

Seven Iberian *Ulmus minor* clones resistant to DED registered for their use as forest reproductive material

Spanish Elm Breeding Program

Juan A. Martín, Alejandro Solla, Martin Venturas, Jorge Domínguez, Eva Miranda, Pablo Fuentes, Margarita Burón (+), Carmen Collada, Salustiano Iglesias, Luis Gil

juan.martin.garcia@upm.es



MINISTERIO
DE AGRICULTURA, ALIMENTACIÓN
Y MEDIO AMBIENTE



3rd International Elm Conference
The elms after 100 years of Dutch elm disease
Florence, 9-11 October 2013



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Dedicated to Margarita Burón, who spent ten years of her life to the conservation and breeding of Iberian elms.

Elm breeding in Europe

- Dutch program 1928
- Italian program 1970s
- **Spanish program 1986**
- EU project (CEMAGREF) 1997
- Other European institutes

American programs

- USDA-ARS program 1930s
- Wisconsin program 1958
- Morton Arboretum program 1972

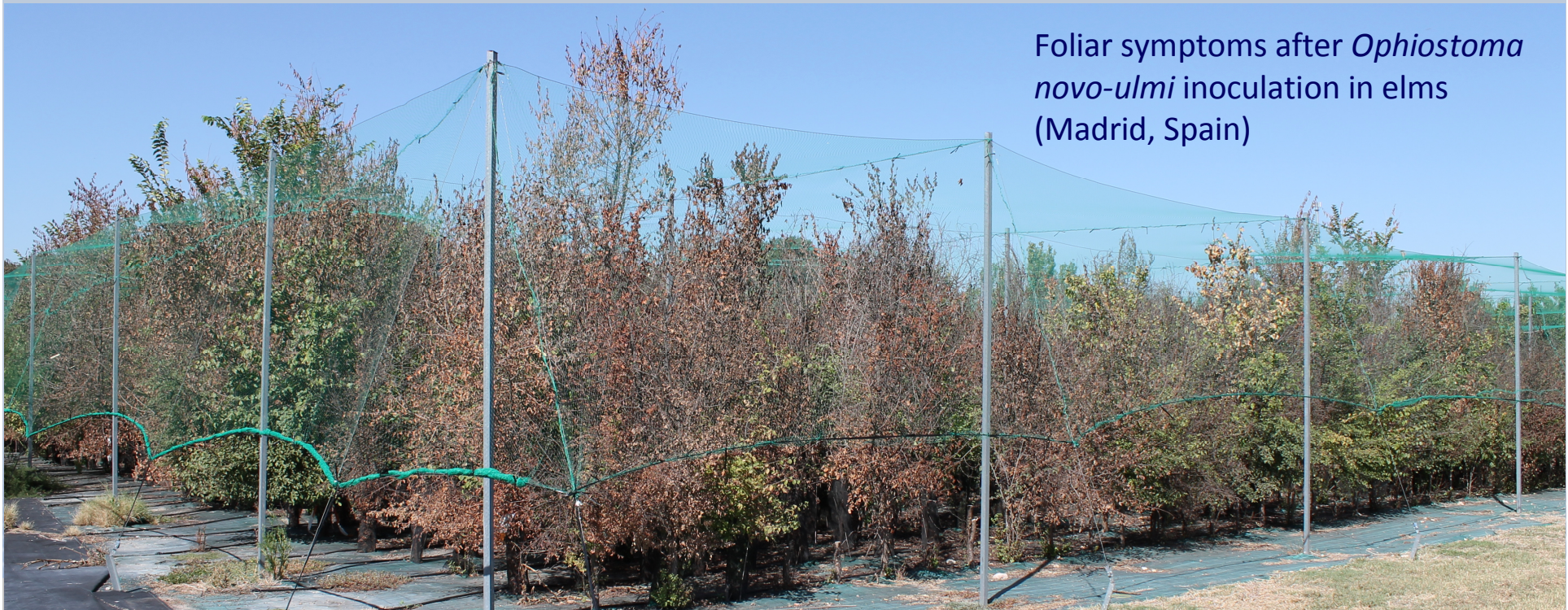


The Spanish elm program – objectives

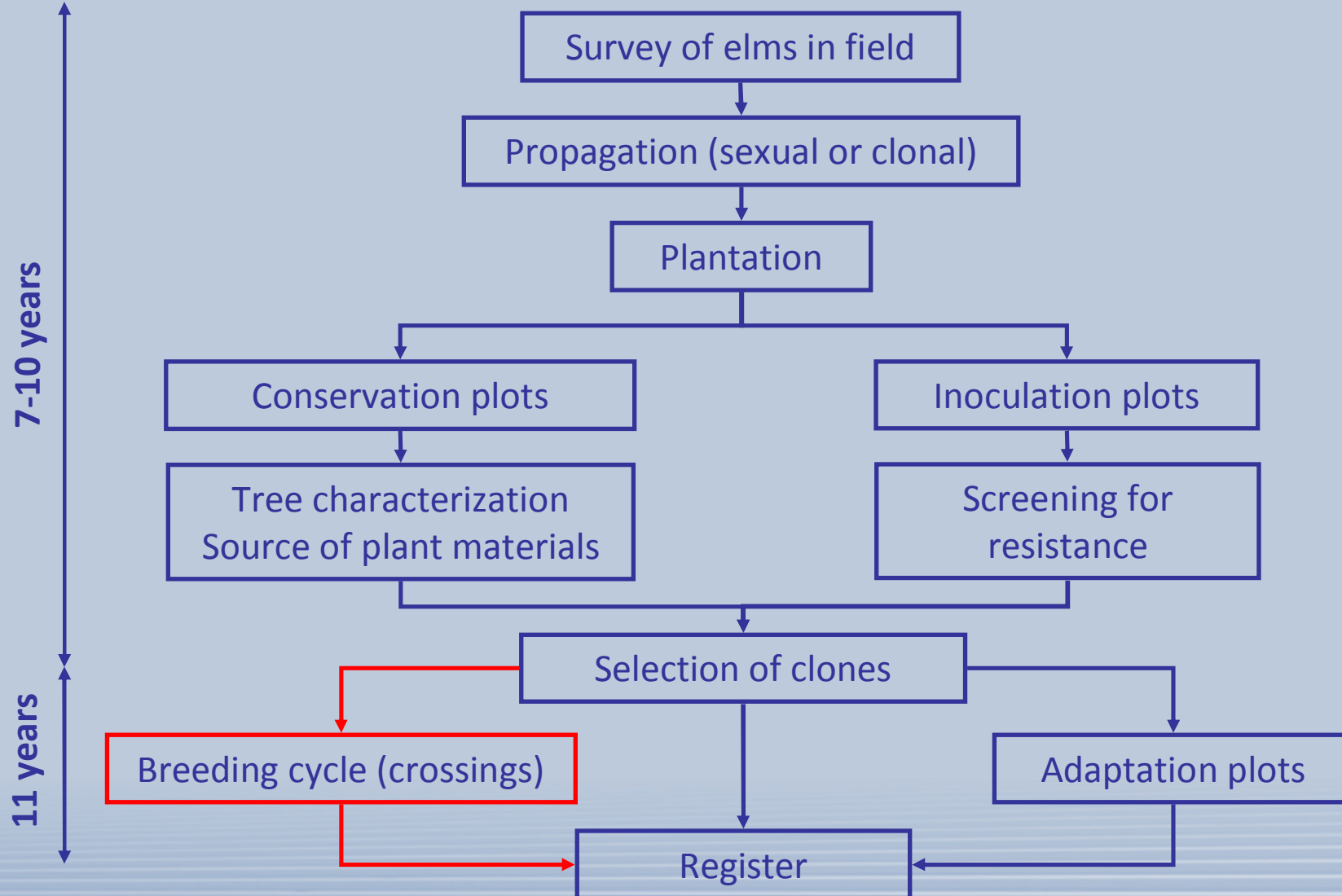
- ✓ 1986-1989: First contact with the DED complex
- ✓ 1990 - : Conservation of elm genetic resources
- ✓ 1993 - 2000 : Crossing native and Asian elms for resistance
- ✓ 1996-2001: EU project RESGEN CT96-78
- ✓ 2001 - : Obtaining native resistant elms
- ✓ 2001 - : Genetic structure and resistance mechanisms of elms
- ✓ 2009 - : Register elm clones as forest reproductive material

Why the program focused on native elms?

- Hybrids not suitable for forest use (Directive 1999/105/EC, RD289/2003)
- Around 10,000 elms have been screened, 50% of which were native
- Around 0,5 % of the native elms show mid to high resistance



Foliar symptoms after *Ophiostoma novo-ulmi* inoculation in elms
(Madrid, Spain)





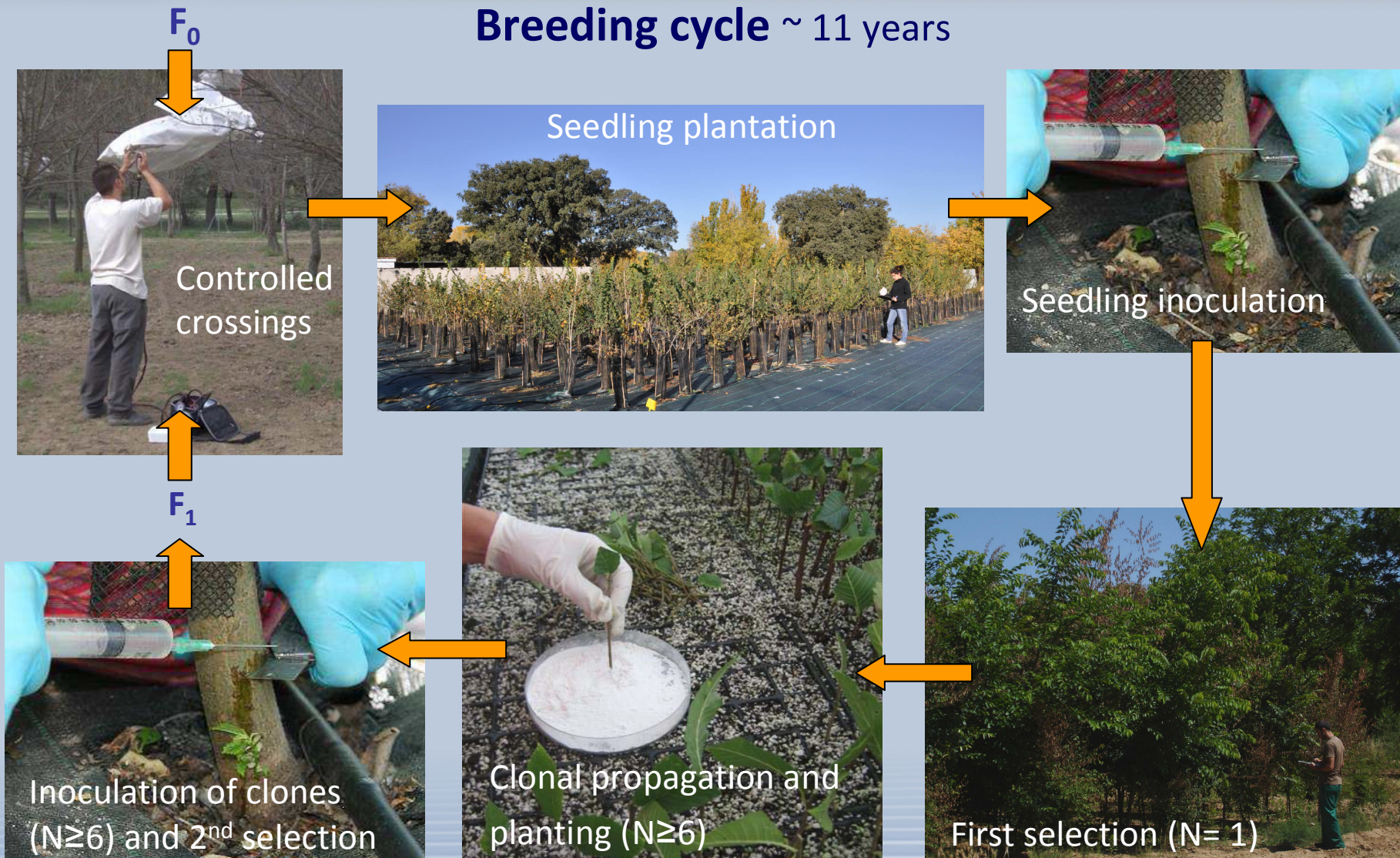
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Breeding cycle ~ 11 years



Selection criteria to register an elm clone

Requirements to register an elm clone as **QUALIFIED MATERIAL**:

- ✓ Tested in a controlled plot with resistant and a susceptible controls ($N \geq 6$)
- ✓ Leaf wilting $< 30\%$ or similar to resistant control during two years
- ✓ Susceptible control clone $> 70\%$ wilting symptoms
- ✓ Inoculation in plants ≥ 4 years-old
- ✓ Distinctive features of the clone should be described

Requirements to register an elm clone as **CONTROLLED MATERIAL**:

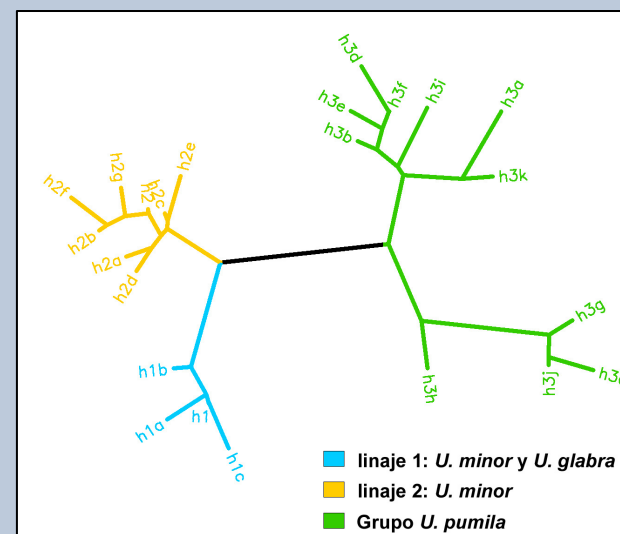
- ✓ Requirements must be met in two different locations

To register the clone, distinctive features should be described

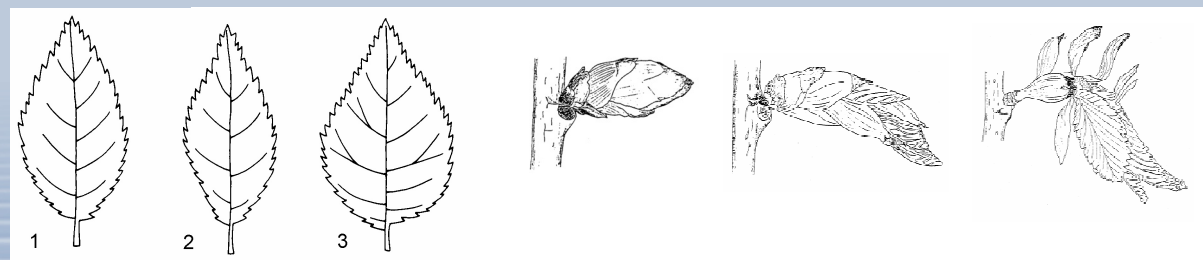
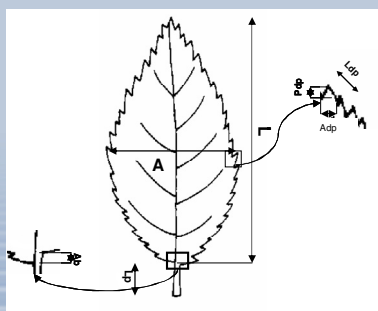
Genetic characterization:

Microsatellites at two levels:

- Chloroplast DNA: lineage
- Nuclear DNA: genotypic diversity



Characterization of phenology, morphology and ornamental value (1-5)



In 2013, six native *U. minor* clones fulfill the requirements of qualified material



In 2013, one native *U. minor* clone fulfills the requirements of controlled material





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"Ademuz"

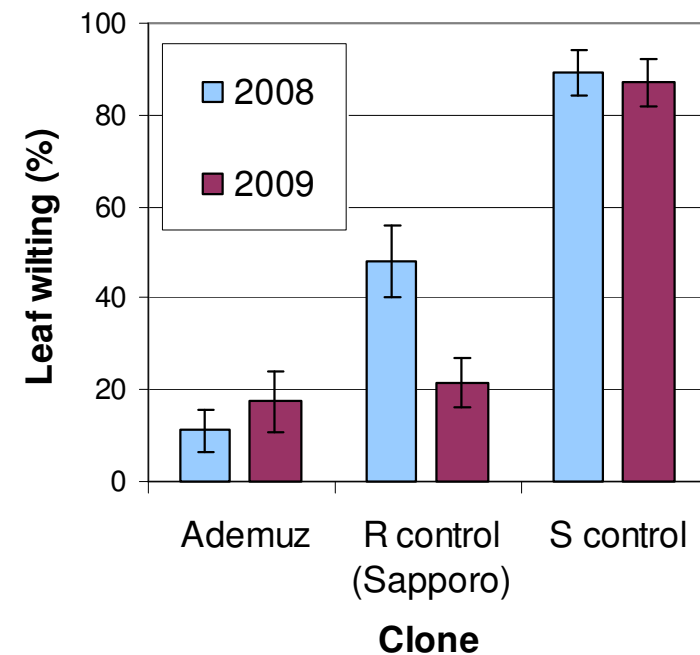


Provenance: Valencia
Vicinity of the town

Ornamental value: 4.5/5
Haplotype: 1



Resistance test in Madrid (N = 10)



Qualified material in 2013
Controlled material in 2016?



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"Dehesa de la Villa"

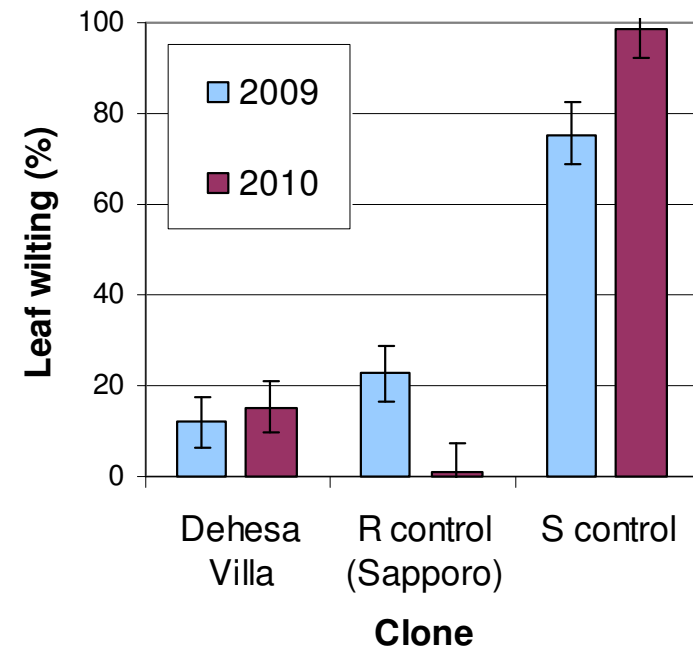


Provenance: Madrid
Historic park

Ornamental value: 4.3/5
Haplotype: 1



Resistance test in Madrid (N = 10)



Qualified material in 2013
Controlled material in 2016?



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"Majadahonda"

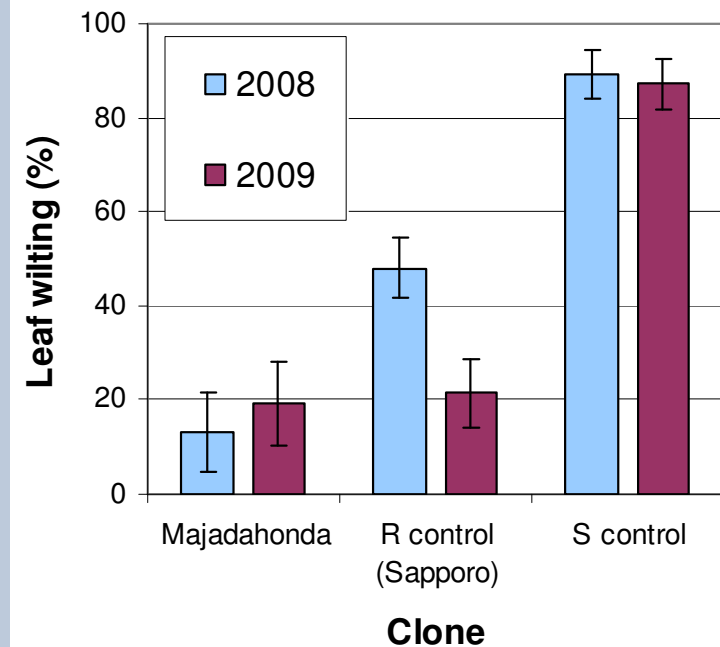


**Provenance: Madrid
Urban area**

**Ornamental value: 4.1/5
Haplotype: 1**



Resistance test in Madrid (N = 6)



**Qualified material in 2013
Controlled material in 2018?**



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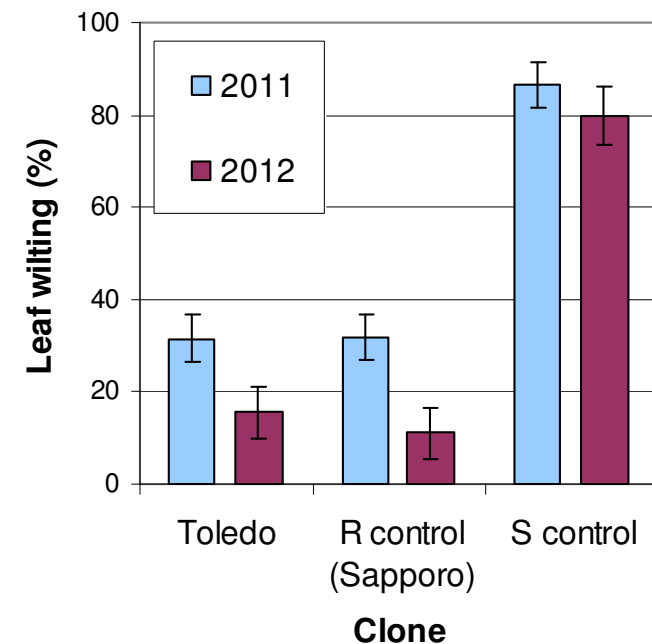


"Toledo"



Provenance: Toledo
City

Resistance test in Madrid (N = 7)



Qualified material in 2013
Controlled material in 2016?

Ornamental value: 2.9/5
Haplotype: 2





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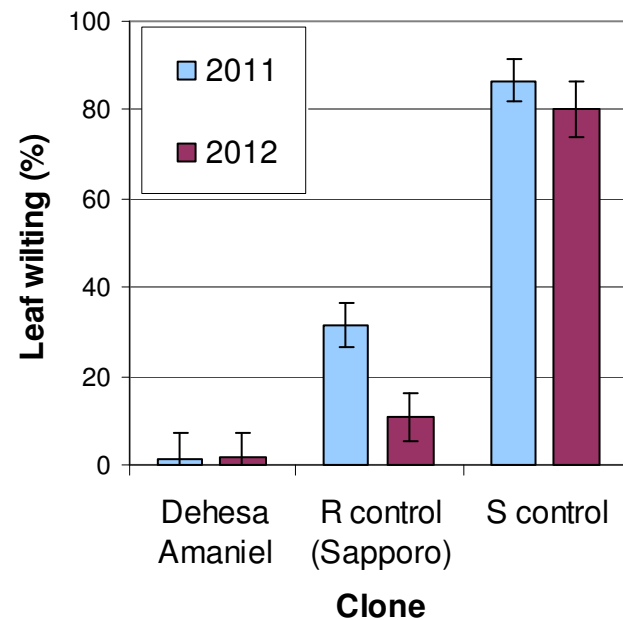


"Dehesa de Amaniél"

Resistance test in Madrid (N = 12)



Provenance: Madrid
Historic park



Qualified material in 2013
Controlled material in 2016?

Ornamental value: 3/5
Haplotype: 1





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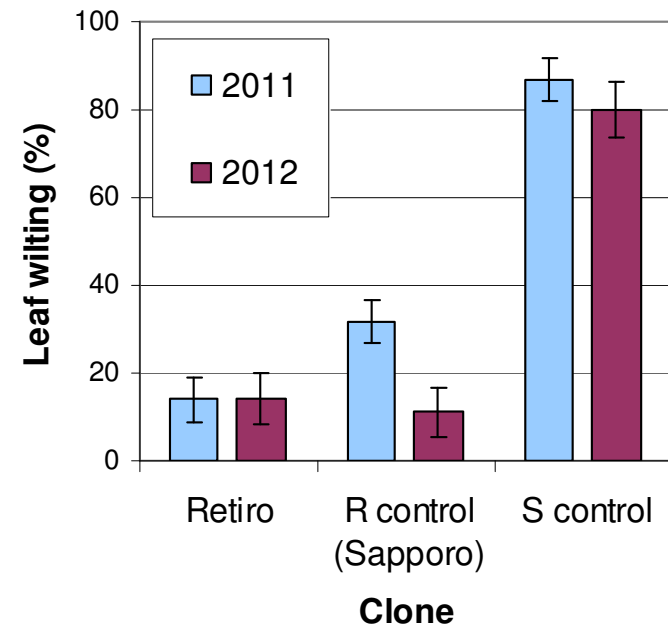


"Retiro"

Resistance test in Madrid (N = 7)



Provenance: Madrid
Historic park



Qualified material in 2013
Controlled material in 2016?

Ornamental value: 4/5
Haplotype: 2





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"Fuente Umbria"



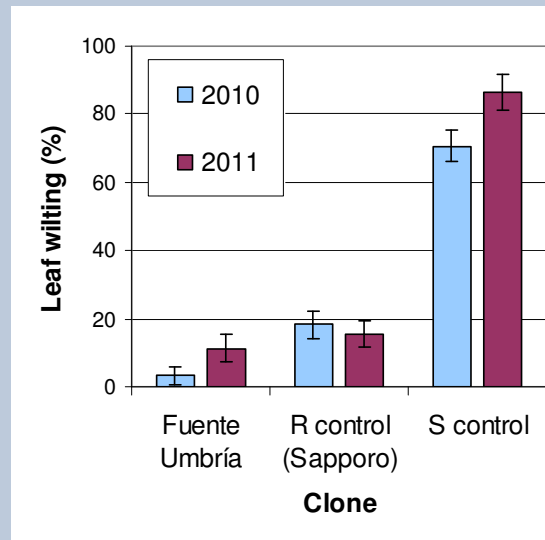
**Provenance: Valencia
Field**



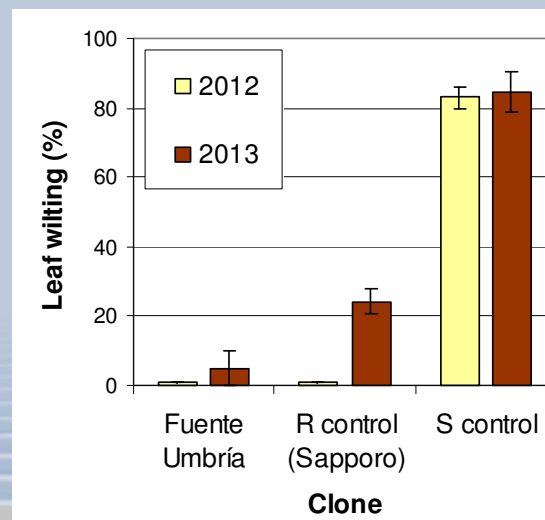
**Ornamental value: 3/5
Haplotype: 2**

**Qualified material in 2013
Controlled material in 2014**

Resistance test in Madrid (N = 12)



Resistance test in Palencia (N = 10)





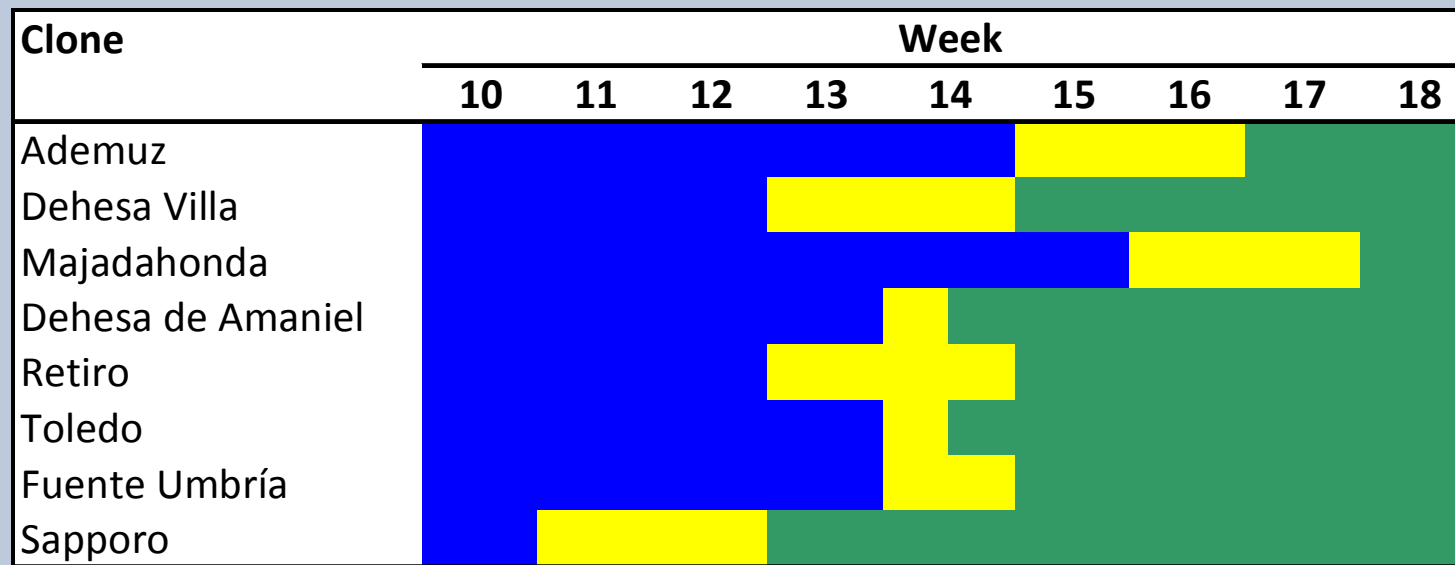
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Leaf phenology (2011)



Next objective: increase the genetic diversity of resistant native elms

- 1,400 seedlings from controlled crossings between the 7 registered *U. minor* clones (F1)
- In 2014, 160 new genotypes will be tested in clonal replicates for the first time
- In 2016, 19 *U. minor* x *U. minor* crossings (F1) will be tested in clonal replicates for the first time



Medium-term objective: offer resistant clones to the market

- Develop in vitro propagation techniques for each clone
- Establish a certified field of reference plants
- Protect the clones in the Community Plant Variety Office (EU)
- Protect five resistant hybrids for ornamental use
- Understand the genetic basis of resistance



Thank you!

