stakeholder engagement and network structure

Expanding participation beyond traditional partners is critical for the EVA Perennials network's relevance and sustainability. This includes:

- **NGOs, SMEs, nurseries dedicated to amateur growers, and fruit growers** to bring practical insights and support uptake. Creating an extensive network of evaluation orchards with nurseries and growers across Europe will enhance the chance of identifying suitably adapted varieties and make them readily available for further exploitation at local level.
- **Value chain stakeholders**: Many of the perennial crops contribute to human diets by a diversity of taste, flavour and health-promoting attributes. They are sold as either fresh or minimally processed products, making high post-harvest quality one of their key breeding goals. Addressing the current and future needs of the value chain requires mapping relevant actors within distribution and retail.
- **Citizen scientists** through participatory phenotyping programmes, enhancing data collection and public awareness. Organizing events for the general public to showcase the diversity available in different crops will enhance awareness and help develop markets for niche crops.
- Targeted outreach to currently **underrepresented regions** to ensure a pan-European reach.

Given the long time frame and different technology-readiness levels of existing germplasm, the network could be structured with **two complementary layers**, which should help balance openness with commercial sensitivity:

- A **pre-competitive research level**, open and collaborative, focused on fundamental evaluations and pre-breeding, using primarily understudied genebank collections.
- A **close-to-market level**, oriented towards commercialization, variety deployment and intellectual property management, contributing to the exploitation of breeding materials and varieties developed in European projects.

National coordination and mapping

A foundational step for future EVA activities is to update the mapping of existing historical collections, evaluation orchards, available phenotyping data, and relevant stakeholders across participating countries. This need was consistently highlighted during the workshop and aligns with initial work already carried out through initiatives such as FruitTreeData and InnOBreed. Understanding national and regional capacities and gaps is essential to ensure that EVA's coordination efforts are realistic, inclusive, and built upon existing infrastructures.

At this stage, emphasis should be placed on gathering baseline information through country-specific consultations, desk-based mapping and partner contributions. These efforts will lay the groundwork for better integration of underrepresented regions, more efficient planning of evaluation activities, and informed alignment with national and regional priorities.

Funding and sustainability

The EVA networks are, in essence, self-sustaining collaborative public–private and public–public partnership networks, coordinated by the ECPGR Secretariat, and rely heavily on in-kind contributions by participating organizations. Ensuring the long-term sustainability of EVA Perennials activities demands a proactive and multifaceted funding strategy that will support activities that cannot be provided in kind. While ECPGR and Germany have provided vital foundational support, the network must pursue diversified funding sources to support and complement in-kind contributions, including:

- Horizon Europe and other EU research and innovation programmes
- EU funds for biodiversity conservation and rural development within the Common Agricultural Policy
- EU co-funded interregional projects through the Interreg programme
- National and regional projects to support specific parts and activities within the networks, including local outreach and engagement
- Public–private partnerships to leverage industry investment, particularly from nurseries and breeders
- Development of value chains around minor and niche crops to generate economic incentives for conservation, direct uses and breeding efforts.

A dedicated EVA Perennials Task Force should be established to coordinate funding applications, partnership management and communication activities, ensuring that the network remains agile and well-resourced.

Main crops of interest

The workshop discussions converged on several priority crops, confirmed by the stakeholder survey (Annex 1), where the establishment of EVA networks appears both feasible and urgently needed:

- **Berries** emerge as crops with significant existing stakeholder engagement and well-established collections, positioning them as strong candidates for the initial phase of network activities. Within the berry group, **strawberries**, **blueberries** and **raspberries** are the most prominent species. This group, potentially in conjunction with **grape**, could serve as a suitable foundation for the establishment of a dedicated network.
- **Stone fruits** are widely cultivated across Europe, with numerous stakeholders demonstrating strong interest in the evaluation, conservation and management of their genetic resources. Among these species, **plum** and **cherry** attract the highest attention, followed by **peach** and **apricot**. This group of fruit trees, along with **pome fruits** – which are particularly valued for **apple** genetic resources, followed by **pear** and various wild accessions – shows considerable potential for the establishment of a dedicated network.

- **Nuts**, particularly **walnuts**, represent a critical gap in European genetic diversity, with strong dependence on foreign breeding programmes. Developing European-adapted materials for climate resilience and market demands is an urgent priority.
- Additional niche and minor crops, especially those with significant wild relatives, should be considered for future expansion, potentially as separate focused projects but inside the previously established network.

Proposed actions and next steps

In a survey to which 28 stakeholders responded (see summary in Annex 1), a first mapping of priority crops and available material, data and expertise was conducted. With these respondents, representing a critical mass of interested public and private sector stakeholders, the development of crop-specific EVA Perennials networks will be attempted, following the schematic steps of priority actions (see also Tables 1 and 2 in Annex 2):

1. Map existing collections and data for priority crops across Europe, identifying gaps in knowledge that the EVA Perennials network could fill
2. Identify and engage with relevant missing stakeholders, establishing complementary expertise and capacity for EVA activities
3. Develop strategic work plans for the priority crops, identifying possible in-kind contributions and funding needs
4. Plan and establish collaborative evaluation orchards across Europe where participating partners grow germplasm for evaluations towards identification of locally most adapted materials.

Mapping of existing collections and datasets

Based on the selected priority crops with a minimum critical mass of engaged stakeholders, the first goal will be to take stock of plant genetic resource materials that could be included in EVA network activities, including any available phenotypic or genotypic data. This analysis should highlight the ongoing characterization and evaluation activities, the most promising and interesting materials but also identify important knowledge gaps and, finally, the ongoing experienced breeding and pre-breeding programmes which already are using local genetic resources as parents. Care should be taken to ensure adequate coverage of different biological status and geographic diversity making use of traditional knowledge and historic datasets where available. ECPGR WG members, participants in relevant EU projects and collection holders for material listed in EURISCO, will be the target audience for this first step.

Identify and engage with relevant stakeholders

Building on the core participants of crop-specific groups, the aim will be to enhance geographic coverage in line with the main collections and markets for the crops, looking to actively engage with stakeholders of various expertise in order to create multidisciplinary, pan-European partnerships that will implement the EVA Perennials network(s).

Develop strategic workplans

Given the EVA framework that is functioning on limited budget and with the in-kind support of participating organizations, and the long timeframe in perennial breeding, it will be crucial to develop clear and strategic work plans with the aim to source suitable plant genetic resources and establish evaluation orchards for downstream evaluations. These collaborative and preparatory actions should be considered a base on which to build follow-up project proposals by the network, to support specific additional experiments that complement the EVA multilocation trials with e.g. pest and disease tests, abiotic stress tolerance, biochemical, nutritional or genetic analyses.

Establish a network of evaluation orchards across Europe

This step, which may take several years to accomplish for some crops, requires common selection of ad hoc accessions, production of suitable planting materials and distribution to

identified EVA network orchards, adhering to relevant phytosanitary requirements. The layout of the orchards, including relevant reference varieties, should be carefully planned and adapted to local environments, allowing for statistical analysis of future evaluation data. In-kind contributions to this activity, especially from private sector partners, should be acknowledged and relevant funding sought for necessary actions that cannot be provided in kind.

Conclusion

The EVA Perennials network initiative embodies a strategic, innovative and inclusive approach to promote and stimulate sustainable utilization and, indirectly, safe conservation of Europe's perennial crop genetic resources. By combining rigorous scientific methodologies, participatory approaches, advanced technologies, simplified legal frameworks, and broad stakeholder engagement, the network aims to foster resilient agricultural systems better adapted to biotic and abiotic stresses, promote biodiversity and support regional economies.

Within the EVA Boost project, first steps towards the establishment of EVA Perennials networks have been made, which should be followed up through engaging with interested stakeholders with the goal of developing strategic work plans for priority crops by the end of the project in 2027. The implementation of these work plans will then depend on continued collaborative effort, sustained funding, and dynamic communication to transform this vision into reality, ensuring that Europe's perennial crop heritage is safeguarded, valorized and enhanced for future generations.

ANNEX I – Summary of the results from the online survey

As a follow-up for the EVA Boost Perennials workshop in Ancona, Italy, a structured survey was developed to collect information from stakeholders on their general interest in participating in an EVA Perennials network, existing issues in their work with relevant crops, priority crops and traits and their potential contribution to different crop-specific networks. The survey was circulated among all relevant ECPGR WGs (*Malus*/*Pyrus*, *Prunus*, Berries, *Vitis*) and the stakeholder list established within EVA Boost, a total of ca. 300 individual recipients, and results collected over two weeks in May 2025.

PART 1 – General information

Among the stakeholder organizations contacted, 28 gave their feedback (Figure 3). The majority of them belong to the Research institution category, while 11% and 7% identified as Genebanks and Private companies, respectively. This underlines once more the need to invite more genebanks and, above all, private companies to get involved in the network. Italy was the most represented country with eight stakeholders responding, followed by France with three. Overall, representatives from 17 countries responded to the survey. Contacts were requested for planning of follow-up activities and respondents were also invited to provide contacts of potential additional stakeholders for further outreach.

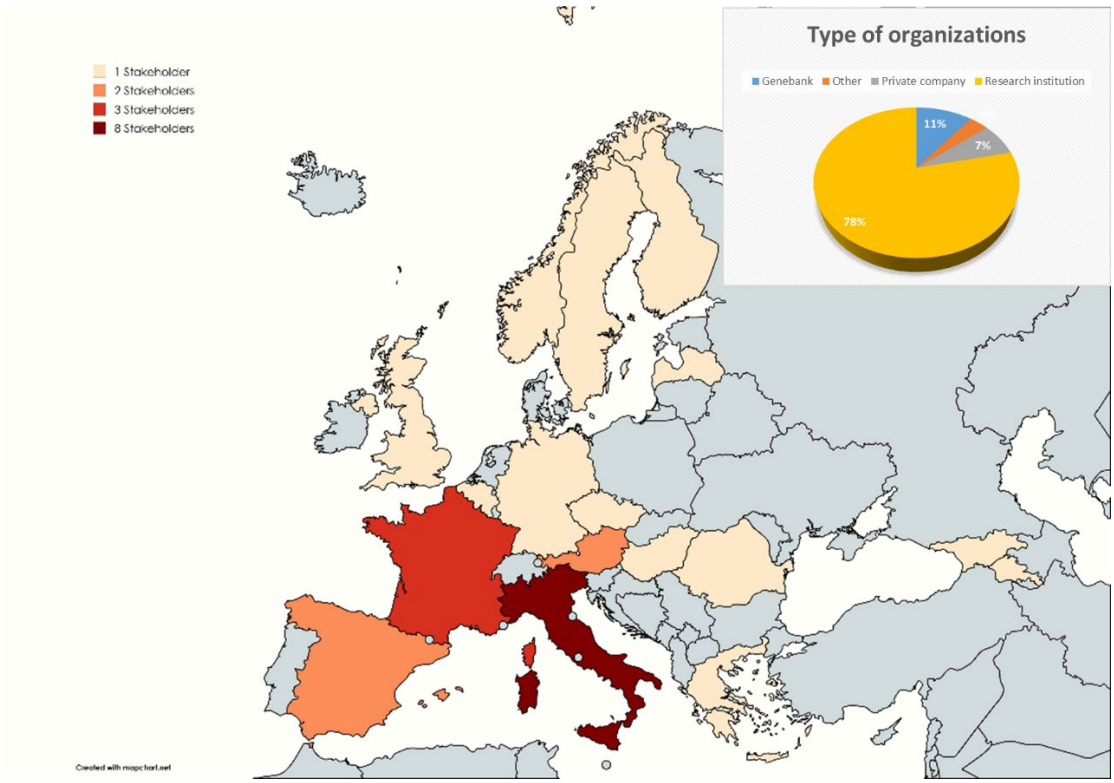


Figure 3: Demographics of survey respondents across countries and organization types.

PART 2 – General issues in genetic resources use and conservation

In the second part of the questionnaire, stakeholders clearly identified “Lack of funding” as by far the most significant issue in the conservation and use of perennial genetic resources (45%). Moreover, 64% of stakeholders reported that they *rarely* (39%) or *never* (25%) used EURISCO to access or share data, highlighting that many existing resources are not being shared or utilized effectively via this platform. This finding is further reflected in the fact that only 35% of stakeholders stated that their genetic resources are *adequately* (14%) or *partially* (21%) represented in EURISCO. Data are summarized in Figure 4.

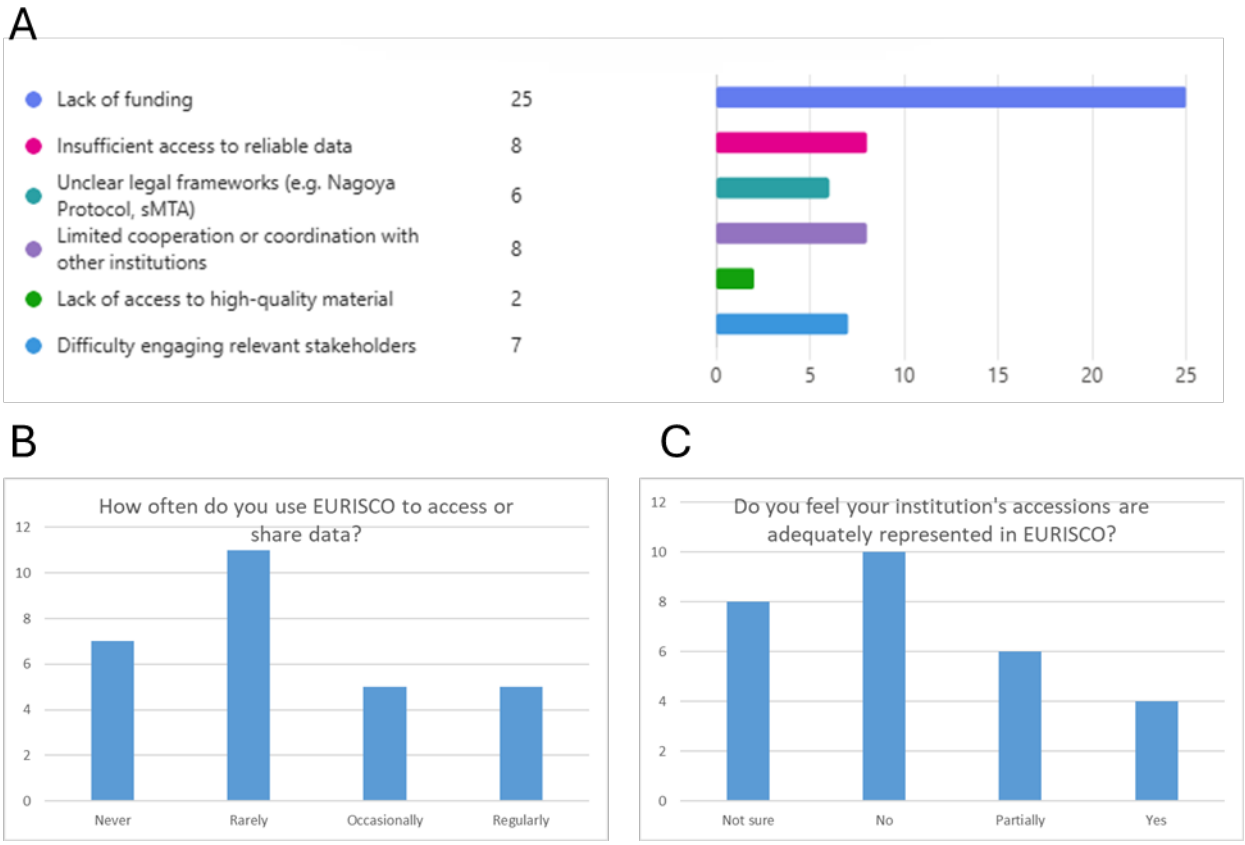


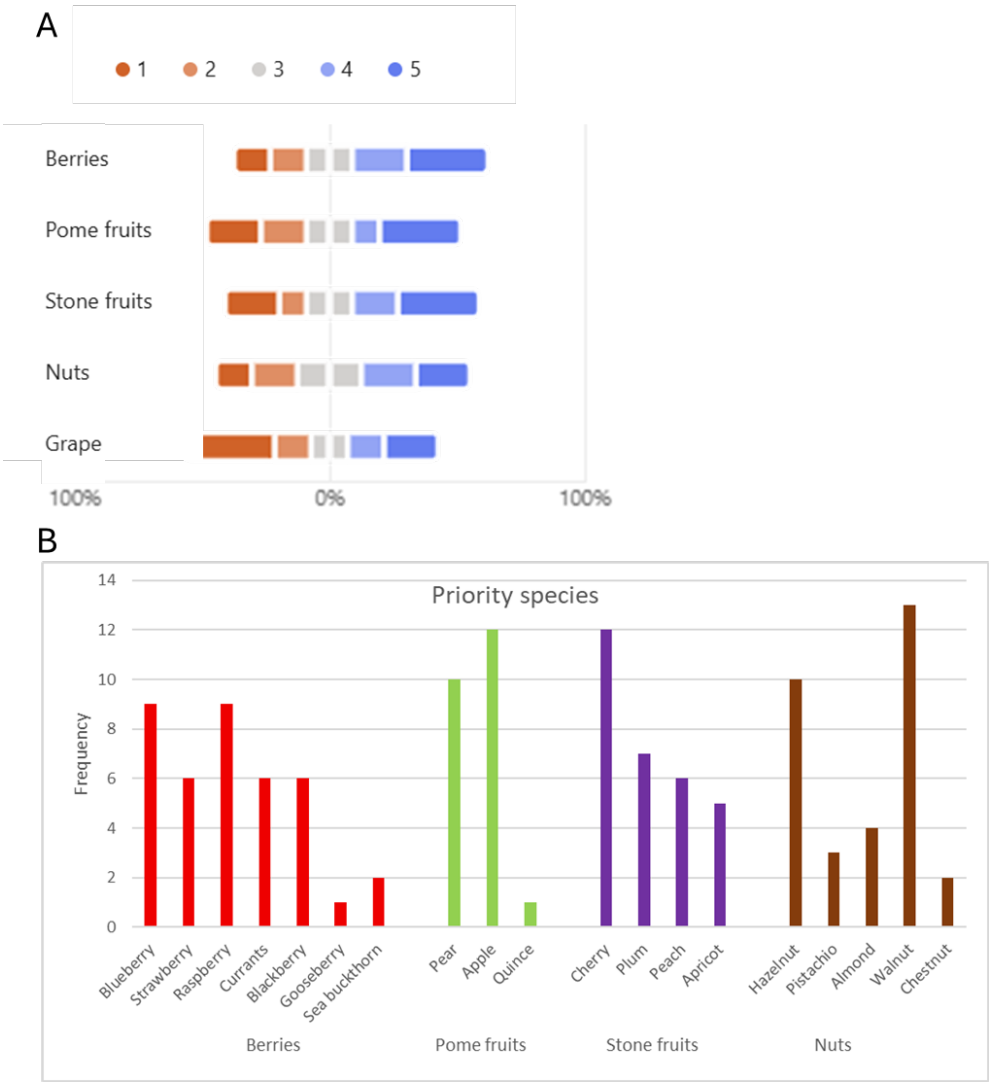
Figure 4. General issues with conservation, documentation and use of perennial genetic resources identified by survey respondents (N = 28).

PART 3 – Development of an EVA Perennial network

The third part of the survey explored the stakeholders’ priorities, expertise and capacity to contribute to the development of such a network. Twenty-six stakeholders listed (inter-)national projects on perennial crops in which they are or were involved, that could feed into an EVA Perennial network (Table in Appendix 1). According to the stakeholders' responses, the strategic priorities for the EVA Boost Perennials initiative should focus on enhancing genetic evaluation and breeding efforts to improve key traits in plant varieties, such as disease resistance and climate adaptability. There was a strong emphasis on the need to secure funding and promote collaboration among networks of stakeholders, including researchers and breeders, to support these goals. The initiative could also highlight the importance of collecting and sharing data and genetic resources, with the aim of creating well-defined, accessible collections usable across Europe. Additionally, there was a clear focus on generating new information and tools to support evidence-based decision-making, underlining the need for coordinated actions to strengthen evaluation infrastructure and align efforts toward shared objectives. Finally, stakeholders were

asked to rate their priority crops for the EVA network on a scale from 1 (low priority) to 5 (high priority). Berries received the highest priority, while Grapes were ranked lowest (Figure 5A), reflecting the interest of respondents to participate in different crop-specific networks. Within each crop, respondents identified priority species that could be the focus of the future EVA Perennial network's activities (Figure 5B).

Figure 5: Priorities for different perennial crops ranked from 1 = low to 5 = high priority (A) and priority species within each crop group (B). Grape refers to *Vitis vinifera* only.



PARTS 4-8 – Species-specific surveys

The following five sections focused on specific perennial crop groups: Berries (B), Pome fruits (P), Stone fruits (S), Nuts (N), and Grapes (G). Stakeholders were first asked whether they would be potentially interested in participating in a network related to each of these groups. All respondents expressed interest in joining one or more crop groups, with a minimum core group of between 5 and 15 partners for each crop (Figure 6A). Figure 6B highlights the overlap between crop interests, where nine partners expressed interest in joining two crop groups, four were interested in three different crops and nine partners had interest in four or even all crop groups. Additional stakeholder mapping will be necessary to confirm interest, as this may depend on the selected species as well as partners' capacity to commit to different activities.

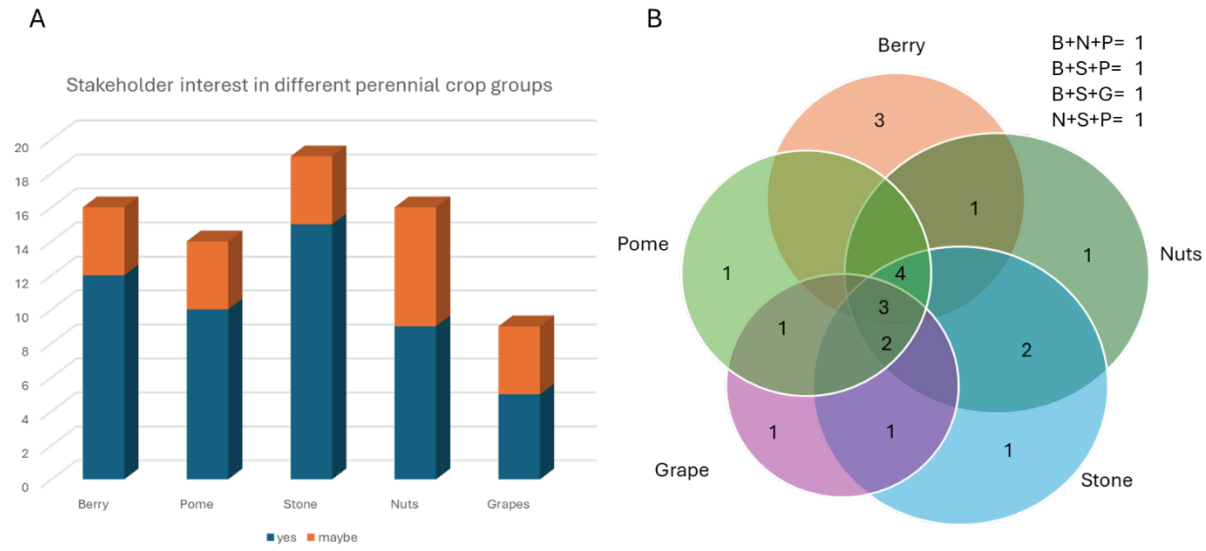


Figure 6: Survey respondents' interest in participating in different crop groups. A) overall interest in each crop and B) overlapping interest between different crops. Numbers in the Venn diagram indicate how many respondents had an interest in multiple crops. Berries (B), Pome fruits (P), Stone fruits (S), Nuts (N), and Grapes (G).

In general, across all perennial crops, it was observed that many partners have access to a wide range of potentially valuable materials. These include wild species, local accessions, varietal collections, breeding material, propagation material, as well as scions, budwood and graftwood. Despite the fact that additional funding will be essential to properly support the management of genetic resources, there was a relatively high willingness among stakeholders to conduct field trials with in-kind contributions (fewer than 25% of respondents answered "no" to this question). Another important outcome was the diversity of expertise available for the characterization of genetic resources. Across all perennial crops, there was a balanced distribution of capacity in key technical areas, including laboratory testing for fruit quality, genotyping and plant phenotyping. To conclude this section, stakeholders were asked two key questions: which traits should be prioritized (Figure 7), and which species, within each group, should be considered a priority (Figure 5B). Notably, stakeholders also highlighted the importance of certain wild accessions of particular species (e.g., strawberry and apple) and noted that some categories encompass multiple species (for instance, "Currant" includes both black and red currants, while "Cherry" refers to both sweet and sour cherry). Regarding trait prioritization, responses were grouped into broader categories common to all crop groups. Resistance to biotic stresses clearly emerged as the top priority trait across all crops assessed in the survey. In some cases, stakeholders simply indicated "resistance to biotic stress" in general terms, while in others, they named specific pathogens (for example, "scab" in apple). Following closely in importance were traits related to fruit quality and characteristics, important for limiting post-harvest food waste. This category included a variety of specific features, ranging from fruit colour and size to taste and overall organoleptic quality.

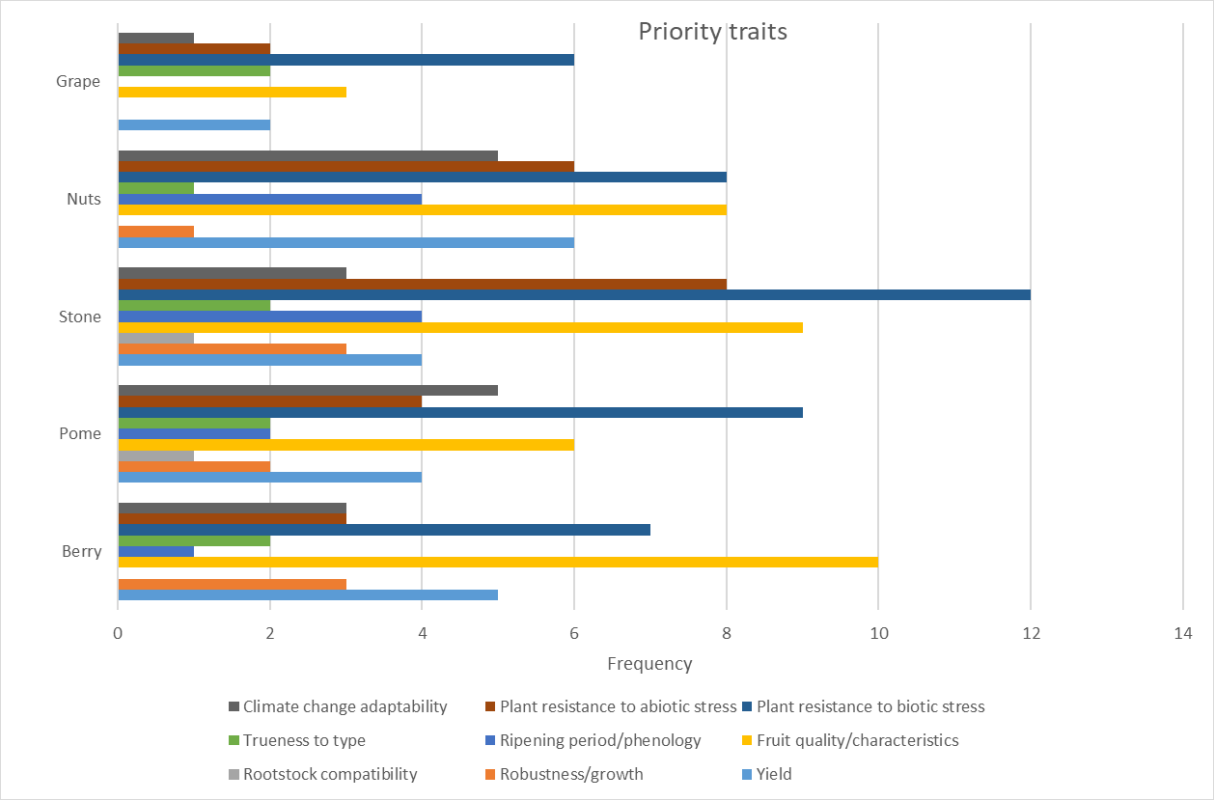


Figure 7: priority traits identified by respondents grouped into main categories. Each network will have to agree on specific priority traits for each species and standard protocols for evaluation.

PART 9 – Open contributions

The final part of the survey was dedicated to open-ended contributions from stakeholders, offering them the opportunity to provide suggestions, comments or feedback to support the successful development of the EVA network. Four key themes emerged from this section:

1. Lack of funding was identified as the most critical limiting factor for EVA network activities, particularly regarding the setup and evaluation of trials, both phenotypic and genomic. Without additional financial support for characterization work, the EVA Network's potential impact on perennial genetic resources could be significantly limited.
2. Strengthening collaboration between the EVA network and national or European projects was considered essential. These projects are currently among the most effective mechanisms for securing funding, facilitating the evaluation and exchange of genetic resources across various fruit tree species, and increasing the visibility of the EVA initiative. This collaboration provides reciprocal benefits as it enables projects with a mechanism to effectively exploit project results, enhancing their technology readiness levels and, at the same time, the EVA networks gain access to publicly generated data and materials, enabling them to incorporate them into breeding programmes.
3. Enhancing stakeholder engagement through regular meetings was highlighted as a means to improve communication, foster collaboration and promote the exchange of knowledge within the network. Expanding the stakeholder community engaged in the EVA perennials networks and public outreach should also be a priority.
4. Expanding phenotyping tools was also recommended, with suggestions to incorporate additional resources such as ampelographic photographs and digital phenotyping techniques to enrich the evaluation process.

Appendix 1 – Table of perennial plant projects

Survey respondents listed projects that could feed into the EVA Perennials network for the different crop types. They include national and international projects, funded by ministries, the EU and ECPGR. Additional historical projects could also be potentially sourced. Projects highlighted in green are ongoing as of July 2025.

PROJECT NAME	FRUIT CROPS	FOCUS LEVEL	FUNDING SOURCE	PERIOD	WEBSITE
ADER 1.1.8. Collecting, maintaining and use of autochthonous genetic biodiversity for the elaboration of integrated strategies useful to fruit species breeding programs (2011-2014)	Many	National (Romania)	Ministry of Agriculture and Rural Development	2011-2014	https://www.madr.ro/cercetare-agricola/planul-sectorial-de-cercetare-ader/ader-2011-2014/ader-1-2011-2014/ader-1-1-8.html
ADER 3.1.2. Management of fruit species genetic resources in situ and ex situ (2015-2018)	Many	National (Romania)	Ministry of Agriculture and Rural Development	2015-2018	https://www.madr.ro/cercetare-agricola/planul-sectorial-de-cercetare-ader/ader-2015-2018/ader-3/ader-3-1-2.html
ADER 6.1.4. Research on the analysis of genetic diversity in some fruit species of economic interest by correlating phenotypical and genotypical techniques in order to develop conservation strategies (2023-2026)	Many	National (Romania)	Ministry of Agriculture and Rural Development	2023-2026	https://www.madr.ro/cercetare-agricola/planul-sectorial-de-cercetare-ader/ps-2023-2026-ader-2026/ader-6-2023-2026/ader-6-1-4.html
ADER 726 Research on the genetic variation, analyzed by the technology sequencing NGS on vegetable and fruit species with economic interest, for genotyping and obtaining a database of the genetic variations specific to the autochthonous fruit species (2015-2018)	Many	National (Romania)	Ministry of Agriculture and Rural Development	2019-2022	https://www.madr.ro/cercetare-agricola/planul-sectorial-de-cercetare-ader/ader-2019-2022/ader-7-2019-2022/ader-726.html
BERRIES - Nordic Public-Private Partnership for pre-breeding	Berry	Nordic countries (NO, FI, EE, LV, SE, DK)	Nordic Council of Ministers	2024-2026	https://www.nordgen.org/our-work/ppp/projects-2024-2026/
BreedingValue	Berry	European	HORIZON Europe	2021-2025	https://breedingvalue.eu/
ECoHisPy - Building and promoting a European Pyrus collection - a case study	Pome fruits	European	ECPGR Activity Grant Scheme	2015	https://www.ecpgr.org/working-groups/maluspyrus/ecohispy
Collaborative action for updating, documenting and communicating the cherry patrimonial richness in EU (EU.CHERRY)	Stone fruits	European	ECPGR Activity Grant Scheme	2016-2017	https://www.ecpgr.org/working-groups/prunus/eucherry
Pomefruit C&E	Pome fruits	European	ECPGR Activity Grant Scheme	2017-2019	https://www.ecpgr.org/working-groups/maluspyrus/pomefruit-ce

PROJECT NAME	FRUIT CROPS	FOCUS LEVEL	FUNDING SOURCE	PERIOD	WEBSITE
DIVERACT	Many	National (France)	CASDAR	2023-2026	https://www.grab.fr/projet-diveract/
Collaborative action for updating the documenting about berry genetic resources in Europe (EUROPE.BERRIES)	Berries	European	ECPGR Activity Grant Scheme	2021-2022	https://www.ecpgr.org/working-groups/berries/europeberries
FRUIT BREEDOMICS - Integrated approach for increasing breeding efficiency in fruit tree crops	Pome/Stone fuits	European	EU FP7	2011-2015	https://cordis.europa.eu/project/id/265582
FruitDiv	Pome/Stone fuits	European	HORIZON Europe	2024-2028	https://fruitdiv.eu/
Improvement of Fruit Tree Data Inclusion in EURISCO (FRUITTREEDATA)	Stone fruits	European	ECPGR Activity Grant Scheme	2023-2025	https://www.ecpgr.org/working-groups/prunus/fruittreedata
EUBerry - The sustainable improvement of European berry production, quality and nutritional value in a changing environment: Strawberries, Currants, Blackberries, Blueberries and Raspberries.	Berries	European	EU FP7	2011-2014	https://cordis.europa.eu/project/id/265942
GenBerry	Berries	European	EU Funding (Gen Res 036)	2003-2008	https://agris.fao.org/search/en/providers/122439/records/6798daddd6a63682f045a56e
GOODBERRY	Berry	European	HORIZON 2020	2016-2020	https://cordis.europa.eu/project/id/679303
International Network on *Prunus* Genetic Resources	Stone Fruits	European	GENRES – CT95-61	1996-1998	Dosba, F. and Fischer, M. (1998). INTERNATIONAL NETWORK ON PRUNUS GENETIC RESOURCES (GEN RES 'EU 061'). Acta Hortic. 468, 187-190 DOI: 10.17660/ActaHortic.1998.468.22
InnOBreed	Grape, Pome/Stone fruits	European	HORIZON Europe	2022-2026	https://innobreed.eu/
Medberry	Berry	European	PRIMA	2019-2023	https://medberry-prima.eu/home
NORDFRUIT Apple	Pome fruits	Nordic countries (NO, FI, SE, DK)	Public-Private Partnership (PPP) for Pre-Breeding	2021-2023	https://publication.nordgen.org/NordGen-PPP-report-2021-2023/ppp-nordfruit-.html
PHENOFRUIT	Many	National (Germany)	Federal Ministry of Food and Agriculture (BMEL)	2020-2023	https://www.fisaonline.de/en/find-projects/details/?tx_fisaresearch_projects%5Baction%5D=projectDetails&tx_fisaresearch_projects%5Bcontroller%5D=Projects&tx_fisaresearch_projects%5Bp_id%5D=15562&cHash=1792998bb2d0ff2e7291a6d293762428

PROJECT NAME	FRUIT CROPS	FOCUS LEVEL	FUNDING SOURCE	PERIOD	WEBSITE
POMALL	Pome fruits	National (Italy)	Regione Lombardia	2022-2023	https://disaapress.unimi.it/al-via-il-progetto-pomall/
MEDPOME-STONE	Pome/Stone fuits	European	PRIMA	2021-2024	https://www.medpome-stone.net
PRUNDOC	Stone fruits	European	ECPGR Activity Grant Scheme	2015	https://www.ecpgr.org/working-groups/prunus/prundoc
Prunus Alignment	Stone fruits	European	ECPGR Activity Grant Scheme	2018-2020	https://www.ecpgr.org/working-groups/prunus/prunus-alignment
RIBESCO	Berries	European	071 AGRI GEN RES	2007-2011	https://www.ecpgr.org/fileadmin/templates/ecpgr.org/upload/Presentations/BERRIES/D_2020-01-15_Ribesco_ECPGR_Karhu.pdf
Ribes-Max	Berries	National (Norwegian)	Norwegian Research Council	2025-2028	https://app.cristin.no/projects/show.jsf?id=2739635
TastyStrawberry (JordbærSmak)	Berries	National (Norwegian)	Norwegian Research Council	2023-2026	https://app.cristin.no/projects/show.jsf?id=2564160
WILDBERRIES	Berries	National (Norwegian)	Norwegian Research Council	2019-2023	https://app.cristin.no/projects/show.jsf?id=649023

ANNEX II – Activities towards implementation of EVA Perennials Networks within EVA Boost

Table 1: Concrete actions agreed upon to advance the EVA Perennials Network within the EVA Boost project until 2027 as well as relevant implementation actions.

Action	Description	Purpose and Impact	Responsible Parties
Capacity and Expectation Survey	Conduct detailed surveys to assess the expertise, capacity, and needs of partners and new stakeholders	Identify the capacity and expertise of possible interested stakeholders, and create a core group for action	EVA Coordination
Data Audit	Review existing data from national inventories, project outputs, and EURISCO to identify overlaps, gaps, and inconsistencies	Identify overlaps, gaps, and inconsistencies; improve resource allocation and planning.	EVA Coordination, ECPGR Working Groups, partners in EU projects
Stakeholder Engagement	Ongoing collaboration with EU projects, ECPGR Working Groups, and outreach to new stakeholders (SMEs, nurseries, NGOs)	Expand and diversify the network; enhance relevance and capacity.	EVA Coordination, EVA Perennials network partners, ECPGR WGs
Priority Crop and Trait Definition	Identify perennial crops and key traits for evaluation and breeding focus.	Focus evaluations on high-impact targets; facilitate resource optimization and planning of appropriate experimental design.	EVA Perennials network crop groups
Confirm stakeholder involvement in each crop group	Depending on agreed priority species and target traits, stakeholders will confirm their commitment to the different crop groups	A minimum critical mass of partners with different contributions to the network is essential to guarantee effective implementation	EVA Perennials network crop groups
Reference Lists and Harmonized Protocols	Develop harmonized accession lists per subgroup to serve as a basis for standardized phenotyping and agree on phenotyping protocols.	Ensure data comparability and quality across locations and partners.	EVA Perennials network, Genebanks
National Scoping Missions	Engage with relevant collection holders in strategic regions (e.g., Balkans, Baltic, Mediterranean) to assess collections and capacities	Map genetic resources, institutional capacity, and collaboration opportunities.	EVA Coordination, ECPGR WGs, National Partners
Standardized Reference Evaluation Orchards	Plan and establish orchards with standardized reference varieties, layout, and replicates across locations	Facilitate consistent, high-quality phenotyping and breeding evaluations to ensure optimal outcomes.	Technical Working Groups, Evaluation partners
Funding Coordination	Compile and maintain an updated calendar of relevant EU and national funding opportunities.	Secure sustainable financial support and effective project management.	EVA Coordination

Table 2. Gantt chart outlining the priority activities and their implementation during the ongoing EVA Boost project (2024-2027).

ACTION	2024–Q4	2025-Q1	2025-Q2	2025-Q3	2025-Q4	2026-Q1	2026-Q2	2026-Q3	2026-Q4	2027-Q1	2027-Q2	2027-Q3
Stakeholder Engagement												
Funding Coordination												
Capacity and Expectation Survey												
Data Audit												
Priority Crop and Trait Definition												
Confirm stakeholder commitment												
National Scoping Missions												
Reference Lists and Harmonized Protocols												
Standardized Reference Evaluation Orchards												