New Disease Reports

First report of '*Candidatus* Liberibacter solanacearum' in the United Kingdom in the psyllid *Trioza anthrisci*

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Specimens of the psyllid, *Trioza anthrisci* (Triozidae) collected from the United Kingdom and Sweden were positive for the phloem-limited proteobacterium '*Candidatus* Liberibacter solanacearum' (Lso). Lso has only been reported in seed in the UK, and has not been reported in crop plants, weed plants or psyllids. This is the first report of Lso haplotype C in the UK and of Lso in *T. anthrisci*, a new potential vector. Haplotype C has been reported in Finland, Germany, Norway and Sweden (Munyaneza *et al*., 2010). Lso haplotype C is associated with disease in carrot in northern Europe. Lso haplotypes A and B are listed EPPO A1 pests and are causal agents of zebra chip disease in potato. These *T. anthrisci* specimens were the first of this species found in the UK (AFC Greenslade, pers. comm.). Lso is yet to be found in the host plants of this psyllid species. Host plants of *T. anthrisci* include three plant species native to the UK: *Angelica sylvestris*, *Anthriscus sylvestris*, *Heracleum sphondylium*, and one introduced species, *Chaerophyllum hirsutum*, all in the Apiaceae. Adults overwinter on conifer/evergreen shrubs (Ouvrard, 2017).

T. anthrisci exists in a complex of eight species, which includes *Trioza apicalis* (carrot psyllid), previously the only species associated with haplotype C. Vectors of other Lso haplotypes include *Bactericera cockerelli* in the Americas and New Zealand and *Bactericera trigonica* in Spain. *T. anthrisci* has been reported in Scandinavia, Western and Central Europe, Turkey and Russia (Altai).

Specimens were caught in 12.2m suction traps in north-east Scotland (Lat 57.644, Long -3.365) and Gotland, Sweden (Lat 57.572, Long 18.409) between 2015 and 2016. Psyllid species identification was confirmed using morphological features and DNA sequencing of COI and ITS2 regions. Voucher specimens were maintained using the DNA extraction method described in Sjölund *et al*. (2016).

Ten specimens of *T. anthrisci* were tested using the real-time PCR assay of Li *et al*. (2009). Five of six specimens from the UK and two of four samples from Sweden tested positive (Table 1). A single *T. apicalis* specimen was caught in 2016 (AFC Greenslade, pers. comm.) and was negative for Lso. Positive samples were sequenced at the ISR-23S rRNA intergenic spacer region using primers Lso TX 16/23F and Lso TX 16/23R (Ravindran *et al*., 2011). A consensus sequence of 353 bp was obtained for Lso-positive specimens. This sequence had 100% identity with sequences KX431889, KX431890 (Lso in *T. apicalis*, Finland), and HM067833 (Lso in carrot, Finland), all reported as haplotype C. Additional ribosomal sequences were obtained for some specimens from both countries at the 16S and 50S region and had 100% identity with sequences that were reported as haplotype C. The 16S region of three specimens (160816.T.ant.20, 161121.T.ant.1, 151002.T.ant.3) were identical to KX431889 and KX431890 (as above), and GU373048 (Lso in carrot, Finland). The 50S region of four specimens (160816.T.ant.20, 160421.T.ant.4, 160421.T.ant.2, 151002.T.ant.3) was identical to JN863093 (Lso in carrot, Sweden).

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References

Li W, Abad JA, French-Monar RD, Rascoe J, Wen A, Gudmestad NC, Secor GA, Lee IM, Duan Y, Levy L, 2009. Multiplex real-time PCR for detection, identification and quantification of '*Candidatus* Liberibacter solanacearum' in potato plants with zebra chip. *Journal of Microbiological Methods* **78**, 59-65. http://dx.doi.org/10.1016/j.mimet.2009.04.009

Munyaneza JE, Fisher TW, Sengoda VG, Garczynski SF, Nissinen A, Lemmetty A, 2010. First report of '*Candidatus* Liberibacter solanacearum' associated with psyllid-affected carrots in Europe. *Plant Disease* **94**, 639. http://dx.doi.org/10.1094/PDIS-94-5-0639A

Ouvrard D, 2017. Psyl'list - The World Psylloidea Database. www.hemiptera-databases.com/psyllist (Accessed 30 June 2017).

Ravindran A, Levy J, Pierson E, Gross DC, 2011. Development of primers for improved PCR detection of the potato zebra chip pathogen, '*Candidatus* Liberibacter solanacearum'. *Plant Disease* **95**, 1542-1546. http://dx.doi.org/10.1094/PDIS-05-11-0386

Sjölund MJ, Kenyon DM, Highet F, Ouvrard D, 2016. Developing an RT-PCR assay for the identification of psyllid species. *Proceedings of Crop Protection in Northern Britain 2016*, 279-282.

Table 1. Mean cycle threshold (Ct) values for the real-time PCR assay for '*Candidatus* Liberibacter solanacearum' for *Trioza anthrisci* specimens from UK and Swedish suction trap catches.

Sample ID	Sex	Catch date	Trap location	Country	Mean Ct	GenBank Accession No.
160421.T.ant.1	F	15-16/07/2015	NE Scotland	UK	32	MF421724
160421.T.ant.2	M	15-16/08/2015	NE Scotland	UK	30	MF421725
160421.T.ant.4	F	02-03/08/2015	NE Scotland	UK	32	MF421726
160816.T.ant.20	F	11-12/07/2016	NE Scotland	UK	24	MF421727
160825.T.ant.13	F	20-21/07/2016	NE Scotland	UK	31	MF421728
161017.T.ant.14	F	27-28/09/2016	NE Scotland	UK	-	-
151002.T.ant.2	F	17/07/2015	Gotland	Sweden	-	-
151002.T.ant.3	F	17/07/2015	Gotland	Sweden	25	MF421729
161121.T.ant.1	M	29/06/2016	Gotland	Sweden	30	MF421730
161121.T.ant.2	F	11/07/2016	Gotland	Sweden	-	-

Figure 1

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