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POnTE Project findings and achievements

Ash dieback and *Hymenoscyphus fraxineus*

What is *Hymenoscyphus fraxineus*?

Hymenoscyphus fraxineus is a fungus responsible for the ash-dieback disease in Europe.
The disease affects trees of all ages. The young ones can be killed in one season and the older ones might succumb after several seasons of infection or can be attacked by other pathogens due to their weakened state. The main symptoms are leaf spots, shoot wilting, lesions in the bark that can completely girdle branches or stems, crown dieback and death of the infected tree. The dieback symptoms may be confused with those caused by other fungi or insects.

The fungus completes its life cycle on the ash leaves, producing little fruit bodies during the summer on the leaf debris of the previous year. Spores are produced and ready to infect other plants from June to September, although they can be released earlier and can last until October under favorable conditions.

The infectious spores of the *Hymenoscyphus fraxineus* can be wind-blown over long distances and the pathogen can spread through the movement of diseased ash plants. Movement of logs or unsawn wood from infected trees might also be a pathway for the disease, although this is considered to be low risk. The pathogen has also been detected on the ash seeds.

There are no effective treatments to protect trees against ash dieback. Once infected, trees cannot be cured; and not all trees die of the infection – some are likely to have genetic factors which give them tolerance of, or resistance to, the disease.

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Hymenoscyphus fraxineus **infects ash leaves**

Where does it come from?

The origin of the fungus is in Eastern Asia, where it lives with little or no harm to the local ash species. The organism was first detected in Europe (Poland) in 1992. Since then, it has colonized the continent ash woodlands, threatening populations of European ash (*Fraxinus excelsior*) and narrow-leaved ash (*F. angustifolia*). Ash dieback can affect forest-related economic activities and biodiversity as it could wipe the native ash population out of Europe and the organisms dependent on ash trees.

How is it established in Europe?

The fungus has been established in many European countries (such as Austria, the Czech Republic, Croatia, Denmark, France, Finland, Germany, Hungary, Latvia, Estonia, Romania and Kaliningrad, Lithuania, Montenegro, Norway, Serbia, Slovakia, Slovenia, Sweden, Switzerland, the Netherlands, the UK) , where it can have devastating effects. The main ash species affected are the common ash and the narrow-leaved ash. The South European flowering ash has been found to be less susceptible to the disease.

The number of infected plants is continuously increasing and today the fungus has been detected in nearly the whole UK territory threatening the native British ash as woodland, hedgerow and urban tree species. British experts consider that 80% of the estimated 80 million UK ashes could die because of the *Hymenoscyphus fraxineus* epidemic.
According to surveys carried out in the EU, mortality rates of ash-dieback in the woodlands

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Dead Ash trees because of the infection of *Hymenoscyphus fraxineus*

vary from 70% up to 80%.

Although the ash dieback was first observed in Europe in the mid-1990s, its specific cause was unknown until 2006. This lengthy time before the discovery of the causal connection between the fungus *Hymenoscyphus fraxineus* and the ash dieback is largely due to the fact that it was caused by a new species, taxonomic issues and confusion with another species, *Hymenoscyphus albidus*, a common fungus feeding on dead and decomposed organic matter. The latter is quite common in Europe – it grows on the dead leaves of ash trees and it is not pathogenic. This is why the appearance of the new disease was difficult to explain and establishing a clear connection between the disease and the fungus was even more arduous. Additionally, *H. albidus* and its deadly relative share similar habitats, are morphologically virtually identical and so they can be differentiated using genetic analysis.

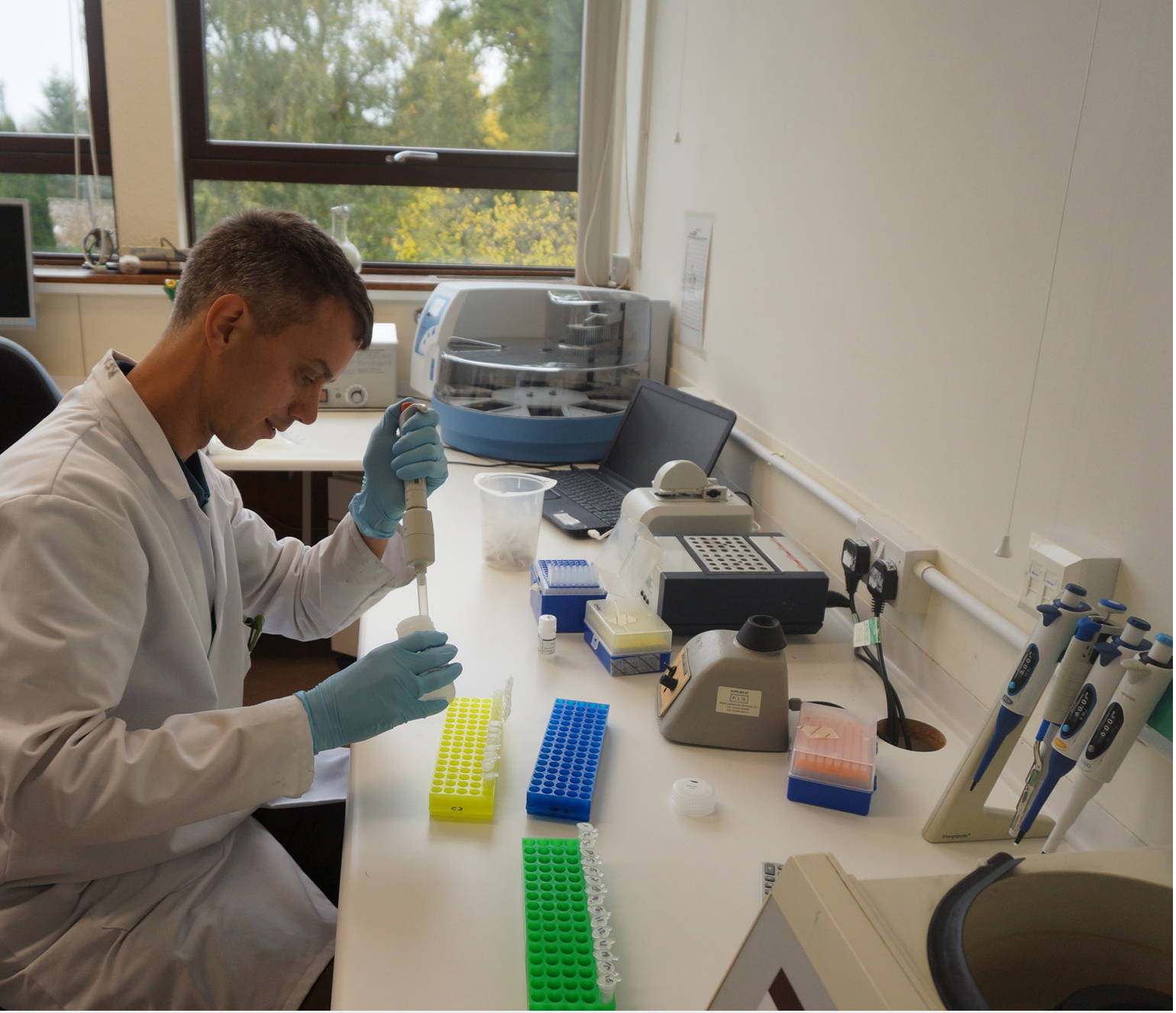
In 2006, the pathogen initially named as *Chalara fraxinea* was identified as the primary cause of the disease. The discovery pushed the European and Mediterranean Plant Protection Organization (EPPO) placing *C. fraxinea* on their Alert List in 2007. In 2011, the genetic analysis indicated that *C. fraxinea* was the asexual stage of a new species called *Hymenoscyphus pseudoalbidus*, so later on, it was renamed as *Hymenoscyphus fraxineus*.

The social impact

Ash dieback impacts people across Europe in various ways and is a challenge for public safety, productivity of commercial forestry, green spaces and human well-being, ecosystem services and carbon sequestration. The detection of the fungus in the British Isles in 2012 raised the political and media interest in an unprecedented way for a tree pest. Since then, the research on the ash dieback has been characterized by a multidisciplinary approach, involving biologists, landscape managers, ecologists, social scientists, tree geneticists and forest pathologists.

The POnTE Project

The 2015–2019 POnTE Project is one of the integrated reactions of European research to the emerging threat of invasive plant pests. Financed by the European Union Horizon 2020 program, the Project relies on the 'know thy enemy' principle, bringing together 25 partners from Europe and Latin America with expertise in plant sciences, agro-engineering and economics. The goal is the development of early detection and surveillance tools, state-of-the-art knowledge and practical solutions against the spread of *Hymenoscyphus fraxineus* and other emerging plant pests. The POnTE Project supported the intensification of research to find the most effective prevention, control, mitigation and management measures for these pests, covering phytosanitary as well as socio-economic dimensions.



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Scientists at work

POnTE and *Hymenoscyphus fraxineus*: main findings and results

1. ***Hymenoscyphus fraxineus* was detected for the first time in Serbia**, on the European ash and narrow-leaved ash. In addition, it was detected for the first time in **Montenegro and the Isle of Man**. The fungus was detected on a range of different *Fraxineus* species and non-*Fraxineus* hosts (*Phillyrea angustifolia, P. latifolia* and *Chionanthus virginicus*) with the first finding on *P. latifolia* made in East Sussex (England) in May 2018. A collection of about 100 isolates and DNA of *H. fraxineus* have been obtained from Austria, Norway, Serbia and UK for population studies. The use of spore traps allowed to determine the time of the year when the spores were released and to define the trend of spore density. The use of three different modelling techniques showed a good fit matching closely to the current known distribution of *H. fraxineus* being, therefore, appropriate to estimate the potential for its establishment in the European territory. The methodology of the EPPO protocol for the detection of *H. fraxineus* has been adapted for the detection of the fungus on ash seeds and in the next revision it can be included as a new matrix. A hot-water treatment has been tested as a control measure for *H. fraxineus* eradication in seeds.

Challenges

The studies showed that warm and dry continental climate was not a limitation for the spread and development of *H. fraxineus* in Serbia and other parts of the western Balkans, but further monitoring is necessary for the evaluation of the final impact of the pathogen.

Credits: ***Forest Research, UK***

Scientists assessing ash trees

2. Studies started on the **relationship between tree stability and visually detectable symptoms** caused by the fungus

Why is this important?

Ash dieback has recently been connected with a high-security risk, and reports of ash trees falling or being thrown have increased throughout all Europe. Consequently, forest owners started to cut trees to minimize the danger. When trees along roads, train lines or public accessed areas are affected, relying on a tested methodology to assess the stability of plants by visual inspection is an essential element for risk management and the implementation of safety measures, such as felling the trees at the right moment.

Challenges

The trials carried out under the POnTE Project show that inferring on the stability of ash trees is possible by combining the visual inspection of basal lesions caused by *H. fraxineus* and root rot caused by secondary pathogens.

3. A **hot-water treatment** has been tested as a control measure for *Hymenoscyphus fraxineus* eradication in seeds.

Why is this important?

The pathogen can spread by spores and through the movement of diseased ash plants, saplings and logs or unsawn wood from infected trees. Ash seeds can be naturally infected with *H. fraxineus*, although the effect of infection on germination is not known. This means that restrictions to the movement of plant material and seeds must be applied in the infected areas, causing major damage to trade and seed producers. Finding a way to eliminate the infection at the seed stage would be a relief for the sector. The hot-water treatment has proven to be effective for other pathogens, and researchers of the POnTE Project are exploring this possibility for *Hymenoscyphus fraxineus*.

Credits: ***Forest Research, UK***

Hot-water treatment on ash seeds

Challenges
The research for eradicating *Hymenoscyphus fraxineus* infection from *Fraxinus excelsior* seeds showed that hot-water treated ash seeds for 5 hrs at 44˚C generally survived and were able to germinate after the long warm: cold stratification required to break morpho-physiological dormancy.

4 . **Asymptomatic ash seedlings and trees** have been identified and will be vegetatively propagated in the search of tolerant trees, which could provide material for future breeding.

Why is this important?
The discovery of these traits of tolerance gives hope for restoring woodlands infested with the pest.

Challenges
The traits of tolerance are a promising area for research to control the spread of *Hymenoscyphus fraxineus*. The tests are time- and resource-consuming and provided mixed results, and the progress of asymptomatic trees must be monitored for a longer period. It is hoped that some of the trial sites can be retained for further 2 to 3 years so that the progress of these asymptomatic trees can be observed.

Credits: ***Forest Research, UK***

Scientists in ash dieback resistance trial

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