

Researching the tolerance to ash dieback of individual trees – an update

by **Steve Lee**, Forest Research

In 2012, ash dieback caused by the fungus *Hymenoscyphus fraxineus* (previously known as ‘Chalara’) was found on established woodland trees growing in eastern Britain. Government funding bodies quickly commissioned a number of research projects to investigate how the disease could be controlled and whether it might be possible to use tree breeding to ‘breed our way’ out of the problem.

Over the next nine months or so, Forest Research became involved in three different research projects:

- Mass screening trials of native ash for tolerance
- The Living Ash Project
- An investigation of the tolerance of different ash species to ash dieback.

Five years later, it is timely to give a brief update on the progress we have made in each of these pieces of work.

Mass screening trials

In 2013 we planted 155,000 common ash (*Fraxinus excelsior*) seedlings across south-east England to see if any showed tolerance to ash dieback. The trees came from a range of provenances across Britain, Ireland and the near-continent. All were sourced from tree nurseries located in the UK or Ireland. They were planted at 14 locations where the disease is known to be present and were monitored over the five years of the research project for signs of infection, tolerance and survival.

At the end of the second growing season, ash dieback had been confirmed at all 14 sites, and by the end of the third growing season infestations with *Hymenoscyphus fraxineus* fungus, had become more widespread at all sites, although around 50% of the trees were alive with no signs of infection. By the end of the fourth growing season, only 15% of all trees were alive and free of any sign of infection. The level of infestation was also much more varied with two sites showing high levels of trees with no sign of infection whilst other sites had barely any trees in this category.

The mass screening trials have now completed their fifth growing season and overall levels of tolerance (ie trees alive with no signs of ash dieback infection) are around just 1%. It would be wrong to extrapolate this figure from controlled field trials to mature trees growing in the wider environment since we don’t know yet what any juvenile:mature correlations might be. We do, however, know that young seedlings appear to be the more susceptible than older trees and certainly are quicker to die. In the

meantime, our findings demonstrate positive signs that we might be able to identify the most tolerant genotypes for further resistance breeding. There also appears to be some significant variation in tolerance depending on where the trees came from in Britain, with some ash sources from the south of Scotland appearing to be slightly more tolerant and those from southern England and Ireland much less so.

In late February 2018, there was a limited amount of grafting onto rootstock of trees showing tolerance to ash dieback but growing on sites that will no longer be accessible to Forest Research once this project comes to an end. A total of 1355 grafts were created from 575 trees. We expect these early selections along with many others currently being identified elsewhere in woodlands and hedgerows, will form the early core of a future resistance breeding programme.

The Living Ash Project

The specific objectives for the Living Ash Project are to establish new genetic trials of ash to investigate the variation and heritability of tolerance to infection with *Hymenoscyphus fraxineus* fungus and develop tissue culture techniques to enable us to rapidly produce large numbers of any tolerant trees identified, for use in future tree planting.

Seed was collected from mother trees in a seedling seed orchard established as part of the ash breeding programme run by Future Trees Trust. The trees which make up the orchard were derived from ash plus trees selected from all over the country for good stem form and superior growth rate well before the arrival of ash dieback. Seed was collected from over 50 mother trees in the seed orchard, raised in a nursery and in 2016, were planted out over three trials sites in the Midlands (at the National Forest near Ashby-de-la-Zouch) and south-east England (Kent and Hampshire).

The trees are currently in their third growing season. Towards the end of the 2018 growing season, but before the leaves fall, Forest Research technicians will assess the level of infection on a tree by tree basis. From these data we should for the first time in Britain, be able to estimate genetic variance components and so derive heritability estimates for tolerance of ash trees to *Hymenoscyphus fraxineus* fungus and so get an idea of whether ‘breeding our way’ out of this problem is a possibility. Data from the continent suggest relatively high heritability which means selecting tolerant trees in woodlands and trials such as in the mass screening trials, will



Mark Oram with an ash tree on a site in Kent at the start of its 6th growing season. No signs of ash dieback so far for this tree.



lead to a general increase in the number of tolerant trees in the landscape. We need to find out if this is also true in Britain. It is very early to make definitive decisions with three year data; trends may well change with age but this marks a starting point so that future progress can be measured.

Investigating the tolerance of different ash species to ash dieback

This project aims to investigate the variation in tolerance to *Hymenoscyphus fraxineus* fungus across different ash species. Those ash species which co-evolved with the pathogen will likely be more tolerant even when grown in the presence of the disease here in Britain. We aim to find out which the tolerant species are such that if necessary in the future,

hybrid crosses might be carried out with the native *Fraxinus excelsior* to induce tolerance. This would be similar to how the Americans have been dealing with chestnut blight by crossing their native chestnut with a tolerant Asian species, and then back-crossing to the American. This is very much seen as 'Plan B' in Britain. The ideal is to select and breed native tolerant stock for tree planting, but in case that proves too difficult it seems wise to develop a second line of defence.

To conduct this research, Forest Research contacted all the main arboreta in Britain and was amazed to discover there were nearly thirty different non-native ash species growing. We had tremendous co-operation with arboreta as we requested

Top: **A very fast growing ash tree free of *Hymenoscyphus fraxineus* infection after 2-growing seasons in progeny trials near Ashby-de-la-Zouch**

Above: **Gustavo Lopez (new Head of Tree Breeding at Forest Research) with a fast growing tree free of ash dieback disease in a progeny trial site in Kent**

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>> scion material (shoots) of at least three different trees representing as many different ash species as possible. The scions were grafted onto native ash rootstock for later planting out into the field at three sites in southern England. Grafting took place over a three year period due to graft incompatibility problems between the species. Data on their tolerance will be gathered in 2018 and in subsequent years.

Looking to the future

Over the last five years, good work has been carried out to establish field trials designed to find trees tolerant to ash dieback disease, and also determine the likely success of any future resistance breeding programme. Elsewhere screening of exotic ash will help identify which species we might want to consider in a future hybridisation resistance breeding programme if that becomes a necessity. Scientists from the Living Ash Project are already busy selecting trees worthy of a new resistance breeding programme. These trees will be planted in a special archive where future breeding work can be carried out, or shoots made available for the establishment of new seed orchards. It is all going to take a decade or two yet, but the objective is to carry out the breeding work necessary to keep ash ecosystems as an important component in the British landscape and ash as a timber species.



Gustavo Lopez looking at a grafted copy of *Fraxinus pennsylvanica* on a *F excelsior* rootstock at Alice Holt

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