



NEW DISEASE REPORT

First report of *Pucciniastrum minimum* (syn. *Thekopsora minima*) causing leaf rust on *Vaccinium corymbosum* (blueberry) in the United Kingdom and pathogenicity on *Vaccinium myrtillus* (bilberry)

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In September 2021, locally grown northern highbush blueberry plants (*Vaccinium corymbosum* cv. 'Liberty') from a nursery in Perthshire, Scotland were discovered to have rust-like disease symptoms (Figures 1, 2). Two of five of the plants appeared to be infected, with less than ten leaves on each plant showing symptoms. Each plant showed characteristic yellow-orange hypophyllous uredinia with urediniospores on the lower leaf surface and circular lesions of necrosis on the upper leaf surface. While defoliation was observed, it is unknown if this was associated with the rust infection.

Morphological observations determined that urediniospores collected from fresh pustules were subglobose, oblong or ellipsoid measuring 9.1–11.9 μm in width, and 11.8–19.2 μm in length ($n = 40$; Figure 3). Urediniospores were entirely echinulate, unlike the urediniospores of *Naohidemyces fisanensis*. Since *Pucciniastrum* and *Naohidemyces* have only subtle differences in the uredinal stage (Sato et al., 1993), urediniospores were collected for DNA extraction and sequence-based identification. The internal transcribed spacer (ITS) region of the ribosomal DNA (rDNA) was then amplified and sequenced with ITS5 and ITS4 primers (White et al., 1990). A BLAST analysis revealed 99.8% identity to a *Thekopsora minima* (synonym of *P. minimum*) isolate from Germany (GenBank Accession No. MN880392; Figure 4). The 671 bp long sequence was deposited in GenBank under Accession No. OK625817.

To fulfil Koch's postulates, detached leaves from healthy blueberry cv. 'Bluecrop' and wild bilberry (*Vaccinium myrtillus*), a native *Vaccinium*



FIGURE 1 *Vaccinium corymbosum* cv. 'Liberty' with leaf loss following disease symptoms caused by *Pucciniastrum minimum*

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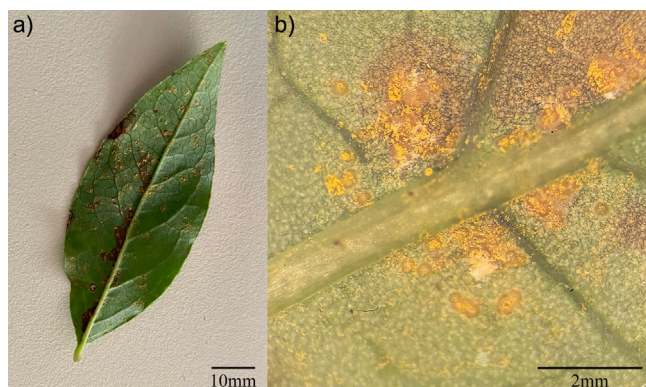


FIGURE 2 Observed yellow/orange urediniospores typical of *Pucciniastrum minimum* on *Vaccinium corymbosum* cv. 'Liberty', a) whole leaf, and b) close up of abaxial leaf surface

sp. in the UK, were surface sterilised with 70% ethanol for two minutes, followed by rinsing with sterile distilled water. Fresh urediniospores from the original symptomatic leaves were then rubbed against the underside of the sterilised leaves. Uninoculated controls comprised sterilised healthy leaves lightly rubbed with leaves without spores. Leaves were placed in a tray lined with a damp paper towel, sealed in a polyethene bag to maintain humidity and incubated at 22°C (12-hour photoperiod, LED lights). After 20 days, yellow-orange uredinia formed in small clusters on inoculated blueberry and bilberry leaves. The clusters were much smaller on bilberry than on blueberry. Microscopy identified the presence of urediniospores on both hosts (Figure 5). No symptoms were observed on the control leaves.

Bilberry is a widespread native species in the UK with particular ecological importance on heathland. The ability of *P. minimum* to cause disease in *V. myrtillus* under laboratory conditions is particularly noteworthy due to the current significant threat of *Phytophthora kernoviae* and *Phytophthora ramorum* on bilberry populations. The pathogen has



FIGURE 3 Echinulate *Pucciniastrum minimum* urediniospores collected from the abaxial leaf surface of *Vaccinium corymbosum* cv. 'Liberty'

been previously reported on highbush blueberry in China, Germany, New Zealand, South Africa, South America and United States (e.g. Padamsee & McKenzie, 2019; Pazdiora et al., 2019; Wichura et al., 2020). To our knowledge, this is the first report of *P. minimum* in the UK and the first time *V. myrtillus* has been identified as a host.

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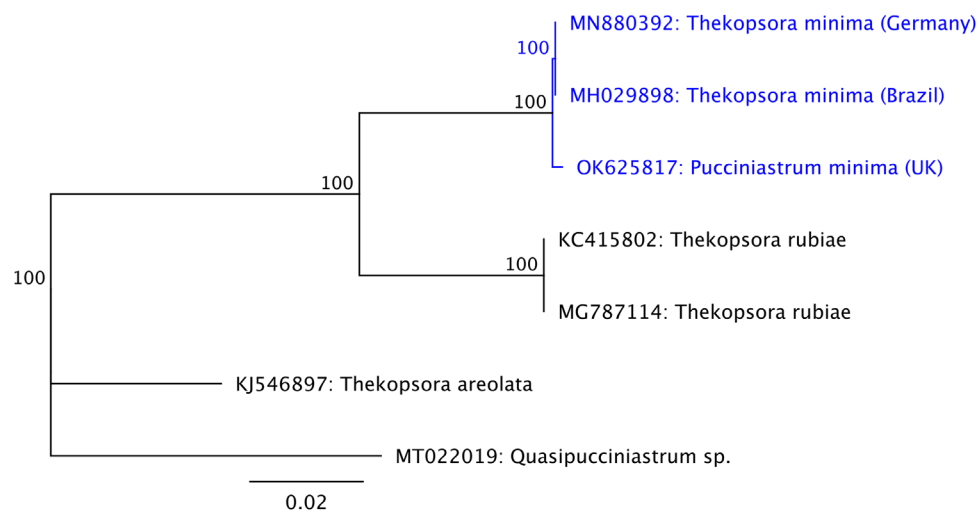


FIGURE 4 Phylogenetic analysis based on the ITS region of the rDNA clusters the isolate under study (OK625817) with *Pucciniastrum minimum* (syn *Thekopsora minima*; highlighted in blue). The phylogenetic tree was generated with Geneious v2021.2, using the neighbour-joining consensus method with a bootstrap test (1,000 replicates)

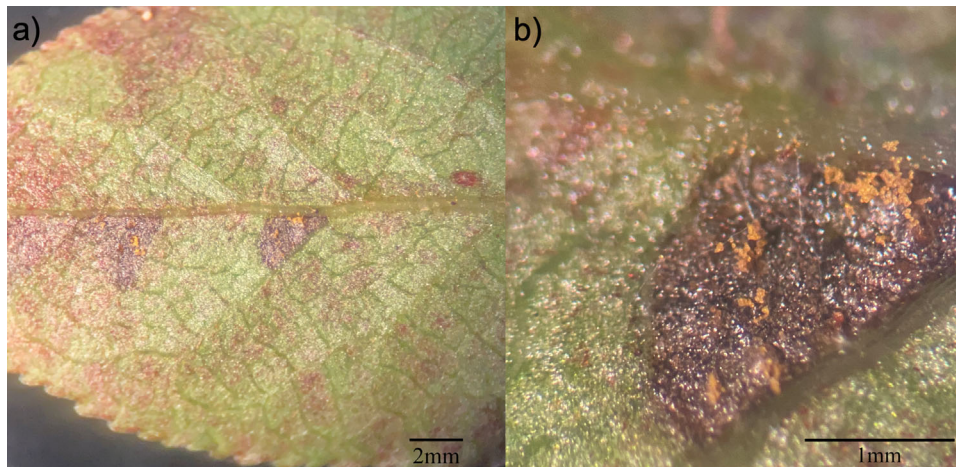


FIGURE 5 Observed yellow/orange urediniospores following inoculation of *Vaccinium myrtillus* with *Pucciniastrum minimum*: a) section of leaf and b) close up of abaxial leaf surface

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