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Munyanez, Joseph E; Sengoda, V. G.; Stegmark, R.; Arvidsson, A. K.; Anderbrant, Olle; Yuvaraj, Jothi Kumar; Rämert, B.; Nissinen, A.

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Disease Notes

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

J. E. Munyaneza and V. G. Sengoda, USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA 98951; R. Stegmark and A. K. Arvidsson, Findus Sverige AB, SE-267 81 Bjuv, Sweden; O. Anderbrant and J. K. Yuvaraj, Lund University, Department of Biology, SE-223 62 Lund, Sweden; B. Rämert, Swedish University of Agricultural Sciences, Plant Protection Biology, SE-230 53 Alnarp, Sweden; and A. Nissinen, MTT Agrifood Research Finland, Plant Production Research, FI-31600 Jokioinen, Finland

Carrot (Daucus carota) plants with symptoms resembling those associated with the carrot psyllid Triozoa apicalis and the bacterium "Candidatus Liberibacter solanacearum" (1–4) were observed in 70% of commercial fields in southeastern Sweden in August 2011, with approximately 1 to 45% symptomatic plants per field. "C. 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 (cv. Nevis and Florida), with the cetyltrimethylammonium bromide (CTAB) buffer extraction method (2,3). DNA was also extracted from 155 psyllids (2). DNA samples were tested by PCR using primer pairs OA2/OI2c (5′-GGCGTATTTTTAATAGGACCGGCA-3′/5′-GCCTGCAGCTTCCGAACCCAT-3′) and CLS14F/R (5′-CTCTAAGATTTCGGTTGGTT-3′/5′-TATATCTATCGTTGACCCAG-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 CLS14F/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. JN863096) showed 100% identity to those...
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).

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).