Clonal propagation of disease tolerant genotypes of highly relevant forest species in Spain (chestnut, cork oak and maritime pine)

Let´s talk about clonal forestry

September 16th, 2022

EFI

iefc European Institute of Planted Forest

IUFRO Interconnecting Forests, Science and People

45 AÑOS 1977-2022 Tragsa GrupoTragsa

TU COMPROMISO HACE FUTURO

OBJETIVOS DE DESARROLLO SOSTENIBLE

SEPI

1 BRED MATERIAL PROPAGATION CONTEXT

ENHANCED INTERNATIONAL WOOD DEMAND

↓

BIOMASS PRODUCTION INCREASE OPORTUNITY

TRANSITION TO BIOECONOMY + CLIMATIC CHANGE MITIGATION

↓

CARBON FIXATION

↓

BIOMASS PRODUCTION INCREASE NEEDED

GLOBALIZATION
CLIMATE CHANGE

BUT

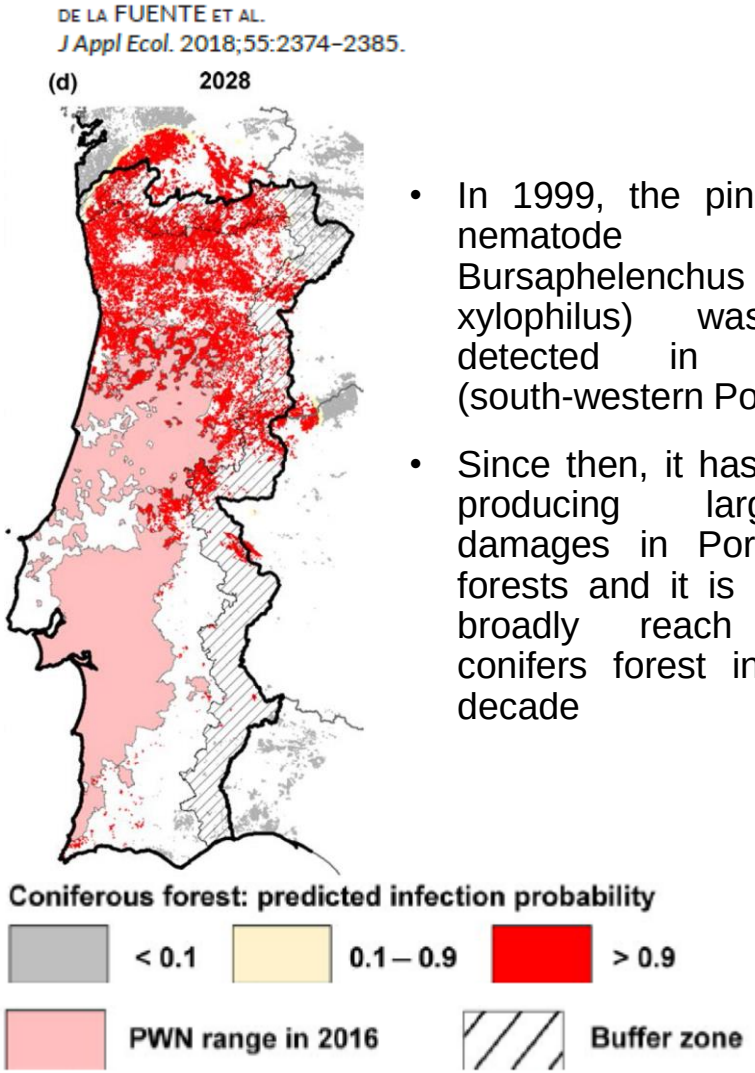
HIGH ECONOMICAL IMPACT PESTS & DISEASES RISK

TOLERANCE BRED GENETIC MATERIAL + DELIVERY PROGRAM=…
=…. COULD HELP INCREASING BIOMASS PRODUCTION

- EFFICIENT DELIVERY PROGRAM OF TOLERANCE BRED GENETIC MATERIAL MEANS:
  - **CLONAL** PROPAGATION OF ELITE GENOTYPES
  - **CLONAL** / SEMINAL PROPAGATION OF ELITE FAMILIES
  - SEMINAL PROPAGATION OF IMPROVED/SELECTED POPULATIONS

2 PINUS PINASTER VEGETATIVE PROPAGATION

PINE NEMATODE (Bursaphelenchus xylophilus) DISEASE THREAT IN GALICIA



- In 1999, the pine wood nematode (PWN, Bursaphelenchus xylophilus) was first detected in Europe (south-western Portugal).
- Since then, it has spread producing large-scale damages in Portuguese forests and it is likely to broadly reach Spain conifers forest in 2020s decade

Centro de Investigación Forestal
LOURIZÁN
XUNTA DE GALICIA
CONSELLERÍA DO MEDIO RURAL

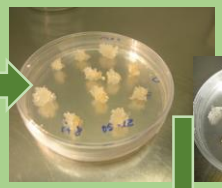
- Pinus pinaster Ait tolerance to PWN breeding program by CIFLOURIZÁN got 6 tolerance families (78% survival in inoculation trials, Díaz Vázquez et al 2020, Revista Foresta)
- Tolerance clones were registered in the Base Material National Catalogue , so to be legally commercialized as Family Progenitors numbered from PF-Q-26/15/001 to PF-Q-26/15/006)

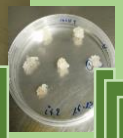
3 PINUS PINASTER VEGETATIVE PROPAGATION

OPERATIONAL MASS PROPAGATION OF PINUS PINASTER Ait. PILOT ACTIVITIES IN GALICIA

GERMINATED SOMATIC EMBRYOS → JUVENILE MOTHER PLANT FIELDS → ROOTED CUTTINGS → PLANTATIONS

INDUCTION

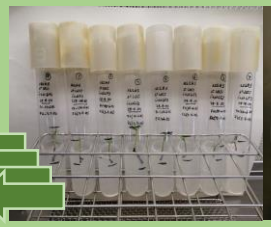




X12-20 v/a

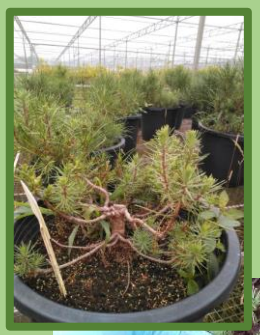
PROLIFERATION

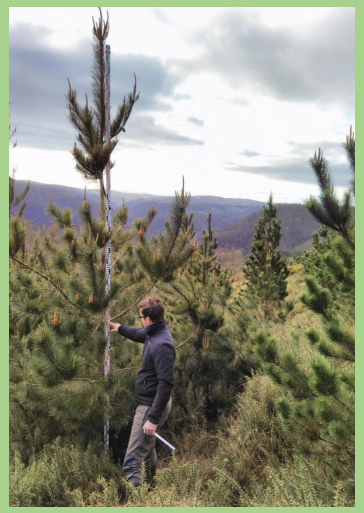
MATURATION



GERMINATION

ACCLIMATION





MASS PROPAGATION SCALING OF TOLERANCE TO PINE NEMATODE OPERATIONAL TEST IN PROGRESS (initiated in 2022) :

- **1 lab**
- **6 nurseries**

FUNDACIÓN ARUME

4 PINUS PINASTER VEGETATIVE PROPAGATION

6 YEARS OLD *Pinus pinaster* BRED FOR GROWING ACITUDES ROOTED CUTTINGS .
MAÑÓN-A CORUÑA-NORTHWESTERN SPAIN

SPRING 2014

WINTER 2020

5 PINUS PINASTER VEGETATIVE PROPAGATION

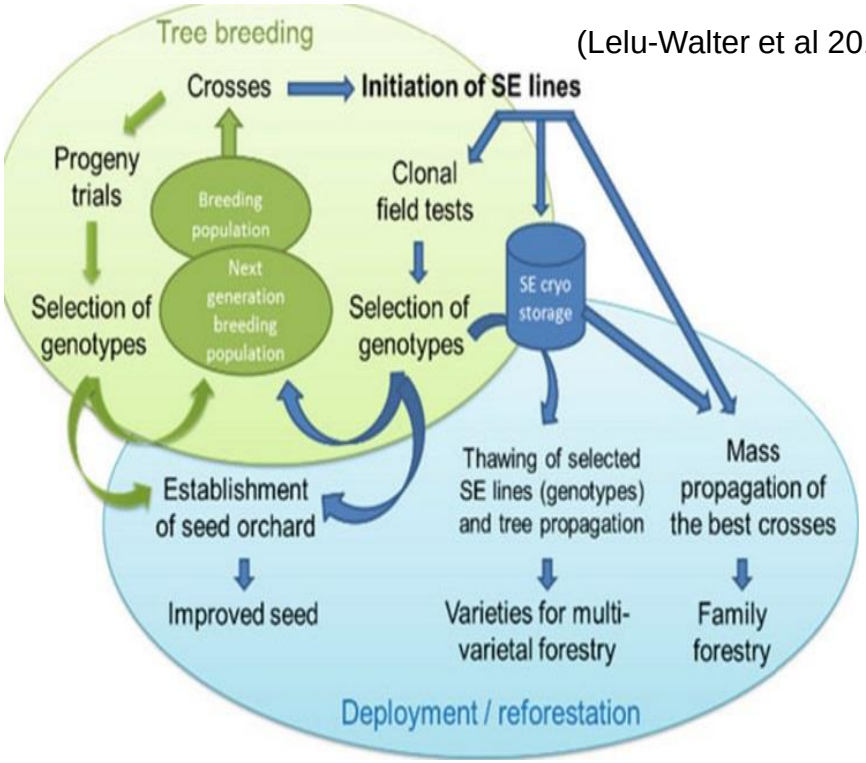
WHAT NEXT?

- WAIT FOR RESULTS FROM THE MASS PROPAGATION SCALING OF Pinus pinaster TOLERANCE TO PWN
- START A NEW SCALING MASS PROPAGATION PROCESS OF Pinus radiata DISEASE TOLERANCE (FINISHING OBTENTION OF NEW TOLERANCE GENETIC MATERIAL INCLUDED)
- INTEGRATED CRYOPRESERVATION ALONG WITH SOMATIC EMBRYOGENESIS IN TO THE BREEDING PROGRAMS

  TO GET ADVANTAGE OF THE

  CLONAL BREEDING

(Lelu-Walter et al 2016)

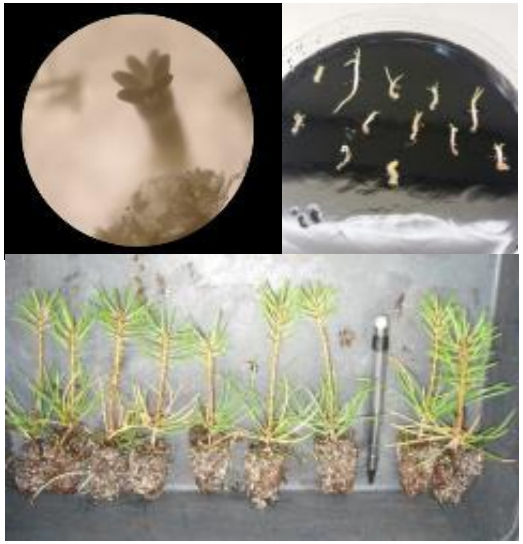


6 MICROPROPAGATION AS A BREEDING TOOL

In R&D projects to:

- Clone outstanding selected genotypes
- Deploy clonal trials
- Cryopreserve selected genotypes

Pinus pinaster and P. radiata

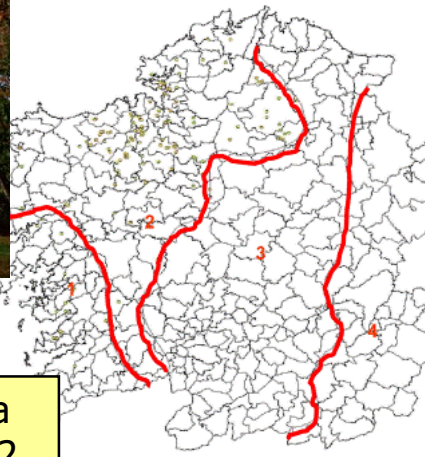


Quercus suber

Castanea spp.

7 SELECTION OF CHESTNUT FOR INK DISEASE TOLERANCE

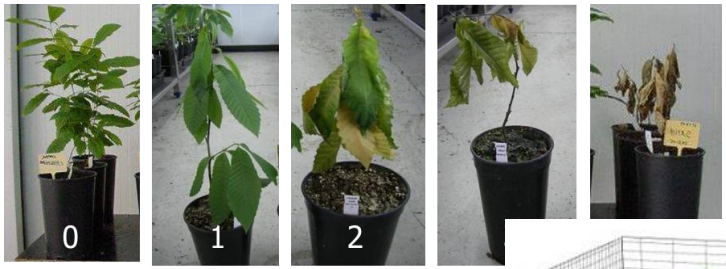
ASYMTOMATIC ADULT TREES SELECTED IN NATURAL STANDS WITH HIGH AFFECTION OF *Phytophtora cinnamomi*.

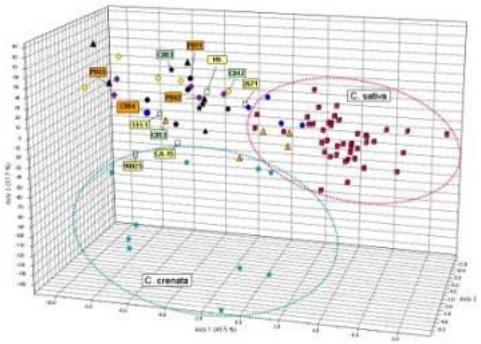


Multiple copies by micropropagation

- ✓ prospection of 18,809 ha in Galicia
- ✓ 206 trees selected in areas 1 and 2

Resistance tests





Molecular caracterization

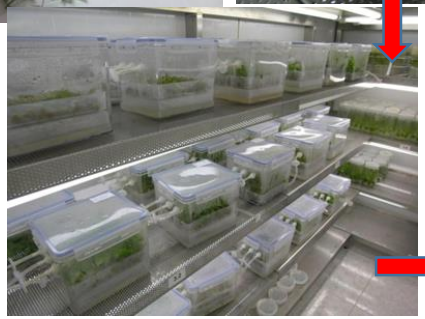
Field trials deployment

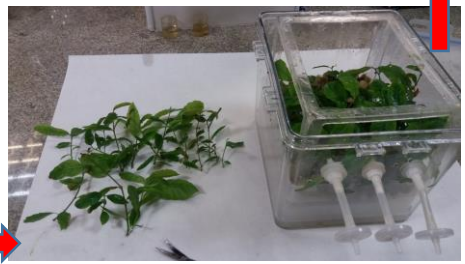
Registration of 8 resistant hybrid clones as rootocks

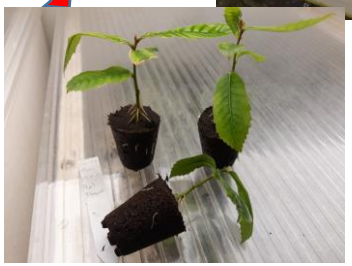
8 CHESTNUT CLONAL PROPAGATION: cuttings and micropropagation

CUTTINGS

MICROPROPAGATION







9 SELECTION OF CORK OAK: tolerance to *P. cinnamomi* or cork production

CORK PRODUCTION

Field selection

Somatic embryogenesis induction

Plant production by SE

Deployment of field trials (2007-2010)

28 highly cork producing genotypes about to enter into FRM Register

Phytophthora TOLERANCE

Acorn collection from asymptomatic trees within damaged stands

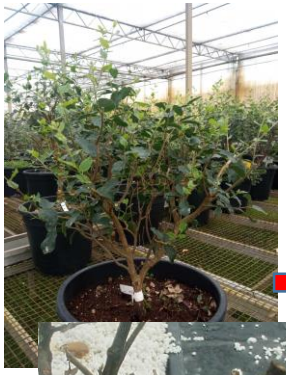
Acorns sown in a split-plot design

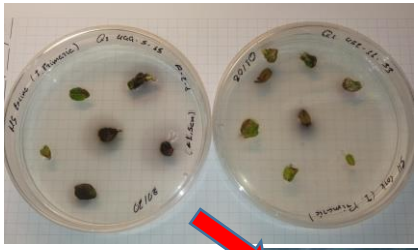
Pc inoculation and water stress treatment

Mortality data recording

Selection of surving seedlinand mother plants with highly surviving progenies, to be cloned

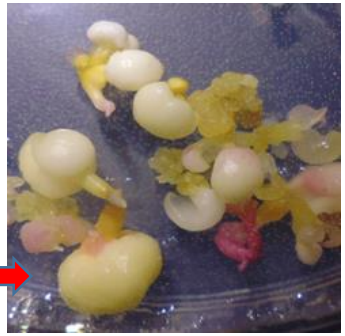
10 MICROPROPAGATION OF CORK OAK BY SOMATIC EMBRYOGENESIS



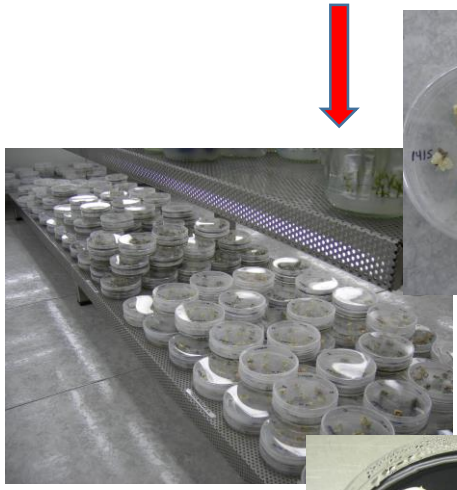


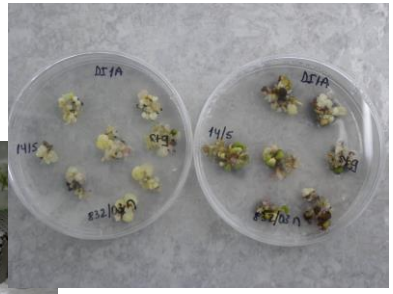
Induction of SE on somatic tissues (leaves)

Newly formed SE



Recurrent or secondary SE





Proliferation phase

Emblings growth

Accclimatization phase

Germinated SE

Maduration phase

11 CLONAL PLANTATIONS OF CHESTNUT AND CORK OAK

Timber plantations

Rodanillo, El Bierzo

Experimental plots

2012

Rueda Chica, Badajoz

2021

Fruit plantations

Villuercas, Cáceres

Dehesa redensification

Ballesteros, Cáceres

Photo: B. Guerin, **Syndicat National des Producteurs de châtaignes**

12 CLONAL PLANTATIONS OF CHESTNUT AND CORK OAK

NEXT STEPS:

- Increase of chestnut producion capacity by the building of a new lab
- Inmediate registration of cork producing genotypes as RFM
- Deployment of experimental plots for tolerance of cork oak
- Development of cork oak SE protocol to industrial scale

Monte Medo, Maceda

Thank you!

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