Barnaby Wylder[1], Mick Biddle[1], Ana Perez-Sierra[2] and Joan Webber[2]
[1]Forestry Commission, Bristol Business Park, Bristol, BS16 1EJ, UK
[2]Forest Research, Alice Holt Lodge, Farnham, Surrey, GU10 4LH, UK

e-mail barnaby.wylder@forestrycommission.gov.uk

A Healthy World and Plants with *Phytophthora*? Multiple Introductions of Tree Pathogens to a Newly Established Woodland

Introduction

Our environment is under unprecedented threat from an increasing number of non-native tree pathogens, with many introductions via the plant trade. Successive initiatives to increase afforestation across the United Kingdom since the early 1990s, has often resulted in plant demand outstripping domestic supply from UK tree nurseries. As a consequence, landowners may often, knowingly or unknowingly, use material grown outside the UK and potentially at higher risk of contamination with novel plant pathogens. The outcome has been an increasing number of introductions of new pathogens, often not identified until many years after planting. This limited study of a single recently-established woodland site in south England is a salutary example of multiple introductions through the planting stock pathway.

Observations

Established between 1996 and 2010, the site in Dorset was the largest, newly-created mainly broadleaved woodland in England. It covered 202 ha (499 acres) and planted tree species were mostly native, intermixed with small components of non-natives. Historically the site had been managed as farmland for centuries (predominantly grassland but also arable crops), divided by undisturbed hedgerow systems.

The site came to attention in 2011 when the site manager reported dieback of grey alder (*Alnus incana*) and ash (*Fraxinus excelsior*) trees. In an area of around 1 ha, more than 100 ash trees were observed with aerial stem cankers (Fig 1). *Phytophthora syringae* was identified as the causal agent, of which ash was a previously unknown host (Webber et al. 2014).

Fig. 1 Aerial lesions caused by *P. syringae* on *F. excelsior*

Grey alder (A. incana) was observed with stem and root cankers causing dieback (Fig 2). Both the symptoms and on-site diagnostic tests indicated the causal agent was a root-attacking Phytophthora sp. although laboratory testing was inconclusive. In 2013, further samples were tested and Phytophthora siskiyouensis identified from cankers and also from associated soil. It was estimated that 10% of ca. 1000 A. incana trees planted on the site were affected (Perez-Sierra et al., 2015). Follow-up investigations in 2014 established the distribution of disease and yielded further isolations of P. siskiyouensis. Since then, gradual felling of A. incana under biosecurity restrictions has been ongoing. The most recent site investigation in 2018 found only a very small number of A. incana trees remained, with a few still exhibiting symptoms. The decline of affected alder trees has been very gradual, and the site remains the only European record of P. siskiyouensis.

Fig. 2 Root and stem lesions caused by *P. siskiyouensis* on *Alnus incana*

Other findings from the site include the confirmation of *Phytophthora plurivora* from the rhizosphere soil of a healthy common alder (*Alnus glutinosa)*, and *Phytophthora cambivora* causing bleeding stem cankers in small-leaved lime (*Tilia cordata*).

Following the first UK identification of ash dieback caused by the fungus *Hymenoscyphus fraxineus* in planted ash trees in Leicestershire in 2012, the Dorset site was also found to have accepted a significant proportion of its ash planting material from the same supplier. Subsequent investigations in 2013 concluded that *H. fraxineus* was likely to have been introduced and causing symptoms on ash trees on the site as early as 2007 - 2008.

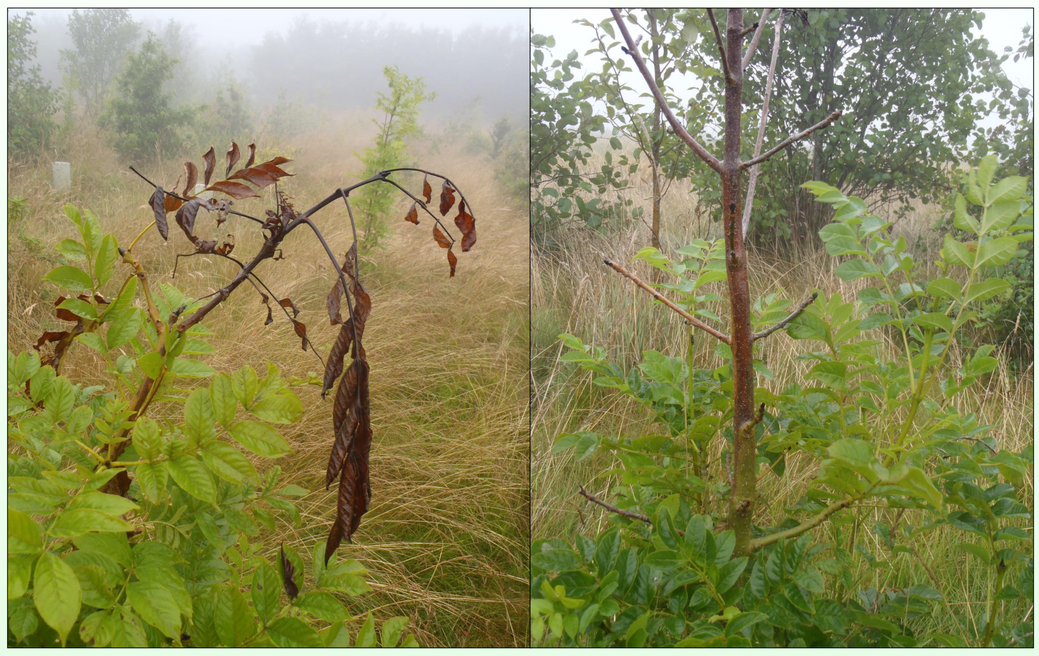

Fig. 3 Recently established *F. excelsior* with *H. fraxineus* infection

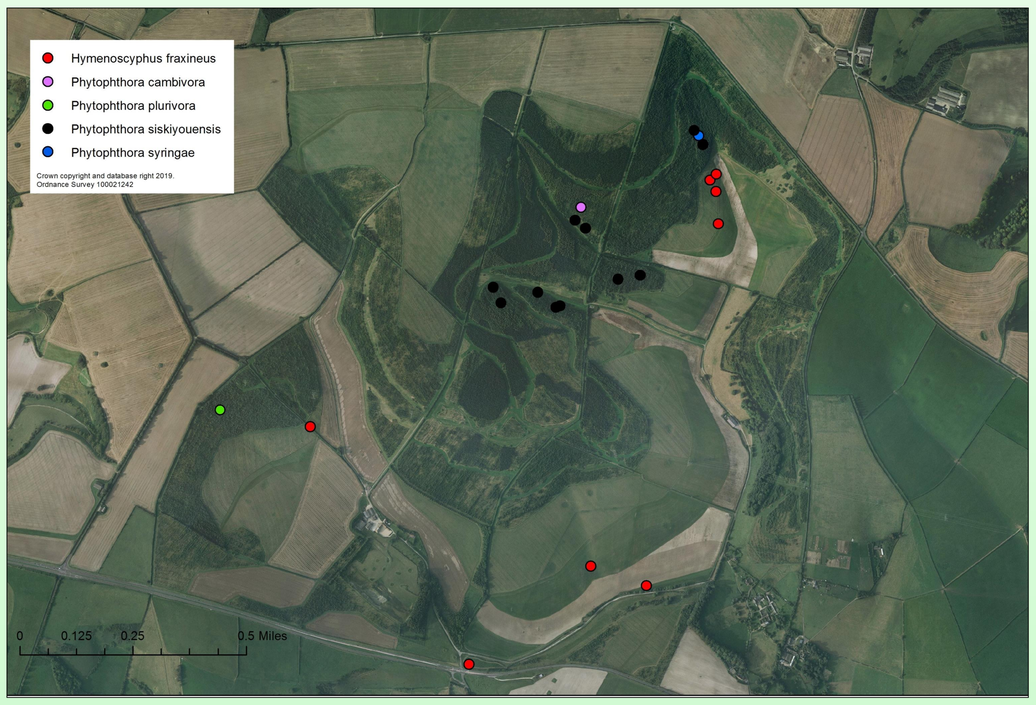

Fig. 4 Overhead aerial photograph of site showing diversity and distribution of tree pathogens identified and confirmed in laboratory

Discussion

Although the site for this new woodland could not be described as pristine undisturbed land, the community of pathogen species attacking the recently established trees was unusual and even novel. There is a strong likelihood that all pathogens detected on the site were introduced on infected planting stock. This scenario is likely to have been repeated but undocumented on multiple similar afforestation sites across the UK.

This is an example of the legacy of problems that can be caused by the introduction of contaminated/infected planting material. The findings also highlight the importance of reporting symptoms in newly established woodland plantings and the need for accurate diagnosis of the causal agent.

In order to prevent similar damage in future plantings, priority should be given to careful selection of species and provision of adequate lead-in times to allow sufficient domestic plant supply. Also, there is a need for consideration of production origin and improved biosecurity practices in the planting stock supply chain.

References

•Perez-Sierra, A., Kalantarzadeh, M., Sancisi-Frey, S. and Brasier, C.M. 2015. *Phytophthora siskiyouensis* causing stem lesions and cankers on *Alnus incana*. New Disease Reports. 31, 17.

•Webber, J., Wylder, B., Harris, A.R., and Brasier, C. 2014. Aerial stem cankers associated with *Phytophthora syringae* on *Fraxinus*: how and why? Page 25, in: Proceedings of the 7th meeting of the IUFRO Working Party S07.02.09: Phytophthoras in forests and natural ecosystems. http://forestphytophthoras.org/sites/default/files/proceedings/IUFRO_Proceedings_2014.pdf.

This work has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 635646, POnTE (Pest Organisms Threatening Europe).