



Phytophthora ramorum, report

In 2017, the first case of *Phytophthora ramorum* in a natural environment on larch trees was identified in Brittany. Read on to find out more about the disease and how outbreaks are managed.

The situation before the disease was discovered in French forests

Phytophthora ramorum is an oomycete plant pathogen that probably originated in Asia and was observed in North America and Europe. In the United States, it causes **Sudden Oak Death (SOD)** and has killed tens of thousands of Fagaceae species, especially California live oaks (namely *Quercus Agrifolia*) due to bleeding cankers on trunks and branches.



SOD: symptoms on oak trees (USA)

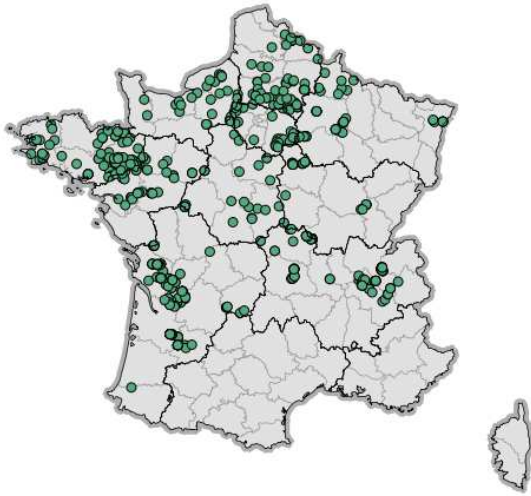
The pathogen can kill trees after a few months to several years. **In Europe, prior to 2010, it attacked rhododendrons and viburnums** (spots on leaves and withering without causing plant death), becoming a source of inoculum for spore production.



Symptoms on rhododendron leaves (foliar host)

The **list of species affected by *P. ramorum* is quite long** (around 150 sensitive species) and changes constantly, but native European oaks appear to not be sensitive to it. In Europe, the pathogen was first reported in Germany and the Netherlands (1993), then in France in 2002. After the pathogen was identified in Oregon in 2001, sampling as organized in Europe. In France, samples taken by the Regional Directorates for Food, Agriculture and Forestry (DRAAFs) found *P. ramorum* at nearly 30% of ornamental nurseries at that time. On adult trees, only 10 trees were found to be infected in the United Kingdom (2003) in outdoor areas and just one in the Netherlands. The pathogen was found on oak, beech, chestnut and European horse chestnut trees in forests with numerous infected rhododendrons. The strong local inoculum pressure allowed the spores to colonise the woody plants. Emergency measures were taken to fight its spread across the European Union by community decision (2002, later reinforced by a 2007 decision) and an **annual monitoring plan** was rolled out in France. This plan applies to nurseries/garden centres and public green spaces (monitored by the regional food departments, SRALs) as well as forests (monitored by the Department of Forest Health, DSF). DSF consultants/observers (COs) take action in tree stands most at risk, i.e., those with a rhododendrons in the understory and around nurseries or resellers of sensitive plants. Checks are carried out in the most sensitive regions:

those with a favourable climate (high rainfall and frequent fog), which is found mainly in Brittany and the Loire Valley.



Locations of checks carried out from 2007 to 2017 by the DSF as part of the national annual monitoring plan

Until 2009, the only cases in forests were found in California and Oregon, and SOD was seen only in American native species, which are virtually non-existent in Europe. The disease appeared to pose no danger, save new developments, to European forests. *P. ramorum* has since been found on Japanese larch trees in England, in 2010 (in Cornwall).



Larch tree dieback in England

This was the first time the pathogen was detected on softwood trees, and larch was not previously on the list of identified affected species. The significant shift in the pathogen's behaviour and the change in how it spread showed that *P. ramorum* has an unpredictable pathogenicity. This finding is a new, considerable risk for France because larch grows in the country. Moreover, this species is a good foliar and terminal host. Foliar hosts do not die but spread the disease (like laurels in the United States or rhododendrons in Europe) while terminal hosts are killed

once infected. Japanese larch plays the role of both host types and therefore has a strong epidemic potential by extensively spreading *Phytophthora* and by causing the death of affected trees. Even worse, in the case of larch, spore production may be up to five times greater than on rhododendrons. Since 2010, DSF COs have increased their monitoring efforts of larch trees in Brittany and Normandy. The same year, Wales, Scotland and Ireland showed the first signs of infection. Between 2010 and 2017, 20,000 ha of damaged forests were recorded in the United Kingdom (tree deaths within one to two years). In 2017, England reported increasing losses in chestnut trees, but this new observation needs to be further studied.



Stand of larch trees in England in May 2012 (a) and May 2013 (b)

Leading outbreak in France

In 2015, COs in Brittany identified symptoms in a stand of larch trees in the Forêt domaniale de Saint-Cadou forest, in Sizun in western Brittany. The stand has since been thoroughly monitored by local COs. In May 2017, a new sample was sent for analysis to the French Agency for Food, Environmental and Occupational Health & Safety (ANSES). It proved to be *P. ramorum*.



Dieback of treetops in Sizun (October 2017)

Once infected, the needles on larch trees turn red, wilt and are unusually small. Dying branches are seen in the crowns, and certain larches show dieback in the treetops. Annual monitoring is carried out on ground plots by the local CO (L. Roche, National Forests Office [ONF]).



Symptoms on needles in Sizun

Bleeding cankers were also observed in the upper crown.



Bleeding canker on a tree trunk, England

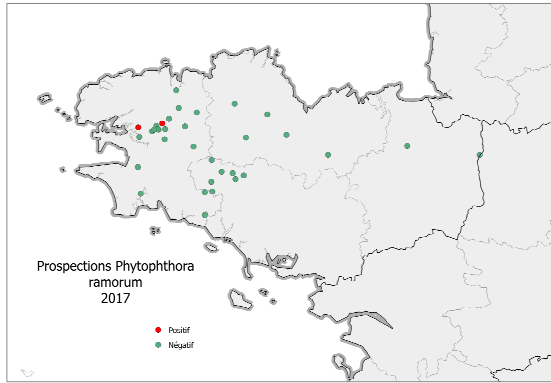
P. ramorum was classified as a category I health risk in France by ministerial decree in 2014, which implies active outbreak management.

In the Saint-Cadou forest, spruce trees (a sensitive species) in adjacent plots were harvested and larch trees are scheduled to be felled. Because autumn is not the ideal season to work the site (wet ground could be considerably compacted), **felling operations were planned for spring 2018**, which would also allow time to find a market for felled trees, such as Breton wood pellet mills. The wood to be harvested totals about 3,700 cubic metres, or enough to fill about 100 log trucks.

To support the DRAAF/SRAL in managing the outbreak, instructions specific to Sizun were drawn up by the SDQSPV (Plant Health Newsletter [BSV]/Department of Forest Health [DSF]/Specialized Contact) based on existing documents from the ANSES and the European and Mediterranean Plant Protection Organization (EPPO), and a national decree is currently being drafted. Additionally, the Nord-Ouest Forest Health Division sent forest managers and owners a memorandum about the outbreak the month it was discovered, which was disseminated nationally and published on the Ministry's website.

Monitoring to better understand the outbreak

In May 2017, the Nord-Ouest Forest Health Division carried out **a situational analysis on larch tree stands in Brittany** using maps from the French National Institute of Geographic and Forest Information (IGN). All Breton COs assessed the 35 stands between May and July. A total of 13 samples were sent to ANSES for analysis, and two came back positive (using the official MOA 018 test method, detection by PCR).



Assessments of larch tree stands

A second outbreak was discovered in Hanvec. This outbreak was treated in winter 2017 (450 cubic metres felled and sent to Breton pellet mills and bark incinerated).

ANSES conducted a more in-depth analysis of the pathogen strains. Molecular studies showed that known *P. ramorum* populations around the world fall into four distinct variants or clones: NA1 and NA2, found in North America, EU1 found in Europe and occasionally in North American nurseries, and EU 2, identified in 2012 in the United Kingdom. The EU1 and EU2 clones are associated with larch losses observed since 2009 in the British Isles. According to various British studies, the EU2 clone appears to be more aggressive than EU1 on larch trees. The strain found in Sizun is EU1.

The DSF repeated its assessments in 2018 in other regions with strong pathogenic potential (especially in Limousin, where the hybrid larch is the second leading species used for reforestation, after Douglas fir).

The aim of assessment is to document the level of prevalence of *Phytophthora* across the country to better determine corrective actions.

An enhanced technique to isolate the pathogen

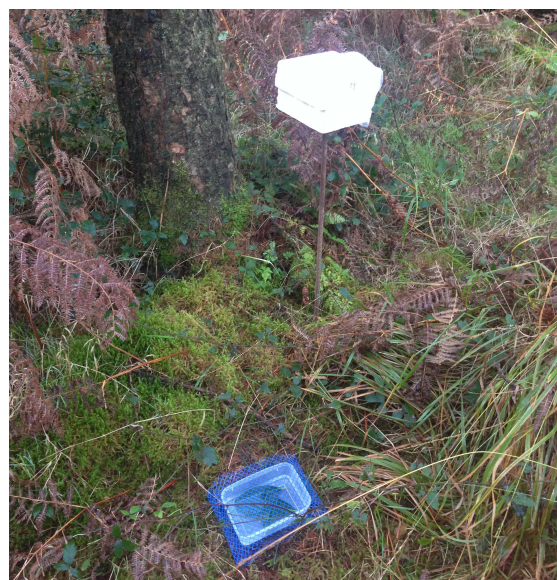
In October 2017, the Nord-Ouest Forest Health Division, the SDQSPV, the COs, INRA and the SRAL worked together to test two experimental techniques to capture spores for early detection and help inform management decisions.



Capture test sites

The test sites were set up in six tree stands in the Finistère and Côtes d’Armor regions (two infected stands, two symptomatic stands, one unaffected stand and one stand with symptomatic chestnut trees).

Two traps – a “physical” trap and a “biological” trap – were tested: the physical trap consisted of a filter paper placed horizontally one metre above the ground. The presence of the pathogen was analysed using PCR. The biological trap was made of very sensitive rhododendron leaves floating in a container of water. The spores falling in the water contaminated the leaves and caused necrosis. This technique made it possible to grow *Phytophthora* in the lab and determine the specific clones.



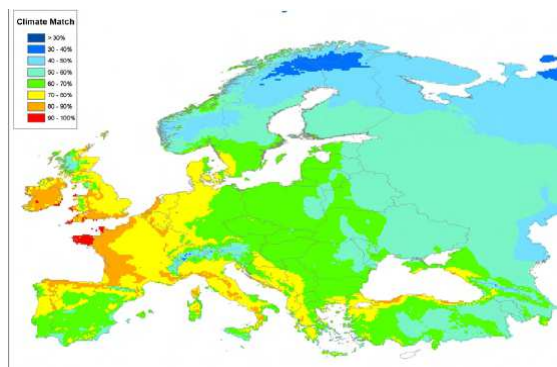
Biological and physical tests set up in Brittany

The tests showed a significant presence of *P. ramorum* at the Sizun plot and an absence of spores at the other sites. The fallen needles also appeared to show a large quantity of spores and could be

useful in the early detection process (samples from an asymptomatic plot in Sizun tested positive). The results demonstrate that high inoculum areas that could be a source of major future losses, such as the situation in England, would be limited. Felling of infected trees in Sizun and Hanvec would eliminate the high risk these areas for pose for other larch tree stands. Risk is further reduced by the scattered distribution of larch stands in Brittany and their small surface area.

There are three ways to detect *P. ramorum* on larch trees in the lab: (1) using necrosis on wood (difficult to sample and tedious in the lab), (2) bundles of needles with necrosis on branches (requires felled trees) and (3) needles sampled from leaf litter. This last new method is a significant advance that makes monitoring more effective and faster.

The DSF drew up a **monitoring protocol for 2018** using fallen needles gathered in Brittany and other high risk regions: Hauts-de-France, Normandy, Corrèze, Creuse, Haute-Vienne, Vienne, Charente, Dordogne, Pyrénées-Atlantiques as well as the seed orchard in the Lot and several points in Ariège, Haute-Garonne and Hautes-Pyrénées.



Areas with favourable climatic conditions for *P. ramorum* according to the European Food Safety Authority (EFSA)

At each site checked, needles will be gathered from the ground regardless of the season. While *P. ramorum* sporulates more in the autumn/winter on needles, it can be detected year round on fallen needles (they remain on needles for about three years).

The DSF and BSV strive to stay abreast of new advances in research that could support monitoring efforts. A request was made to ANSES to evaluate the sensitivity of various hosts. A project will also be launched with INRA to work on multiple issues that have been raised: refining detection methods, investigating potential wild reservoirs, better defining at-risk zones, etc.



Larch tree stand in Sizun (October 2017)

Regulatory status: A harmful organism unregulated by Directive 2000/29 (on protective measures against the introduction into and spread within the Community of organisms harmful to plants) but considered a serious risk for the Community according to a Pest Risk Analysis and as such emergency measures were taken in 2002 (Commission Decision 2002/757/EC). A French national monitoring plan followed (DGAL/SDQP/N2008-8082). In 2014, *P. ramorum* was classified as a category I health risk in line with the French decree of 15 December 2014 (on the list of category I and II health risks for plants). *P. ramorum* is on the EPPO Alert List. Required eradication measures are taken by prefectural decree.



Sizun, may 2018