EPPO Datasheet: *'Candidatus Phytoplasma fraxini'*

Last updated: 2023-07-12

IDENTITY

Preferred name: *'Candidatus Phytoplasma fraxini'*
Authority: Griffiths, Sinclair, Smart & Davis
Taxonomic position: Bacteria: Tenericutes: Mollicutes: Acholeplasmatales: Acholeplasmataceae
Other scientific names: *Phytoplasma fraxini* Griffiths, Sinclair, Smart & Davis
Common names: Ash yellows phytoplasma, AshY, Lilac witches' broom phytoplasma, lWB, witches' broom of lilac, yellows of ash
view more common names online...
EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: PHYPFR

Notes on taxonomy and nomenclature

'*Candidatus* Phytoplasma fraxini' formerly 16SrVII group or Ash Y, is a species that contains several strains: 16SrVII-A has been reported in North America, and 16SrVII-B, 16SrVII-C, 16SrVII-D, 16SrVII-E, 16SrVII-F, and 16SrVII-G in South America. However, the strain found in the central area of Colombia 16SrVII-G, which is believed to have originated in North America, is more similar to 16SrVII-A than to the strains described in South America (Griffiths *et al*., 1999; Barros *et al*., 2002; Flôres *et al*., 2015; Gajardo *et al*., 2009; da Silva *et al*., 2017; Franco-Lara *et al*., 2020).

HOSTS

'*Candidatus* Phytoplasma fraxini' was initially reported in wild plants of the Oleaceae family affected with Ash yellows disease (AshY) and Lilac witches'-broom (LWB), in Canada and the United States. Susceptible species within the *Fraxinus* genus include *F. americana* (white ash), *F. angustifolia, F. bungeana, F. excelsior* (European ash), *F. latifolia, F. nigra* (black ash), *F. ornus* (flowering ash), *F. pennsylvanica* (green ash or red ash*), F. potamophila, F. profunda, F. quadrangulata* (blue ash), and *F. velutina* (Sinclair and Griffiths, 1994). Within the genus *Syringa*, plants of *S.* x *diversifolia, S.* x *henryi, S.* x *josiflexa, S. josikaea, S. julianae, S. komarowii, S. laciniata, S. meyeri, S. microphylla, S. nanceiana, S. oblata, S. patula, S. persica, S.* x *prestoniae, S. sweginzowii, S. tomentella, S. villosa, S. vulgaris* and *S. yunnanensis* have been reported as hosts (Sinclair and Griffiths, 1994; Sinclair *et al*., 1996, Walla *et al*., 2000).

In 2001, '*Ca.* P. fraxini' was first reported in South America, infecting diseased urban *Fraxinus uhdei* (urapan) trees in Bogotá, Colombia (Griffiths *et al*., 2001). Evidence suggests it has moved from *F. uhdei* to other urban tree species such as *Acacia melanoxylon* (Fabaceae), *Croton* spp. (Euphorbiaceae), *Eugenia neomyrtifolia* (Myrtaceae), *Liquidambar styraciflua* (Altingiaceae), *Magnolia grandiflora* (Magnoliaceae), *Pittosporum undulatum* (Pittosporaceae), *Populus nigra* (Salicaceae), *Sambucus nigra* (Viburnaceae) and *Salix humboldtiana* (Salicaceae)) and *Quercus humboldtii* (Fagaceae) (Franco-Lara and Perilla-Henao, 2014; Franco-Lara *et al*., 2017, Franco-Lara, 2019). It also infects plants from several families in Cundinamarca, the Colombian department in which Bogotá is located. Susceptible plants include potato *Solanum tuberosum* (Solanaceae) and strawberry *Fragaria* x *ananassa* (Rosaceae) crops, and the grass *Cenchrus clandestinus* (Poaceae) and weeds *Amaranthus dubius* (Amaranthaceae), *Cymbalaria muralis* (Plantaginaceae), *Fumaria capreolata* (Papaveraceae), *Holcus lanatus* (Poaceae), *Gnaphalium spicatum* (Asteraceae), *Gnaphalium cheiranthifolium* (Asteraceae), *Lepidium bipinnatifidum* (Brassicaceae), *Senecio vulgaris* (Asteraceae), *Sonchus oleraceus* (Asteraceae) and *Taraxacum officinale* (Asteraceae) (Franco-Lara, 2019; Varela-Correa and Franco-Lara, 2020; Franco-Lara *et al*., 2023).

In Brazil, '*Ca.* P. fraxini' has been found in natural infections in the Asteraceae *Erigeron* sp. and *Vernonia brasiliana* , and in the Apocynaceae *Catharanthus roseus* (Barros *et al*., 2002; Montano *et al*., 2014; Flôres *et al*., 2015; da

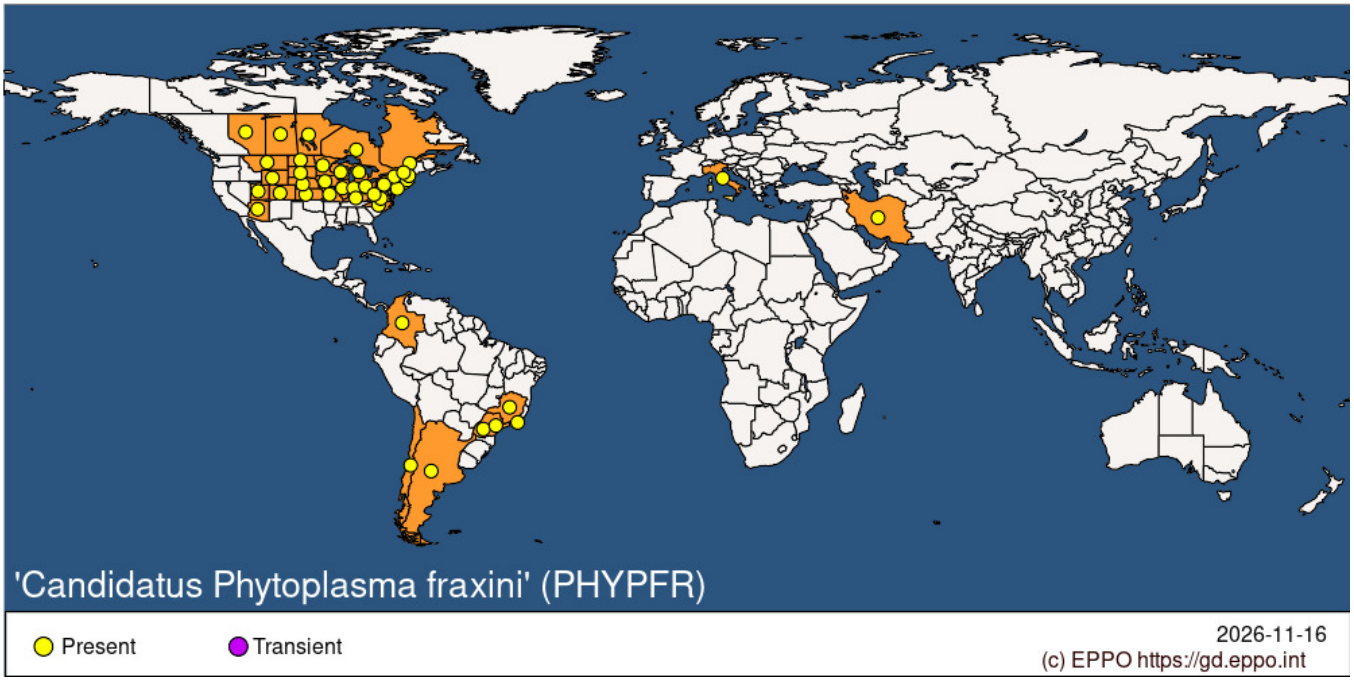
Silva *et al*., 2017). In Argentina this bacterium is found associated with Argentinian alfalfa witches´-broom in *Medicago sativa* (Fabaceae) (Conci *et al*., 2005), strawberry (Fernández *et al*., 2013) and Asteraceae weeds *Artemisia annua* and *Conyza bonariensis* (Meneguzzi *et al*., 2008). In Chile, '*Ca.* P. fraxini' has been detected in vineyards infecting *Vitis vinifera* (Vitaceae), and weeds such as *Convolvulus arvensis* (Convolvulaceae), *Galega officinalis* (Fabaceae), *Gaultheria phillyreifolia* (Ericaceae), *Paeonia lactiflora* (Paeoniaceae), *Polygonum aviculare* (Polygonaceae) and *Ugni molinae* (Myrtaceae) (Fiore *et al*., 2007; Arismendi *et al*., 2010; Arismendi *et al*., 2011: Gajardo *et al*., 2009; Longone *et al*., 2011).

Outside the Americas, '*Ca.* P. fraxini' has been occasionally detected in Italy infecting grapevine (Zambon *et al*., 2018) and *Hypericum perforatum* (Hypericaceae) (Bruni *et al*., 2005), and in Iran in *Phoenix dactylifera* (Arecaceae) (Ghayeb Zamharir and Eslahi, 2019).

Experimental hosts include *C. roseus*, *Cuscuta* spp. (Convolvulaceae) (dodder), *Daucus carota* (Apiaceae), *Phaseolus vulgaris* (Fabaceae), and *Trifolium pratense* (Fabaceae) (Sinclair and Griffiths, 1996; Perilla-Henao *et al*., 2016).

Host list: *Acacia melanoxylon*, *Amaranthus dubius*, *Artemisia annua*, *Cenchrus clandestinus*, *Convolvulus arvensis*, *Croton sp.*, *Cymbalaria muralis*, *Erigeron bonariensis*, *Eugenia neomyrtifolia*, *Fragaria x ananassa*, *Fraxinus americana*, *Fraxinus angustifolia*, *Fraxinus bungeana*, *Fraxinus excelsior*, *Fraxinus latifolia*, *Fraxinus nigra*, *Fraxinus ornus*, *Fraxinus pennsylvanica*, *Fraxinus profunda*, *Fraxinus quadrangulata*, *Fraxinus sogdiana*, *Fraxinus uhdei*, *Fraxinus velutina*, *Fraxinus*, *Fumaria capreolata*, *Galega officinalis*, *Gamochaeta purpurea*, *Gaultheria phillyreifolia*, *Gnaphalium cheiranthifolium*, *Holcus lanatus*, *Hypericum perforatum*, *Lepidium bipinnatifidum*, *Liquidambar styraciflua*, *Magnolia grandiflora*, *Medicago sativa*, *Paeonia lactiflora*, *Phoenix dactylifera*, *Pittosporum undulatum*, *Polygonum aviculare*, *Populus nigra*, *Prunus sp.*, *Pyrus sp.*, *Quercus humboldtii*, *Salix humboldtiana*, *Sambucus nigra*, *Senecio vulgaris*, *Solanum tuberosum*, *Sonchus oleraceus*, *Syringa josikaea*, *Syringa julianae*, *Syringa komarowii*, *Syringa laciniata*, *Syringa meyeri*, *Syringa nanceiana*, *Syringa oblata*, *Syringa persica*, *Syringa pubescens subsp. microphylla*, *Syringa pubescens subsp. patula*, *Syringa tomentella subsp. sweginzowii*, *Syringa tomentella subsp. yunnanensis*, *Syringa tomentella*, *Syringa villosa*, *Syringa vulgaris*, *Syringa x diversifolia*, *Syringa x henryi*, *Syringa x josiflexa*, *Syringa x prestoniae*, *Syringa*, *Taraxacum officinale*, *Ugni molinae*, *Vernonanthura brasiliana*, *Vitis vinifera*

GEOGRAPHICAL DISTRIBUTION



EPPO Region: Italy (mainland)
Asia: Iran, Islamic Republic of
North America: Canada (Alberta, Manitoba, Ontario, Québec, Saskatchewan), United States of America (Arizona, Colorado, Connecticut, Illinois, Indiana, Iowa, Kansas, Kentucky, Massachusetts, Michigan, Minnesota, Missouri,

Montana, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Dakota, Utah, Vermont, Virginia, West Virginia, Wisconsin, Wyoming)
South America: Argentina, Brazil (Minas Gerais, Parana, Rio de Janeiro, Sao Paulo), Chile, Colombia

BIOLOGY

The epidemiology of '*Ca.* P. fraxini' associated diseases has been described in detail for Bogotá and surrounding areas of Cundinamarca, in Colombia. In this area, '*Ca.* P. fraxini' is usually present in mixed infections with ' *Candidatus* Phytoplasma asteris' related strains (Franco-Lara and Perilla-Henao, 2014; Perilla-Henao *et al*., 2016; Franco-Lara, 2019; Franco-Lara *et al*., 2020; Franco-Lara *et al*., 2023). At least two insect vectors are present in this area, *Amplicephalus funzaensis* and *Exitianus atratus* (both Hemiptera: Cicadellidae) (Perilla-Henao *et al*., 2016). These are polyphagous insect species that transmit both phytoplasmas and reproduce in the widespread grass species *C. clandestinus*. Other Cicadellidae species within the Deltocephalinae and Typhlocybinae are known to become infected with phytoplasmas but their ability to transmit these has not been tested (Perilla-Henao *et al*., 2016; Lamilla *et al*., 2022). *C. clandestinus* is an asymptomatic host of both '*Ca.* P. fraxini' and '*Ca.* P. asteris´ and hosts not only *A. funzaensis* and *E. atratus*, but also other potential insect vectors.

Potential insect vectors in Canada include *Graminella nigrifrons* (Hemiptera: Cicadellidae) (Arocha-Rosete *et al*., 2011) and *Paraphlepsius irroratus* (Hemiptera: Cicadellidae) and spittlebug *Philaenus spumarius* (Hemiptera: Cercopidae) (Matteoni and Sinclair, 1988). In the United States, *Scaphoideus* spp. and *Colladonus clitellarius* (Hemiptera: Cicadellidae) (Hill and Sinclair, 2000) have both been detected as infected with phytoplasmas. In Chile, *Paratanus exitiosus* (Hemiptera: Cicadellidae) (Longone *et al*., 2011) is a potential insect vector of '*Ca.* P. fraxini'.

DETECTION AND IDENTIFICATION

Symptoms

Symptoms vary between species, but some general features are observed. In susceptible taxa, Ash yellows and Lilac witches'-brooms are characterized by slow growth, loss of vitality, dieback (dead branches) and sometimes, early death of the plant. Other symptoms on trees species include light green or chlorotic foliage, witches´-brooms (proliferation of axilar shoots from one point that results in broom-like appearance), tufted foliage (branches with slow twig growth and short internodes that cause foliage to appear bunched), epicormic shoots (abnormal and disorderly proliferation of shoots that emerge from the trunk or branches), small leaves (leaves that never reach the normal leaf size), deliquescent branching (loss of apical dominance), abnormally elongated or shortened branches) which produce a deformation of the normal architecture of the tree crowns (Sinclair and Griffiths, 1994; Sinclair *et al* ., 1996; Franco-Lara and Perilla-Henao, 2014; Lamilla *et al*., 2022).

In herbaceous plants such as potato, symptoms include leaf yellowing and curling, leaves with purple margins, excessive shoot proliferation and abnormally short or long internodes and leaves with altered shape and development (Varela-Correa and Franco-Lara, 2020; Franco-Lara *et al*., 2023). Infected strawberry plants show symptoms such as virescence, achenes' hypertrophy and phyllody development that prevent the normal fruit formation (Perilla-Henao and Franco-Lara, 2012; Fernandez *et al*., 2013). In infected grapevines, symptoms vary with the plant variety; however, yellowing, downward rolling of leaves and leaf vein reddening are commonly observed (Gajardo *et al*., 2009). Alfalfa plants infected with *Ca*. P. fraxini' can become stunted and develop small leaves, excessive shoot proliferation and flower abnormalities, although some plants are almost asymptomatic (Conci *et al*., 2005). In plants of infected *Erigeron* sp., *Conyza bonariensis, Gaultheria phillyreifolia* and *Ugni molinae,* the main symptom is the formation of witches´-brooms, while in *Paeonia lactiflora,* plant malformation, necrosis, leaf rolling and flower virescence and flower bud drying are observed (Barros *et al*., 2002; Meneguzzi *et al*., 2008; Arismendi *et al*., 2011). Some infected plants, such as the kikuyu grass *C. clandestinus* are completely asymptomatic (Franco-Lara, 2019).

Morphology

Electronic microscopy observations have shown the presence of pleomorphic translucid bodies of about 1 ?M in the sieve tube elements or companion cells of infected potato plants and Andean oak (*Q. humboldtii*) trees infected with ' *Ca*

. P. fraxini'. These bodies were not observed in tissues other than the phloem. Using electronic microscopy, they were indistinguishable from other phytoplasmas (Lamilla *et al*., 2021; Franco Lara *et al*., 2023).

Detection and inspection methods

Symptoms are important evidence of the occurrence of phytoplasmas; however, their presence should be confirmed by molecular methods. The most common method of detection is amplification of the 16Sr RNA gene by PCR techniques. A commonly used method is detection of the 16SrRNA gene by nested PCR using universal primers for phytoplasmas (Bertaccini *et al*., 2019; Lee *et al*., 1993; Gundersen & Lee; 2006), followed by RFLP analysis or sequencing of the amplicon (Lee *et al*., 1998; Zhao *et al*., 2009). Real-time PCR methods have also been developed to detect '*Ca.* P. fraxini' with universal primers (Christensen *et al*., 2004; Satta *et al.*, 2017).

PATHWAYS FOR MOVEMENT

'*Ca*. P. fraxini' is transmitted locally by insect vectors. Long distance spread of the pathogen can be caused by movement of infected material such as stem cuttings or seed-tubers. Grafting of infected material is also a possible pathway for phytoplasmas movement. There is no evidence of '*Ca*. P. dispersal by seeds.

PEST SIGNIFICANCE

Economic impact

Several of the '*Ca*. P. fraxini' susceptible species are tree or bushes of ornamental and ecological value in wild and urban forests. In these cases, the economic impact of the disease is mainly due to the negative impact on ecosystem services and loss of trees. Direct economic impact can occur in timber trees as well as in crops such as potato, strawberry, alfalfa, and grapevine, although the economic losses have not been estimated.

Control

Currently there are no curative methods against phytoplasma diseases, and resistance or tolerance to these pathogens is rare. Classical approaches include roguing, and insecticide treatments can be used against vectors, although these measures do not eliminate completely the source of inoculum. Integrated pest management strategies can be designed but require knowledge of the particularities of each pathosystem such as the susceptibility of the plant hosts, the insect vectors involved and their feeding habits. In economically important systems, symptoms and insect vector appearance should be permanently monitored to take further management decisions. For instance, tubers obtained from potato fields infected with phytoplasmas should not be used as seed-tubers for future planting seasons. Infected plants should not be used as propagating or grafting materials. Elimination of infected weeds is recommended, but it is not a definitive control measure. Using phytoplasma-free planting material should be a priority and molecular tests to confirm the absence of phytoplasmas in them is recommended.

Phytosanitary risk

´*Ca*. P. fraxini' can infect plants in many botanical families. As with other phytoplasmas, its host range is more dependent on the feeding habits of the insect vectors than on the susceptibility of the plant hosts. The phytosanitary risk of ´*Ca*. P. fraxini' relates to its ability to infect woody and herbaceous plants, but so far it has not been associated with any devastating disease.

PHYTOSANITARY MEASURES

In the case of trees and crops, phytoplasma-free planting material should be used and, where appropriate should have been produced in the framework of a certification scheme. It may also be recommended that plants for planting originate from pest-free places of production.

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Datasheet history

This datasheet was first published online in 2023. It is maintained in an electronic format in the EPPO Global Database. The sections on 'Identity', 'Hosts', and 'Geographical distribution' are automatically updated from the database. For other sections, the date of last revision is indicated on the right.

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