4th Mediterranean Plant Conservation Week

VALÈNCIA | 23-27 OCTOBER | 2023

Organized by:

VNIVERSITAT DE VALÈNCIA Jardí Botànic

GENERALITAT VALENCIANA Conselleria de Medi Ambient, Aigua, Infraestructures i Territori

CIEF CENTRE PER A LA INVESTIGACIÓ I L'EXPERIMENTACIÓ FORESTAL

Global Oak Pollen Bank

VNIVERSITAT DE VALÈNCIA

Funded by:

Oak Conservation and Research Fund

International Oak Society

In partnership with:

Cincinnati Zoo & Botanical Garden

The Huntington Library, Art Museum, and Botanical Gardens

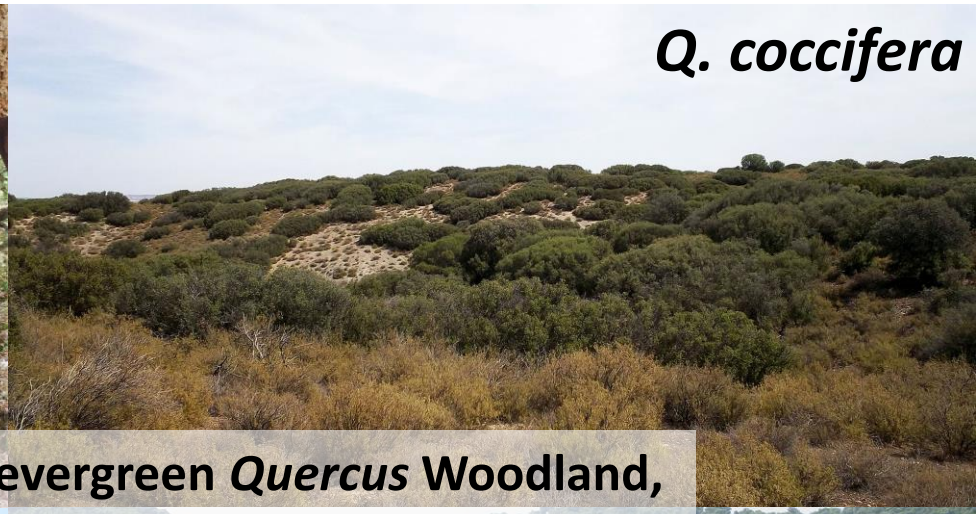
Kunming Institute of Botany

Daniel Ballesteros

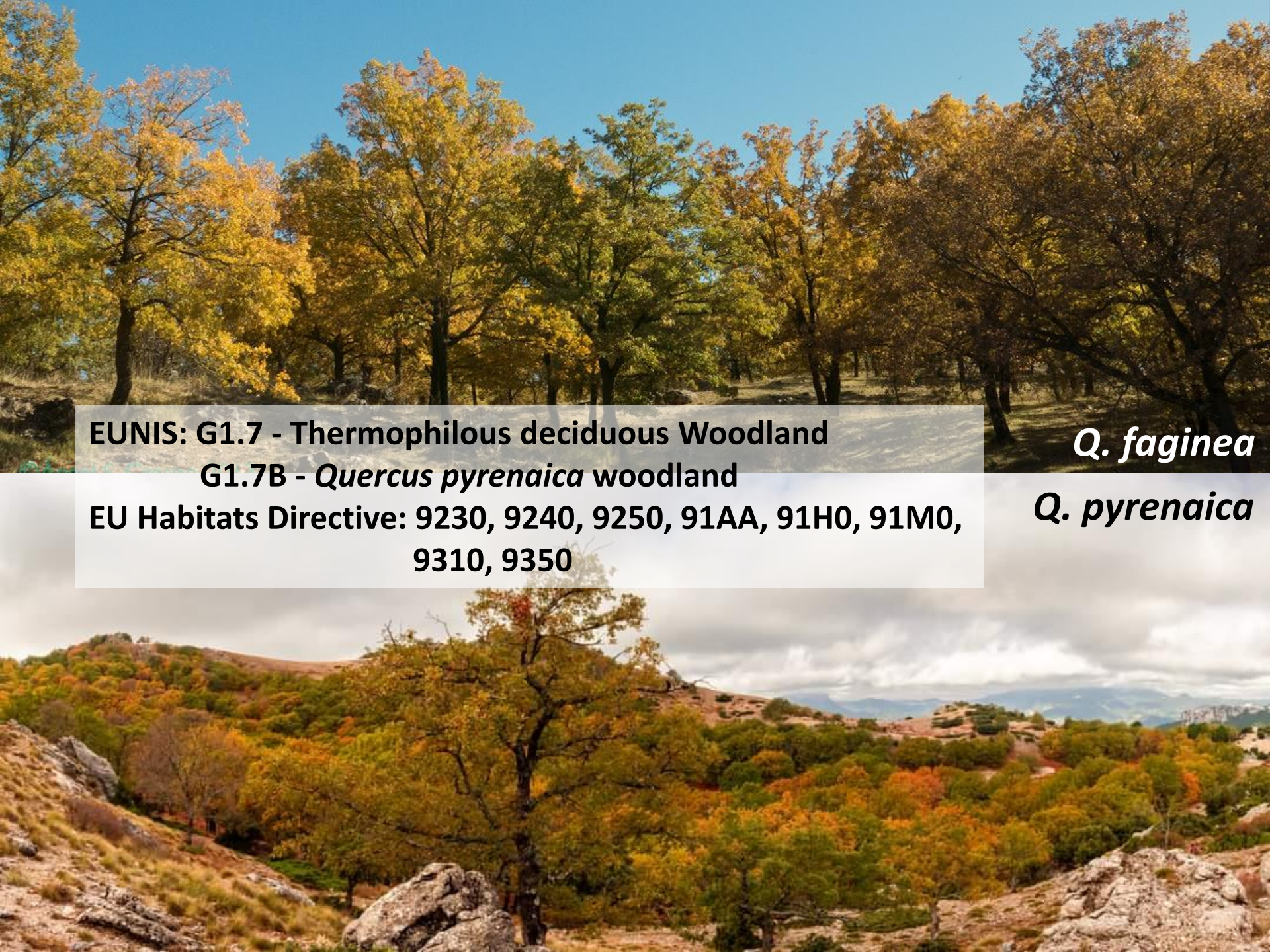
University of Valencia, Spain

Royal Botanic Gardens, Kew, UK

Quercus (oaks) are some of the most important trees in Mediterranean landscapes



EUNIS: G2.1 - Mediterranean evergreen *Quercus* Woodland,
F5.11 - Evergreen *Quercus* matorral
EU Habitats Directive: 9330, 9340, 9390, 93A0, 6310

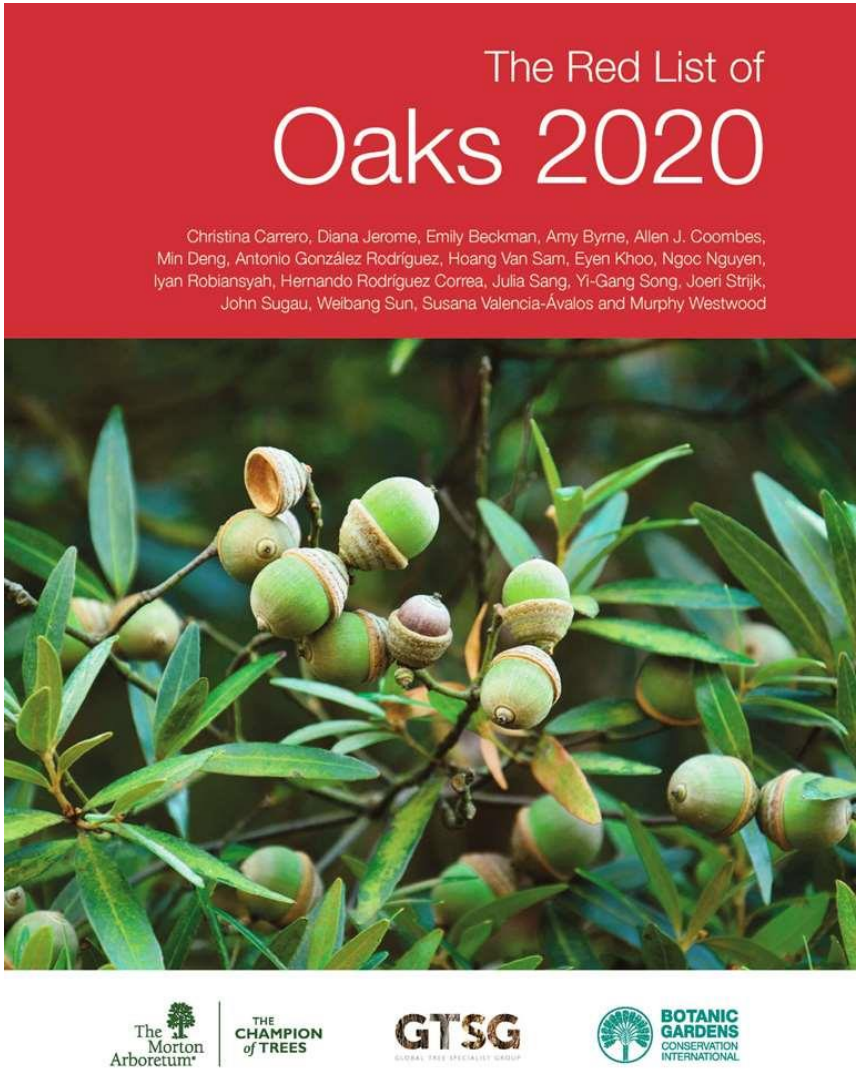


EUNIS: G1.7 - Thermophilous deciduous Woodland
G1.7B - *Quercus pyrenaica* woodland
EU Habitats Directive: 9230, 9240, 9250, 91AA, 91H0, 91M0, 9310, 9350

Q. faginea

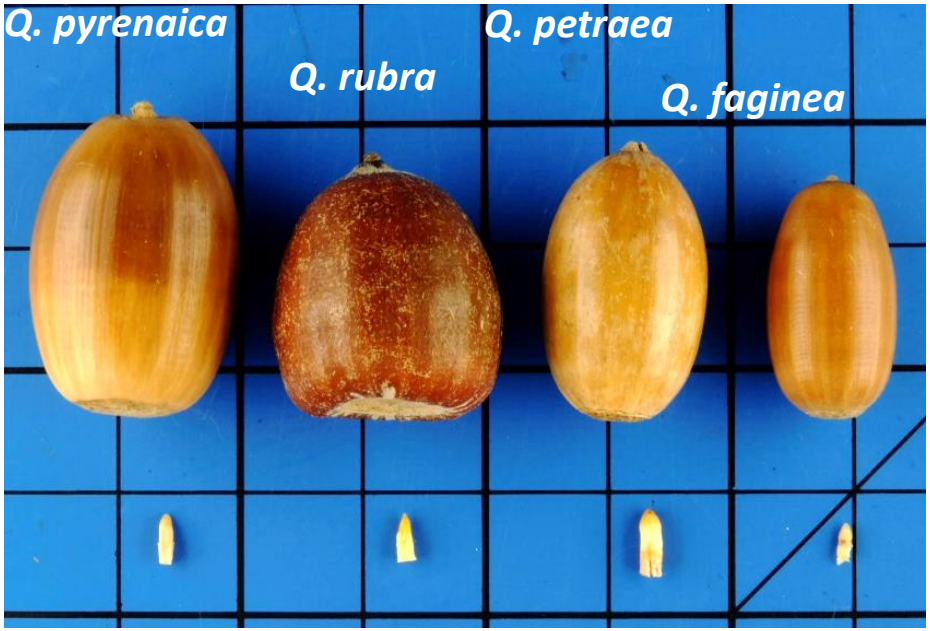
Q. pyrenaica

Many *Quercus* sp. (oaks) are endangered

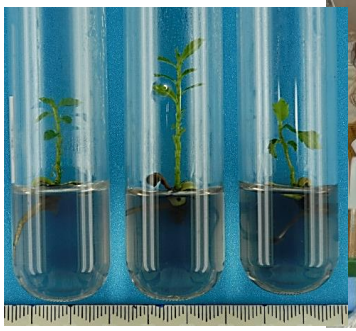


Oak **seeds are not conserved** for the long-term in **conventional seed banks** due to their **recalcitrant** nature: sensitivity to drying and freezing

Q. ithaburensis



Important efforts are put in research on the **cryopreservation** of seed embryos or other plant tissues.



But the **implementation** of these high-tech approaches is still **very limited**.

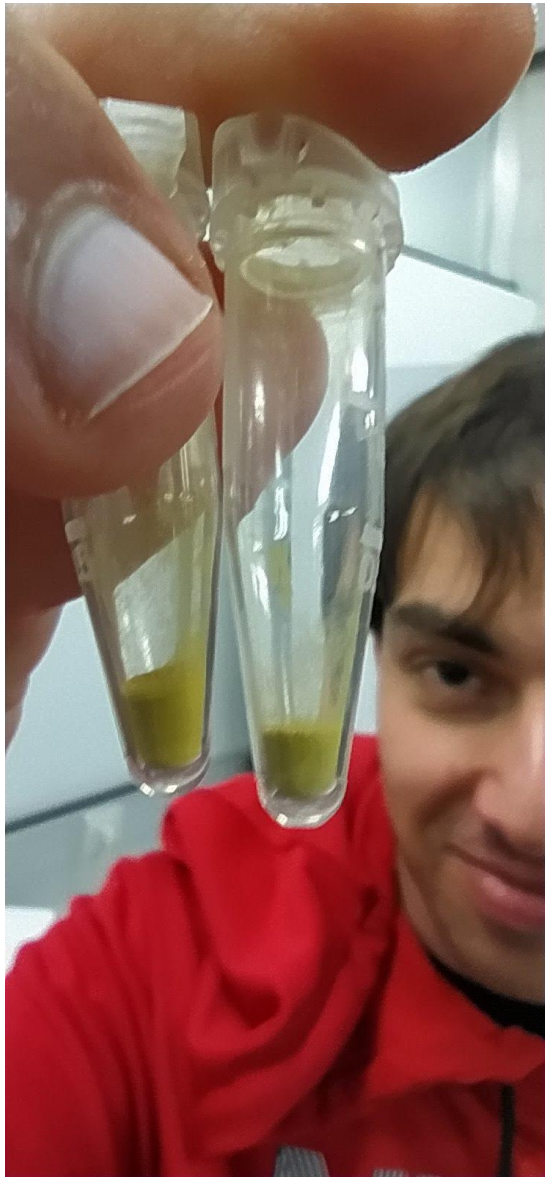
One currently poorly explored route to immediately strengthen the conservation of this important group of plants is to establish a **pollen bank**.

Oak pollen appears to tolerate drying and freezing, at least in the four species studied to date (representing less than 1% of all species globally).

The Global Oak Pollen Bank has two aims:

(1) To conduct **basic research** on drying and freezing tolerance in a diversity of *Quercus* species across territories and the oak evolutionary tree to confirm the universality of these traits in the oaks.

(2) To create the **first "Global Oak Pollen Bank"** that will preserve using **low-tech approaches** the genetic diversity of a variety of endangered oak species, as well as key species in ecosystem restoration projects, in Europe and three of the most important **oak hot-spots** (USA, Mexico and China).



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The Global Oak Pollen Bank team:

Principal Investigator

Daniel Ballesteros
University of Valencia, Spain
Royal Botanic Gardens, Kew, UK

Project Partners

Hugh W. Pritchard, Yu Tu and Hongying Chen
Kunming Institute of Botany, Chinese Academy of Sciences, China

Valerie C. Pence
Center for Conservation and Research of Endangered Wildlife, Cincinnati Zoo and Botanical Garden, USA

Raquel Folgado
The Huntington Library, Art Museum, and Botanical Gardens, USA

The Global Oak Pollen Bank

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Training

Spring 2023: Victor Tomas, MSc student at University of Valencia

Spring 2024: BSc student from University of Valencia

Fall 2024: Technical staff (university, government, bot. gardens)

Additional Partners

Jeremy Foster
Pollen Bank, Chicago Botanic Gardens, USA

CHICAGO BOTANIC GARDEN

San Diego Zoo Wildlife Alliance, USA

Ana M. López Peralta and M. Elena Pérez Gómez
National Germplasm Bank, National Center of Forest Genetic Resources “El Serranillo”, Spain

VICEPRESIDENCIA
MINISTERIO PARA
LA TRANSICIÓN
ECOLÓGICA Y RETO
DEMOGRÁFICO


NEVER
GIVE
UP

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Species studied/banked:

Spain	USA (Cincinnati)	USA (California)	China
Q. ilex (2 pop., 10 genot.) *Q. coccifera* (1 pop., 7 genot.) *Q. faginea* (2 pop., 2 genot.) *Q. cerroides* (1 pop., 1 genot.) *Q. pyrenaica* (1 pop., 1 genot.) *Q. virginiana* (1 genot.) *Q. macrocarpa* (1 genot.) *Q. polymorpha* (1 genot.)	*Q. havardii* *Q. muehlenbergii*	*Q. virginiana* *Q. agrifolia* *Q. engelmanii* *Q. suber* *Q. myrsinifolia*	*Q. serrata* *Q. aliena* *Q. variabilis* *Q. franchetii* *Q. longispica*

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RESULTS:

Native species targeted by new partners:

Spain (National Germplasm Bank)	USA (Chicago)	UK (RBG Kew?)
Q. pyrenaica	*Q. alba*	*Q. robur*
Q. suber	*Q. coccinea*	*Q. petraeae*
Q. canariensis	*Q. ellipsoidalis*	
Q. lusitanica	*Quercus x schuettei* (*Q. bicolor* x *Q. macrocarpa*)	
Q. faginea	*Quercus x jackiana* (*Q. alba* x *Q. bicolor*)	
Q. ilex	**USA (San Diego)**	
Q. petrea		
Q. pubescens		
Q. robur		
Q. coccifera	*Q. cedrodensis*	
Q. rubra		
Q. alpestris		
Q. pauciradiata		

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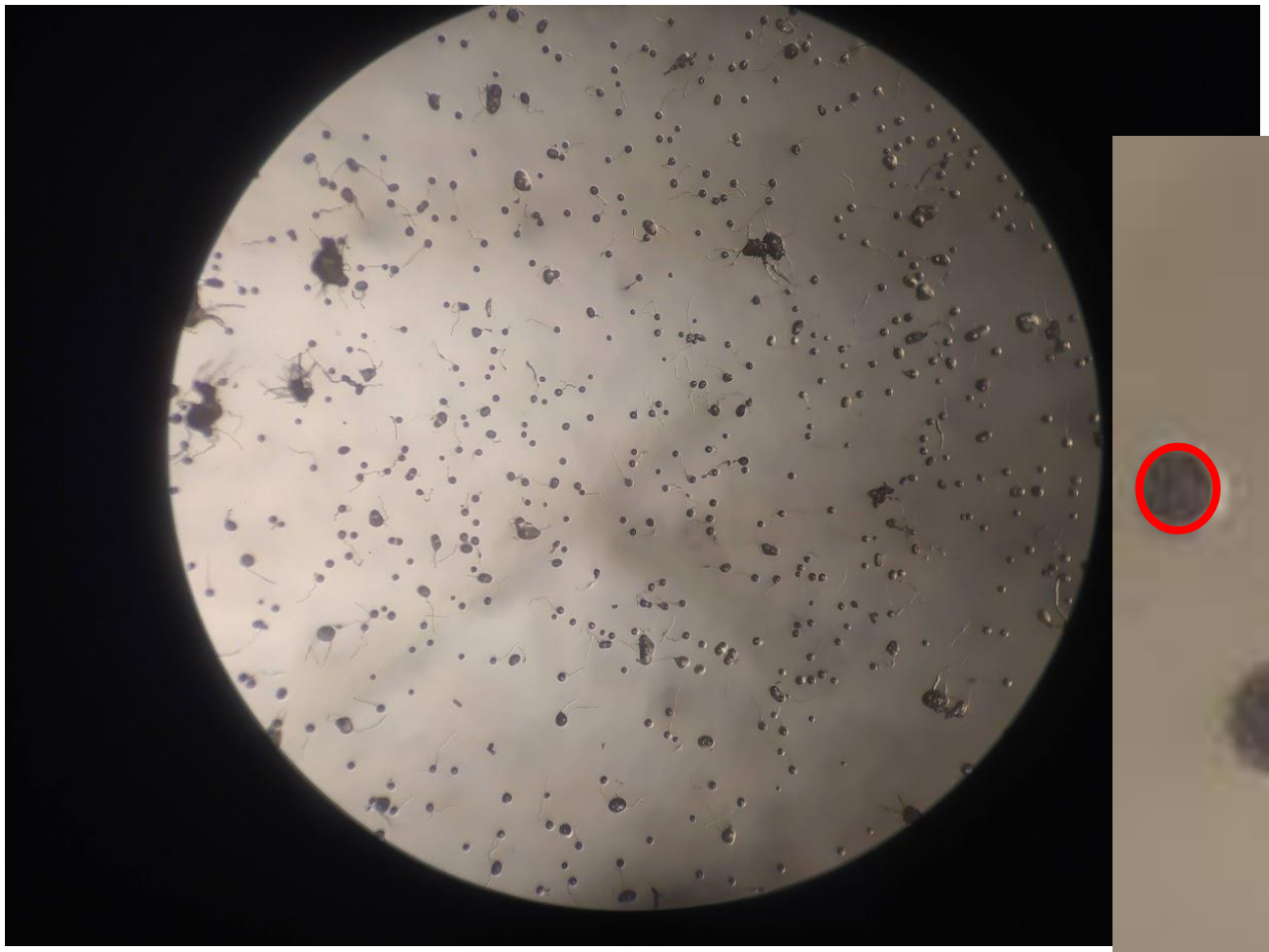

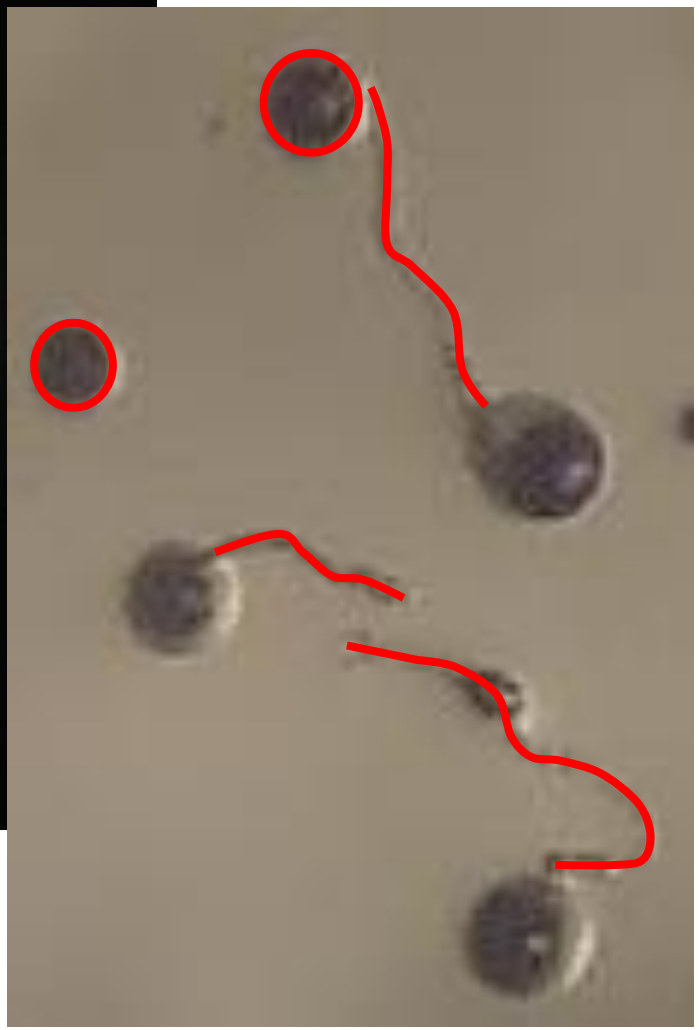

Pollen germination (agar 0,8%): best with 15 or 20% sucrose

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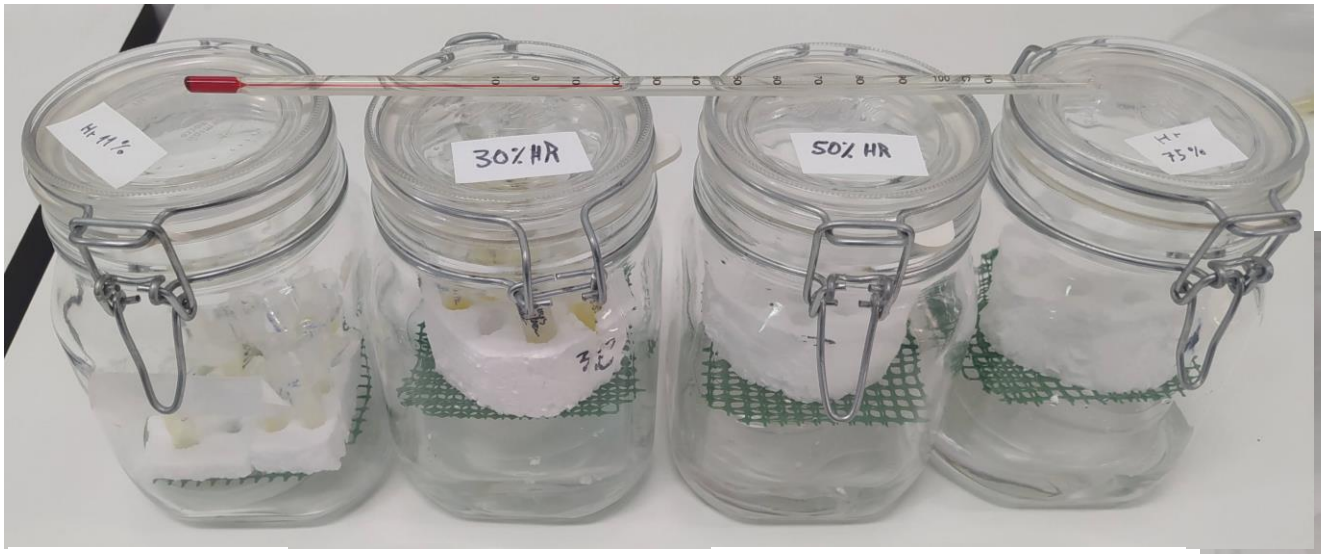
Drying and freezing tolerance + longevity experiments:



21°C

4°C

-20°C

-80°C

-180°C

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RESULTS:

Drying tolerance experiments:

eRH	Moisture content (FWB)				
	Q. aliena	*Q. variabilis*	*Q. serrata*	*Q. franchetii*	*Q. longispica*
Initial	4.71% ^{bc}	4.48% ^{b}	4.33% ^{c}	4.58% ^{bc}	6.97%
15%	2.61% ^{c}	2.03% ^{b}	3.28% ^{c}	3.46% ^{c}	4.43%
30%	4.27% ^{bc}	3.69% ^{b}	4.16% ^{c}	4.43% ^{bc}	5.07%
50%	5.68% ^{b}	5.01% ^{b}	6.56% ^{b}	6.68% ^{b}	5.35%
75%	11.76% ^{a}	10.95% ^{a}	9.62% ^{a}	10.82% ^{a}	10.42%

eRH	Germination rate				
	Q. aliena	*Q. variabilis*	*Q. serrata*	*Q. franchetii*	*Q. longispica*
Initial	69.51%^{A}	70.23%^{A}	68.73%^{AB}	62.23%^{A}	74.92%^{A}
15%	55.94%^{B}	77.10%^{A}	69.02%^{A}	63.23%^{A}	73.65%^{A}
30%	53.59%^{B}	75.15%^{A}	65.00%^{AB}	58.65%^{A}	73.33%^{A}
50%	43.38%^{BC}	66.59%^{B}	61.53%^{B}	48.01%^{B}	68.19%^{AB}
75%	36.58%^{D}	37.36%^{C}	23.66%^{C}	13.29%^{C}	48.21%^{C}

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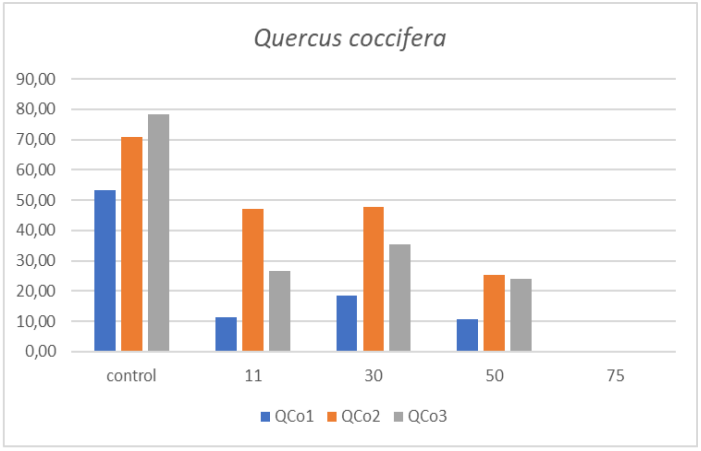
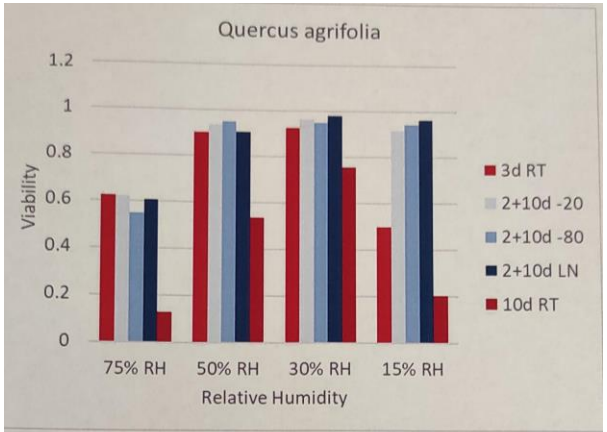
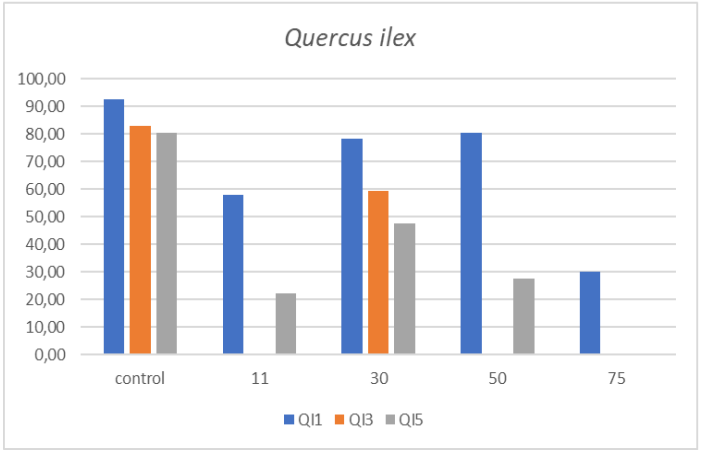
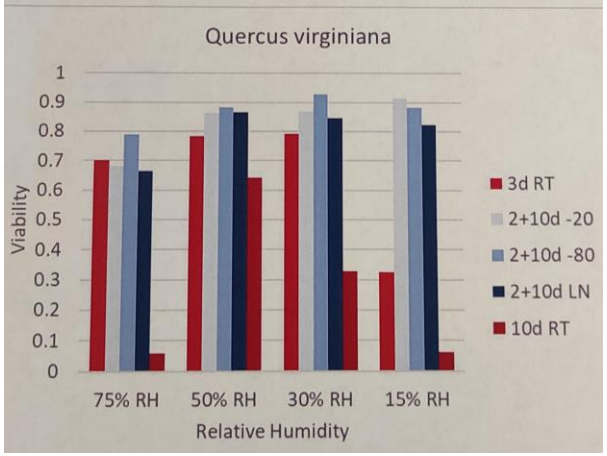
Drying and freezing tolerance experiments:









Oak pollen tolerates drying up to 11% RH, but some damage may occur when drying<15%

Dry pollen tolerates storage <0°C (incl. cryo)

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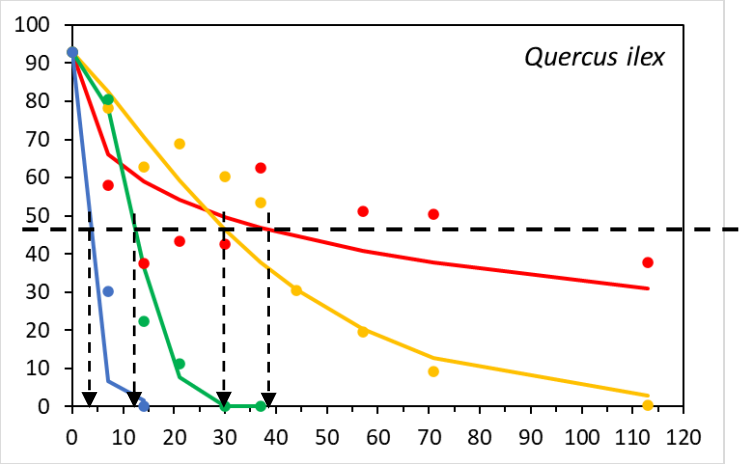
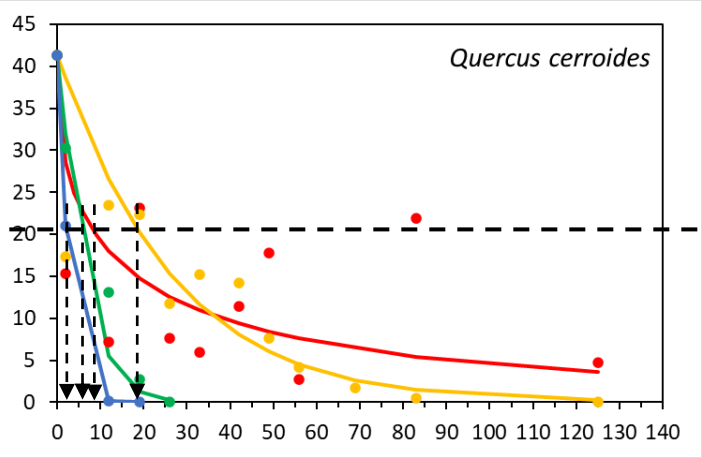
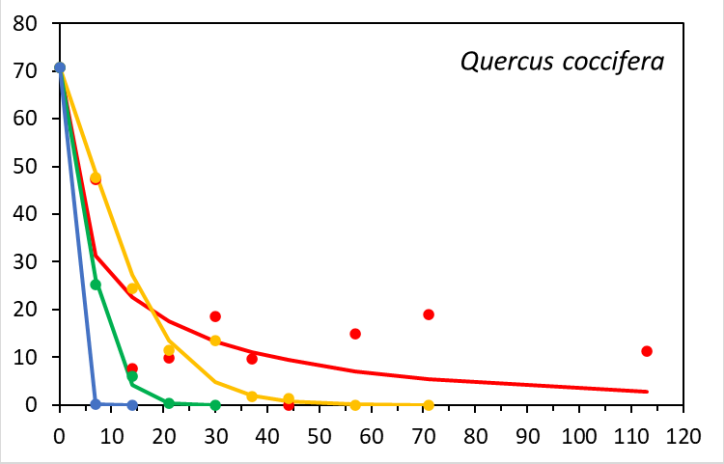
Longevity experiments:







p50 (11-30% RH): 11-38 days

p50 (50% RH): 4,7-12,2 days

p50 (75%): 0,2-2 days

Drying <50% RH increases longevity of oak pollen.

Fast viability loss in the first 2 weeks.

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RESULTS:

Long-term storage experiments (incl. cryo) are ongoing.

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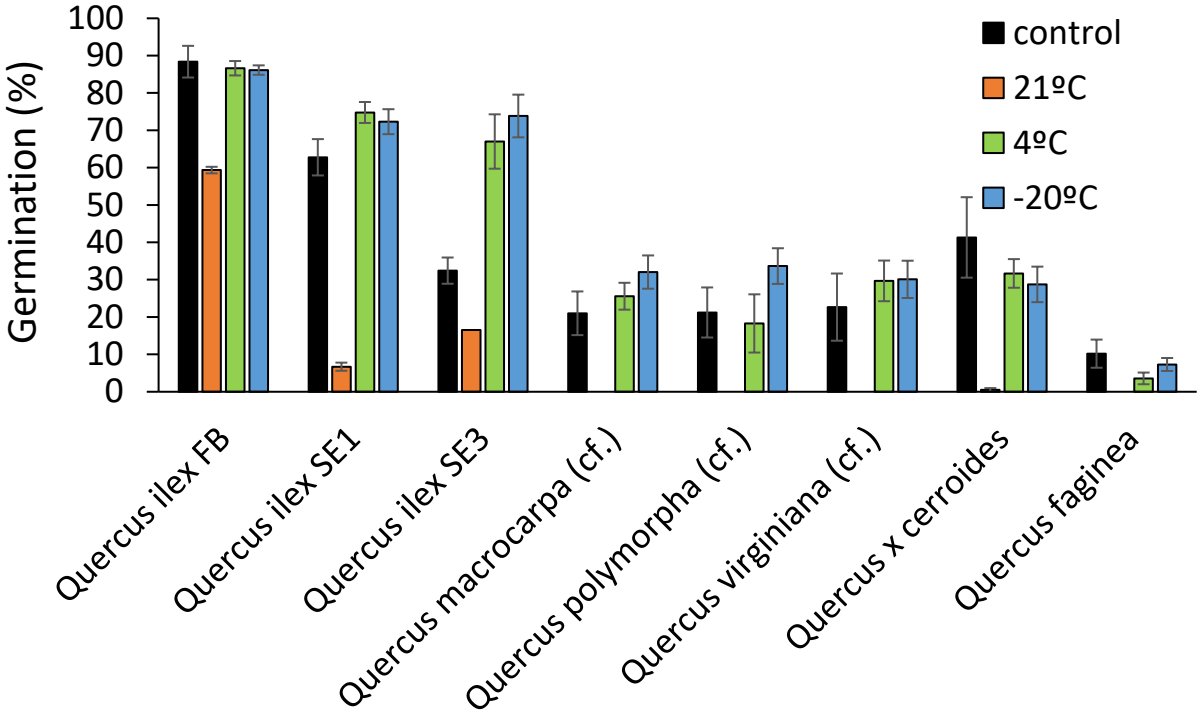
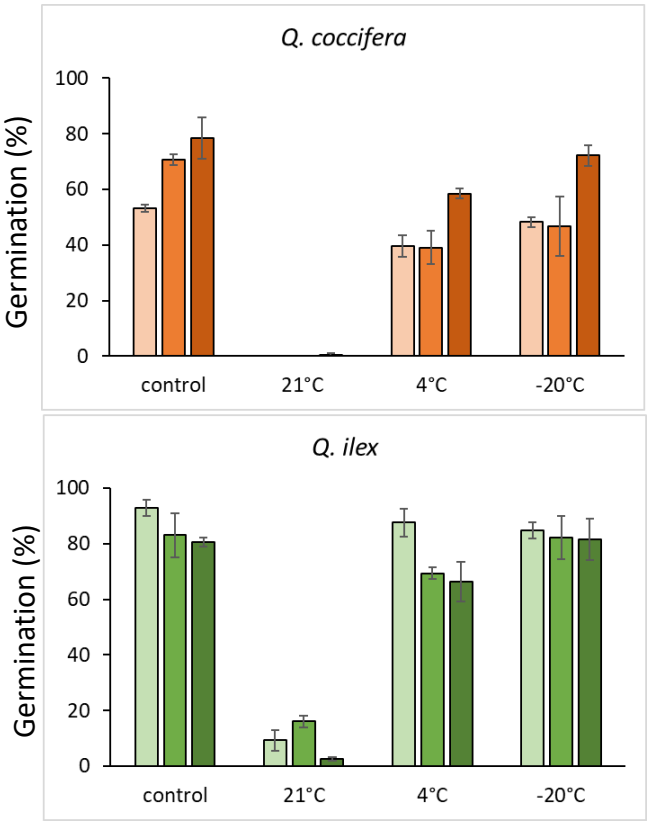
Freezing tolerance/longevity experiments:





Storing dry pollen at low temperatures extends its viability across species and genotypes within a species.

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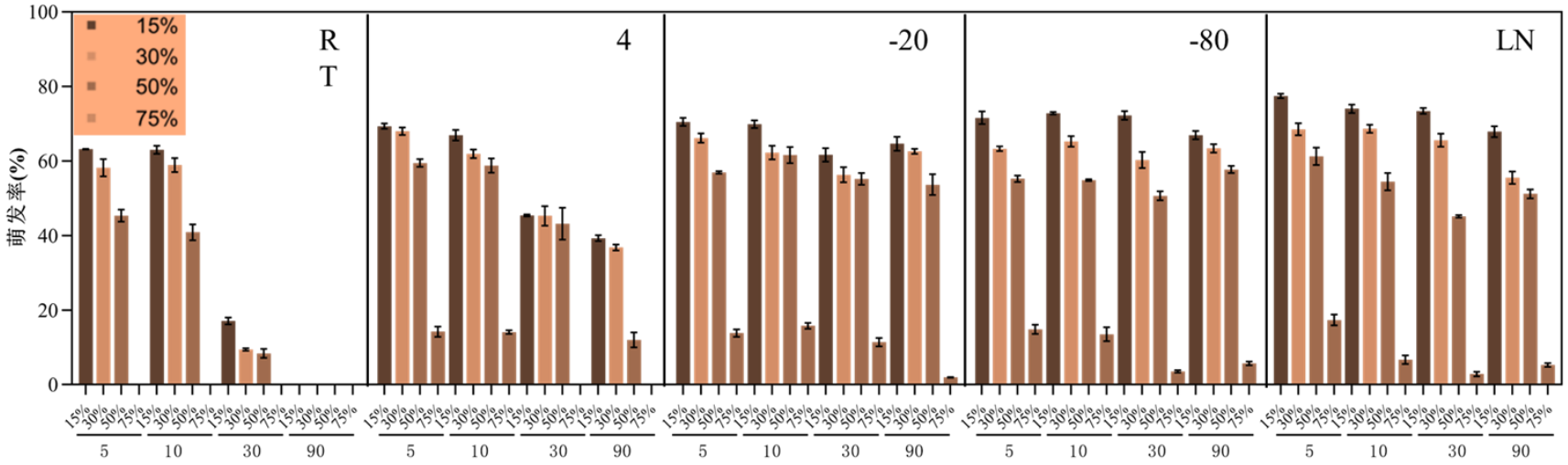
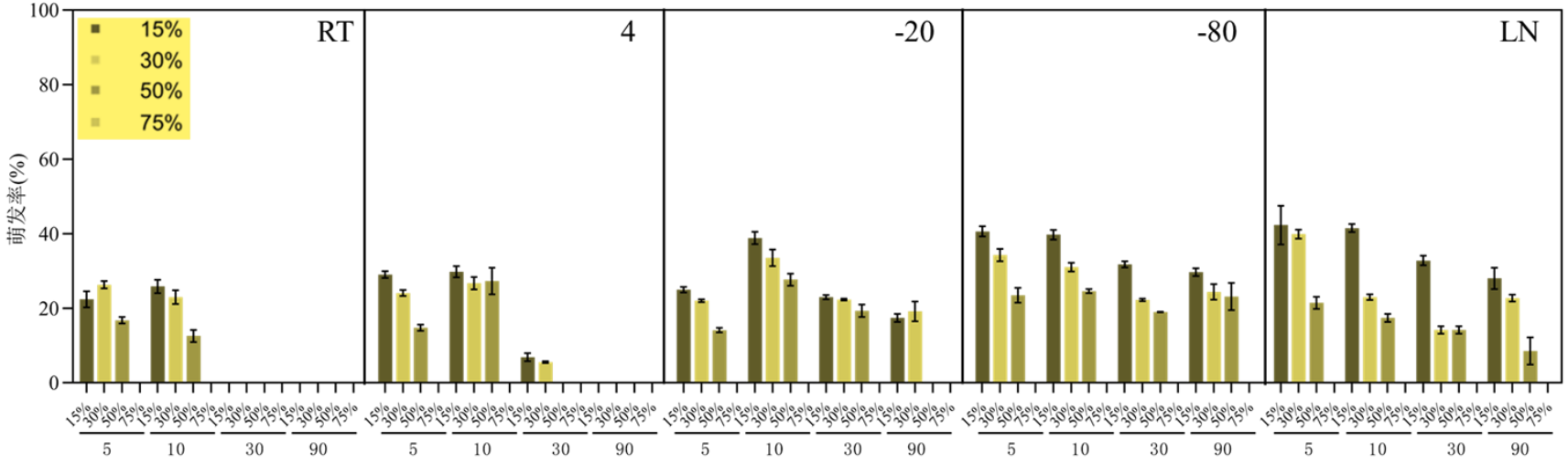
RESULTS:

Long-term storage experiments are ongoing.

Q. variabilis



Q. franchetii



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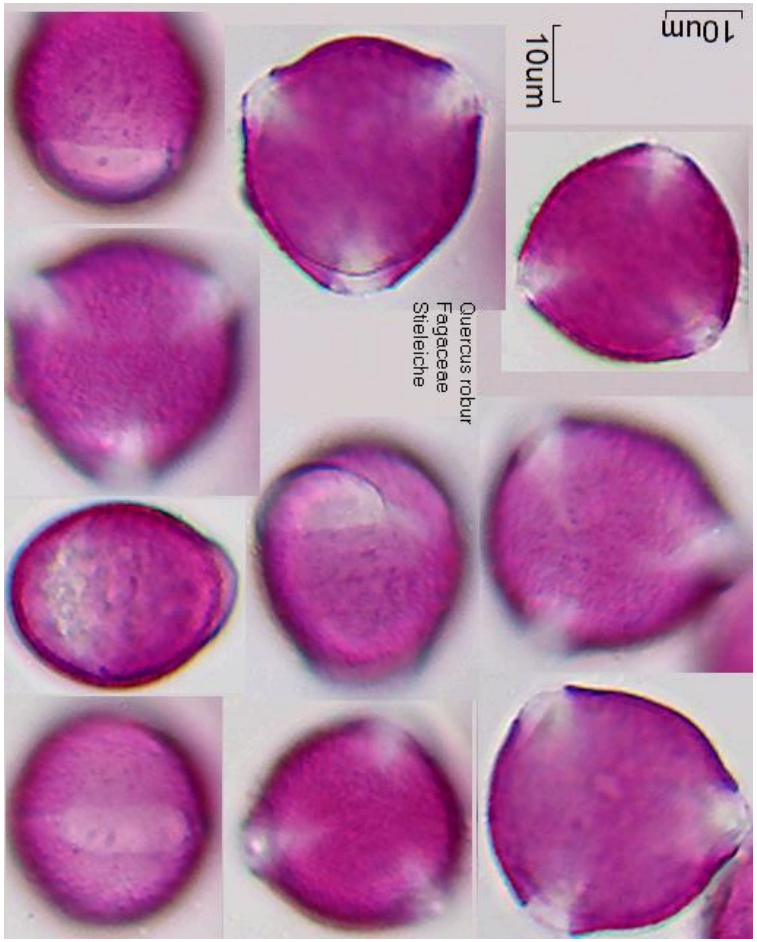
SUMMARY:

- Short collection window (2-4 weeks).
- Mature catkins release high quality pollen after over night room drying.
- Viability test: Pollen germination on 15 or 20% sucrose (agar 0,8%).
- Oak pollen tolerates drying up to 11% RH.
- Damage observed when drying < 15% could be related to imbibitional damage.
- Drying <50% RH increases (by 1 fold) longevity of oak pollen.
- Dry oak pollen tolerates storage <0°C (incl. cryogenic temperatures).
- Storing dry pollen at low temperatures extends its viability across species and genotypes within a species.
- Fast processing of pollen (within 1-2 weeks) is suggested.

The Global Oak Pollen Bank CONCLUSIONS:

- **Oak pollen can be banked using standard conditions of seed banks.**
- **Oak pollen can be banked using dry cryogenic storage.**
- **Pollen longevity appears to be related to the plant ecology**
- **Special considerations:**
  - **short collection window**
  - **fast processing needs**

  (drying and cold storage)



THANKS

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Victor Tomas, Pablo Bernal, Natalia Fanegas and Pierre Butel for their excellent assistance in the field and the lab.

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