

Mini data sheet on '*Candidatus Phytoplasma phoenicium*'

'*Candidatus Phytoplasma phoenicium*' was added to the EPPO A1 List in 2017. A full datasheet will be prepared, in the meantime you can view here the data which was previously available from the EPPO Alert List (added for the second time to the EPPO Alert List in 2015 - deleted in 2017).

'*Candidatus Phytoplasma phoenicium*' (almond witches' broom)

Why: almond witches' broom was brought to the attention of the EPPO Secretariat in 2001 by scientists who observed a new phytoplasma disease causing extensive mortality on almond trees in Lebanon. This new almond disease was added to the EPPO Alert List in 2001. In 2006, the disease was removed from the EPPO Alert List as no particular international action was requested by EPPO member countries. However, since then a rapid spread of almond witches' broom has taken place in Lebanon, a new phytoplasma species '*Candidatus Phytoplasma phoenicium*' has been found to be associated with the disease in Lebanon and Iran, the host range has extended to peach and nectarine, and epidemiological studies have identified potential insect vectors and wild host plants. During discussions with EFSA, concerns about the risks that '*Ca. P. phoenicium*' may present to almond, peach and nectarine crops were raised again. Considering the severity of this disease on several major stone fruit trees, the EPPO Secretariat decided that '*Ca. P. phoenicium*' should be added again to the EPPO Alert List.

Where: symptoms of almond witches' broom were first reported in the 1990s in Southern Lebanon. Later studies showed that the disease had spread to many other *Prunus*-growing regions of Lebanon (detected in 16 out of the 26 Lebanese districts during 2009/2010 surveys). In Iran, symptoms of almond witches' broom disease have been observed in the central and southern parts of the country. Although some genetic variability is observed among phytoplasmas found on stone fruit trees in Iran and Lebanon, '*Ca. P. phoenicium*' has been detected in both countries. This genetic variability might be explained by different epidemiological and environmental situations (e.g. host plants, insect vectors, climate).

EPPO region: Iran, Lebanon.

On which plants: the disease was initially found on almond (*Prunus dulcis*), but later also observed on peach (*P. persica*) and nectarine (*P. persica* var. *nucipersica*). Grafting experiments and molecular analysis have revealed that '*Ca. P. phoenicium*' does not affect apricot (*P. armeniaca*), cherry (*P. avium*), and plum (*Prunus domestica*). During recent studies, '*Ca. P. phoenicium*' has been detected in asymptomatic *Smilax aspera* (Smilacaceae) and in wild almond trees (*Prunus scoparia*), indicating that wild plants probably play a role in the disease epidemiology by acting as reservoirs for the phytoplasma.

Damage: on almond trees, the disease is characterized by shoot proliferation and appearance of witches' broom on the stems, small yellowish leaves, bushy growth, and general dieback. Infected trees either do not produce any fruit, or produce a limited number of deformed fruits, resulting in a practically 100% unmarketable fruit production. Total loss of production usually happens 1-2 years after the onset of the first symptoms. In the case of peach and nectarine, the first symptoms which can be observed are early flowering (15 to 20 days before normal), followed by the early development of all buds on infected branches. In addition, phyllody (during the flowering period), development of serrate, slim, light green leaves, as well as witches' brooms developing from the trunk and the crown of the trees are then observed. Tree mortality has commonly taken place, and it is estimated that over a period of 20 years more than 150 000 trees have been killed in Lebanon. In this country, it

is noted that the disease can be found from coastal areas to mountainous areas (>1200 m), in properly managed orchards, abandoned orchards and isolated wild trees.

Transmission: experiments have shown that the leafhopper, *Asymmetrasca decedens* (Hemiptera: Cicadellidae) is a vector of the disease. During these studies, it has also been found that the incubation period of the disease in plants could exceed one year. It is noted that further research is needed on the mode of transmission of 'Ca. P. phoenicium' by *A. decedens*. In another survey about potential vectors of 'Ca. P. phoenicium' conducted in Lebanon from 2011 to 2013, preliminary transmission experiments have shown that two *Tachycixius* species, *T. viperinus* and *T. cf. cypricus* (Hemiptera: Cixiidae), could transmit the phytoplasma to healthy peach plants. However, further studies are needed to clarify the taxonomic status and biology of these insects, as well as their potential role in disease transmission in orchards.

Pathway: plants for planting of almond (*P. dulcis*), peach and nectarine (*P. persica*, *P. persica* var. *nucipersica*) from Iran and Lebanon, infectious insect vectors?

Possible risks: almond, peach and nectarine are economically important stone fruit crops around the Mediterranean Basin. Extensive tree mortality has been observed, in particular on almond trees in Lebanon. In January 2011, Lebanon decided to list almond witches' broom as a regulated pest and announced that a National plan would be implemented to manage the disease (destruction of infected trees and use of healthy planting material). Control of phytoplasma diseases is difficult in the field, and usually relies on the control of insect vectors and the use of phytoplasma-free planting material. Preliminary experiments have showed that several tissue culture techniques coupled with thermotherapy could produce phytoplasma-free almond plantlets, and thus might be used as a sanitation technique for the production of healthy planting material (e.g. in the framework certification schemes). Because 'Ca. P. phoenicium' is associated with a lethal and emerging disease of several economically important stone fruit crops, it is desirable to avoid its spread within the EPPO region and warn NPPOs about its severe impacts on almond, peach and nectarine fruit production.

Sources

- Abou-Jawdah Y, Abdel Sater A, Jawhari M, Sobh H, Abdul-Nour H, Bianco PA, Molino Lova M, Alma A (2014) *Asymmetrasca decedens* (Cicadellidae, Typhlocybae), a natural vector of 'Candidatus Phytoplasma phoenicium'. *Annals of Applied Biology* 165(3), 395-403.
- Abou-Jawdah Y, Abdel Sater A, Jawhari M, Sobh H, Abdul-Nour H, Bianco PA, Molino Lova M, Alma A. (2014) *Asymmetrasca decedens* (Cicadellidae, Typhlocybae), a natural vector of 'Candidatus Phytoplasma phoenicium'. *Annals of Applied Biology* 165(3), 395-403.
- Abou-Jawdah Y, Abou-Fakhr E, Sobh H, Molino Lova M, Vercesi A, Bianco PA (2010) Almond witches'-broom phytoplasma (*Candidatus Phytoplasma phoenicium*): a real threat to almond, peach and nectarine. *Julius-Kühn-Archiv* 427, 418-420.
- Abou-Jawdah Y, Karakashian A, Sobh H, Martini M, Lee IM (2002) An epidemic of almond witches'-broom in Lebanon: classification and phylogenetic relationships of the associated phytoplasma. *Plant Disease* 86(5), 477-484.
- Abou-Jawdah Y, Karakashian A, Sobh H, Martini M, Lee IM (2002) An epidemic of almond witches'-broom in Lebanon: classification and phylogenetic relationships of the associated phytoplasma. *Plant Disease* 86(5), 477-484.
- Abou-Jawdah Y, Molino-Lova M, Bianco PA, Choueiri E, Fakhr R, Hajj-Hassan S, Haydar L, Al Achi R (2012) Almond witches' broom phytoplasma, officially declared as a regulated pest in Lebanon. Abstract of a paper presented at the 22nd International Conference on virus and other graft transmissible diseases of fruit crops (Roma, 2012-06-3/8), p 21.
- Abou-Jawdah Y, Sobh H, Akkary M (2009) First report of almond witches'-broom ('Candidatus Phytoplasma phoenicium') causing a severe disease on nectarine and peach trees in Lebanon. *Bulletin OEPP/EPPO Bulletin* 39(1), 94-98.
- Casati P, Quaglino F, Abou-Jawdah Y, Picciau L, Cominetti A, Tedeschi R, Jawhari M, Choueiri E, Sobh H, Molino Lova M, Beyrouthy M, Alma A, Bianco PA (2015) Wild plants could play a role in the

diffusion of diseases associated with phytoplasmas of Pigeon pea witches' broom group (16SrIX) (in press).

- Chalak L, Elbitar A, Rizk R, Choueiri E, Salar P, Bové JM (2005) Attempts to eliminate *Candidatus* phytoplasma phoenicium from infected Lebanese almond varieties by tissue culture techniques combined or not with thermotherapy. *European Journal of Plant Pathology* 112(1), 85-89.
- Choueiri E, Jreijiri F, Issa S, Verdin E, Bové J, Garnier M (2001) First report of a phytoplasma disease of almond (*Prunus amygdalus*) in Lebanon. *Plant disease* 85(7), p 802.
- Molino Lova M, Guaglino F, Abou-Jawdah Y, Choueiri E, Sobh H, Casati P, Tedeschi R, Alma A, Bianco PA (2011) Identification of new 16SrIX subgroups, -F and -G, among '*Candidatus* Phytoplasma phoenicium' strains infecting almond, peach and nectarine in Lebanon. *Phytopathologia Mediterranea* 50, 273-282.
- Personal communications with Dr Choueiri (Agricultural Research Institute of Lebanon) and Dr Garnier (INRA, Villenave d'Ornon, France), 2001-05.
- Quaglino F, Kube M, Jawhari M, Abou-Jawdah Y, Siewert C, Choueiri E, Sobh H, Casati P, Tedeschi R, Molino Lova M, Alma A, Bianco PA (2015) '*Candidatus* Phytoplasma phoenicium' associated with almond witches'-broom disease: from draft genome to genetic diversity among strain populations. *BMC Microbiology* 15(148). DOI 10.1186/s12866-015-0487-4
- Salehi M, Salehi E, Abbasian M, Izadpanah K (2015) Wild almond (*Prunus scoparia*), a potential source of almond witches' broom phytoplasma in Iran. *Journal of Plant Pathology* 97(2), 377-381.
- Tedeschi R, Picciau L, Quaglino F, Abou-Jawdah Y, Molino Lova M, Jawhari M, Casati P, Cominetti A, Choueiri E, Abdul-Nour H, Bianco PA, Alma A (2015) A cixiid survey for natural potential vectors of '*Candidatus* Phytoplasma phoenicium' in Lebanon and preliminary transmission trials. *Annals of Applied Biology* 166(3), 372-388.
- Verdin E, Salar P, Danet JL, Choueiri E, Jreijiri F, El Zammar S, Gélie B, Bové JM, Garnier M, Zirak (2003) '*Candidatus* phytoplasma phoenicium' sp. nov., a novel phytoplasma associated with an emerging lethal disease of almond trees in Lebanon and Iran. *International Journal of Systematic and Evolutionary Microbiology* 53(3), 833-838.
- Zirak L, Bahar M, Ahoonmanesh A (2009) Characterization of phytoplasmas associated with almond diseases in Iran. *Journal of Phytopathology* 157(11-12), 736-741.

EPPO RS 2001/094, 2002/083, 2011/042, 2013/035, 2015/035, 2015/097, 2015/213, 2016143

Panel review date 2017-03

(Re)Entry date 2015-11