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## First report of "Candidatus Liberibacter solanacearum" associated with psyllid-affected carrots in Sweden

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## Disease Notes

### First Report of "*Candidatus Liberibacter solanacearum*" Associated with Psyllid-Affected Carrots in Sweden

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Carrot (*Daucus carota*) plants with symptoms resembling those associated with the carrot psyllid *Triozia apicalis* and the bacterium "*Candidatus Liberibacter solanacearum*" (1–4) were observed in 70% of commercial fields in southern Sweden in August 2011, with approximately 1 to 45% symptomatic plants per field. *T. apicalis*, a pest of carrot in northern and central Europe, including Sweden, can cause as much as 100% crop loss and is associated with "*Ca. L. solanacearum*" (1–4). Symptoms on affected plants include leaf curling, yellow and purple discoloration of leaves, stunted growth of shoots and roots, and proliferation of secondary roots (3). Carrot plant and psyllid samples were collected from fields in the province of Halland. Total DNA was extracted from petiole and root tissues of 33 symptomatic and 16 asymptomatic plants (cvs. Nevis and Florida), with the cetyltrimethylammonium bromide (CTAB) buffer extraction method (2,3). DNA was also extracted from 155 psyllids (3). DNA samples were tested by PCR using primer pairs OA2/OI2c (5'-GCGCTTATTTTAAATAGGAGCGGCA-3'/5'-GCCTCGCGACTTCGCAACCCAT-3') and CL514F/R (5'-CTTAAGATTTCGGTTGTT-3'/5'-TATATCTATCGTTGCACCAG-3'), to amplify a portion of 16S rDNA and rplJ/rplL ribosomal protein genes, respectively, of "*Ca. L. solanacearum*" (2,3). A 1,168-bp 16S rDNA fragment was detected in the DNA from all 33 symptomatic and two asymptomatic plants, and a 668-bp rplJ/rplL fragment was amplified from the DNA of all 33 symptomatic and four asymptomatic plants, indicating the presence of liberibacter. DNA from 23 and 49 psyllid samples yielded similar amplicons with OA2/OI2c and CL514F/R primer pairs, respectively. Amplicons from the DNA of four carrot roots and three *T. apicalis* with each primer pair were cloned (pCR2.1-TOPO; Invitrogen, Carlsbad, CA) and three clones of each of the 14 amplicons were sequenced (MCLAB, San Francisco, CA). BLAST analysis of the 16S rDNA consensus sequences from carrot (GenBank Accession No. JN863095) and *T. apicalis* (GenBank Accession No. NJ863096) showed 100% identity to those

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of "*Ca. L. solanacearum*" previously amplified from carrot (GU373048 and GU373049) and *T. apicalis* (GU477254 and GU477255) from Finland (2,3). The rplJ/rplL consensus sequences from carrot (GenBank Accession No. JN863093) and *T. apicalis* (GenBank Accession No. JN863094) were 99% identical to the sequences of rplJ/rplL "*Ca. L. solanacearum*" ribosomal protein gene from carrots in Finland (GU373050 and GU373051). To our knowledge, this is the first report of "*Ca. L. solanacearum*" associated with carrot and *T. apicalis* in Sweden. The disease associated with this bacterium caused millions of dollars in losses to potato and several other solanaceous crops in North and Central America and New Zealand (1). This plant pathogen is also associated with significant economic damage to carrot crops observed in Finland (2,3).

*References:* (1) J. E. Munyaneza. Southwest. Entomol. 35:471, 2010. (2) J. E. Munyaneza et al. Plant Dis. 94:639, 2010. (3) J. E. Munyaneza et al. J. Econ. Entomol. 103:1060, 2010. (4) A. Nissinen et al. Entomol. Exp. Appl. 125:277, 2007.

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## Supplemental Material



Carrots exhibiting symptoms associated with the psyllid *Trioza apicalis* and the bacterium "*Candidatus* Liberibacter solanacearum": leaf curling and discoloration (left), leaf curling only (center), and healthy carrots (right).

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