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Crop Cousins, promise for the future

6.2 Practice Abstract Batch 1

Acronym:	COUSIN - Crop Wild Relatives utilisation and conservation for sustainable agriculture
Project Number:	101135314
Call Topic:	HORIZON-CL6-2023-BIODIV-01-13 (RIA)
Start date:	1 st January 2024
Duration:	60 months

Date of release	30/09/2025
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Dissemination level (Sen/Public)	Public
Type (Report/Data/Dec/etc)	Report
Status (Version number)	1



Funded by the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI) and UK Research and Innovation (UKRI).



Contents

1. Introduction	3
2. Methodology	3
3. Results	4

1 Introduction

A Practice Abstract (PA) is a short summary of two pages aimed at providing practitioners and stakeholders, such as farmers, breeders and policy makers, with relevant examples of good practices and recommendations. Within the COUSIN project, a total of 40 Practice Abstracts will be produced and published, both in English and in partner's languages, across three dedicated deliverables. This document presents the first batch of Practice Abstracts (D6.2)

Table 1: The three PA Batches and related deliverables

Work package N°	Related deliverable N°	Deliverable Name	Lead Beneficiary	Due Date
WP6	D6.2	Practice abstract Batch 1	RSR	30/09/2025
WP6	D6.3	Practice abstract Batch 2	RSR	30/06/2026
WP6	D6.9	Practice abstract Batch 3	RSR	31/12/2028

2 Methodology

A first list of three Practice Abstracts (PA1, PA2, PA3), along with the organizations responsible for their preparation, was agreed upon with the partners at the beginning of the project, together with a template and a layout based on the EIP-AGRI common format. These three first Abstracts have been produced and published on the COUSIN in November 2024 and in May 2025. The themes of the remaining seven Practice Abstracts have been defined during the Annual Meeting held in February 2025 in Catania, in the framework of a dedicated workshop. Initial ideas were then elaborated by the partners together with the WP6 leader, RSR, through several meetings. Once defined, all Practice Abstract content has been validated by the Coordination Team and, when necessary, by the Work Package leaders and Flagship Crop leaders.

Table 2: Practice abstract meetings

Date	Event	Activity
07/02/2024 - 08/02/2024	COUSIN Kick-off meeting	Preliminary list of PAs (1-3) established
10/06/2024	–	Template for practice abstracts finalised
17/06/2024	WP6 Monthly meeting	Meeting on PA 1-3 definition
19/02/2025 - 20/02/2025 - 21/02/2025	COUSIN Annual Meeting	Dedicated workshop to define Preliminary list of PAs (4-10)
30/09/2024	–	Dedicated meeting on PA 1-3 work
24/11/2024	–	Publication of PA 1 on COUSIN website

29/05/2025	–	Publication of PA 2 on COUSIN website
30/05/2025	–	Publication of PA 2 on COUSIN website
04/07/2025	WP6 Contributing Partners Meeting	Revision of preliminary list of PAs (4-10)
22/09/2025 - 25/09/2025	–	PA drafts (4 - 10) submitted to management team

3 Results

The results of the collaborative work among partners are summarised in Table 3, which lists the first set of Practice Abstracts produced under WP6. Each abstract addresses a key aspect of Crop Wild Relatives (CWR) conservation and use, with the responsible partner indicated.

Table 3 : Practice abstracts Batch 1

N°	Title	Partner leader	Supporting partner
PA1	Conserving Crop Wild Relatives (CWRs) in situ. The role of Genetic Reserves	URJC	
PA2	Conserving Crop Wild Relatives (CWR) in situ. Where to establish a genetic reserve and who to involve	URJC	
PA3	Crop Wild Relatives in Europe. Prioritising species for in situ and ex situ conservation	URJC	
PA4	The policy context of Crop Wild Relatives. Addressing policy gaps to ensure sustainable food systems	AUTH	
PA5	Working with others for Crop Wild Relatives (CWRs). Stakeholder engagement in the use and conservation of CWRs	ESSRG	APRI
PA6	Prospects of breeding with CWR on wheat to enhance site adaptation and drought tolerance	GZPK	FiBL
PA7	Success story of breeding with Crop Wild Relatives. The Brassica case study at the University of Catania	UNICT	
PA8	Characterisation and use of wild relatives in pea breeding	CSIC	
PA9	Making use of barley's wild relative. Barley research in the COUSIN project for future agriculture	JHI	
PA10	Boosting lettuce stress resilience. Exploiting <i>Lactuca serriola</i> genetic diversity for more resilient and sustainable crops	WUR	



Conserving Crop Wild Relatives (CWRs) *in situ*

The role of Genetic Reserves

Introduction

Crop wild relatives are a great source of diversity to develop new crop varieties. Farmers and plant breeders have used them for centuries, but their potential has not been fully exploited yet. Because many of their populations are currently threatened in their natural habitats, it is paramount that they are properly known, secured, and monitored in situ in Genetic Reserves, and that they are made readily available to end-users.



Objectives

Crops need to constantly adapt to new challenges and demands due to climate change, consumer's preferences, or market product innovation. To address those, plant breeders need access to the broadest range possible of traits diversity. Here, *in situ* conservation of CWRs plays a key role. The COUSIN project contributes to conserve CWRs *in situ* in Europe with the establishment of Genetic Reserves (GRs), i.e. public or private areas designated for the long-

term active conservation of crop wild relative populations in their natural habitats. GRs are low-input areas which require a set of minimum standards for their establishment, a management and monitoring plan in place, and a long-term conservation agreement signed by the landowners or land managers. Moreover, to ensure overall success it is important to build a strong network of stakeholders that support, promote, encourage, and contribute to the management of the GRs.





Results

Thanks to the COUSIN project, five genetic reserves are being established in Greece, Italy, Switzerland and Spain. They directly contribute to building a European network of GRs, whose data will be added to Europe's plant genetic resources conservation database platform (EURISCO). Greece, Italy and Switzerland will be establishing pilot GRs that will be critical to disseminate their purpose and facilitate the establishment of national networks. The two new GRs in Spain add to the initiated national network, therefore contributing to achieving Target 7 of its National Strategy to conserve CWRs. COUSIN also opens a new opportunity to connect people and institutions at both local and national level as stakeholders with an interest and impact on CWR conservation and use are identified, informed, and engaged.

Recommendations

Farmers, local stakeholders (e.g. conservation managers, environmental educators, citizens), policy makers (e.g. town council), and any other institution directly involved in the establishment of a Genetic Reserve will benefit from gaining new knowledge and skills on CWRs identification and *in situ* conservation and management. These will be of great value to get new perspectives when planning local conservation activities or strategies, to increase local plant diversity knowledge or to encourage nationwide *in situ* CWRs conservation.

Plant breeders and researchers will have species and population data available and accessible through EURISCO providing a bridge between *in situ* conservation and use.

Further readings

- COUSIN project website, <https://cousinproject.eu/>
- Maxted, N., Avagyan, A. Frese, L., Iriondo, J.M., Magos Brehm, J., Singer, A. and Kell, S.P. (2013). Preserving diversity: a concept for in situ conservation of crop wild relatives in Europe. Rome, Italy: In Situ and On-farm Conservation Network, European Cooperative Programme for Plant Genetic Resources, Rome, 14 pp.
- Maxted, N., Hunter, D., Ortiz Ríos, R. (2020) Plant Genetic Conservation. Cambridge University Press.
- Molina, A., Torres, E., Rubio Teso, ML., Álvarez, C., De la Rosa, L., Rincón, V., Tardío, J., Guasch, L., Iriondo, JM. (2022). Estrategia Nacional de Conservación y Utilización de Parientes Silvestres de los Cultivos (PSC) y Plantas Silvestres de Uso Alimentario (PSUA). Ministerio de Agricultura, Pesca y Alimentación.





Conserving Crop Wild Relatives (CWR) *in situ*

Where to establish a genetic reserve and who to involve

Introduction

From farms to protected areas, genetic reserves (GRs) for the in situ conservation of CWR can be established in both private and public lands as long as there is a commitment to preserve the target populations in the long run. To achieve this, it is important to build a strong network of stakeholders that will support the landowner or land manager in the maintenance of the GR and make the genetic resources available to end-users.



Objectives

The main challenge when conserving CWR in situ is to ensure that GRs are maintained in the long run (i.e. decades). For this purpose, it is critical to develop criteria and methodological approaches that consider social, managerial, and even political aspects. These are necessary to help conservation practitioners find the best locations for GR establishment, and to provide guidance to set up a local network of stakeholders that supports the initiative.

To achieve this, COUSIN aims at:

- (i) establishing GRs where the ecological conditions and day-to-day management practices remain unchanged to maintain existing CWR populations;
- (ii) signing voluntary conservation agreements with landowners;
- (iii) engaging and coordinating relevant stakeholders across multiple sectors (e.g., regulatory bodies, industry, and conservation) to collaboratively address CWR conservation and use;
- and (iv) providing the framework to implement clear protocols for accessing CWR genetic resources.





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Results

COUSIN uses a comprehensive two-fold strategy for identifying optimal GR sites: a top-down approach based on plant distribution databases and species distribution modelling, and a bottom-up approach that directly engages farmers and landowners, ensuring local knowledge and participation are integral to site selection.

Following the second approach, potential sites in Greece, Italy, Switzerland and Spain are being identified to establish five pilot GRs. For instance, in Spain the two sites identified are in Biosphere Reserves territories: Monfragüe and Sierra del Rincón, in private and public lands respectively.

After establishing the GRs and developing comprehensive management plans, the project will work closely with landowners to secure conservation agreements. These agreements will ensure the long-term in situ conservation of the target CWR populations.

Recommendations

Conserving CWR in situ offers multiple strategic benefits. By establishing GRs, landowners and land managers can enhance the value of both private and public lands by supporting food security, creating new economic opportunities, improving ecosystem management, and providing innovative approaches to land stewardship.

The establishment of the five pilot GRs will provide plant breeders and researchers with direct access to CWR genetic resources while fostering cross-sector collaboration. The stakeholder networks built through this initiative will open new opportunities for cooperation, strengthening relationships between sectors around a shared goal of conserving genetic diversity and providing agricultural resilience.

Further readings

- **Conserving Crop Wild Relatives (CWRs) in situ. The role of Genetic Reserves.** *1 Practice abstracts.*
- **COUSIN project,** <https://cousinproject.eu/>
- **Iriondo JM, Magos Brehm J, Dulhoo ME & Maxted N (eds). 2021.** *Crop wild relative population management guidelines. Farmer's Pride: Networking, partnerships and tools to enhance in situ conservation of European plant genetic resources.* https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2021/07/Crop_Wild_Relative_Population_Management_Guidelines.pdf



Co-funded by
the European Union

Funded by the European Union, the Swiss State Secretariat for Education, Research and Innovation (SERI contract number 22.0412) and UK Research and Innovation (UKRI). Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or REA, nor SERI or UKRI.



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Crop Wild Relatives in Europe

Prioritising species for *in situ* and *ex situ* conservation



Introduction

A Crop Wild Relative (CWR) can be any species that is closely related to a crop. But if we were to conserve all taxa that fall under this broad definition, the number of target CWR in Europe will be too large to manage. Thus, to develop strategies for the effective conservation of CWR in situ and ex situ it is paramount that we prioritize species based on criteria that consider international, European, and national interests.

Objectives

More than 12.000 species have been identified as CWR in Europe (Kell et al 2008). In the past, prioritization efforts resulted in a European checklist based on three main criteria: the socioeconomic value of crops, the potential value of their related CWR for variety improvement, and their threat status (Kell et al. 2017; Rubio-Teso et al. 2020).

An opportunity is presented here to revise the existing European checklist, especially for those CWR related to COUSIN flagship crops (wheat, lettuce,

pea, barley, and Brassica), and to generate an updated version under the project's scope.

The new checklist generated is the starting point to identify 'hotspots' for *in situ* conservation that consider COUSIN flagship CWR-rich habitats, pedo-climatic conditions, different management regimes (e.g. protected areas, agricultural lands), and resilience to climate change.





Results

The COUSIN project has generated an exhaustive priority checklist for Europe of 1408 CWR taxa belonging to 42 different families. The checklist specifically targets CWRs that are native to Europe and related to food security, i.e. wild relatives of food and fodder/forage crops. It is based on (i) the previously existing European CWR priority checklist, (ii) global checklists that prioritize CWR of crops important for nutrition and food security (Vincent *et al.* 2019; Castañeda-Álvarez *et al.* 2016), and (iii) some national CWR priority checklists. The latter have been primarily screened for CWR related to COUSIN flagship crops. In addition, expert's validation has been performed, particularly CWR of flagship crops, which have been prioritised and commented by COUSIN plant breeders and researchers.

Recommendations

The COUSIN CWR checklist constitutes a baseline for conservation action and sustainable use in Europe, particularly of those taxa related to the project's flagship crops (wheat, barley, pea, lettuce and brassicas) as it aims at maximizing their CWR species diversity. It underpins a European strategy to establish a network of genetic reserves for both *in situ* and *ex situ* conservation of CWR.

At the country level, the COUSIN CWR checklist is a starting point for designing a national strategy for the conservation and sustainable use of CWR. Thus, it can be used to develop the country's own national CWR checklist and a database of populations occurrence, covering the genetic diversity contained therein. Furthermore, it is also a valuable source of information available for plant breeders and farmers interested in their utilization for the development of new cultivars.

Further readings

- **Castañeda-Álvarez NP et al (2016)** *Global conservation priorities for crop wild relatives. Nature Plants, 2(4), 1–6.*
- **Kell et al (2008)** *Crops and wild relatives of the Euro-Mediterranean region: making and using a conservation catalogue. In: Maxted et al (eds.) Crop wild relative conservation and use.*
- **Kell et al (2017).** *Broadening the base, narrowing the task: prioritizing crop wild relative taxa for conservation action. Crop Science, 57:1042-1058.*
- **Rubio-Teso ML et al (2020)** *In situ plant genetic resources in Europe: crop wild relatives. [https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2020/10/D1.2 In situ PGR in Europe crop wild relatives.pdf](https://more.bham.ac.uk/farmerspride/wp-content/uploads/sites/19/2020/10/D1.2%20In%20situ%20PGR%20in%20Europe%20crop%20wild%20relatives.pdf)*
- **Vincent H et al (2019)** *Modelling of crop wild relative species identifies areas globally for in situ conservation. Communications Biology, 2(1), 1–8.*





The policy context of Crop Wild Relatives

Addressing policy gaps to ensure sustainable food systems

Introduction

Amid growing climate change and food insecurity pressures, the wild relatives of cultivated crops could offer genetic potential to breed varieties that can adapt and prosper under these evolving conditions. Despite this potential, current agricultural policies place limited explicit focus on Crop Wild Relatives (CWRs), risking missed opportunities to build more resilient agri-food systems.



Objectives

Building on the need to unlock the full potential of Crop Wild Relatives (CWRs) for resilient agriculture, the COUSIN Project examines how existing European and international frameworks address their conservation and use. While many of these frameworks contain elements that can support CWRs, they are not yet a distinct focus. To respond to this, COUSIN combines policy-related insights from peer-reviewed literature and European and international projects to provide

an evidence-informed basis for strengthening policy frameworks relevant to the conservation and sustainable use of CWRs. This approach identifies priority policy themes and conservation areas, along with opportunities to embed both in situ and ex situ measures into agricultural and biodiversity strategies, with the goal of delivering multifaceted benefits.





Results

COUSIN's policy review revealed that while existing frameworks contain supportive elements, they rarely address CWRs directly. Three dimensions emerged. Economically, incentives and market tools are limited, while productivity gains from CWR-derived traits remain untapped. Societally, farmers, rural communities, and indigenous knowledge holders are insufficiently involved in shaping and implementing conservation strategies, along with weak benefit-sharing mechanisms. Environmentally, conservation of wild plant diversity is fragmented and under-resourced, with limited links to agricultural systems and climate goals. These patterns indicate structural gaps that restrict the integration of CWRs into broader agricultural and biodiversity policy agendas.

Recommendations

Implementing the COUSIN Project's findings can unlock the full potential of CWRs by creating synergies between value-driven breeding innovation, community wellbeing, and environmental stewardship. Well-designed financial incentives and new market opportunities can drive their integration into breeding, boosting productivity and reducing external inputs. Engaging rural communities in conservation, ensuring fair benefit-sharing, and safeguarding traditional agricultural knowledge can expand CWR use while fostering cohesion and inclusive societies. Embedding both in situ and ex situ conservation into agricultural and biodiversity policies secures genetic diversity and strengthens farms' capacity to face climate change and food insecurity. Unlocking CWRs through effective policies is an investment in sustainable, resilient agri-food systems.

Further readings

- Jago, S., Elliott, K., Tovar, C., Soto Gomez, M., Starnes, T., Abebe, W., Alexander, C., Antonelli, A.,, Williams, C., Yohanna, C., Grace, O., Darbyshire, I., & Borrell, J. (2024). Adapting wild biodiversity conservation approaches to conserve agrobiodiversity. *Nature Sustainability*, 7(11), 1385-1394 <https://doi.org/10.1038/s41893-024-01427-2>
- Tacconi, F., Waha, K., Ojeda, J. J., & Leith, P. (2022). Drivers and constraints of on-farm diversity. A review. *Agronomy for Sustainable Development*, 42(1), 2. <https://doi.org/10.1007/s13593-021-00736-6>
- Vogt, M. A. B. (2021). Agricultural wilding: rewilding for agricultural landscapes through an increase in wild productive systems. *Journal of Environmental Management*, 284, 112050. <https://doi.org/10.1016/j.jenvman.2021.112050>





Working with others for Crop Wild Relatives (CWRs)

Stakeholder engagement in the use and conservation of CWRs

Introduction

The conservation and sustainable use of CWRs is often undercut by a disconnect between people working in the food and agriculture sector, conservation agencies, professional breeders, and everyday citizens living on the land. To design effective strategies for the long-term management of CWR, it is paramount to build bridges between these disconnected areas and co-create solutions with all actors involved.



Objectives

CWRs can provide benefits to all segments of society by diversifying agroecosystems, adapting to climate change, offering possibilities for bioprospecting, or improving the quality of diets. To reap these benefits, COUSIN aims to engage a wide variety of existing and potential stakeholders, such as breeders, farmers, consumer groups, climate regulatory and implementation bodies, food manufacturers, and farming businesses.

There are many advantages of doing this, for instance, harnessing the expertise of various fields, tailoring research, breeding and conservation efforts to local contexts and needs, identifying pitfalls early and ensuring the credibility of project results while increasing policy uptake. Stakeholder involvement can also help enhance the recognition of CWR's value for society and, perhaps most importantly, create a culture of collaboration among the different actors.





Results

COUSIN partners mapped key stakeholders at the project's start and tailored a 'value proposition' for each, reflecting local realities. They engaged business (43%), academic (40%), civil society (32%), and policy actors (17%) to support research, implementation, and policy uptake. Engagement ranges from information sharing (e.g., newsletters, conferences) to collaborative efforts like joint conservation planning with landowners. Such collaborations foster context-specific solutions for CWRs that respect cultural practices, legal frameworks, and resource availability.

Recommendations

Experiences from COUSIN show that the long-term conservation and use of CWRs will (should) depend on local people: farmers, civilians, landowners, conservationists, breeders, and many others whose daily work impacts the future of these species. Therefore, the long-term needs and wellbeing of these actors is a central question in stakeholder engagement. It is a two-way relationship that can be nurtured by listening and by creating a shared vision of how to maintain and best utilise CWRs. This process should be a conscious effort to facilitate social processes locally for sustained collaboration. Another important finding is that policymakers, food and feed manufacturers, and consumers are generally less engaged in CWR-related work. It would be important to widen the scope of engagement and raise more awareness of the value of these species for the entire food industry as well as for biodiversity conservation policy.





Prospects of breeding with CWR on wheat to enhance site adaptation and drought tolerance



Introduction

Wheat plays a vital role in Europe's food supply. However, challenges such as the demand to reduce pesticides and fertilizers, along with more unpredictable weather patterns, have made it harder to achieve consistent high yields and maintain flour quality. By incorporating crop wild relatives (CWR) into breeding efforts, we can develop more resilient wheat varieties that deliver stable yields, superior nutritional value, and contribute to healthier diets in the future.

Objectives

Wheat varieties must adapt to evolving agricultural policies, climatic changes, and shifting consumer preferences. Farmers are increasingly seeking innovative solutions such as improved drought tolerance, enhanced nutrient efficiency, or better local adaptation—qualities that breeders aim to develop by incorporating traits from crop wild relatives (CWRs). These wild relatives often possess unique resilience traits not found in modern varieties. Three

main challenges emerge: first, identifying CWRs with beneficial traits; second, introducing these traits into high-yielding and high quality elite varieties; and third, determining the farming systems and environments where these traits are most effective. The COUSIN project maps which CWR alleles benefit specific cropping systems and climates, enhancing future wheat production through careful selection under field conditions.





Results

In the COUSIN project, 3 CWRs were crossed with market cultivars in 1999, resulting in 4 distinct populations. They were grown for a first period for more than 20 generations in two different environments: an organic and a conventional farming system, conducted by the University of Bonn. This adaptation process was based solely on natural selection. The genetic heterogeneity and the long time-span in two divergent farming systems resulted in 8 distinctly adapted populations. In the second period, the yield performance of all 8 populations was examined in three years described by substantial drought from the flowering to the ripening stage. The performance trials showed that populations adapted to organic farming had higher drought tolerance and yielded more than those adapted to conventional farming, in both organic and conventional systems.

Further readings

- COUSIN project website, <https://cousinproject.eu/>
- LiveSeeding project page, <https://liveseeding.eu/>
- University Bonn, Plant Breeding, <https://www.uni-bonn.de/de/neues/107-2024>
- Schneider, M., Ballvora, A. & Léon, J. Deep genotyping reveals specific adaptation footprints of conventional and organic farming in barley populations—an evolutionary plant breeding approach. *Agron. Sustain. Dev.* 44, 33 (2024). <https://doi.org/10.1007/s13593-024-00962-8>
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- R. W. Allard, Genetic Changes Associated with the Evolution of Adaptedness in Cultivated Plants and Their Wild Progenitors, *Journal of Heredity*, Volume 79, Issue 4, July 1988, Pages 225–238,
- The respective publication of the described wheat populations – still under review.
Schneider, M., Ballvora, A., Döring, T. F., Messmer, M.M., Léon, J., Alleles from crop wild relatives accumulated by long-term adaptation to low-input environments contribute to yield advantages in wheat, under review in *Plant Breeding*.

Selection in low-input environments can lead to more stable yields under stress, due to adaptation for improved nutrient uptake and water-use efficiency. COUSIN partners use these adapted populations and knowledge from previous projects (e.g. LiveSeeding) as a basis for single-line selections, crossings, population improvement, and local testing. The goal is to develop resilient wheat varieties adapted to sustainable farming systems.

Recommendations

The conducted adaptation of CWR-enriched populations over a long period, together with a yield trial under drought stress, highlights the value of CWR alleles for the breeding of resilient varieties. The environment in which the selection is performed plays a crucial role, emphasizing the importance of the local ecosystem on the breeding and selection success.



Success story of breeding with Crop Wild Relatives

The Brassica case study at the University of Catania



Introduction

Brassica oleracea L., including cabbage, cauliflower, and broccoli ($2n = 18$), easily intercross with several wild species native to the Mediterranean area, such as *B. drepanensis* (Caruel) Damanti, *B. incana* Ten., *B. macrocarpa* (Guss.), *B. rupestris* Raf., and *B. villosa* Biv. These crop wild relatives (CWRs) are valuable sources of traits for resilience and health-promoting compounds.

Objectives

Brassica macrocarpa Guss., endemic to the Egadi Islands, Sicily, is classified as critically endangered in the IUCN Red List of Threatened Species due to its very narrow extent of occurrence, limited area of occupancy, and risk of decline caused by potential human disturbance of its habitat. The University of Catania (UNICT) tested its use in interspecific hybridization with broccoli, taking as reference the success of the commercial hybrid

Beneforte, obtained by crossing a commercial line with *B. villosa* to increase the content of health-promoting compounds. The aim is to propose new genotypes with higher levels of bioactive compounds, addressing the needs of farmers and breeders for crops with improved health value and environmental resilience, while contributing to the conservation of valuable crop wild relatives.





Results

During the first year of the COUSIN project, we successfully identified elite genotypes combining high levels of bioactive compounds, such as polyphenols and glucosinolates, with strong antioxidant capacity, showing that nutritional traits can be added to breeding programs without reducing crop performance. The F₁ hybrids from crosses between commercial broccoli cultivars and *B. macrocarpa* had the highest total levels of these compounds, particularly in glucosinolates. The incorporation of CWRs traits such as for *B. macrocarpa*, known for its glucosinolate richness and drought stress tolerance, offers a dual advantage for the development of functional foods and resilient crops, especially under climatic change.

Recommendations

COUSIN is the European Union-funded project on the use and conservation of wild species for more sustainable, resilient, and nutritionally valuable agriculture. The underutilised genetic and phytochemical diversities of the *B. oleracea* complex species (n=9) populations, widespread in the Mediterranean countries, along with the derived dynamic populations, as indicated in EU Regulation 848/2018 on the organic agriculture, offer a powerful strategy for breeding next generation *B. oleracea* cultivars with enhanced agronomic traits and improved health-promoting properties. These results provide useful insights for farmers and breeders in selecting and developing crops under changing environmental conditions.

Further readings

- Bothmer, R., Gustafsson, M., & Snogerup, S. (1995). Brassica sect. Brassica (Brassicaceae) II. Inter- and intraspecific crosses with cultivars of *B. oleracea*. *Genet. Resour. Crop Evol*, 42(2), 165-178.
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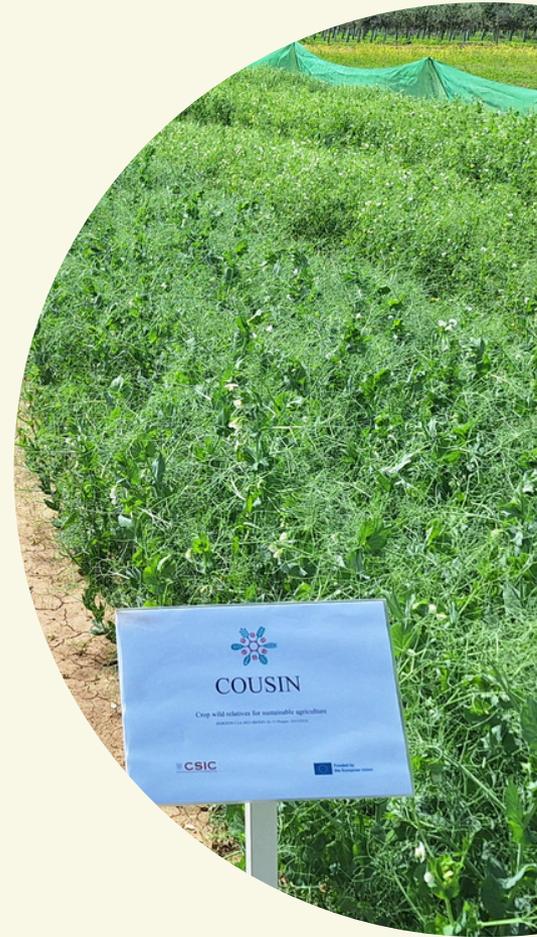




Characterisation and use of wild relatives in pea breeding

Introduction

Pea (*Pisum sativum*) is a cool season legume crop domesticated from wild and primitive *Pisum* species in the Fertile Crescent some 10,000 years ago. It is today produced worldwide, mainly in temperate regions. Depending on its uses, field peas, vegetable peas, and forage peas, are distinguished, each one with different uses differing therefore in quality requirements. Pea yield can be constrained by a number of biotic and abiotic stresses to which there is insufficient genetic resistance available. Wild relatives, including subspecies of *P. sativum*, or the most distant *P. fulvum* offers a reservoir of sources of resistance and other valuable traits that can be exploited in pea breeding.



Objectives

COUSIN aims to explore valuable traits in wild pea relatives with the final aim of their exploitation in cultivated peas. The strategy begins by identifying priority traits absent in cultivated forms and searching for them through germplasm screening. This is followed by wide hybridization and breeding at several levels: from classical selection in target environments – at research stations and with participatory farmers – to advanced molecular tools such as QTL mapping and genome-enabled prediction of key traits.

Result

IAS-CSIC is running a long-term pea pre-breeding program which started with a major focus on developing cultivars adapted to Mediterranean rain fed farming conditions. Their first priority was broomrape (*Orobanche crenata*). Since pea germplasm have little resistance to this wild relatives were used to identify potential sources of resistance. After huge efforts in crossing and selection the first cultivars with resistance to broomrape derived from *Pisum fulvum* were registered by CSIC.





Similarly, we registered the first cultivars carrying the novel powdery resistance gene (Er3) also derived from *P. fulvum*. These pre-existing CWR derived cultivars, together with a large number of segregating populations derived from crosses with other *Pisum* species were made available to COUSIN academic partners for scientific studies and to breeders for testing and selection under their conditions. Additionally, a large *Pisum* spp. germplasm collection is being phenotyped for resistance to a range of diseases (broomrape, rust, powdery mildew, ascochyta blight, fusarium wilt, aphanomyces root rot) and pests (aphid and bruchus weevil) under field conditions (inoculated plots) or/and controlled conditions (seedlings inoculated in growth chambers). New crosses have been made this season with selected resistant accessions. This will continue all along the project.

Recommendations

CWR pea cultivars and near cultivars with valuable traits missing in cultivated pea (i.e. *Orobanche* resistance) are being made available to farmers. Similarly, missing sources of resistance to other key stresses are being identified and introduced by sexual crossing into segregating populations made available to breeders.

Further readings

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Making use of barley's wild relative

Barley research in the COUSIN project for future agriculture



Introduction

*Wild barley (*Hordeum vulgare* subsp. *spontaneum*) is the closest crop wild relative (CWR) to cultivated barley (*Hordeum vulgare* subsp. *vulgare*). It displays significant genetic variation associated with the broad range of habitats in which it grows however much of this variation, which is potentially valuable, was lost during the process of domestication.*

Objectives

Many of the wild characteristics found in barley's CWR may now be needed in lower-input agronomic systems or in more competitive environments such as those found in organic or regenerative agriculture practices such as intercropping and minimum tillage. However, the use of barley's CWR is fraught with practical difficulties as many of the characteristics of wild barley, such as the ear shattering for grain dispersal in the wild, mitigate

against its immediate use in arable agriculture. The utilisation of the CWR in barley breeding is therefore a balance between the selection against CWR traits such as shattering while maintaining the potential benefits that come from the novel genetic variants present in the broader variation found in wild barley (e.g. root architecture, biotic resistance). This forms the basis of the barley work in the COUSIN project.





Results

Fortunately, the project can take advantage of the advances on genomic and genetic research to aid in the selection against known undesirable CWR traits and also to determine the genetics and mechanisms underlying the less well known positive attributes that CWR could bring to modern barley. Evidence is accumulating of the importance of certain CWR-derived genes for root growth in organic rather than conventional systems and work is ongoing to study this further with CWR derived populations being grown in multiple sites within the COUSIN project. In addition new populations have been developed that take advantage of advances in the understanding of the genetics of domestication traits to rapidly develop resources that can be used for validation and use.

Recommendations

The CWR-derived populations being developed and trialled in the COUSIN project will be tested in farm conditions. This will establish pilots across Europe for CWR-based participatory breeding and CWR use in diversified farming systems. Importantly this will enable the utilisation of the positive attributes that CWR can bring to barley production in particular root architecture. The modern spring barley crop in Europe is almost completely dependent on the green revolution semi-dwarfing gene that adapted the crop to higher input conditions but is known to affect root growth. As agronomic practices change, the work in COUSIN will provide alternative adapted barley material that leverages beneficial barley CWR traits for future barley production.

Further readings

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Boosting lettuce stress resilience

Exploiting *Lactuca serriola* genetic diversity for more resilient and sustainable crops



Introduction

Wild relatives such as Lactuca serriola carry a wealth of untapped genetic diversity that helps them thrive under stress, while cultivated lettuce often struggles when nutrients are limited, especially under low phosphate conditions, leading to reduced yields. Exploring lettuce CWRs can reveal useful traits and genetic regions that breeders can use to develop stronger, more resilient lettuce varieties.

Objectives

The COUSIN project explores how wild lettuce (*Lactuca serriola*) copes with stress, focusing on low phosphate availability. Phosphorus is essential for plant growth, yet phosphate fertilisers are costly, environmentally harmful, and based on finite resources. Lettuce is the most important of the leafy vegetable crops, which in total cover 18.1% of the fresh vegetable production area in Europe.

By screening diverse wild lettuce populations, the project identifies both visible traits (like leaf growth, photosynthesis, and nutrient content) and their underlying genetic markers. High-throughput phenotyping and genome-wide analysis connect plant performance under stress to specific genes. These insights give breeders practical tools to introduce resilience traits into cultivated lettuce, helping farmers reduce fertiliser use while maintaining yield and quality.





Results

Around 150 wild lettuce accessions were tested under both normal and low phosphate conditions using hydroponics and advanced imaging technologies. Clear differences emerged: some plants maintained better leaf growth, chlorophyll function, and nutrient balance under stress. A genome-wide association study (GWAS) highlighted a key region on chromosome 6 linked to improved photosynthetic efficiency (Φ PSII) in low phosphate conditions. Representative accessions from different regions were selected for whole-genome sequencing. These findings confirm that wild lettuce carries valuable traits for phosphorus use efficiency, traits that can be transferred to cultivated lettuce.

Recommendations

New lettuce varieties developed from *Lactuca serriola* lines with higher phosphorus efficiency could transform farming. For growers, this means lower fertiliser costs, more stable yields in low-input systems, and a reduced environmental footprint. For breeding companies, the identified genetic markers offer a shortcut to selecting superior lines and tailoring them for different regions or production systems. Tapping into wild lettuce diversity not only could improve sustainability but also could strengthen crop resilience in the face of nutrient stress and global fertiliser challenges.

