EPPO Datasheet: *Xiphinema americanum sensu stricto*

Last updated: 2023-10-10

Datasheets on *Xiphinema americanum sensu lato*, *Xiphinema bricolense*, *Xiphinema californicum* and *Xiphinema rivesi* are also available in Global Database.

IDENTITY

Preferred name: *Xiphinema americanum sensu stricto*
Authority: Cobb
Taxonomic position: Animalia: Nematoda: Enoplea: Dorylaimida: Longidoridae
Other scientific names: *Tylencholaimus americanus* (Cobb) Micoletzky, *Xiphinema americanum* Lamberti & Bleve-Zacheo
Common names: American dagger nematode, tobacco ring nematode
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EPPO Categorization: A1 list
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EU Categorization: Quarantine pest ((EU) 2019/2072 Annex II A)
EPPO Code: XIPHAA

Notes on taxonomy and nomenclature

Xiphinema americanum sensu stricto (s.s). Cobb, 1913 is a member of the *Xiphinema americanum sensu lato (s.l.)* group which comprises 64 nominal species (EPPO, 2017; Mobasseri *et al*., 2019; Lazarova *et al*., 2019; Vazifeh *et al* ., 2019). Most members of the group are difficult to distinguish both morphologically and biochemically. Furthermore, no reliable molecular tests to distinguish between members of *X. americanum s.l.*, or for the identification of species that have been confirmed as virus vectors can be recommended yet. Therefore, although it is difficult, identification remains reliant on morphological identification.

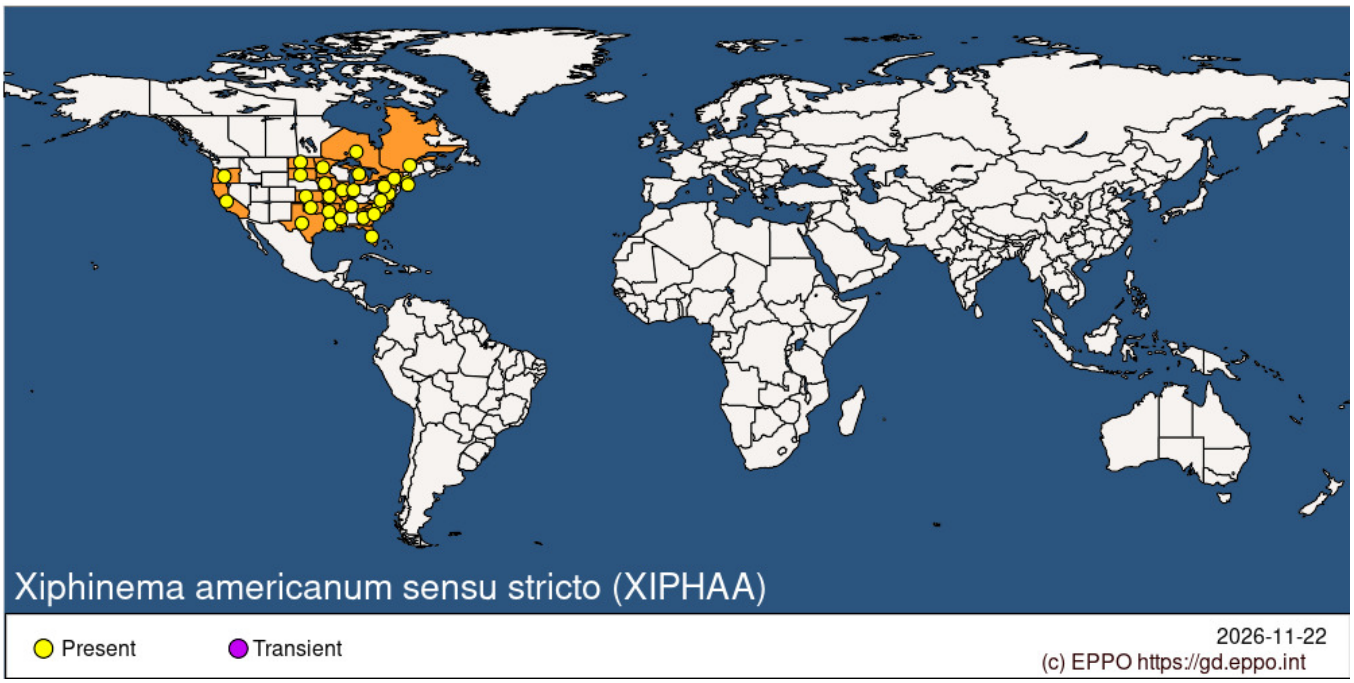
HOSTS

X. americanum s.s. appears to be non-specific with regard to host plants, having been recorded from agricultural, horticultural and forest soils. The host plants of particular quarantine significance are those to and from which *X. americanum s.s.* transmits viruses. Brown *et al*. (1994) reported that *X. americanum s.s.* transmits cherry rasp leaf virus (CRLV) (*Cheravirus*), tobacco ringspot virus (TRSV) (*Nepovirus*) and tomato ringspot virus (ToRSV) (*Nepovirus*). Klos *et al*. (1967) reported *X. americanum s.l.* as a vector of peach rosette mosaic virus (PRMV) (*Nepovirus*); however, it is unclear whether *X. americanum s.s.* can vector PRMV. The ability to transmit virus may also vary among different populations of the same nematode species (Griesbach & Maggenti, 1989). Brown *et al*. (1984) noted the broad-spectrum virus transmission capabilities of the North American populations compared with the relatively narrow specificity of transmission that exists between indigenous European viruses and their vector species. Important host plants of these viruses include *Malus* spp., *Prunus* spp. (plum, cherry and peach), *Vitis* spp. (Taylor & Brown, 1997). The host plant range of these viruses is wide, including woody and ornamental plants and several weed species.
It was recently recorded as causing damage of potato (Goraya *et al*., 2023).

Host list: *Malus, Prunus avium, Prunus domestica, Prunus persica, Prunus, Rosa sp., Solanum tuberosum, Vitis vinifera, Zoysia sp.*

GEOGRAPHICAL DISTRIBUTION

X. americanum s.s. has been reported from North America and has not been reported in the EPPO region.



North America: Canada (Ontario, Québec), United States of America (Arkansas, California, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New York, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia)

BIOLOGY

X. americanum s.s. is a migratory ectoparasite and spends its entire life cycle in the soil, moving in the moisture film covering soil particles. The individuals appear to be attracted to young growing roots where they feed by puncturing, with their stylet, several successive layers of cells and extracting cytoplasm. Females produce eggs parthenogenetically (males being rare or absent). The number of developmental stages for this species is unclear, data indicates the possibility of either 3 or 4 juvenile development stages. Alkemada and Loof (1989) reviewed the literature on *X. americanum s.l.* juveniles and reported that some published measurements clearly indicated four juvenile stages, while three larval developmental stages were also reported (Halbrendt & Brown, 1992; Robbins *et al* ., 1996). The life cycle requires at least 1 year to complete. Optimum temperatures for reproduction are 20-24°C (Hunt, 1993). There is no specialized long term survival stage however, all stages have been found to survive and mature (but not multiply) in soil in the absence of a host. The nematode does not survive long periods in frozen soil, and in areas of low winter temperatures overwintering is mainly in the egg stage. Where the soil is not frozen, all stages can survive over winter.

X. americanum s.s. is an efficient vector of several viruses, with adults and juvenile stages able to transmit viruses (McGuire, 1964; Teliz *et al.*, 1966). However, the viruses do not persist during the successive juvenile developmental stages (Bitterlin & Gonsalves, 1986; Hunt, 1993; Brown *et al.*, 1994; Taylor & Brown, 1997). When the nematode feeds on a virus-infected plant, virus particles are extracted from the cells within the cytoplasm, and these adhere to the lining of the stylet and pharynx. The virus particles are injected into the next healthy plant on which the nematode feeds. Nematodes may transmit virus acquired up to 2 years previously (Bitterlin & Gonsalves, 1987).

DETECTION AND IDENTIFICATION

An EPPO diagnostic protocol is available for *Xiphinema americanum sensu lato* (EPPO, 2017) as well as an IPPC

Diagnostic Protocol (IPPC, 2016).

Symptoms

Plants roots attacked by *X. americanum s.s.*, in the absence of a virus, generally exhibit no clear characteristic symptoms in the aerial parts. Symptoms are most often similar to those resulting from environmental stresses. With high population densities, a general reduction in vigour is observed and this appears in characteristic patches in the crop corresponding to the highest concentration of nematodes (Heve *et al*., 2015). When nematode feeding results in virus transmission the characteristic symptoms of the particular virus develop in the crop. These usually first appear in the aerial parts of the plant in the growing season after transmission to the roots has occurred. However, some host plants remain symptomless after infection and therefore may escape detection (NVWA, 2010).

Morphology

X. americanum s.s. nematodes are minute, soft-bodied, vermiform and almost transparent. They have a hard, needle-like stylet (odontostyle and odontophore) at the mouth-end of the body. General morphological characteristics of *X. americanum s.s.* are relatively short compared to other non *X. americanum s.l.* species (usually <150 ?m) stylet (odontostyle + odontophore), thick cuticular lining of the pharynx, males usually absent or rare, female genital branches equally developed, uterus short and without Z-organ, presence of symbiotic bacteria surrounding the oocytes and in the intestines of juveniles, short conoid tail with rounded terminus, females without sperm present in uteri or oviduct.

Detection and inspection methods

X. americanum s.s. can be detected by extraction from soil or growing media (as is the case with most ectoparasitic plant?parasitic nematodes). Nematode extraction techniques, such as the Flegg?modified Cobb technique (Flegg, 1967) or Oostenbrink (Oostenbrink, 1960) or other suitable elutriation methods can be used for extraction of longidorid nematodes. Migratory endoparasites may also be present in soil residues adhered to plant roots, bulbs and tubers. Consequently, *X. americanum s.s.* may be found following processing of plant material using other methods such as modified Baermann processes. Detailed descriptions of extraction equipment and procedures can be found in EPPO PM 7/119 Nematode extraction (EPPO, 2013). Following extraction, nematodes are examined using high-power microscopy in order to identify the specimens.

PATHWAYS FOR MOVEMENT

X. americanum s.s. spends the entirety of its life cycle in the soil, feeding on roots of host plants. It can only live in moist soil where it can move at most 1 m per year, unless assisted by run-off. Bare rooted plants free from soil are not a pathway for movement. The pest is transported solely in soil associated with plants for planting, plant products, bulk soil and any other goods contaminated with soil. Spread over longer distances is possible in moist soil transported with or without plants. Soil and growing media attached to (agricultural) machinery, tools and packaging materials may also constitute a pathway for movement, but such soil may dry out and consequently lead to reduced viability of the pest.

PEST SIGNIFICANCE

Economic impact

The importance of *X. americanum s.s.* is linked to its capacity to vector of the following American viruses (Taylor & Brown, 1981), which are important mainly on fruit crops: ToRSV, TRSV, CLRV and PRMV.

Both ToRSV and TRSV have wide host ranges. Reported effects of the viruses on economically important crops were performed by NVWA (2010). Adverse economic effects caused by ToRSV are principally related to fruit crops, particularly grapes and raspberries. In grapes, yield reductions between 37 and 63% were reported in vineyards in New York, USA. Fifty percent yield reductions were reported in some raspberry cultivars whilst other cultivars were

unaffected. ToRSV was also implicated in apple union necrosis and decline in American apple orchards. Severe losses have also been reported on blueberry in New York and peach in Pennsylvania. The virus is known to infect species of *Prunus*, *Ribes* spp. and *Rubus* spp., however it was not detected in neighboring peach orchards (Sertkaya, 2010). Among the horticultural crops ToRSV has been reported to produce symptoms on leaves of pelargonium, making plants unmarketable. In Lithuania, ToRSV was detected in 4.6% of one raspberry cultivar (Stankiene *et al*., 2012), although impacts due to the virus infection are unknown. TRSV causes yield losses in soybean and blueberries in the USA. Serious losses were also reported in grapes in vineyards affected by a mixed infection of TRSV and ToRSV. The virus also affects cucurbits but causes only minor damage to these crops. Elsewhere, 60-80% yield losses were reported in aubergine in India and minor losses were reported in capsicum in Mexico (FERA, 2014).

After introduction into the production area, the virus associated with its vector will spread slowly since the nematodes will spread naturally 1 m at maximum per year. The virus and its vector may spread over longer distance mainly with trade of plants with soil attached but the total infested area will however increase slowly. Thus, on the short term, e.g. the first 10 years after introduction the impact is assessed to be low and only very locally impact may occur. Longer term (decades), the virus-vector combination is expected to spread further mainly by human assistance and the impact may become similar to that in the USA where both the virus and vector are present. In Europe the impact of ToRSV and/or TRSV in combination with the vector may become higher than in the USA because of the limited availability of soil fumigants in Europe. The potential impact of the viruses in combination with the vector in Europe was assessed as follows (NVWA, 2010):

- - ToRSV: high impact for several fruit crops.
  - TRSV: high impact for blueberry and probably also for grapes.
  - CLRV: low impact.
  - PRMV: low impact.

Control

Control of viruliferous nematodes in the field is problematic. Disinfection of soil can be carried out by physical (heat, steam) or chemical (nematicides) treatments. However, the efficacy of these measures is limited (it is considered that the efficacy never reaches 100%) and the nematodes that remain in the soil can still transmit viruses to the roots of the host plants (EFSA, 2018). Soil disinfection by physical treatments does not eliminate nematodes under field conditions due to the vertical distribution (depth) of the nematode which depends on availability of roots of host plants and moisture regime (EFSA, 2018). The use of nematicides is restricted in EPPO countries (e.g. EU countries) and at present, no methods are available to control nematode populations in an established orchard (NVWA, 2010).

Keeping the soil free from plants for over 2 years will significantly reduce the nematode population.

Phytosanitary risk

The main phytosanitary risk for the EPPO region is linked to the capacity of *X. americanum s.s.* to transmit three American viruses CRLV, TRSV and ToRSV, which are also quarantine pathogens. *X. americanum s.s.* may thus introduce or spread these viruses.

If the viruses were introduced or spread in the EPPO region, introduction of the vector nematodes would create an additional phytosanitary risk of more rapid spread, and more complex measures for the certification of virus-free material of fruit crops would be needed. Populations of *X. americanum s.s.* from outside the EPPO region, especially those from North America, could establish and spread in the EPPO region.

Natural spread of the nematode (and associated viruses) is slow and considered to be at maximum 1 m per year. The virus and its vector may spread over longer distance with trade of plants with soil attached but the total infested area will increase slowly. Thus, on the short term, e.g. the first 10 years after introduction the impact is deemed to be low (NVWA, 2010) and only very local impact may occur. On a longer term (decades), the virus-vector combination is expected to spread further mainly by human assistance and the impact may become similar to that in the USA where both the virus and vector are present (NVWA, 2010). In Europe the impact of ToRSV and TRSV in combination

with the vector may become higher than in the USA because of the limited availability of soil fumigants.

There are numerous reports of TRSV and ToRSV detection in the EPPO region, however, most relate to interceptions, are under eradication and are not known to be widely distributed. CRLV is not known to be present in the EPPO region.

Klos *et al.*, (1967) reported *X. americanum s.l.* species as a vector of PRMV, it is unclear whether, *X. americanums.s.* can vector PRMV. Should *X. americanum s.s.* be proven as a vector of PRMV this would result in additional risk as PRMV was detected at a low incidence in west Anatolia, Türkiye during almond nursery trees survey in 1992 and 1993 (Azerý & Çýçek, 1997).

PHYTOSANITARY MEASURES

It can be recommended that soil from non-EPPO countries where *X. americanum sensu s.s.* occurs should be prohibited. Plants with roots may also be prohibited or precautions should be taken to ensure that the nematodes will not be carried in the roots. The field from which the plants came should have been tested and found free from the nematodes and, if the plants were in a growing medium, that must be either inorganic or have been tested, or treated against nematodes. If this is not the case, soil or growing medium attached to the plants can be removed and after removal, the plants can be repotted in pest-free soil or growing medium before export. Plants should have then been kept under special conditions to avoid the risk of reinfestation.

Soil or growing medium can be treated to kill nematodes by heating to 60°C and maintaining at that temperature for 1 h.

The use of certified or tested plants for planting, grown under specific conditions to prevent infestation help to reduce the risk of introduction and spread of TRSV, ToRSV and CRLV and *X. americanum s.s.* vector nematodes. Only planting material originating from areas where these viruses and their vector have not been reported, and where surveillance is carried out to confirm the absence of the pest (Pest Free Area, Pest Free Production Site) could be declared as pest free material and could be therefore used in the EU (Jager *et al.*, 2018). The use of certified or tested plants for planting help to reduce the risk of introducing and spreading of viruses not present or having a limited distribution in the region, and of their vector nematodes. Only planting material originating from areas where these viruses and their vector nematodes have not been reported, and where surveillance is carried out to confirm the absence of the pest (Pest Free Area, Pest Free Production Site) can be declared as pest free material.

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ACKNOWLEDGEMENTS

This datasheet was prepared in 2023 by Tom Prior. His valuable contribution is gratefully acknowledged.

How to cite this datasheet?

EPPO (2026) *Xiphinema americanum sensu stricto*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Datasheet history

This datasheet was first published in the EPPO Bulletin in 1984 and revised in the two editions of 'Quarantine Pests for Europe' in 1992 and 1997 (as part of *Xiphinema americanum*), as well as in 2023. It is now 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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Co-funded by the European Union