CAPS Datasheets provide pest-specific information to support planning and completing early detection surveys.

‘*Candidatus* Phytoplasma solani’

Scientific Name

‘*Candidatus* Phytoplasma solani’ Quaglino et al., 2013

Synonym:
Phytoplasma solani

Common Names

Disease:
Bois noir, blackwood disease of grapevine, grapevine yellows, maize redness, stolbur

Phytoplasma:
Bois noir phytoplasma, maize redness phytoplasma, potato stolbur phytoplasma, stolbur phytoplasma, tomato stolbur phytoplasma

Figure 1. A ‘dornfelder’ grape cultivar infected with ‘*Candidatus* Phytoplasma solani’. Courtesy of Dr. Michael Maixner, Julius Kuhn-Institut (JKI).

Type of Pest

Phytoplasma

Taxonomic Position

Class: Mollicutes, **Order:** Acholeplasmatales, **Family:** Acholeplasmataceae

Pest Recognition

This section describes characteristics of the organism and symptoms that will help surveyors recognize possible infestations/infections in the field, select survey sites, and collect symptomatic material. For morphological descriptions, see the Identification/Diagnostic resources on the AMPS pest page on the CAPS Resource and Collaboration website.

Pest Description

Phytoplasmas are plant-pathogenic wall-less bacteria that are typically vectored to plants by phloem feeding insects or transferred by grafting with infected plant material. They are unculturable bacteria and obligate symbionts of plants and insects, generally associated with a variety of characteristic symptoms in many plant species worldwide but also reported in asymptomatic plants. Their taxonomy is primarily determined by phylogenetic analysis of the 16S ribosomal RNA (16S rRNA) gene sequences (Bertaccini et al., 2009). Recently, the use of five additional housekeeping genes (*secY*, *secA*, *rplV-rpsC*, *groEL* and *tufB*) or whole genome sequences has been introduced to support species designation (Bertaccini et al., 2009. ‘*Candidatus* Phytoplasma solani’ (herein abbreviated ‘*Ca*. P. solani’) belongs to the RFLP analysis-based phytoplasma classification group 16SrXII, also known as the Stolbur group. The ‘*Ca*. P. solani’ reference strain STOL1/1 (GenBank accession number AF248959) is a member of subgroup 16SrXII-A. To date, additional phytoplasma strains have been identified, which are classified as ‘*Ca*. P. solani’-related strains and members of 6 distinct subgroups (16SrXII-F, -G, -J, -K, -N and -P), according to their 16S rDNA RFLP pattern (Quaglino et al., 2014; Duduk et al., 2023, Eroglu et al. 2010, Zhao et al., 2009).

‘*Ca.* P. solani’, also known as stolbur phytoplasma, affects a wide range of wild and cultivated plants, including grape (Maixner, 2011) (Fig. 1), corn (Jović et al., 2009), and solanaceous hosts (Ember et al., 2011). Numerous weedy hosts also act as pathogen reservoirs (Quaglino et al., 2014), significantly impacting the epidemiology of diseases associated with ‘Ca. P. solani’. In cultivated grapevines, various ‘*Ca.* P. solani’ -related strains are associated with ‘Bois Noir’ -black wood in French- (BN) disease. Through analysis of their elongation factor Tu (*tuf*) gene sequences, two major molecular type or genotype of the ‘*Ca*. P. solani’ strains have been identified:tuf-a and tuf-b. *Urtica dioica* (stinging nettle) serves as the primary reservoir host for the tuf-a genotype strains (Aryan et al., 2014) and *Convolvulus arvensis* (field bindweed) is generally recognized as the reservoir host for tuf-b genotype strains(Cvrković et al., 2014) (Fig. 2).

Figure 2: a) *Urtica dioica* (stinging nettle), the common reservoir host of the tuf-a genotype of ‘*Ca.* P. solani’, and b) *Convolvulus arvensis* (bindweed), the common reservoir host of the tuf-b genotype. Photo credits: (a) Robert Vidéki, Doronicum Kft., Bugwood.org, (b) Steve Dewey, Utah State University, Bugwood.org

Symptoms

In grapes:

Typical symptoms of Bois noir (BN) disease in grapevines (*Vitis vinifera* L.) include discoloration of leaves and veins, downward curling of the leaf blade often forming a triangular shape, shorter internodes, lack of or incomplete lignification of shoots, which later turn black, abortion of fruit clusters and shriveling of the ripening fruit (Fig.3). In most cultivars, the symptoms of BN disease remain restricted to the infected vines for several years. The disease does not usually kill the infected vines, but grape production can be significantly reduced (Maixner, 2011). Extended remission of visual symptoms and even complete recovery of infected vines are known phenomena, although very unpredictable and still not fully understood (Maixner, 2011). In red grape

Figure 3: Symptoms of ‘*Ca.* P. solani’ infection in grape. Leaf blotching in Pinot Noir grapes (a), leafroll in Kerner grapes (b), leaf blotching (c), short internodal spacing (d), browning of stems (e), and stunted fruit growth (f). Courtesy of Dr. Michael Maixner, Julius Kühn-Institut (JKI).

Cultivars shown: a) Pinot Noir, b) Kerner, c, d, e) Riesling, and f) Dornfelder cultivars, the phytoplasmal infection causes premature leaf reddening. In white grape cultivars, you might observe leaf yellowing and the development of necrotic veins. Shriveled grape clusters occur in both red and white grape cultivars (Maixner, 2011).

In corn:

Symptoms of ‘*Ca* P. solani’ in field corn (*Zea mays* L.) are commonly known as maize redness disease and include midrib, leaf, and stalk reddening, followed by drying out of the entire plant, abnormal ear development, and incomplete kernel set (Fig. 4) (Kovačević et al., 2014). Maize redness (MR) may cause significant economic losses. Environmental factors play a role in both the intensity and incidence of MR, with more severe disease being associated with early-planted fields and hot, dry summers (Jović et al., 2009).

Figure 4: Symptoms of maize redness disease in infected field corn. Photos courtesy of Dr. Jelena Jović, Institute of Plant Protection and Environment, Zemun (RS) eppo.int.

In potato:

Symptoms of ‘*Ca.* P. solani’ in potato (*Solanum tuberosum* L.) include reddening and upward rolling of leaflets, smaller leaves, shortened internodes, and aerial tuber formation (Holeva et al., 2014). Plants grown from infected tubers give rise to normal or spindly sprouts (hair-sprouting) (EPPO, 2025). When normal sprouts arise, symptoms are first apparent about 60 to 80 days after sowing, as a yellowing and rolling of the leaves (Zimmerman-Gries, 1970). This is followed by production of aerial stolons and tubers in different parts of the stems close to the axils (where the leaf meets the stem) (Fig. 5) (Zimmerman-Gries, 1970).

In tomato, pepper and celery:

Tomato (*Solanum lycopersicum* L.) plants infected with '*Ca.* P. solani' typically have thinner leaves, abnormal flower buds with enlarged sepals ('big bud') and malformed fruits (Batlle et al., 2008). Leaves that develop before infection become greenish yellow, especially at the margins, which may roll upward. Lateral shoots develop and give infected plants a bushy profile (EPPO, 2025). Pepper plants (*Capsicum annuum*) show stunting and leaf yellowing, while celery plants (*Apium graveolens* L.) express leaf whitening and stunting (Delić et al., 2016) (Fig. 5).

In wheat, strawberry, and stone fruit:

Wheat (*Triticum aestivum* L.) symptoms of '*Ca*. P. solani' infection are marked by reddening of the upper leaves(Jović et al., 2009), though the incidence and severity of damage in this crop has not been well documented. In strawberry (*Fragaria* × *ananassa* (Weston) Duchesne ex Rozier), symptoms of '*Ca*. P. solani' infection include stunted growth, poor root development, purple leaf discoloration, leafroll, sterile flower formation, and the production of small and deformed fruit (Terlizzi et al., 2006). '*Ca*. P. solani' can infect stone fruit (Quaglino et al., 2013), but it is unclear if there are significant impacts on these hosts. Reported symptoms were similar to peach yellow leafroll disease (PYLR), including early reddening, leaf curling, decline, abnormal fruits, and in some cases chlorosis and death of peach trees (Quaglino et al., 2013).

In weeds:

Bindweed (*Convolvulus arvensis* L.) plants infected by '*Ca*. P. solani' exhibit symptoms of stunting, shoot proliferation, leaf color change and yellowing (Quaglino et al., 2014; Salem et al., 2013). We found no description of typical symptoms in *Urtica dioica* (stinging nettle).

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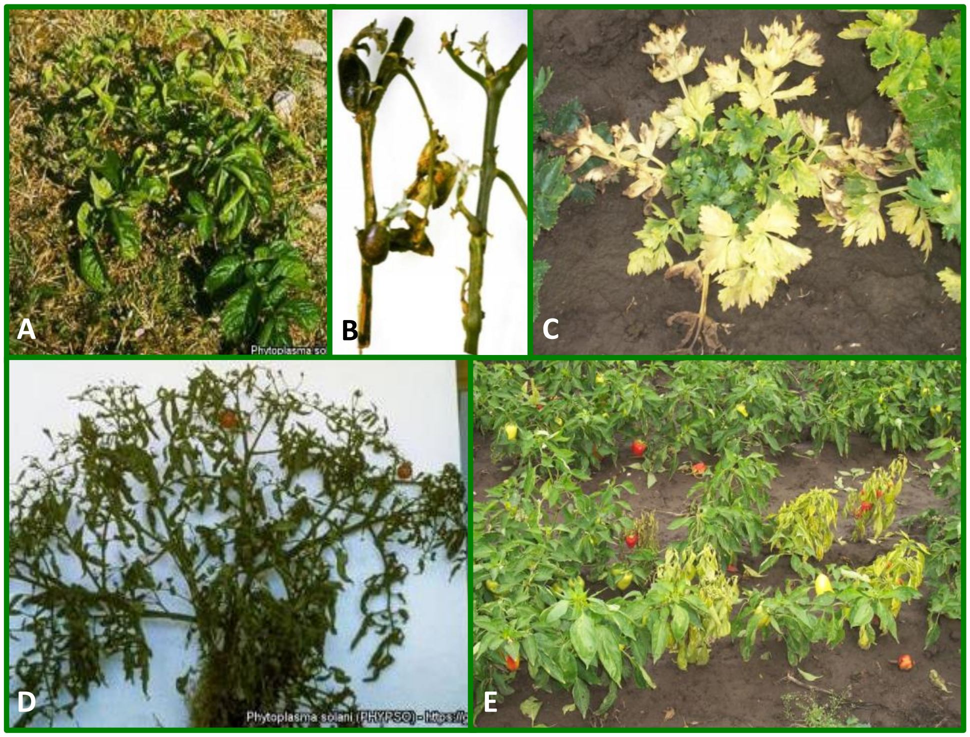

Figure 5: symptoms of ‘*Ca*. P. solani’ infection in potato, including aerial tubers **(A, B)**, celery **(C)**, tomato **(D)**, and pepper **(E)**. Photos (A) and (D) courtesy of Ministry of Agriculture (TR), (B) courtesy of M.T. Cousin, INRA, Versailles, France, (C) and (E) courtesy of Xavier Foissac, INRA.

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Easily Mistaken Species

Other phytoplasmas cause similar symptoms in these hosts and they can only be distinguished by molecular methods.

Grapevine yellows diseases can be caused by a variety of phytoplasmas not known to be present in the United States:

- ‘*Ca*. P. australiense’ causing Australian grapevine yellows. Found in Australia and New Zealand (Davis et al., 1997)
- ‘*Ca*. P. vitis’ causing flavescence dorée. Found in Europe.
- Buckland Valley grapevine yellows phytoplasma (16SrXXIII-A). Found in Australia (Wei et al., 2022).

North American grapevine yellows (NAGY) disease is caused by strains related to '*Ca*. P. asteris' and '*Ca*. P. pruni' (Davis et al. 2015). NAGY is known to occur in Arkansas,

Kansas, Maryland, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Virginia (Costanzo, 2024; Davis et al., 2019; Dermastia et al., 2017).

Both maize bushy stunt disease and corn stunt spiroplasma disease are present in the United States (Nault, 1980; Pérez-López et al., 2016 Bayer, 2024). Maize bushy stunt phytoplasma (MBSP) infected field corns display symptoms of leaf chlorosis, older leaf red coloration, shortening of the internodes and host stunting (Nault, 1980). It is associated with "*Ca.* P. asteris' and '*Ca*. P. pruni'-related strains (Gamarra et al., 2022). Symptoms of corn stunt spiroplasma (CSS) disease include stunting, short internodes, leaf reddening and streaking, and multiple small ears (Bayer, 2024). It is caused by *Spiroplasma kunkelii* (Bai et al., 2002).

Commonly Encountered Non-targets

Grapevine plants infected by the grapevine red blotch virus (GRBV; genus *Grablovirus*, family *Geminiviridae*) display red blotch symptoms on leaf blades (Sudarshana et al., 2015), similar to symptoms in Figure 3a, and GRBV is present in many states (Yao et al., 2018). Peach yellow leafroll disease (PYLR), produces early reddening, leaf curling and abnormal fruits of peach trees (Quaglino et al., 2013). Corn plants with purplish or reddish leaves, stalks and husks are commonly observed in fields late in the growing season due to a buildup of anthocyanin pigments (Berning, 2024). Tomatoes with herbicide damage or genetic aberrations, and peppers infected by fungal pathogens (*Fusarium*, *Verticillium*, *Pythium*, and *Sclerotium* spp.) can sometimes look like symptoms in Figure 5 (d and e) (Pernezny et al., 2003). Tomatoes with bacterial canker may have similar symptoms of upward-rolling leaves and discolored stems (Pfeufer, 2019).

Biology and Ecology

'*Ca*. P. solani' is transmitted to grape, its primary economic host, mainly from weed reservoir hosts by insect vectors (Maixner et al., 1995). Reservoir hosts are vital to the survival and spread of the phytoplasma (EPPO, 2025). The most common weed reservoir hosts are closely associated with vineyards in Europe, with *Convolvulus arvensis* (field bindweed) growing between rows as ground cover and *Urtica dioica* (Stinging nettle) growing outside the vineyards in ditches (Maixner et al., 1995;Maixner, 2011; Mori et al., 2012; Pavan et al., 2024). Both *Convolvulus arvensis* and *Urtica dioica* are widely present in the U.S. (NRCS_USDA, 2025), and weed removal is an effective practice for BN control in vineyards (Pavan et al., 2024; Pierro et al., 2024).

The planthopper, *Hyalesthes obsoletus* (Fig. 6, left), is the most important vector in Asian and European countries and *Reptalus panzeri* (Löw, 1883) (Fig. 6, right) is an important vector in the Balkans (Maixner, 1994;Maixner, 2011;Johannesen et al., 2012; Cvrković et al., 2014). Under experimental conditions, the incubation (latent) period of '*Ca*. P. solani' in the vector *H. obsoletus* was 2 to 7 days (Neklyudova et al., 1973), while the latent period in *R*. panzeri is unknown. There are other minor vectors, but they are unlikely to play a significant role in the transmission of the pathogen (Table 1) and have longer incubation periods ranging from 1 to 2 months (Neklyudova et al., 1973).

Hyalesthes obsoletus acquires and transmits the phytoplasma to grapevine at a high rate, and few insects are required for significant spread of the disease, making this species the most important vector for '*Ca*. P. solani' (Bressan et al., 2007)

Nymphs of *H. obsoletus* overwinter in the soil as second or third instars, feeding on the roots of infected weed hosts, such as bindweed and stinging nettle, from which they acquire '*Ca.* P. solani' (Mori et al., 2020). When they become adults, *H. obsoletus* feed erratically on grapevine but transmit the phytoplasma at a high rate, making chemical control of the vector ineffective in preventing transmission (Bressan et al., 2007). The intermittent relationship of the planthopper with grapes means that the distribution of BN is not correlated to the presence of insect vectors, but is rather closely associated with the presence of reservoir weed hosts (Maixner, 2011).

Figure 6: Left: *Hyalesthes obsoletus* (Michael F. Schönitzer, Creative Commons), Right: *Reptalus panzeri* (Courtesy of Gernot Kunz, Karl-Franzens University of Graz, Austria).

Reptalus panzeri is not as well studied as *H. obsoletus,* but is known to transmit the phytoplasma to both grape and corn (Jović et al., 2009;Cvrković et al., 2014). In corn, it lays eggs in the soil, where the nymphs acquire the phytoplasma by feeding on infected roots (Jović et al., 2009). This vector's contribution to BN epidemiology in grapevine is unknown.

In solanaceous hosts, disease outbreaks seem to occur in cycles with the most severe attacks occurring when hot, dry conditions force the vectors to move from infected weeds to cultivated solanaceous plants, which are not preferred hosts. It is unclear whether vectors spread *Ca*. P. solani between solanaceous hosts in the same field during outbreaks (EPPO, 2025).

Known Hosts

Grape is the primary host. There are numerous other reported plant hosts of '*Ca.* P. solani', but the literature is either contradictory or does not detail the damage or losses caused by this disease. Therefore, we have listed any species that are uncertain hosts (Other Hosts below) separately until additional information becomes available.

The host list below includes cultivated and wild plants that 1) are infected by the pathogen under natural conditions, 2) are frequently described as major, primary, or preferred hosts, and 3) have primary evidence damage documented in the literature. Plants are highlighted in bold if they are commercially produced and the pathogen causes economically significant damage.

Major Hosts

Apium graveolense (celery), *Capsicum annuum* (pepper) (Delić et al., 2016), *Fragaria×ananassa* (strawberry) (Hodgetts et al., 2015), *Prunus* spp. (stone fruits) (Quaglino et al., 2013), ***Solanum lycopersicum*** (tomato) (Ember et al., 2011), ***S. tuberosum*** (potato) (Ember et al., 2011), *Triticum aestivum* (wheat) (Jović et al., 2009), ***Vitis vinifera*** (grape) (Quaglino et al., 2013), ***Zea mays*** (corn) (Quaglino et al., 2013)

Other Hosts

Beta vulgaris (sugar beet) (Ember et al., 2011), *Cichorium intybus* (chicory) (Pavlovic et al., 2014b), *Daucus carota* (carrot) (Mitrovic et al., 2021), *Eucalyptus camaldulensis* (river red gum) (Baghaee-Ravari et al., 2018), *Helianthus annuus* (sunflower) (Avramov et al., 2016), *Hibiscus cannabinus* (kenaf) (Chinmay et al., 2014), *Lavandula angustifolia* (lavender) (Chuche et al., 2018), *Pistacia vera* (pistachio) (Zamharir, 2018), *Pisum sativum* (pea) (Quaglino et al., 2013), *Salvia miltiorrhiza* (red sage) (Yang et al., 2016), *Solanum melongena* (eggplant) (Ember et al., 2011), *Sophora alopecuroides* (sophora root) (Allahverdi et al., 2014)

Wild Hosts

Calendula officinalis (common marigold) (Pavlovic et al., 2014a), *Convolvulus arvensis* (bindweed) (Quaglino et al., 2014), *Datura stramonium* (jimson weed) (Lotos et al., 2013), and *Urtica dioica* (stinging nettle) (Atanasova et al., 2015)

Pest Importance

This phytoplasma is one of the most important diseases of grapevine in Europe (Johannesen et al., 2008) and could pose a serious threat to grape, corn, potato, tomato and other crops in the United States if it were established. These are multi-billion dollar commodities cultivated on millions of acres in the United States (USDA-NASS, 2024).

The effects of this pathogen are well documented. Under severe conditions, yield losses from diseases caused by '*Ca*. P. solani' could be as high as 40-90% in corn (Jović et al., 2007), 68% in grapevine (bois noir, BN) (Ember et al., 2018), 30–80% in potato (EFSA, 2014), 60% in tomato, 90% in pepper, and 100% in celery (Navrátil et al., 2009).

'*Ca.* P. solani' is listed as a harmful organisms in 36 countries, including Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Moldova, Montenegro, North Macedonia, Serbia, Russia, Ukraine, and EU member countries (EPPO, 2024). If the phytoplasma were found in the United States, potential trade impacts with these countries could result, although the pathogen is already established in some of these countries (see Known Distribution).

Known Vectors (or associated insects)

'*Ca.* P. solani' is vectored by numerous planthoppers in the Cixiid and Cicadellid families (Maixner, 1994;Maixner, 2011;EPPO, 2025;Březíková et al., 2007;Batlle et al., 2008;Jović et al., 2009;EFSA, 2014) (Table 1). The most important vector is *Hyalesthes obsoletus*, which transmits '*Ca*. P. solani' to grape, potato, and tomato. Another important vector is *Reptalus panzeri*, which transmits '*Ca*. P. solani' to both grape and corn (Cvrković et al., 2014).

Table 1: A list of insects known to carry '*Ca.* P. solani'. Important vectors in bold.

Anaceratagallia ribauti	*Lygus pratensis*
Anoscopus albifrons	*Lygus rugulipennis*
Aphrodes bicinctus	*Macrosteles cristatus*
Dictyophara europaea	*Macrosteles incisus*
Euscelis lineolatus	*Macrosteles laevis*
Euscelis incisus	*Macrosteles quadripunctulatus*
Euscelis plebeja	*Macrosteles viridigriseus*
Exitianus capicola	*Pentastiridius leporinus*
Hyalesthes obsoletus	***Reptalus panzeri***
Hyalesthes phytoplasmakosiewiczi	*Reptalus quinquecostatus*
Lygus gemellatus	*Speudotettix subfusculus*

Known Distribution

Africa: Niger (Reckhaus et al., 1988). **Asia**: China, India, Iran, Israel, Japan, Jordan, Kyrgyzstan, Lebanon, Saudi Arabia, Taiwan, Tajikistan, Uzbekistan (Chinmay et al., 2014;Gao et al., 2013;Quaglino et al., 2013;Salem et al., 2013;EPPO, 2024;Choueiri et al., 2002;Bau et al., 2011;Shimomoto et al., 2020). **Europe**: Albania, Armenia, Austria, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, France, Georgia, Germany, Greece, Hungary, Italy, Kosovo, Macedonia, Moldova, Montenegro, Poland, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Turkey, Ukraine (Mitrev et al., 2007;Balakishiyeva et al., 2010;Bobev et al., 2013;Kovačević et al., 2014;Lotos et al., 2013;Quaglino et al., 2013;Starović et al., 2013;Quaglino et al., 2014;EPPO, 2024;Bunjaku et al., 2022). **Caribbean**: Cuba (Quaglino et al., 2013) **South America**: Chile (Gajardo et al., 2009).

In 2006, '*Ca*. P. solani' was found in British Columbia, Canada, in grapevines that were imported from Europe the same year (Rott et al., 2007). Every plant from this lot was destroyed, and there have been no additional detections of '*Ca*. P. solani' in Canada.

In 2014, '*Ca*. P. solani' was found in symptomatic strawberry plants in Norfolk, United Kingdom (Hodgetts et al., 2015). The infected plants, which were imported from Spain, were destroyed. EPPO evaluated the situation and confirmed that the pathogen had been successfully eradicated (EPPO, 2024).

This phytoplasma is native to Bosnia and Herzegovina, Croatia, France, Italy, Kosovo, Montenegro, Russia, Serbia and Slovenia (Cousin et al., 1968; Panjan, 1950; Sukhov et al., 1946). '*Ca.* P. solani' has been introduced, and is most likely established, in Albania, Austria, Bulgaria, the Czech Republic, Germany, Greece, Hungary, Poland, Slovakia, Spain, and Switzerland (EPPO, 2024).

This pathogen has not been reported in the United States.

Pathway

'*Ca.* P. solani' is most likely to enter the United States through infected propagation materials (rootstocks, cuttings, and other grafting materials). *Vitis* and *Zea* are NAPPRA for all plant parts except seeds, except *Vitis* plants for planting are permissible from Canada. While some minor hosts can be imported, whether or not these minor hosts could be a source of *Ca.* P. solani is unclear. The import of *Fragaria* spp. (strawberry) plant material is allowed from Israel (USDA, 2025) which is known to have '*Ca.* P. solani'. The find of '*Ca*. P. solani' in the UK on strawberry plants, which were imported from Spain (Hodgetts et al., 2015) demonstrates that the phytoplasma can be transported in this manner. Potato (*Solanum tuberosum*) seeds are permissible from Canada, Chile and New Zealand while herbaceous plants of potato from Canada for planting is also permissible (USDA, 2025). Tomato (*Solanum lycopersicum*) seeds are permissible from world-wide countries, and tomato plants for planting are permissible from Canada and Mexico (USDA, 2025).

Phytoplasmas are not known to be seed-transmissible (CABI, 2024).

While the introduction of infected insect vectors into the United States might be a potential pathway, '*Ca.* P. solani' is not transmitted vertically (from mother to offspring) (EFSA, 2014) and the retention time of the phytoplasma within the vector is uncertain.

Use the PPQ ACIR manual listed below to determine 1) if host plants or material are allowed to enter the United States from countries where the organism is present and 2) what phytosanitary measures (e.g., inspections, phytosanitary certificates, post entry quarantines, mandatory treatments) are in use. These manuals are updated regularly.

Agricultural Commodity Import Requirements (ACIR) manual: ACIR provides a single source to search for and retrieve entry requirements for imported commodities. https://acir.aphis.usda.gov/s/

Potential Distribution within the United States

For '*Ca*. P. solani' to establish and spread in the United States, the phytoplasma, a vector, and susceptible plant hosts are required. *H*. *obsoletus* and *R*. *panzeri*, the most important vectors for the phytoplasma, are not currently present in the United States or the western hemisphere. However, similar hemipteran insects or sucking pests already present in the United States may be able to vector this phytoplasma. While transmission through infected planting material is possible, it is likely to be contained by phytosanitary measures, if appropriately applied (EPPO, 2025; Maixner, 2011). The main reservoir hosts of '*Ca*. P. solani', *Convolvulus arvensis* and *Urtica dioica* are both widespread throughout the United States and present in every state (BONAP, 2015). We found no evidence for any of the known minor vectors for this phytoplasma being in the United States.

Survey and Key Diagnostics

Approved Methods for Pest Surveillance*:

For the current approved methods and guidance for survey and identification, see Approved Methods for Pest Surveillance (AMPS) pest page on the CAPS Resource and Collaboration website, at https://approvedmethods.ceris.purdue.edu/.

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Versions

January 2025 (Version 2)

- Edited Figures1, 2 and 3 in the **Pest Recognition** section.
- Revised pest description in the **Pest Recognition** section.
- Revised BN symptoms on host plants and added bindweed (*Convolvulus arvensis*) symptom in the **Pest Recognition** section.
- Revised **Easily Mistaken Species** section.
- Revised **Commonly Encountered Non-targets** section.
- Revised **Biology and Ecology** section.
- Revised **Known Hosts** section.
- Revised **Pest Importance** section.
- Revised **Known Vectors (or associated insects)** section.
- Revised **Pathway** section.
- Revised **Potential Distribution within the United States** section.
- Added BN symptom on weed and revised **Survey and Key Diagnostics** section.
- Revised **References** section.

Reviewer

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