New findings in ash research by Teagasc

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Outline of the presentation

- Introduction. Ash in distress!
- Study 1. What makes an ash tree tolerant to ash dieback?
- Study 2. Lenticels and ash dieback; a shortcut for infection.
- Study 3. Is Irish ash ready for the future climate?

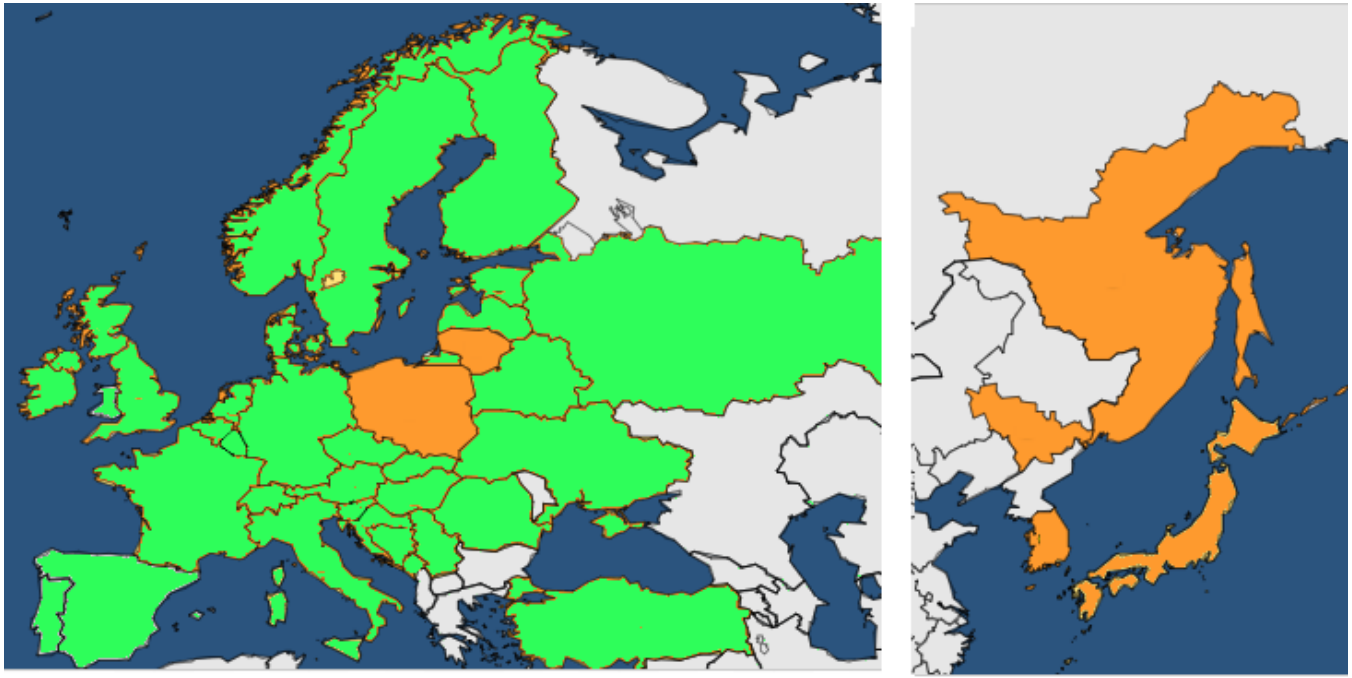
Introduction

Hymenoscyphus albidus and *H. fraxineus*

Specialists. Natural decomposers of ash leaves in soil in their native environments.

Introduction

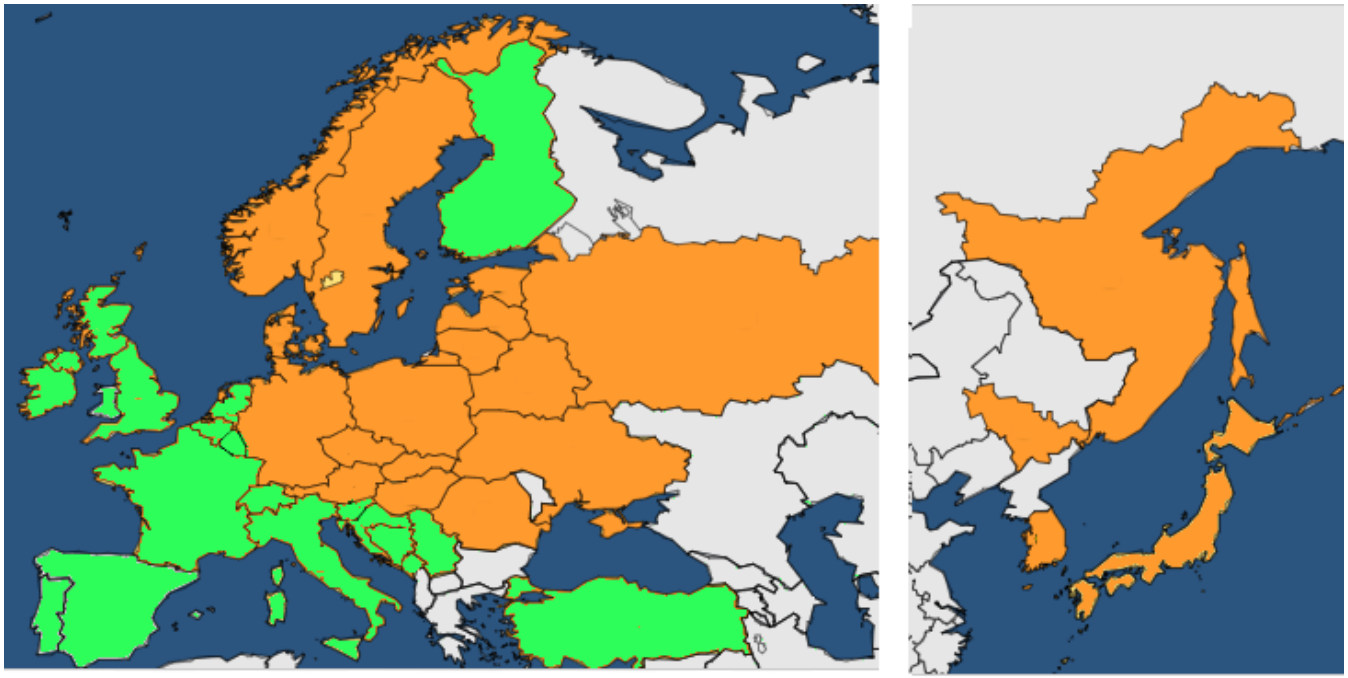
Invasive pathogen meets naïve host



1990s *H. albidus* *H. fraxineus*

Introduction

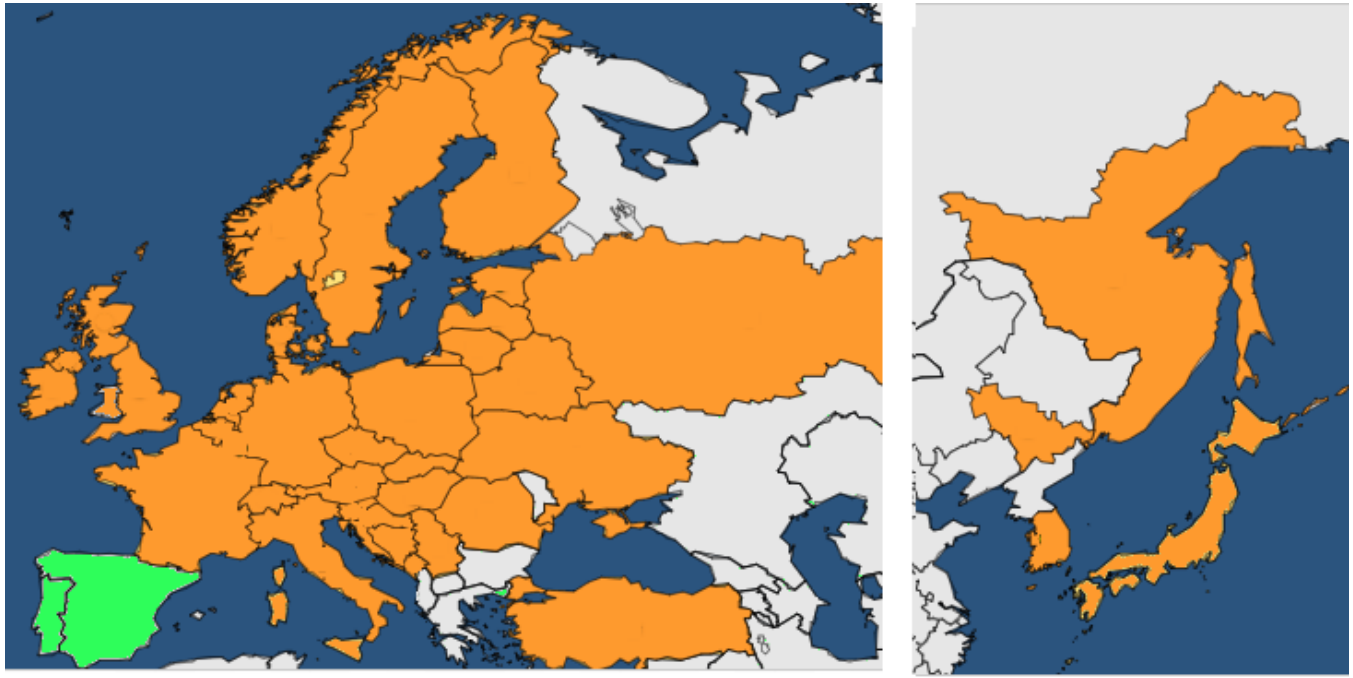
Invasive pathogen meets naïve host



2000s *H. albidus* *H. fraxineus*

Introduction

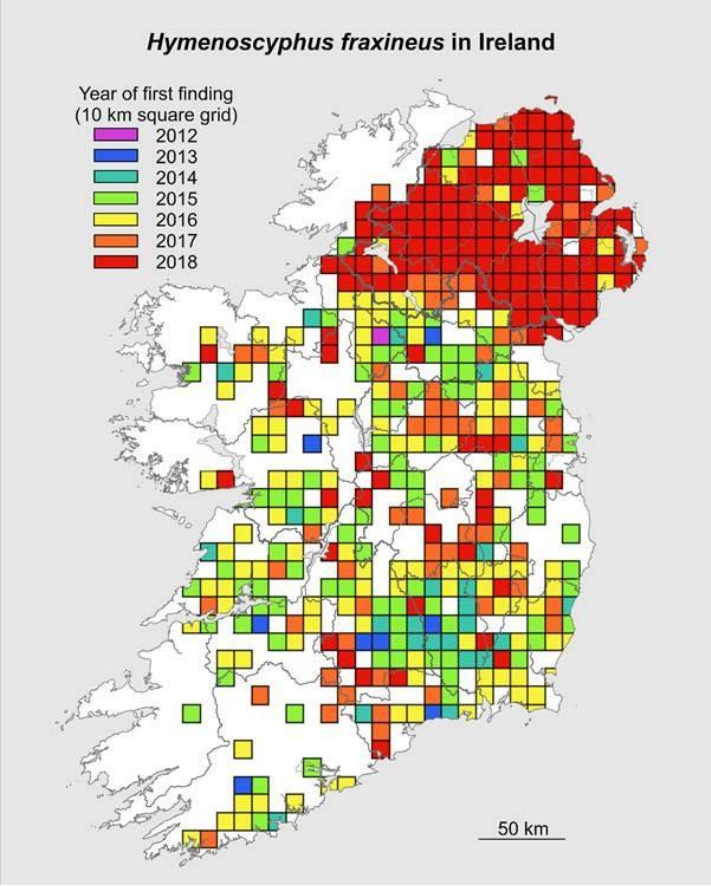
Invasive pathogen meets naïve host



2010s H. albidus H. fraxineus

Introduction

Ireland. 2012 to 2018



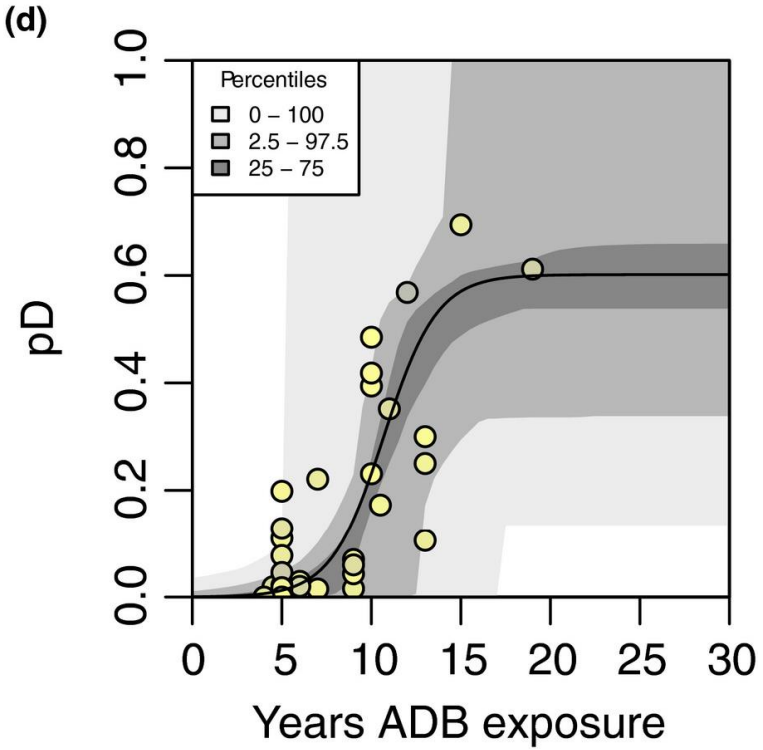
Invasion in 6 years

25.000 ha of ash threatened

Ash trees pose a threat where they stand

Huge impact on broadleaf forestry in Ireland

Introduction



- Modelling work shows that within 2 decades mortality reaches 60%
- Most ash trees die
- What happens with the rest?

$$wGOF = \frac{\text{model sum of squares}}{\text{total sum of squares}} = 1 - \frac{\text{residual sum of squares}}{\text{total sum of squares}} = 1 - \frac{\sum_i n_i \cdot \left(\hat{p}_{Di} - p_{Di}\right)^2}{\sum_i n_i \cdot \left(p_{Di} - \overline{p_D}\right)^2}$$

Coker *et al.* 2019

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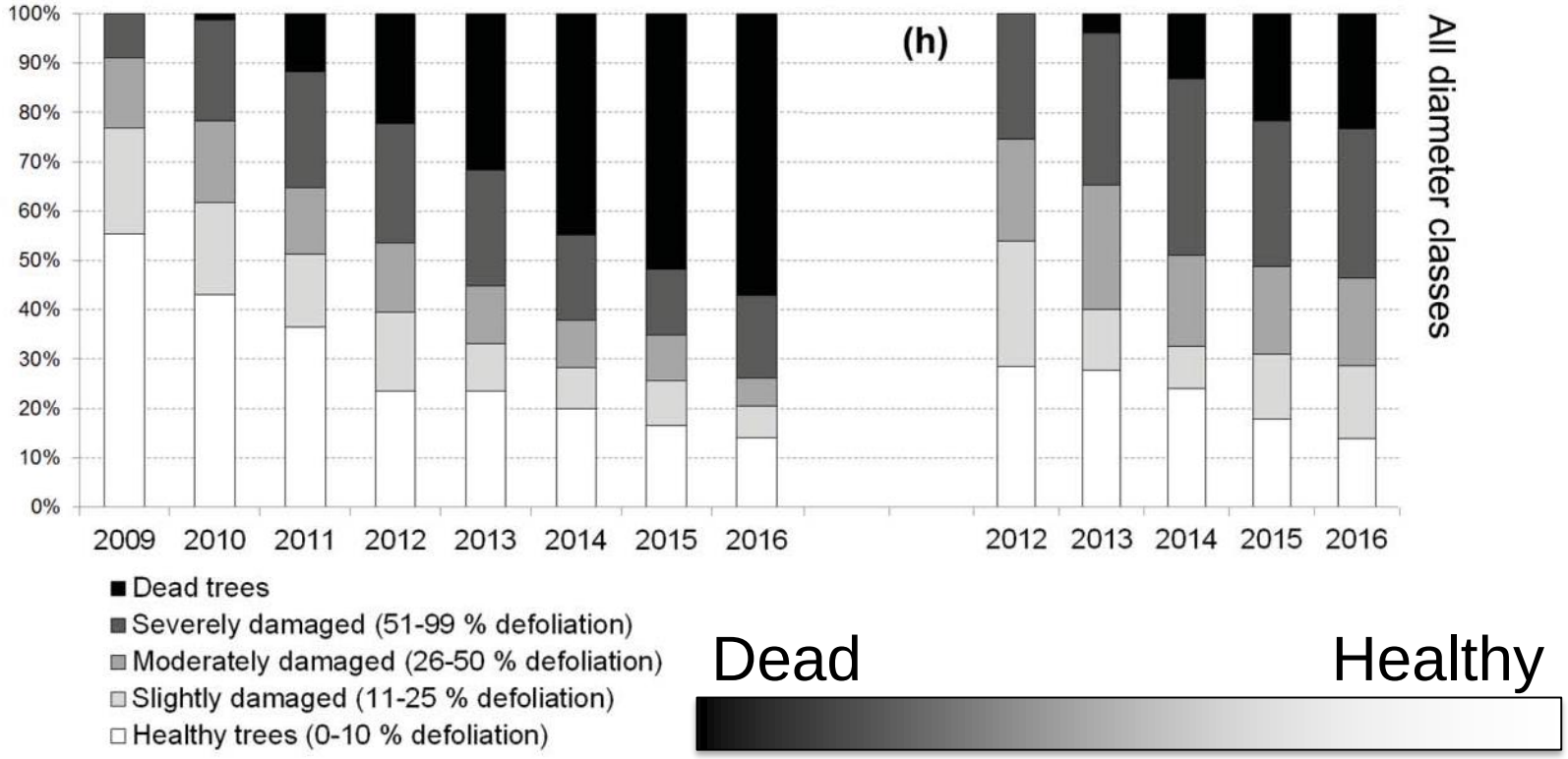
Introduction

- What happens to the trees that survive?

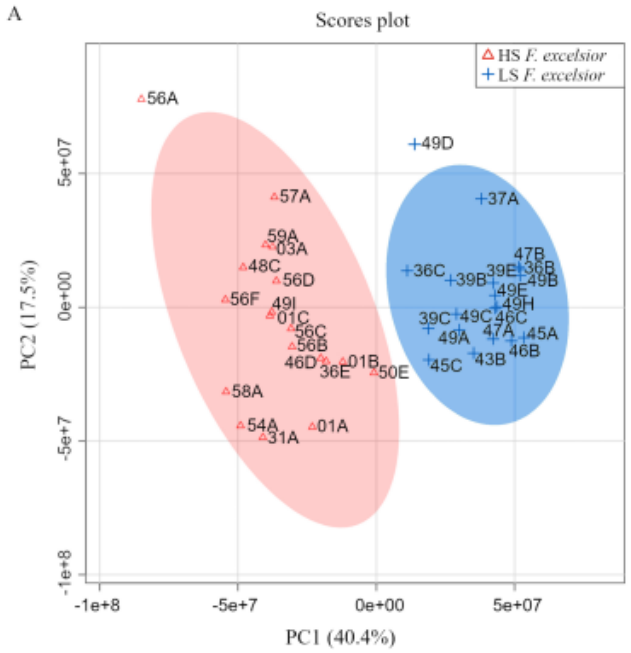


Timmermann *et al.* 2017

Study 1

- What makes an ash tree tolerant?

Metabolomics study; Comparison of all chemicals in two sets of tolerant and susceptible ash.



They are very different chemically

63 chemicals differ between tolerant and susceptible

29 higher in susceptible and 34 higher in tolerant

Nemesio-Gorriz *et al*. 2020

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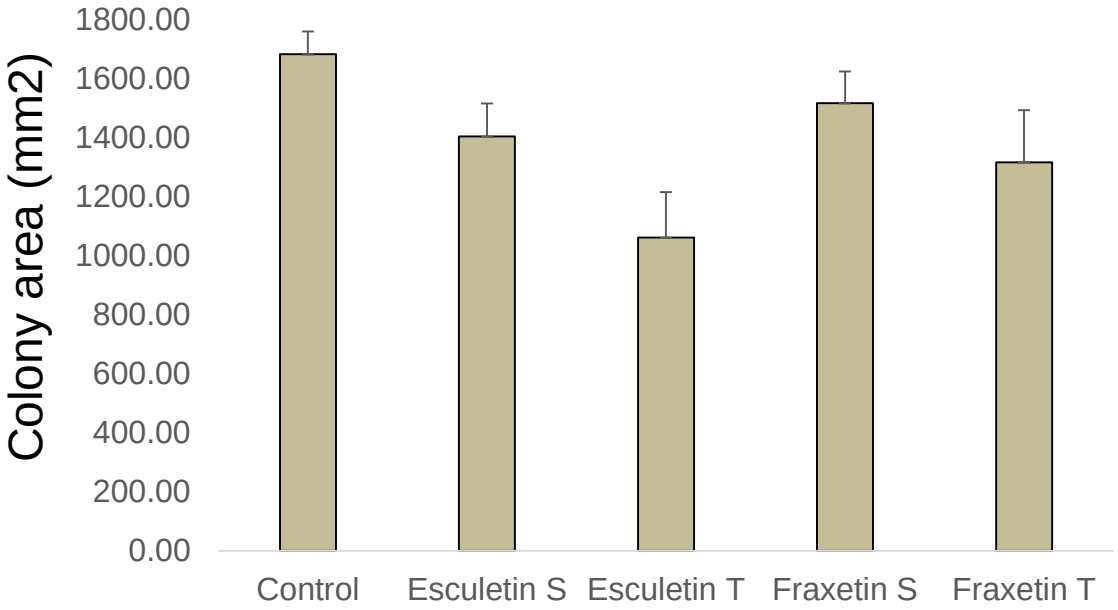
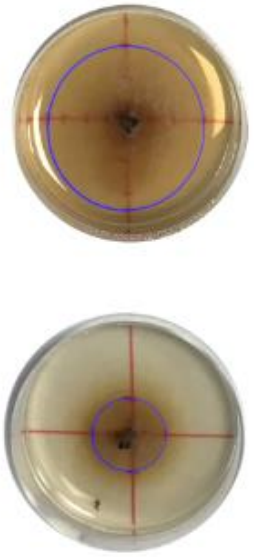
Study 1

- What makes an ash tree tolerant?

Two chemicals, fraxetin and esculetin, are highly abundant in ash and inhibit the growth of *H. fraxineus*





Nemesio-Gorriz *et al*. 2020

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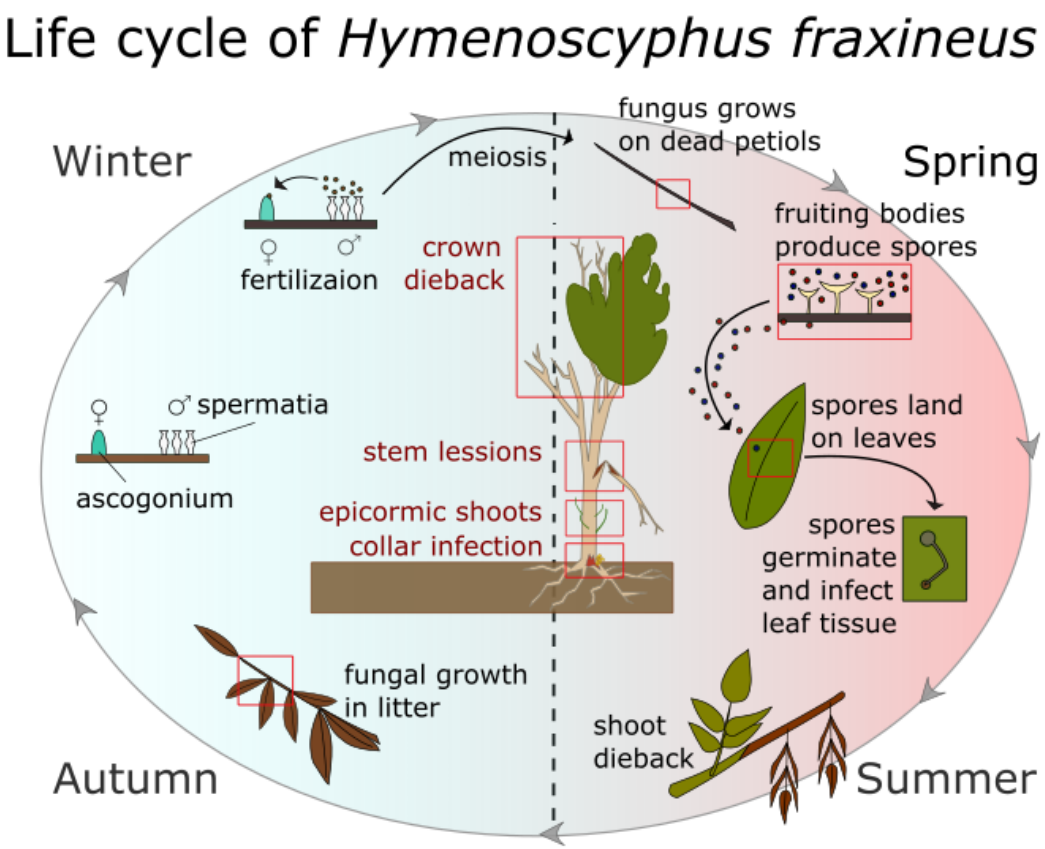
Study 2



H. Fraxineus infects ash trees through the leaves and progresses into the tree

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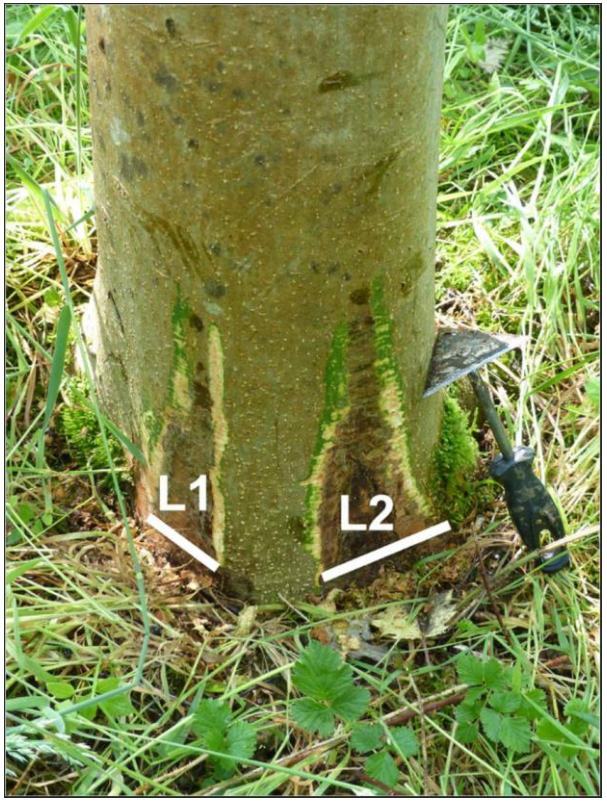
Study 2

Stem and collar infections on healthy trees have bee reported under conditions of high humidity and high disease pressure.

These infections can cause healthy trees to collapse

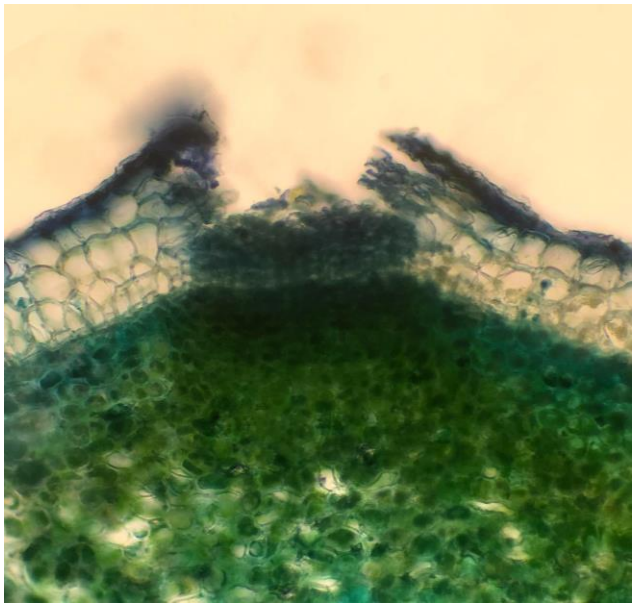
How do these infections happen?



Muñoz *et al.* 2016

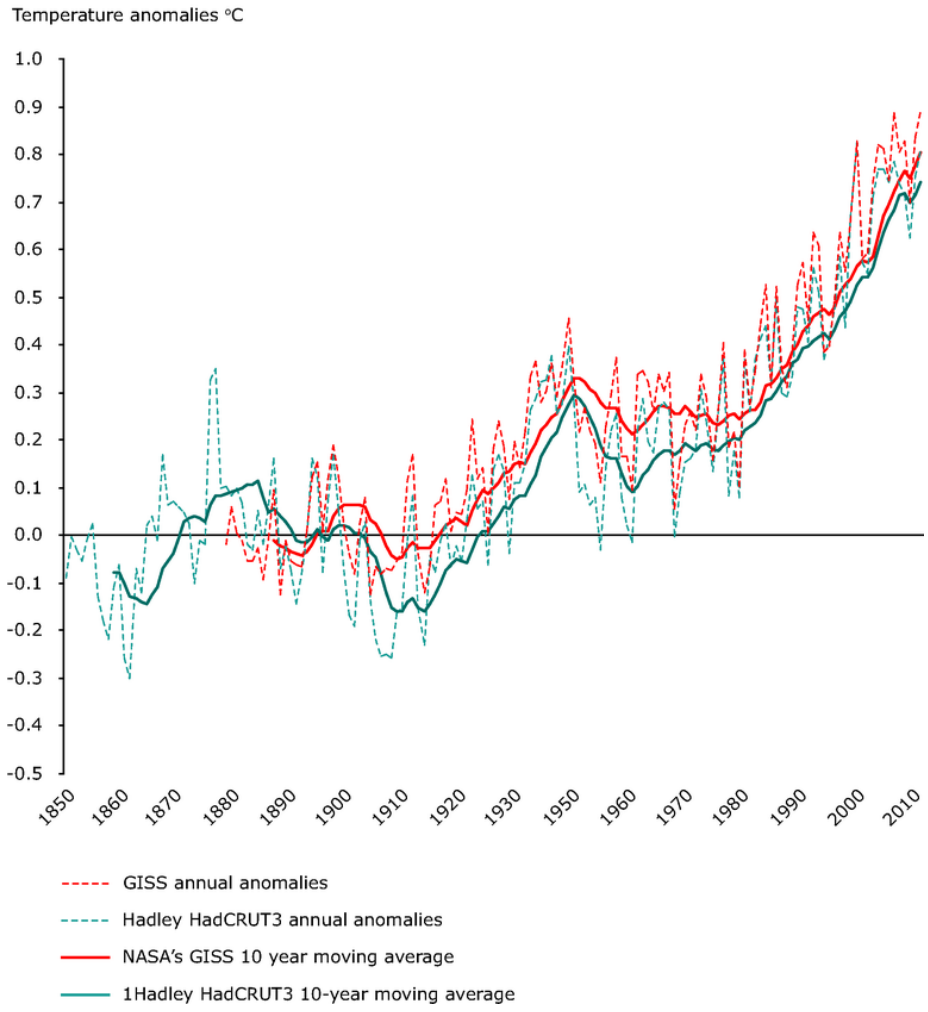
Study 2

Lenticels, small porous cell masses that allow gas exchange in woody plants, were found to be entry ways for *H. fraxineus* in ash.



Nemesio-Gorriz *et al*. 2019

Study 3



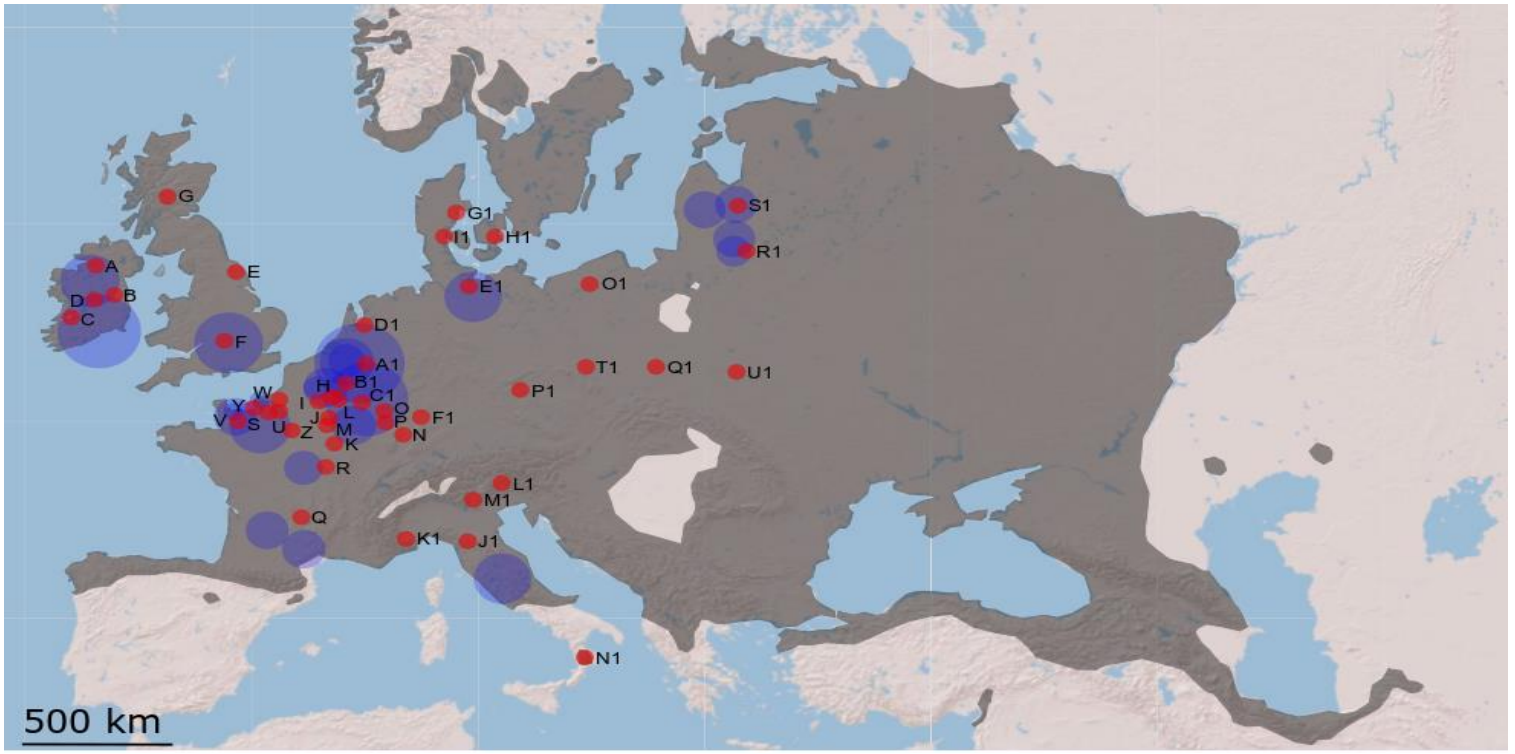
Trees are long-lived organisms. When they are born they are adapted to the climate in which their parents have lived.

Climate is changing faster than tree generations.

Is Irish ash well adapted to Ireland?

Study 3

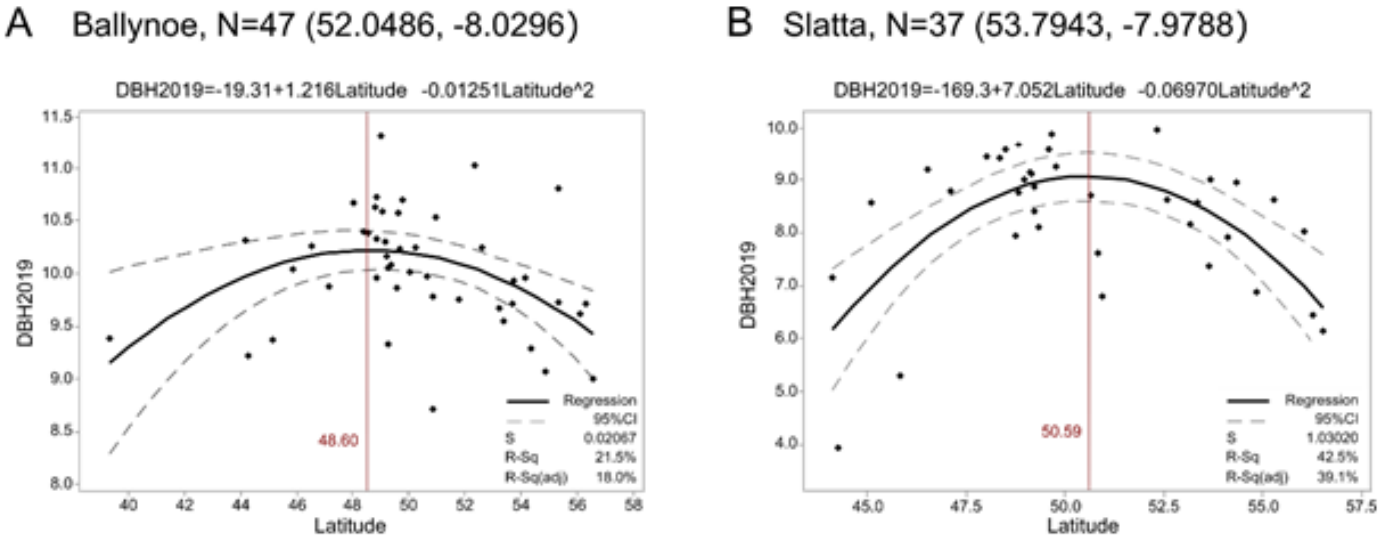
Growth after 15 years of 40-50 European provenances of ash in two trials in Co. Cork and Co. Roscommon.



Nemesio-Gorriz *et al.* in prep.

Study 3

Trees from provenances too north or too south will grow less (Frost damage, shorter growing season, etc.)



It is possible to estimate an “optimal latitude” for the site. In both cases, latitude associated with maximum growth was below the latitude of the trial sites (Mean value of 3.80).

Nemesio-Gorriz *et al.* in prep.

Study 3

- Are our forest genetic resources up to date in terms of climate adaptation?

- Climate will continue changing in the next decades when trees will be growing

- Breeding for resistance to ash dieback offers a chance for a new start with “optimally adapted material”

Thank you for your attention!