



National Plant Protection Organization, the Netherlands

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1	What is the scientific name (if possible up to species level + author, also include (sub)family and order) and English/common name of the organism? <i>Add picture of organism/damage if available and publication allowed.</i>	<i>Erwinia</i> sp. 'assigned to the <i>E. pyrifoliae</i> taxon'. <i>Erwinia pyrifoliae</i> , family Enterobacteriaceae. <i>Erwinia pyrifoliae</i> is a pathogen, closely related to the main fire blight pathogen <i>E. amylovora</i> (EPPO Reporting Service 2000/011, 2002/047) described for the first time in 1999 in Korea (Kim et al., 1999). <i>E. pyrifoliae</i> is primarily a pathogen of Asian or Nashi pear ( <i>Pyrus pyrifolia</i> ) causing fire blight on Nashi pear and is considered to have a restricted geographic distribution in East Asia (Korea and Japan).
2	What prompted this quick scan? <i>Organism detected in produce for import, export, in cultivation, nature, mentioned in publications, e.g. EPPO alert list, etc.</i>	During the last months in 2013, strawberry plants were found at two different locations in the Netherlands, showing intense blackening of their immature fruits, their fruit calyx and the attached stems (Figs 1-5). No symptoms on the leaves were observed. The discolouration was also obvious inside the young fruits which presented an intense darkening/blackening of the fruit tissue at the edges and an intense shining of the fruit tissue in the middle. Release of bacterial slime was additionally observed on the surface of the young fruits and their attached stems (ooze formation). Fruits were in many cases (but not always) heavily misformed. These symptoms were mainly observed on strawberry cultivar Elsanta, and to a lesser extent to other cultivars (Lambada and Sonata), which in many cases were cultivated in the same greenhouse compartment. In most of the cases these symptoms were present in the whole greenhouse and the incidence was high: each of about 50% of the plants had at least one symptomatic fruit.
3	What is the (most likely) area of distribution?	<i>Erwinia pyrifoliae</i> attacking Asian (Nashi) pear is a pathogen considered to be geographically restricted (endemic) to Eastern Asia: Korea (Rhim et al. 1999; Shrestha et al., 2003 ) and Japan (Beer et al. 1996). <i>Erwinia</i> sp. "assigned to the <i>E. pyrifoliae</i> taxon" and pathogenic to strawberry has previously been found in Belgium (see below Question 4) and now also in the Netherlands.

4	<p>Has the organism been detected, sighted and/or has it established itself in nearby countries (DE, BE, LU, FR, UK) <i>Yes/no. If 'yes', provide details. No interceptions</i></p>	<p>Yes, symptoms similar to those in the Netherlands on immature Elsanta strawberry fruits had also been seen in one field in Belgium in 2011 during the survey for <i>X. fragariae</i> (personal communication with Johan van Vaerenbergh, ILVO). <i>Erwinia amylovora</i> – like colonies had been isolated from 3 samples. The isolates reacted with <i>E. amylovora</i> antibodies commonly used in diagnosis of fire blight but negative results were obtained in the <i>ams</i> TaqMan PCR and in the pathogenicity test on immature pear fruits. 16sRDNA analysis assigned the isolates to the <i>Erwinia</i> species and <i>recA</i> sequencing attributed the isolates to the <i>Erwinia pyrifoliae</i> taxon. Pathogenicity tests on strawberry leaves, in petioles and in immature strawberry fruits were negative but tooth prick inoculation of the epicalyx of immature strawberry fruits quickly resulted in oily necrosis with abundant formation of exudate on the epicalyx and on the sepals. The bacterium was reisolated from the affected tissue. Spray inoculation of strawberry flowers resulted in necrosis without ooze formation but reisolation tests were not conclusive to assign the <i>Erwinia</i> isolates to the symptoms (low titers).</p>
5	<p>Does the organism cause any kind of plant damage in the current area of distribution and/or does the consignment demonstrate damage suspected to have been caused by this organism? <i>Yes/no + host plants + short explanation of symptoms.</i> <i>Please indicate also when the organism is otherwise harmful (e.g. predator, human/veterinary pathogen vector, etc.).</i></p>	<p><i>Erwinia pyrifoliae</i> is known to cause fire blight on Asian (Nashi) pear. This pathogen was initially isolated from necrotic symptoms of leaves and branches of <i>Pyrus pyrifolia</i> (Kim et al., 1999). Symptoms on pear trees in the Korean orchards resembled those of fire blight, due to <i>Erwinia amylovora</i> (Kim et al., 1999), especially symptoms on immature pear fruits. In general, symptoms include black to brown stripes in the leaf midribs, dark brown leaf spots and necrotic petioles. Necrotic symptoms sometimes extend to large parts of the trees and affected entire branches, blossoms and young fruits. Flowers appear to be water soaked and turn brown to black. Immature fruits appear oily becoming brown to black and often exuding droplets of bacterial ooze. The symptoms observed on immature strawberry fruits in the Netherlands (Figs 1-5) resembled the fruit symptoms described for Asia pear but it is uncertain if the strawberry isolates can attack Asian pear and vice versa.</p>
6	<p>Indicate the (provisional) probability of establishment of the organism in the Netherlands regarding climate and ecology. a. In greenhouses (low, medium, high) b. Outdoors (low, medium, high) c. Otherwise (e.g. storage facilities, human environment) <i>Please illustrate with information/references</i></p>	<p>Greenhouse conditions seem suitable for establishment although it is not yet known how the bacterium survives periods without a (fruit bearing) crop. In Belgium, the bacterium was found in the open field but also in those cases the original source of infection was unknown.</p>
7	<p>What are the host plants? Which host plants are commercially grown in the Netherlands and which are present in the natural environment? <i>If establishment is restricted to greenhouse climate, list only host plants in greenhouses.</i></p>	<p><i>Erwinia pyrifoliae</i> is the etiological agent of shoot blight disease in Asian pear (<i>Pyrus pyrifolia</i>) (Matsuura et al., 2007). No reports are known that it can attack strawberry. The susceptibility of a few <i>E. amylovora</i>-hosts to <i>E. pyrifoliae</i> has been examined by Kim et al. (2001). A strong preference was found for pear varieties, including European pear (<i>P. communis</i>), whereas <i>Cotoneaster</i>, <i>Crataegus</i>, <i>Malus</i>, <i>Prunus</i>, <i>Rubus</i> produced necrotic symptoms in a few cases only. Although this refers to a limited host screening with <i>Erwinia pyrifoliae</i> strains, it provides indications for a slightly wider host-range than originally thought. Relatively little is known about the genetic basis of virulence of <i>Erwinia pyrifoliae</i>.</p>
8	<p>Provide a provisional estimation of type and amount of direct and indirect economic damage (e.g. lower quality, lower production, export restrictions, threat to biodiversity, etc.) likely to occur if the organism</p>	<p>The immature strawberry fruits showing intense blackening on fruit tissue or on their fruit calyx and the attached stems (Figs 1-5) were totally unmarketable. Depending on the time infection occurs during the production of strawberry fruits, the economic losses can vary from low (infection occurs at the end of the harvesting period) to very high (infection occurs at an early stage of the crop).</p>

	would become established?	
9	How rapid is the organism expected to spread after introduction (by natural dispersal and human activity)?	The pathogen is assumed to be easily spread by human activities because symptoms were observed throughout the greenhouses (see Question 2).
10	In what manner could the organism enter the Netherlands? <i>Mention pathways.</i>	The pathogen is already present in the Netherlands. The current distribution of <i>Erwinia</i> sp. "assigned to the <i>E. pyrifoliae</i> taxon" and pathogenic to strawberry is unknown. The pathogen is related to <i>E. pyrifoliae</i> pathogenic to pear which is known from eastern Asia (Korea and Japan) but it is currently unknown if the pathogen isolated from strawberry can also infect pear and on what kind of plant material (other than strawberry fruit) the pathogen could be introduced with.
11	Has the organism been detected on/in a product (cut flowers, fruit, ...) destined for the consumer market? <i>If "no", please go to question 13</i>	Yes, the organism has been detected at two locations in the Netherlands, on strawberries (fruit production in greenhouses).
12	If the organism has been found on/in product other than plants for planting (e.g. cut flowers, fruit, vegetables), are there any risks of introduction and establishment in crop areas and/or natural environment in the Netherlands? <i>Only to be answered in case of an interception and/or a find.</i>	Not relevant: the pathogen has not been intercepted on fruit but found at two strawberry fruit producers in the Netherlands.
13	Additional remarks	Several <i>Erwinia</i> species have recently been described that have restricted geographic distribution and host range (European pear <i>Pyrus communis</i> and/or Asian pear syn. Nashi pear; <i>P. pyrifolia</i> ), when compared to the broader-host-range fire blight pathogen of pear and other <i>Rosaceae</i> , <i>Erwinia amylovora</i> (Palacio-Bielsa et al., 2012). Among them, <i>E. pyrifoliae</i> causes blight of Asian pear and has thus far been reported only from Korea and Japan (Kim et al., 1999; Geider et al., 2009), <i>Erwinia</i> sp. strain Ejp617 causes pear shoot blight (Park et al., 2011) and <i>E. uzenensis</i> causes bacterial black shoot disease of pear (Matsuura et al., 2012). <i>Erwinia tasmaniensis</i> is a <i>Rosaceae</i> epiphyte, not known to be pathogenic to pear (Geider et al., 2006), but having genomic indications of potential phytopathogenicity to unknown hosts (Kube et al., 2008), and <i>E. billingiae</i> (formerly <i>Pantoea agglomerans/Enterobacter agglomerans</i> ) is a cosmopolitan epiphyte with no indications of phytopathogenicity (Mergaert et al., 1999; Kube et al., 2010). <i>Erwinia piriflorinigrans</i> is one of the newest members of this group, causing necrosis of pear flowers but no advancing symptoms into shoots. It does not affect other <i>Rosaceae</i> host plants and thus far it has only been reported in Spain (Lopez et al., 2011).
14	References	Beer SV, Kim J-H, Zumoff CH, Bogdanove AJ, Laby RJ, Gustafson HL, Momol T and Aldwinckle HS 1996. Characterization of bacteria that cause "bacterial shoot blight of pear" in Japan. Acta Horti 411, 179-181. EPPO Reporting Service 2000/011, 2002/047. Geider K, Auling G, Jakovljevic V, Völksch B 2009 A polyphasic approach assigns the pathogenic

		<p>Erwinia strains from diseased pear trees in Japan to <i>Erwinia pyrifoliae</i>. Lett Appl Microbiol, 48:324-330.</p> <p>Geider K, Auling G, Du Z, Jakovljevic V, Jock S, and Volksch B. 2006 <i>Erwinia tasmaniensis</i> sp. nov., a nonphytopathogenic bacterium from apple and pear trees. <i>Int J Syst Evol Microbiol</i> <b>56</b>: 2937–2943.</p> <p>Kim W-S, Gardan L, Rhim S-L, Geider K 1999 <i>Erwinia pyrifoliae</i> sp. nov., a novel pathogen that affects Asian pear trees (<i>Pyrus pyrifolia</i> Nakai). <i>Int J Syst Bacteriol</i> 1999, 49:899-906.</p> <p>Kim W-S, Jock S, Paulin J-P, Rhim S-L, and Geider K 2001. Molecular detection and differentiation of <i>Erwinia pyrifoliae</i> and host range analysis of the Asian pear pathogen. <i>Plant Dis.</i> 85:1183-1188.</p> <p>Kube M, Migdoll AM, Müller I, Kuhl H, Beck A, Reinhardt R, Geider K, 2008. The genome of <i>Erwinia tasmaniensis</i> strain Et1/99, a non-pathogenic bacterium in the genus <i>Erwinia</i>. <i>Environ Microbiol</i>, 10(9):2211-2222.</p> <p>Kube M, Migdoll AM, Gehring I, Heitmann K, Mayer Y, Kuhl H, Knaust F and Geider K. et al. 2010 Genome comparison of the epiphytic bacteria <i>Erwinia billingiae</i> and <i>E. tasmaniensis</i> with the pear pathogen <i>E. pyrifoliae</i>. <i>BMC Genomics</i> 11, 393.</p> <p>Lopez M M, Rosello M, Llop P, Ferrer S, Christen R and Gardan L. 2011. <i>Erwinia piriflorinigrans</i> sp. nov., a novel pathogen that causes necrosis of pear blossoms. <i>Int J Syst Evol Microbiol</i> 61, 561–567.</p> <p>Matsuura T, Mizuno A, Tsukamoto T et al., 2012. <i>Erwinia uzenensis</i> sp. nov., a novel pathogen that affects European pear trees (<i>Pyrus communis</i> L.). <i>International Journal of Systematic and Evolutionary Microbiology</i> 62, 1799–803.</p> <p>Matsuura T, Shinohara H, Inoue Y, Azegami K, Tsushima Se, Tsukamoto T and Mizuno A. 2007. <i>Erwinia</i> isolates from the bacterial shoot blight of pear in Japan are closely related to <i>Erwinia pyrifoliae</i> based on phylogenetic analyses of <i>gyrB</i> and <i>rpoD</i> genes. <i>J. Gen. Plant Pathol.</i> 73:53-58.</p> <p>Mergaert J, Hauben L, Cnockaert MC, Swings J, 1999. Reclassification of nonpigmented <i>Erwinia herbicola</i> strains from trees as <i>Erwinia billingiae</i> sp. nov. <i>Int J Syst Bacteriol</i>, 49(2):377-383.</p> <p>Palacio-Bielsa A, Rosello M, Llop P and Lopez MM, 2012. <i>Erwinia</i> spp. from pome fruit trees: similarities and differences among pathogenic and non-pathogenic species. <i>Trees</i> 26, 13–29.</p> <p>Park DH, Thapa SP, Choi BS et al., 2011. Complete genome sequence of Japanese <i>Erwinia</i> strain Ejp617, a bacterial shoot blight pathogen of pear. <i>Journal of Bacteriology</i> 193, 586–7.</p> <p>Rhim S L, Völksch B, Gardan L, Paulin J P, Langlotz C, Kim W-S and Geider K. 1999. <i>Erwinia pyrifoliae</i>, an <i>Erwinia</i> species different from <i>Erwinia amylovora</i>, causes a necrotic disease of Asian pear trees. <i>Plant Pathol.</i> 48:514-520.</p> <p>Shrestha R, Koo J H, Park D.H. Hwang I, Hur J H and Lim C K 2003. <i>Erwinia pyrifoliae</i>, a causal endemic pathogen of shoot blight of Asian pear tree in Korea. <i>Plant Pathol.J.</i> 19:294-300.</p>
15	<p style="text-align: center;"><b>Conclusions</b></p>	<p><i>Erwinia</i> sp. “assigned to the <i>E. pyrifoliae</i> taxon” and pathogenic to strawberry is a recently detected pathogen on strawberry. Thus far, it has been found in Belgium and the Netherlands but its origin is unknown. The observations indicate that the potential impact for strawberry fruit production can be high at least under greenhouse conditions in the Netherlands. Greenhouse conditions in the autumn (higher humidity) may be more suitable for disease development than during spring and summer. Basic information on e.g. its host range, mechanisms of survival and spread is currently lacking. Research may clarify its relationship with <i>Erwinia pyrifolia</i> present in eastern Asia, its host range, the way it survives, spreads etc. and how the disease can be controlled/prevented.</p>

16	<b>Follow-up measures</b>	No official measures: the pathogen may already be present in the Netherlands for several years and its current distribution is highly uncertain. A pest report has been published.
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Figure 1 to 5: Intense blackening of the immature fruits, the fruit calyx and the attached stems of strawberry fruits in greenhouses in the Netherlands.