The Food & Environment Research Agency

Rapid Pest Risk Analysis (PRA) for

Xanthomonas arboricola pathovar *corylina.*

STAGE 1: INITIATION

1. What is the name of the pest?
Xanthomonas arboricola pv.*corylina* (Xac). This pathogen is the causal agent of bacterial blight of hazelnut (also known as hazelnut blight, bactériose du noisetier and bakterienbrand: haselnuss). Xac was first identified as *X. campestris* pv. *corylina* (Miller et al., 1940) and was subsequently assigned to *X. arboricola* based on comparative genetic analysis (Vauterin et al.,1995).

2. What initiated this rapid PRA?
The need for a rapid PRA was identified during the assessment of Xac for inclusion in the UK Plant Health Risk Register in order to help inform the decision on whether statutory action against future interceptions is justified.

3. What is the PRA area?
The PRA area is the United Kingdom of Great Britain and Northern Ireland.

STAGE 2: RISK ASSESSMENT

4. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?
Xac is not listed in the EC Plant Health Directive but is recommended for regulation by EPPO as an A2 listed organism. However, the pathogen is regulated by the EU as a quality pest for *Corylus avellana* only under the EU Fruit Marketing Directives, under 93/48/EC requiring visual "substantial freedom" in propagating material and fruit plants.

5. What is the pest's current geographical distribution?

Table : Distribution of Xac	
North America:	Canada, USA
Central America:	
South America:	Chile
Europe:	Croatia, France, Germany (transient), Italy, Macedonia, Netherlands, Poland, Russia, Slovenia, Spain, Turkey, UK
Africa:	
Asia:	Iran
Oceania:	Australia, New Zealand

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF
[2] https://www.eppo.int/QUARANTINE/quarantine.htm

6. Is the pest established or transient, or suspected to be established/transient in the UK/PRA Area? *(Include summary information on interceptions and outbreaks here).*

In the UK, only a single outbreak of hazelnut blight has been reported. Xac was isolated from symptomatic trees in a plantation comprising of cobnut, filbert (*Corylus maxima*) and some hedgerow *C. avellana* at Chard, (Somerset) in 1976 (Locke and Barnes, 1979). The report mentions that the plantation comprised of young trees (1-5 years-old) and that the disease was also found in a hazelnut hedge downwind of the plantation. A small follow up survey including nurseries and plantations producing plants, cobnut and coppice in parts of Hampshire and the south west of England was completed during 1976 and 1977. Hazelnut blight was not found on any other hedgerow hazel, but Xac was isolated from leaves of 60 year-old trees at Cranborne (Dorset); from a large hazel coppice near Shaftesbury, (Dorset) and from cobnut stock at nurseries near Crewkerne (Somerset) and Petersfield (Hampshire). There have been no further surveys of hazelnut blight since the 1976 outbreak and so it is not possible to know if the Xac is still present in the UK. A small area was entered under the PHPS for a few years and received annual visual inspections, but none was found.

Xac is not required to be reported to the Plant Health Service unless at 'high levels' in propagating material and consequently there is no information available as to the presence of the pathogen from the PHSI inspections. However, the absence of any further disease findings from commercial sources or published records over the long period since the 1976 outbreak suggests that either the pathogen is no longer present or is not causing significant disease in propagating material that is subject to inspection.

7. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK/PRA area?
Corylus avellana (hazelnut) is the primary host. Two ornamental *Corylus* species are grown in UK parks and gardens are also susceptible: *C. colurna* (Turkish hazel) and *C. maxima* (filbert). The purple form of filbert is very commonly grown in UK gardens. Hazelnut is a major component of UK woodland (predominantly as an under-storey tree) and hedgerows, which contributes significantly to the rural landscape and so hazelnut has an important social value. As a native tree the leaves and nuts are an important wildlife food source and consequently hazel has a major environmental value. Hazelnut is also grown for coppice and in amenity plantings additionally. There are also some orchards for nut production though acreage had reduced to 250 acres by 1990 (Kentish Cobnuts Association- http://kentishcobnutsassociation.org.uk/the-cobnut/technical-information/). Together these uses produce a demand for hazel trees for planting and their production has a significant economic value.

8. What pathways provide opportunities for the pest to enter and transfer to a suitable host and what is the likelihood of entering the UK/PRA area? (*By pathway*):

Pathway 1. Imported hazel plants for planting. The import of hazel plants for planting is covered by the 1993 EU Marketing Directive 93/48/EC that requires imported plants to have been inspected and found 'substantially free of symptoms' (see section 16). Whilst this reduces entry risks, Xac can produce asymptomatic infections that can be difficult to detect, which increases risks and introduces uncertainty. There is additional uncertainty because the scale of imported hazel plants for planting from affected regions of Europe is unknown. Together these factors make it difficult to assess entry risks and consequently a low confidence score is attributed to the entry score.

Pathway 2. Imported hazel nuts. Immature green hazel nuts can be infected superficially with Xac (Lamichhane and Varvaro, 2014) and nuts planted from Xac infected plants can produce infected seedlings (EPPO, 1986). However, since imported hazel nuts are not planted, this pathway is scored as unlikely with a high degree of confidence.

Pathway 1	Very unlikely	☐	Unlikely	☐	Moderately likely	☑	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

Pathway 2	Very unlikely	☐	Unlikely	☑	Moderately likely	☐	Likely	☐	Very likely ☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			

9. How likely is the pest to establish outdoors or under protection in the UK/PRA area? (*The likelihood rating should be based on the area of potential establishment, e.g. where hosts are present and the climate is suitable, within the UK/PRA area)*

Xac can survive in fallen leaves and soil only a few months and the pathogen overwinters in cankered trees (EPPO, 1986). The 1976 outbreak of Xac (Locke and Barnes, 1979) demonstrates that the pathogen can establish in southern England. However, 1976 was an extremely hot summer (Met Office data, 2012) and it is possible that Xac establishment around this period was exceptional and associated with the very hot conditions over this period.

There is evidence for a climatic limitation to the establishment of Xac in the UK. Most extensive and serious hazelnut blight outbreaks have been reported from countries that have a warmer climate or have hotter summers than the UK. For example, serious hazelnut outbreaks have been reported in central Italy, southwest France, Iran and Poland (Lamichhane et al., (2012), Luisetti et al., (1975) Kazempour et al., (2006) and Pulawska et al., (2010). In Italy, where hazelnut blight is endemic (Scortichini and Rossi, 1991) Xac is more frequently found in central and southern Italy than in Piedmont district in the north of Italy (M. Scortichini, Pers. Comm). EPPO PQR data suggests that Xac is not endemic and in Holland where the status of the pathogen is described as 'present few occurrences'; in Germany Xac is considered 'transitory under eradication' whilst in Denmark the pathogen is considered to be 'no longer present'. The absence of reported hazelnut blight in the UK in recent decades, and the limited occurrence in more northerly countries, suggests that the relative cooler climate, compared to southern and central Europe, limits Xac establishment.

Without survey data it is not possible to confirm if Xac has died out in the UK over the long period since the 1976 outbreak. The wide distribution of Xac found in the survey done immediately after the UK outbreak, demonstrates that the pathogen was present over an extensive range of south west England and Hampshire, which suggests that disease may have been present over a substantial time period. However, it is possible that in the UK periods of exceptionally hot weather are required for significant symptoms of hazelnut blight to develop. The low confidence score attributed to the establishment 'outdoors' score reflects considerable uncertainty associated with the degree to which UK climatic conditions may limit establishment and the fact that no significant surveys after the 1976 outbreak have been undertaken to provide evidence for continued establishment. However, considering the experience of hazelnut blight in northern European countries, where the disease has not persisted, it is most likely that establishment risks would not be higher than moderately likely.

Under protection the warmer temperatures may be more conducive to disease establishment however, hazel is generally grown outdoors and establishment under protection is scored as unlikely.

Outdoors	Very unlikely	☐	Unlikely	☐	Moderately likely	☑	Likely	☐	Very likely ☐
Confidence	High Confidence	☐	Medium Confidence	☐	Low Confidence	☑			

Under Protection	Very unlikely	☐	Unlikely	☑	Moderately likely	☑	Likely	☐	Very likely	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

10. If the pest needs a vector, is it present in the UK/PRA area?
Xac is not vectored.

11. How quickly could the pest spread in the UK/PRA area?
Natural spread of Xac is mediated through water splash and wind driven rain (EPPO, 1986). Hazelnut blight is mostly found and is most damaging in cultivated hazel where production systems introduce vulnerabilities to the trees. The layering of hazelnut stems for propagation from an infected mother plant is an efficient means of disease transmission and pruning tools can also provide a means for local spread of Xac infection (EPPO, 1986). These transmission routes spread hazelnut blight slowly over short distances

Trade of infected nursery stock will spread the disease very efficiently. The potential for asymptomatic infection exacerbates the potential for Xac transmission in propagation material because the disease could be spread before a disease problem is discovered.

Natural Spread	Very slowly	☐	Slowly	☑	Moderate pace	☐	Quickly	☐	Very quickly	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				
With trade	Very slowly	☐	Slowly	☐	Moderate pace	☐	Quickly	☐	Very quickly	☑
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

12. What is the pest's economic, environmental and social impact within its existing distribution?

Economic Impacts. Xac infections produce leaf blights, bud necrosis, stem infections (including cankers and bleeds). Stem necrosis can girdle branches leading to death of the branch or tree, which occurs especially in young trees 1-4 years old (EPPO data sheet, 1986). Mortality in trees grown in Oregon (USA) of up to 10% has been reported (Miller et al., 1949). The same study also refers to complete loss of trees in one 2-ha area of 4-year-old plants that were completely killed by girdling of the base of the trees and also documents cobnut yield losses of between 1 and 10%. Infections are most extensive in cultivated hazelnut where management and propagation practices that involve cutting or layering make the trees vulnerable to infection.

In their review of *X. arboricola* disease of hazelnut, Lamichhane and Varvaro (2014) identified several severe outbreaks in recent years from Serbia, central Italy and Chile. The outbreak of hazelnut blight in central Italy (Lamichhane et al., 2012) reports infection of up to 80% of trees (up to 4 years of age) and documents that by late summer leaf blight and twig diebacks had advanced so that branches became girdled and died. In Italy, where the disease is endemic, Xac has been found in wild hazelnut, which may provide an environmental reservoir of infection (Scortichini and Rossi, 1991) that could exacerbate disease incidence in managed hazel. Hazelnut blight incidence of between 60-90% was reported for the outbreak in Chile (Lamichhane et al., 2012). Here, propagation from infected suckers taken from asymptomatically infected mother plants may have contributed to disease dissemination first in nurseries and then in fields.

In recent years there have been increasing reports of Xac occurrence that have been reviewed by Lamichhane et al., (2014). The review lists first disease reports from Denmark, Slovenia and Spain (between 2003 and 2004); Iran, Germany, Sardinia and Sicily (between

2004 and 2006); and Poland (2007-9). However, it is not clear if the increase in recent reports reflects an increase in hazelnut blight incidence or is due to greater reporting.

Periods of drought have also been shown to predispose hazel to Xac blight (Moore et al, 1974), though a recent study in Italy found a strong positive correlation between disease incidence and rainfall, as well as soil nitrogen and 'thermal shock' (associated with frost) that was determined as the difference between maximum and minimal daily temperatures (Lamichhane et al., 2013).

Economic impacts outside the UK are scored as large reflecting the importance of hazelnut production in some warmer countries. There is medium confidence associated with the economic impacts reflecting the range of disease severity found in individual outbreaks and the value of crop losses.

Environmental and Social Impacts. Although wild hazelnut trees can be infected with Xac, there have been no reports of impacts that constitute a significant environmental threat and impacts are scored as small. Experience of hazelnut blight in Europe over many years justifies a high confidence score.

There have been no reports of significant social impacts arising from the hazelnut blight, which are scored as small with a high degree of confidence.

Economic Impacts

Impacts	Very small	☐	Small	☐	Medium	☐	Large	☑	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

Environmental Impacts

Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐				

Social Impacts

Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large	☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐				

13. What is the pest's potential to cause economic, environmental and social impacts in the UK/PRA area?

UK Economic Impacts. Unfavourable climatic conditions have most likely limited the potential for Xac to establish and cause disease in the UK. The absence of reports of hazelnut blight after the 1976 outbreak (Locke and Barnes, 1979), suggests that future economic impacts from hazelnut blight will be limited, which justifies the small economic impact score. However, some tree deaths were reported in the UK in 1976 and the disease can spread rapidly in production systems and it is possible that impacts could be significant to some growers in certain circumstances, for example if a production system become heavily infected. However, good standards of propagation and phytosanitary practice should minimise these risks (see section 16). A medium confidence score has been used to reflect uncertainty in economic impacts.

UK Environmental and Social Impacts. Although wild hazelnut trees can be infected with Xap, there have been no reports of impacts that constitute a significant environmental threat

and impacts are scored as small. Experience of hazelnut blight in Europe over many years justifies a high confidence score. Only very small UK social impacts are anticipated from hazelnut blight.

Economic Impacts	Very small	☐	Small	☑	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			
Environ - mental Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☑	Medium Confidence	☐	Low Confidence	☐			
Social Impacts	Very small	☑	Small	☐	Medium	☐	Large	☐	Very large ☐
Confidence	High Confidence	☐	Medium Confidence	☑	Low Confidence	☐			

14. What is the pest's potential as a vector of plant pathogens?
None.

15. What is the area endangered by the pest?
The report of Xac in Hampshire, Dorset, Somerset, Gloucestershire and Hampshire (Locke and Barnes, 1979) demonstrates that Xac can establish in southern England. However, this report was from an exceptional period of prolonged hot temperatures. Climatic limitations probably limit establishment of Xac in the UK and southern England is therefore most at risk from hazelnut blight.

STAGE 3: PEST RISK MANAGEMENT

16. What are the risk management options for the UK/PRA area?
(Consider exclusion, eradication, containment, and non-statutory controls; under protection and/or outdoors).

Use of high-quality propagation material free of disease is the most important means of minimising hazelnut blight disease risks. Import of hazelnut plants (*Corylus avellana)* for planting is covered under the EU Fruit Marketing Directive (93/48/EEC) that requires as a minimum standard that all material marketed is 'substantially free of symptoms'. Although this directive does not apply to Filbert (*C. maxima*), it is likely that, in practice, the same action would be taken. For ornamental plants a similar standard is applied to Filbert (*C. maxima*) propagating material but not to 'finished' plants under the Ornamental Marketing Directive (93/48/EEC). These standards offer a significant protection from introduction of hazelnut blight on plants for planting. However, the possibility of asymptomatic infections and the fact that the standard does allow for the presence of a low incidence of disease means protection from infected planting material is not complete. Additionally, it is possible that Xac is present at a low-level in the UK environment.
Growers should therefore take account of the possibility of the presence of Xac when considering hazel propagation and management systems. No plant protection products are registered against this disease but high standards of plant propagation and management practices that reduce spread of hazelnut blight can minimise risks. Use of disease free propagation material is the most important factor. Regular inspection of propagation stock and early removal of infected plants or symptomatic branches will reduce disease.

17. Summary and conclusions of the rapid PRA.
Provide an overall summary and conclusions and then short text on each section:

This rapid PRA shows: A single outbreak of hazelnut blight has been recorded in the UK from 1976. The absence of further disease reports suggests Xac has limited potential to establish and cause disease in UK climatic conditions. Measures contained within EU Marketing Directives reduce entry risks for Xac though it is possible that the pathogen could be imported through asymptomatically infected plants for planting. Growers should be alert to the possibility of Xac infection and adopt high standards of phytosanitary management that will reduce disease impacts.

Risk of establishment is scored as moderately likely and in the UK, is probably limited by unfavourable climatic conditions. There was an outbreak of Xac in Hampshire and south western England associated with an exceptionally hot period in 1976. No further surveys have been done so the current UK Xac status is not known. Uncertainty surrounding the potential for establishment is reflected in the low confidence score.

Risk of entry of Xac is largely controlled through measures in the EU Marketing Directives however, entry of asymptomatically infected plants for planting is still possible and entry risks are scored as moderately likely.

Economic, environmental and social impact. Economic impact from Xac is scored as small, with medium confidence attributable to differences in the degree to which production systems can be affected and uncertainty surrounding establishment potential. Environmental and social impacts are scored as very small.

Endangered area. The warmer climate in southern England makes this region more susceptible to hazelnut blight.

Risk management options. Hazel growers and producers should be aware of the possibility of Xac infection and adopt high standards of phytosanitary management. Use of disease free material for propagation is very important. Regular inspection of plants and early removal of infected branches or plants can help to minimise problems.

Key uncertainties and topics that would benefit from further investigation
A survey to determine if hazelnut blight `is present in the UK would reduce uncertainty with respect to the potential for Xac to establish in the UK.

18. Is there a need for a detailed PRA or for more detailed analysis of particular sections of the PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.
(For completion by the Plant Health Risk Group) ✓ *(put a tick in the box)*

No	✓

Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

19. IMAGES OF THE PEST

Hazelnut blight –leaf symptoms	*Hazelnut blight –husk symptoms*

	
Photo courtesy M. Scortichini (Atlas of Plant Pathogenic Bacteria)	*Photo courtesy M. Scortichini* (Atlas of Plant Pathogenic Bacteria)

20. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?
[*For completion by the Plant Health Risk Group*]

Yes Statutory action ☐ No Statutory action ☑

The pest is already covered by existing EU marketing regulations for these hosts.

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Date of production: 1 September 2014

Version no.: 1

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