EUROPEAN AND MEDITERRANEAN PLANT PROTECTION ORGANIZATION
ORGANISATION EUROPEENNE ET MEDITERRANEENNE POUR LA PROTECTION DES PLANTES

24-29158

Report of a Pest Risk Analysis for *Toumeyella parvicornis*

A colony of females of *Toumeyella parvicornis* with mobile juvenile (nymphs).
Courtesy: Eric Chapin – EPPO Global Database (EPPO Code: TOUMPA)

An EFSA pest categorisation for *Toumeyella parvicornis* was prepared in 2022 (EFSA PLH Panel, 2022). In March 2023, based on the review of the EPPO Alert List and the EFSA pest categorization, *T. parvicornis* was identified by the EPPO Panel on Phytosanitary Measures as a candidate for a pest risk analysis (PRA) review, which was prepared by the EPPO Secretariat and reviewed by the Panel on Phytosanitary Measures in October 2023. The draft PRA report was then prepared by Mr Eyre and included targeted literature searches conducted to make it more representative to the whole EPPO region and to update the analysis with recent publications. The PRA report was presented to the meeting of the Panel on Phytosanitary Measures in March 2024. An Express PRA prepared in Ireland (DAFM, 2022, revised in 2024) was also consulted. The probabilities of entry, establishment, spread, and potential impact have been established by the Panel on Phytosanitary Measures for the EPPO region on a five-level scale (very low, low, moderate, high, very high) with a three-level scale of uncertainty (low, moderate, high).

Pest: *Toumeyella parvicornis,* pine tortoise scale

PRA area: EPPO region

Assessors: EFSA pest categorisation: EFSA Panel on Plant Health (PLH) (2022),
DAFM Express Pest Risk Analysis: *Toumeyella parvicornis:* Department of Agriculture, Food and the Marine of Ireland, 2022 (revised in 2024).
PRA report: Mr Dominic Eyre, Defra, GB, with subsequent discussions in the Panel on Phytosanitary Measures.

Dates: The EFSA pest categorisation was adopted by the EFSA Panel on Plant Health on 27 January 2022. It was reviewed by the Panel on Phytosanitary Measures in October 2023. The PRA report was prepared in February 2024 and presented to the Panel in March 2024. It was sent to the Panel on Quarantine Pests for Forestry on 30 April 2024.

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Based on this PRA report, *Toumeyella parvicornis* is recommended for addition to the EPPO A2 List of pests recommended for regulation as quarantine pests. Measures for *Pinus* spp. plants for planting (except seeds, tissue culture and pollen) and cut branches (including Christmas trees) are recommended.

STAGE 1: INITIATION

Reason for doing initial PRA: *Toumeyella parvicornis* is a scale insect pest of *Pinus* spp. which was first described from Florida (US) in 1897 and was only known to occur in North America until the early 2000s. It was accidentally introduced into Turks & Caicos Islands (2005) and Puerto Rico (2009) where it was found on endemic pine species (*P. caribaea* var. *bahamensis* and *P. caribaea* var. *hondurensis*, respectively). In 2014, its presence was first recorded in Italy, in several municipalities of Campania region (Naples and neighbouring municipalities), infesting *Pinus pinea* in urban environments. By 2020, the pest had spread to a larger area along the coast from Caserta to Salerno causing serious damage. In 2018, *T. parvicornis* was also found in the city of Rome (Lazio) damaging pine trees and raising concerns among the public, as *P. pinea* is an iconic tree in the city landscape. Following an outbreak and an EFSA horizon scanning in 2020, a pest categorization was performed. In 2021, *T. parvicornis* was found in France in a limited area in Saint-Tropez and Ramatuelle (Var Department, Province Alpes-Côte d'Azur). The pest was added to the EPPO Alert List in 2021.

Taxonomic position of pest: Insecta: Hemiptera: Coccidae: ***Toumeyella parvicornis***, pine tortoise scale.

STAGE 2: PEST RISK ASSESSMENT

PROBABILITY OF INTRODUCTION

Entry

Geographical distribution:
(Source: EPPO Global Database: https://gd.eppo.int/taxon/TOUMPA/distribution; last consulted 06 March 2024)

Toumeyella parvicornis is native to North America (Bertin et al., 2022) (Fig. 1).

Canada: Manitoba, Ontario, Quebec.

USA: Alabama, California, Colorado, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, West Virginia, Wisconsin.

Mexico.

Turks and Caicos Islands (introduced in 2005).

Puerto Rico (introduced in 2009).

France: found in 2021 in a limited area in Saint-Tropez and Ramatuelle (Var Department, Province Alpes-Côte d'Azur).

Italy:
Abruzzo (Bertin et al., 2022; Somma et al., 2023).
Campania: First found in 2014 (Bertin et al., 2022); 203 out of 550 municipalities are known to be infested and 28% of 2 700 sites surveyed were infested (Somma et al., 2023).
Lazio (Bertin et al., 2022; Somma et al., 2023).

Puglia (Bertin et al., 2022; Somma et al., 2023): It was first detected in the region in July 2021 in Bari (Tagarelli et al., 2022).
Tuscany (Bertin et al., 2022; Somma et al., 2023).

Updated geographical distribution is available in the EPPO GD (https://gd.eppo.int/taxon/TOUMPA/distribution)

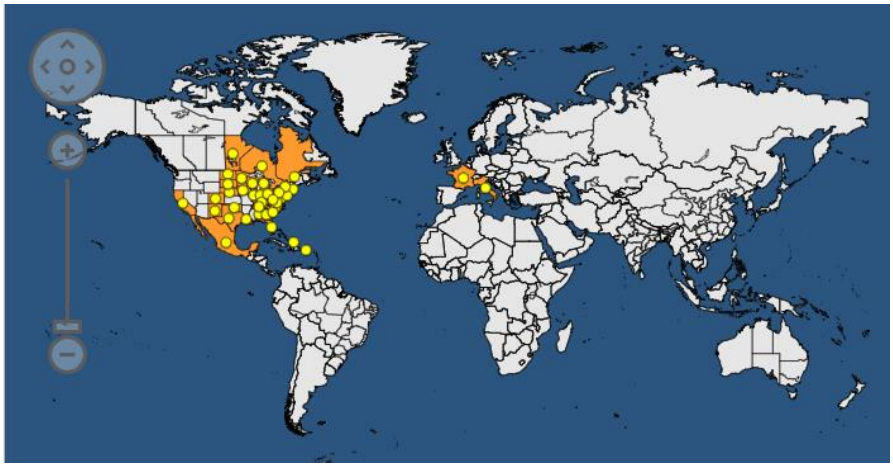

Fig. 1. Distribution of *Toumeyella parvicornis* (from EPPO Global Database, last update: 12 December 2023).

Major host plants or habitats:

Pinus banksiana (Rose et al., 1999; Clarke, 2013)
Pinus caribaea (Segarra-Carmona and Cabrera-Asencio, 2010)
Pinus caribaea var. *bahamenis* (Malumphy et al., 2012)
Pinus caribaea var. *hondurensis* (EPPO GD, 2024)
Pinus contorta (Cooper and Cranshaw, 2004; Clarke, 2013)
Pinus echinata (Clarke, 2013)
Pinus elliottii (Clarke, 2013)
Pinus glabra (Hamon, William, 1984)
Pinus halepensis (Somma et al., 2023)
Pinus mugo (Clarke, 2013)
Pinus nigra (Clarke, 2013; Somma et al., 2023)
Pinus nigra var. *laricio* (Garonna et al., 2018)
Pinus palustris (Malumphy and Anderson, 2016)
Pinus pinaster (Garonna et al., 2018)
Pinus pinea (Garonna et al., 2015; Bertin et al., 2022; Somma et al., 2023)
Pinus resinosa (Clarke, 2013)
Pinus strobus (Clarke, 2013)
Pinus sylvestris (Cooper and Cranshaw, 2004; Nystrom and Ochoa, 2006; Clarke, 2013)
Pinus taeda (Clarke, 2013)
Pinus virginiana (Clarke, 2013)

In Canada, *T. parvicornis* 'probably occurs throughout the native range of jack pine [*Pinus banksiana*], its primary host' (Rose, 1999). In Manitoba, the order of host preference for *T. parvicornis* is *P. bankisana*, *P. sylvestris* followed by *P. resinosa* (Rabkin and Lejeune, 1954).

Cryptomeria sp. was recently mentioned as a principal host of *T. parvicornis* (Klingeman et al., 2020), however additional checking revealed that it had been an error in the manuscript and *Cryptomeria* sp. had been incorrectly listed as a host for *T. parvicornis* (W. Klingeman, 2024, pers. comm.).

An updated list of host plants is available in the EPPO GD (https://gd.eppo.int/taxon/TOUMPA/hosts)

Which pathway(s) is the pest likely to be introduced on:

It is unknown how *T. parvicornis* was introduced into Italy. The importation of pines from North America to EU is prohibited. The likelihood that the pest was introduced on bark, round wood, sawn wood with bark or wood chips is considered very low because pre-export treatments including drying are considered to be very effective versus this pest. Even if introduced on one of these pathways, the pest would find it difficult to reach a suitable host. Cut branches could potentially be a pathway, but the trade of cut branches of hosts from North America to Italy is prohibited. There have been no records of this pest being intercepted in the EU (up until 20 August 2021) (EFSA PLH Panel, 2022) and there have been no records in England and Wales (up until 31 January 2024). Therefore, the introduction into Italy is likely to have occurred on an illegal movement of plants or cut branches.

Categories of pathways listed below are based on the EFSA pest categorisation (EFSA PLH Panel, 2022) but terminology is adjusted according to the EPPO (2022a) PM 5/5(1) Decision-Support Scheme for an Express Pest Risk Analysis.

Pathways:

1. Plants for planting

1.1. entry into countries where the pest is not present, from North America:
1.1.1. for countries that **prohibit** this trade: very low likelihood with low uncertainty;
1.1.2. for countries that **do not prohibit** this trade: moderate likelihood with moderate uncertainty (because the volume of trade is not known).

1.2. entry into countries where the pest is not present, from Italy or France:
– moderate likelihood with moderate uncertainty. *Pinus* spp. trees are regularly traded within the EPPO region, and a low level of infestation would be very difficult to spot. Italy is a major exporter of hardy ornamental nursery stock. Susceptibility of the most commonly traded trees needs to be investigated further.

In Italy (Ministero, 2021), the movement of host plants from the demarcated area outwards or from the 'infested zone' (5 km) to the 'buffer zone' is prohibited and by way of derogation, the movement of host plants is permitted only under official supervision of the competent regional Phytosanitary Service and after the application of treatment with authorized plant protection products. Reporting of new cases is obligatory. Additional measures include: application of plant protection products, silvicultural operations to strengthen the resistance.

In France (EPPO, 2023; FREDON PACA & DRAAF PACA, 2023), official measures include monitoring of demarcated area (2.5 km) and of nurseries in the infested area and around, the obligation for professional operators to report any finding and prune or destroy infested plants, as well as the prevention of movement of infested plant material out of the demarcated area. In addition, it is required that host plants for planting are only traded out of the demarcated area after an official inspection.

Intra-EU27 trade of HS code 0602 9047 (Conifer and evergreen outdoor trees, shrubs and bushes, incl. their roots [excl. with bare roots, cuttings,

slips, young plants and fruit, nut and forest trees]) amounted to between 132 000 and 203 000 t per year in 2016–2022 and this had a value of €103–249 million (Eurostat). Jansen et al. (2019) collated data for 2004–2014 on intra-European trade in forest plants and seeds, which included most, but not all EU countries. Over this period 30 million trees were traded per year, the majority of these were Norway spruce (*Picea abies*), but 2.4% (720 000 p.a.) were *P. sylvestris* and 0.05% (15 000 p.a.) were *P. pinaster.* Most of the *P. sylvestris w*as imported by Scandinavian and Baltic countries and they sourced it from northern Europe. *Pinus pinaster* was only traded by France and Spain. The imports into Spain came from Portuguese sources. In addition to trade in forestry reproductive material, there is also a trade within Europe of plants for landscaping, i.e. to be planted in public and private gardens, parks and on commercial property.

2. Cut branches (including Christmas trees)
For a new infestation to be initiated, the pest would need to be able to transfer from the cut branches to a living host after arrival in the EPPO region. For Christmas trees in northern Europe, cold winter temperatures would be likely to limit the probability of this occurring.

2.1. entry into countries where the pest is not present, from North America:
2.1.1. for countries that **prohibit** this trade: very low likelihood with low uncertainty;
2.1.2. for countries that **do not prohibit** this trade: moderate likelihood with moderate uncertainty (because the volume of trade is not known).

The introduction of *T. parvicornis* into the Turks and Caicos Islands is strongly suspected to have occurred on Christmas trees (cut branches). However, the Turks and Caicos are likely to have suitable temperatures for *T. parvicornis* year-round.

2.2. entry into countries where the pest is not present, from Italy or France:
– moderate likelihood with low uncertainty because it is likely there are numerous commercial and non-commercial international movements of this commodity (the uncertainty is lower here than in 2.1.2, because cut branches are more easily transported in a vehicle within Europe and also because there is more uncertainty for the data on trade for countries other than the EU). Products could have a low level of infestation on them.

3. Round wood, sawn wood with bark, bark, wood chips with bark
The pest is not generally associated with wood, although it could possibly be present if there are epicormic shoots on round wood or there are cones as a contaminant. There is likely to be a low opportunity for the pest to transfer to a host.

3.1. entry into countries where the pest is not present, from North America:
– low likelihood with low uncertainty;

3.2. entry into countries where the pest is not present, from Italy or France:
– low likelihood with low uncertainty.

4. Sawn wood without bark
If the bark is removed completely, the pest cannot be associated with sawn wood.

4.1. entry into countries where the pest is not present, from North America:
– very low likelihood with low uncertainty**;**

4.2. entry into countries where the pest is not present, from Italy or France:
– very low likelihood with low uncertainty**.**

5. Cones
T. parvicornis crawlers can be found on cones of host trees but only the males are thought to be able to develop on the surface of cones (Clarke, 2013). Survival is likely to be even lower for any cone that has been detached from the tree. Pine cones are likely to be traded as decoration. Plants other than fruits or seeds are prohibited (EU and GB).

5.1. entry into countries where the pest is not present, from North America:
– low likelihood with moderate uncertainty**;**

5.2. entry into countries where the pest is not present, from Italy or France:
– low likelihood with moderate uncertainty.

6. Natural spread

6.1. entry into countries where the pest is not present, from North America:
– very low (negligible) likelihood with low uncertainty;

6.2. entry into countries where the pest is not present, from Italy or France:
– low likelihood with low uncertainty because the pest is not currently close to the borders of other countries and the outbreak in Italy (that could include natural and human-assisted spread) was evaluated to expand at the speed of 7–15 km per year.

Express PRA prepared in Ireland noted that if *T. parvicornis* is not regulated at the EU level and allowed to spread, it will eventually pose a threat to Ireland (DAFM, 2022). Thus, the overall likelihood of entry of the pest to Ireland was estimated as high with low uncertainty.

Establishment

Plants at risk in the PRA area:

Pinus spp. are widely present across the EPPO region and many of them are known hosts. It is likely that there are additional *Pinus* spp. that are present in the EPPO region that are currently not known to be hosts of *T. parvicornis* but could turn out to be hosts. Distribution maps of three of the host species are presented below.

Pinus sylvestris is one of the primary hosts in the northern part of the pest's range in North America (Clarke, 2013; Fig. 2).

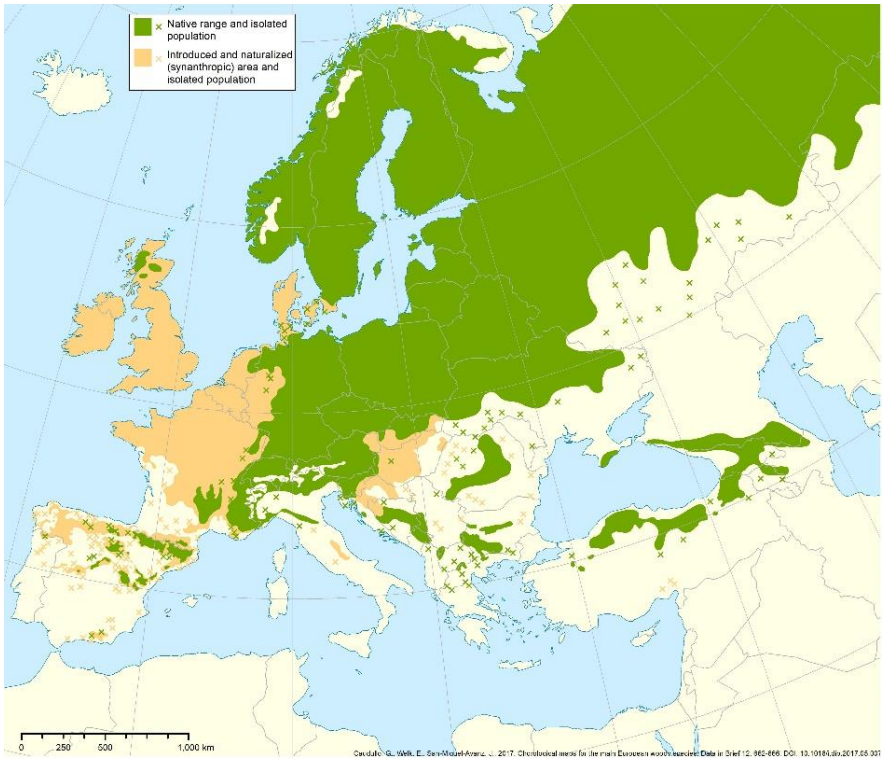

Fig. 2. Distribution of *Pinus sylvestris* in Europe (from Caudullo et al., 2017).

Pinus nigra is a host in North America and Italy (Fig. 3).

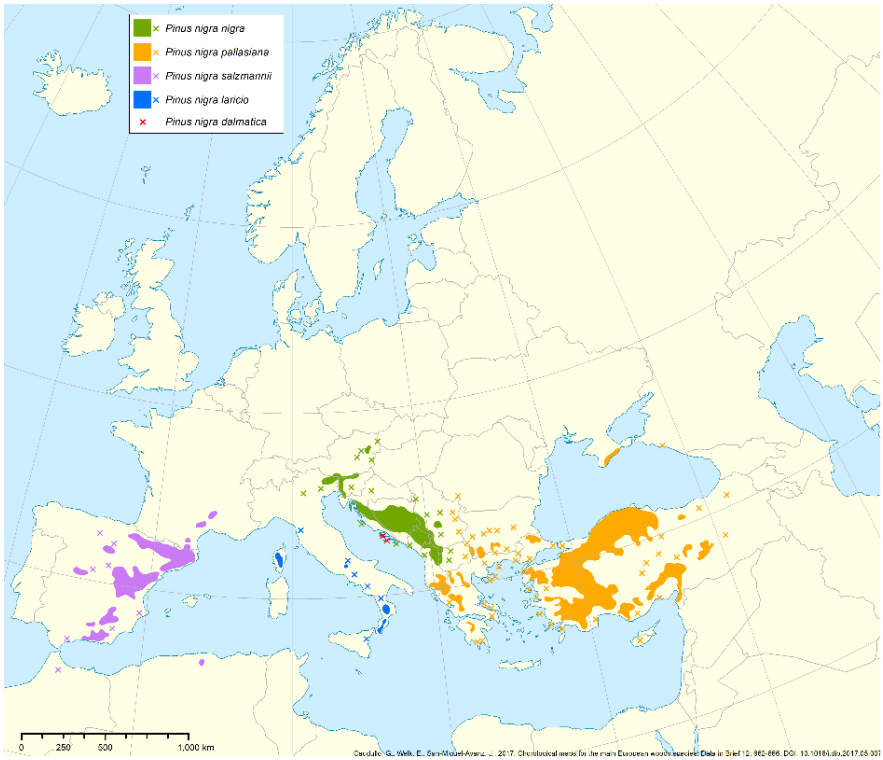

Fig. 3. Distribution of *Pinus nigra* in Europe (from Caudullo et al., 2017).

Pinus pinea is a major host in Italy (Fig. 4).

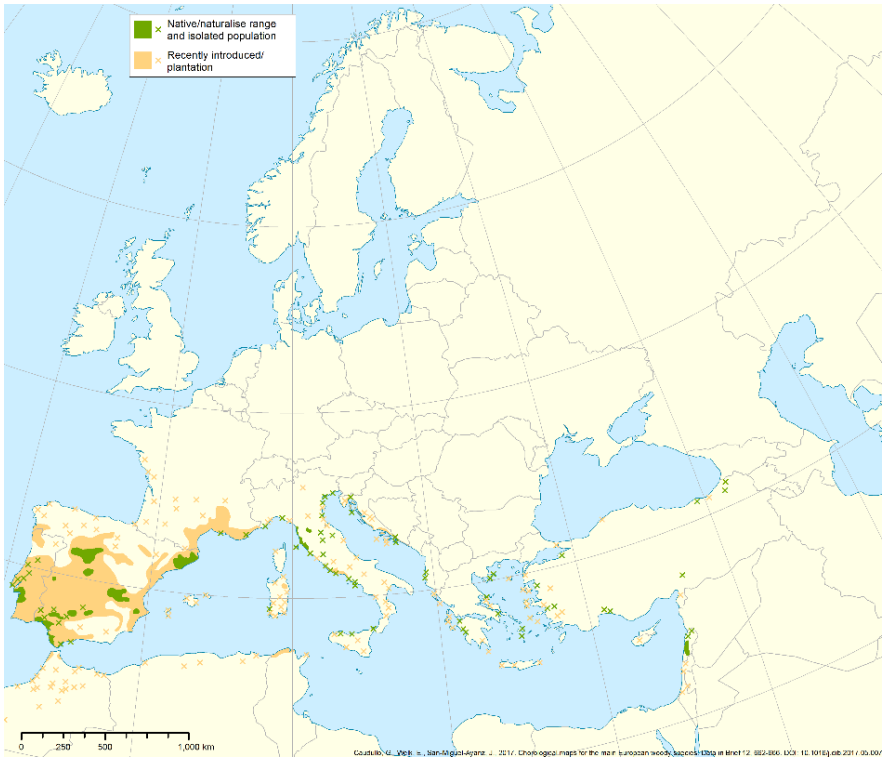

Fig. 4. Distribution of *Pinus pinea* in Europe (from Caudullo et al., 2017).

Climatic similarity of present distribution with PRA area (or parts thereof):

The EFSA pest categorisation includes the map (Fig. 5) which shows the six climatic zones that occur both in the EU and in the countries where the pest is present. This map (as well as one in Fig. 1) has strong limitation as it includes all climatic zones known for the whole countries in which pest is recorded at least once.

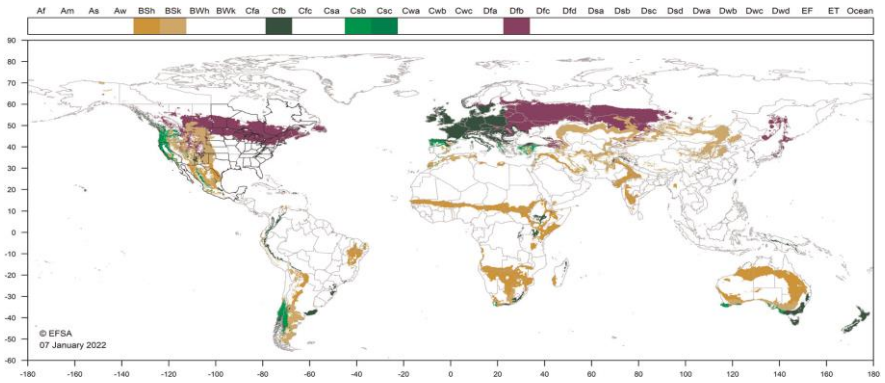

Fig. 5. World distribution of Köppen-Geiger climate types that occur both in the EU and in the countries where *T. parvicornis* has been reported (EFSA PLH Panel, 2022).

An assessment of the climatic suitability of Europe has been published since the EFSA pest categorisation by Di Sora et al. (2023a). The authors used four different modelling techniques to estimate the potential distribution of *T. parvicornis*: Generalized Linear Model, Multivariate Adaptive Regression Splines, Random Forest and Maxent (Fig. 6). The results have very limited predictive power as only the current distribution data of *T. parvicornis* from France and Italy were used to inform the models. They more likely depict some of the areas in the EPPO region that are highly suitable and where high impact is expected. However, many of the areas that are depicted as being unsuitable are also likely to be suitable for the pest.

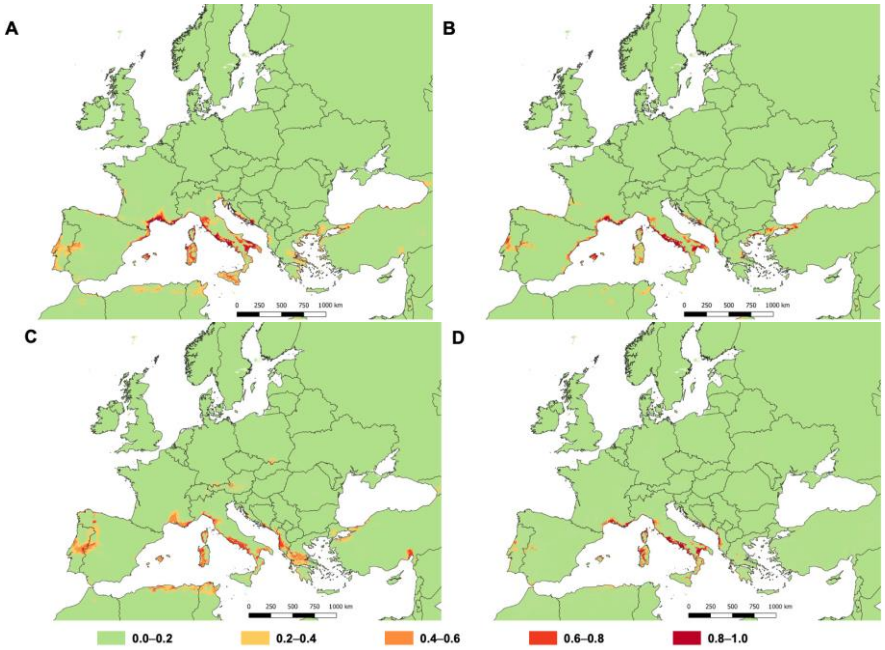

Fig. 6. Distribution of suitable areas for *T. parvicornis* in Mediterranean Europe based on bioclimatic variables using Generalized Linear Model (GLM) (A), Multivariate Adaptive Regression Splines (MARS) model (B), MaxEnt model (C), and Random Forest (RF) model (D). Different colours indicate 'classes of suitability' (green = very low; yellow = low; light orange = intermediate; dark orange = high; red = very high) (from Di Sora et al., 2023a).

T. parvicornis is established in North America and on Caribbean islands, demonstrating a very broad range of climatic tolerances. It is reported to have one generation per year in Colorado and Nebraska, two in Maryland, Virginia and North Carolina and four generations in southern Georgia (Clarke, 2013). It does not demonstrate a pronounced seasonality and can produce up to five generations per year on the Caribbean islands (Malumphy, Anderson, 2016). Some of the regions where the pest is established have cold winters. For example, in Lincoln, Nebraska, the mean daily minimum temperature in January is 14.4°F (= –9.8°C) (https://lincolnweather.unl.edu/lincoln-ne-1991-2020-climate-normals). This is colder than the equivalent January mean minimum temperature in Vantaa, Helsinki which is –8.1°C (https://www.ncei.noaa.gov/pub/data/normals/WMO/1981-2010/RA-VI/Finland/).

Express PRA prepared in Ireland considered it is highly likely (with low uncertainty) that the pest would establish in Ireland and would most likely produce one generation per year and at most up to two generations per year (DAFM, 2022).

To summarise, the parts of the EPPO region which have a very similar climate to where the pest has already been detected (parts of Italy and France; Fig. 6) are very likely to be suitable for establishment with a low uncertainty. However, these areas are likely to be a major underestimate of the potential area for establishment in the EPPO region. The distribution of *T. parvicornis* suggests that the pest is likely to be able to establish a lot further north and cold tolerance is unlikely to be a barrier to establishment in north-west Europe. Additional data (e.g. point location data or temperature-response data) would be needed to give a better indication of the northern limit.

Characteristics (other than climatic) of the PRA area that would favour establishment:	Other than climate and host presence, there are no characteristics mentioned by EFSA PLH Panel (2022) that would influence the likelihood of establishment. In Italy, most infestations have been recorded on *P. pinea* in urban areas (Bertin et al., 2022). In Campania, *T. parvicornis* has been recorded at altitudes up to 840 m above sea level (Somma et al., 2023). This upper altitude may correlate with a climatic limit for the pest. Parisi et al. (2023) have used satellite data (Sentinel-2) to monitor the condition of Mediterranean pine forests in Italy. The results have shown that the forest in this area appears to be suffering from a number of abiotic and biotic stresses and therefore could be particularly vulnerable to further stresses such as a damage caused by a new pest.
Which part of the PRA area is the area of potential establishment:	As modelled by Di Sora et al. (2023a), areas in the EPPO region with a similar climate to the areas where it has already established in Europe, are very likely to be areas where the pest could establish if hosts are present. The presence of the pest in Canada could indicate a potential to establish in the northern area of the EPPO region.
Spread	There are two forms or morphs of *T. parvicornis.* In North America, the leaf form, which feeds on pine needles, is present in the southern part of the distribution, whereas the twig or bark form is found dominant in the northern parts of the distribution across the US-Canadian border (Clarke, 2013; Garonna et al., 2018; EFSA PLH Panel, 2022). The form present may influence the importance of different pathways. **Natural spread**: *T. parvicornis* is spreading in southern Italy and in 2021 it was found in southern France. Natural spread by the first instars crawling or being carried by wind (up to 4.8 km; Rabkin and Lejeun, 1954), other animals, machinery or vehicles, will occur locally and usually relatively slowly. Despite being under official control, *T. parvicornis* is likely to continue to spread given its natural dispersal ability. **Movement on plants for planting**: Adult females and nymphs can be carried on *Pinus* spp. plants for planting. This pathway presents a high likelihood of facilitating introduction and spread because on this pathway the scale insects do not need to transfer to another host to find suitable host plants. The scale insect population will be able to develop on the imported plant before spreading to other suitable hosts (EFSA PLH Panel, 2022). Since its introduction, *T. parvicornis* has rapidly spread across several regions in Italy (Russo et al., 2023). Spatial analysis on the progress of *T. parvicornis* infestations has shown a spread rate of about 7 km/year heading north, 8 km/year eastwards, and 15 km/year southwards with new territorial records located along the main regional road network (Somma et al., 2023) that could give some indication of hitchhiking. In a population genetics study by Russo et al. (2023), the COI gene showed a single haplotype in Europe which differed by five nucleotide substitutions from the American population of *T. parvicornis*. This finding indicates that the Italian population of *T. parvicornis* could have been the source of the population that has established in France and plants for planting or cut branches are the most likely source pathway. DAFM (2022) estimated the magnitude of spread of the pest in Ireland as low–moderate with moderate uncertainty.

POTENTIAL ECONOMIC CONSEQUENCES

How much economic impact does the pest have in its present distribution:

North America

In the continental USA and Canada, the most common impact from the pest is reduced growth that is a consequence of the insect feeding and sooty mould reducing the photosynthetic potential of the needles. Heavy infestations can lead to the death of branches or trees. Seedlings and saplings are the most susceptible. Christmas tree plantations can suffer from dieback or branch deformities (Clarke, 2013).

Clarke et al. (1992) reported that *T. parvicornis* is a pest of seed orchards in Canada. Rose et al. (1999) reported that infestations did not tend to last long in Canada and were generally controlled by ladybirds (Coleoptera: Coccinellidae), but chemical control may be used on high value trees. There are current recommendations for treatments to control *T. parvicornis* in Ontario, demonstrating that it is an economic pest in the province (Ontario MAFRA, 2021). Infestations of pine tortoise scale in Canada are generally localized, but can be severe (Natural Resources Canada, 2024). Nystrom and Ochoa (2006) listed and rated the importance of forestry pests in Ontario, and *T. parvicornis* was given the second highest rating (B) which is described as pests 'of moderate importance, capable of sporadic or localized injury to trees or shrubs'.

Puerto Rico

In 2009, at the nursery believed to be the source of the outbreak in the Guilarte State Forest there was almost complete infestation of the seedlings. 'Severe damage to twigs and foliage was observed, with extensive damage and death caused to shoot terminals. Infested twigs had a greyish black appearance caused by the build-up of sooty moulds' (Segarra-Carmona and Cabrera-Asencio, 2010).

Turks and Caicos Islands

The severe attack of *T. parvicornis* on the Caicos pine *P. caribaea* var. *bahamensis* (Pinaceae) resulted in the death of most of the host trees in the Turks and Caicos Islands (TCI) in just over a decade (Sanchez et al., 2019).

Italy

P. pinea is the most susceptible tree species in Italy, *P. pinaster* can withstand infestation better and *P. halepensis* suffers negligible damage (Regione Tuscany, 2023). Heavy attacks of *T. parvicornis* on *P. pinea* cause a progressive defoliation on the canopies, the plants quickly decline and are often irreversibly compromised (Bertin et al., 2022).

'T. parvicornis is having a serious economic, environmental and social impact in southern Italy. The scale is contributing to the severe decline in health and some mortality of stone pines, particularly in Naples and Rome, and surrounding areas' (EFSA PLH Panel, 2022).

In addition to the impact on trees, *T. parvicornis* produces honeydew leading to sooty mould stains on cars and artefacts, creating great discomfort for residents and users of parks (Mancini, 2022).

Describe damage to potential hosts in PRA area:

See the text for Italy above. *P. pinea* is described as the symbolic tree of Rome and so damage or death of trees could have a significant cultural impact. In Italy, *P. pinea* is the most susceptible species (Regione Tuscany, 2023). Italian Mediterranean pine forests cover an area of more than 240 000 ha, of which about 65 000 ha are maritime pine (*P. pinaster*) forests, 48 000 ha are stone pine (*P. pinea*) forests, and Aleppo pine (*P. halepensis*) forests account for 115 000 ha (Parisi et al., 2023). Other areas of the EPPO region where there are large areas of *P. pinea* (e.g., Spain and Portugal) will be at risk; *P. pinea* is also present around the Mediterranean coast (Fig. 4).

P. sylvestris is also a known host plant and accounts for 28 million ha and 20% of the productive forest area in Europe (San-Miguel-Ayanz et al., 2016). Nordic countries carried out a study to identify the pests presenting the greatest threat to their *Picea abies* and *P. sylvestris* forests (Marinova-Todorova et al., 2020). From a long list of 1062 pests, *T. parvicornis* was one of 14 pests identified as presenting the greatest threat, but the potential impacts were projected to be limited to nursery and ornamental trees.

How much economic impact would the pest have in the PRA area:

T. parvicornis can have three generations a year in a Mediterranean climate which increases the probability of impacts (Bertin et al., 2022). In areas with a similar climate to the locations where the pest has been found in Italy, the impact is likely to be high with low uncertainty. The impact is likely to be progressively lower further north because the potential for the pest to form damaging populations will be lower.

It is possible to achieve a high level of control of *T. parvicornis* in urban trees using trunk-injected insecticides (Bertin et al., 2022; Di Sora et al., 2022, 2023b; Giordano et al., 2023) which could reduce the damage to high value trees. However, the costs of treatment, the viability of long-term control using trunk injections and any potential impacts on non-target organisms would need to be considered.

Express PRA prepared in Ireland considered that potential impact in Ireland would be low – moderate with moderate uncertainty (DAFM, 2022).

CONCLUSIONS OF PEST RISK ASSESSMENT

Summarize the major factors that influence the acceptability of the risk from this pest:

Estimate the probability of entry:

Entry from North America into countries that prohibit the movement of *Pinus* cut branches or plants for planting: **very low with low uncertainty**.

Entry from North America into countries that do not prohibit the movement of *Pinus* cut branches or plants for planting: **moderate with high uncertainty** because the volume of trade is unknown.

Entry into EPPO countries, where the pest is not present, from Italy or France: moderate likelihood with low uncertainty, there is evidence that the population in Italy could have been the source of the infestation in France.

Pathway	Entry from North America	Entry from infested countries in EPPO region
1. Plants for planting	1.1.1. **If prohibited**: Very low (low uncertainty) 1.1.2. **If not prohibited**: Moderate (moderate uncertainty)	1.2. Moderate (moderate uncertainty)
2. Cut branches (including Christmas trees)	2.1.1. **If prohibited**: Very low (low uncertainty) 2.1.2. **If not prohibited**: Moderate (moderate uncertainty)	2.2. Moderate (low uncertainty)
3. Round wood, sawn wood with bar, bark, wood chips with bark	3.1. Low (low uncertainty)	3.2. Low (low uncertainty)
4. Sawn wood without bark	4.1. Very low (low uncertainty)	4.2. Very low (low uncertainty)
5. Cones	5.1. Low (moderate uncertainty)	5.2. Low (moderate uncertainty)
6. Natural spread	6.1. Very low (low uncertainty)	6.2. Low (low uncertainty)

Estimate the probability of establishment:

High likelihood with low uncertainty, already established in a part of the EPPO region where the pest may have three or more generations a year. A large part of the EPPO region where host plants are widely distributed is likely to be suitable for establishment.

Estimate the magnitude of spread:

Moderate likelihood with moderate uncertainty. Spread has been calculated at 7–15 km/year in southern Italy. Spread would be expected to be slower if populations establish in northern Europe because there would be fewer generations per year and there is no evidence that parthenogenesis occurs in this pest. It is also likely that there will be new outbreak foci that are the result of spread on plants for planting or cut branches.

Estimate the potential economic impact:

In areas with a similar climate to the locations where the pest has been found in Italy, the impact is likely to be high with low uncertainty. The impact is likely to be progressively lower further north because the potential for the pest to form damaging populations will be lower. The pest has already had environmental, economic and social impacts in Italy. As the pest spreads, the impacts can be expected to increase within Italy and France and with probable introductions into other EPPO countries.

Degree of uncertainty:

Key and other main uncertainties are as follows:
Impact on different host species.
The potential northern limit in the EPPO area is unknown.

OVERALL CONCLUSIONS

It is concluded that *T. parvicornis* poses a risk to the EPPO region and phytosanitary risk management measures should be recommended to substantially reduce the risk.

STAGE 3: PEST RISK MANAGEMENT

IDENTIFICATION OF THE PATHWAYS

Pathways studied in the pest risk management	Evaluation of the need for management measures for the different hosts: because of the wide host range within *Pinus*, measures are recommended for the whole genus. Management measures are proposed for **likely pathways**: – plants for planting of *Pinus* spp., – cut branches of *Pinus* spp. (including Christmas trees). No management measures required for other pathways.

IDENTIFICATION OF POSSIBLE MEASURES

Risk management measures were first drafted based on other EPPO recommendations (EPPO, 2022a).

Possible measures for pathways

Possible measures for plants for planting of *Pinus* spp. (except seeds, tissue culture and pollen)

Measures related to the crop or to places of production:
Pest free area

Measures related to consignments:
Inspection of plants alone is not reliable as early infections of *T. parvicornis* are difficult to detect if only a small number of nymphs are present, and the pest has never been intercepted during quarantine inspections.

In PRA for *Chionaspis pinifoliae* (Diaspididae) (EPPO, 2022b), a systems approach is also proposed. The Panel on Phytosanitary Measures considered that similar measures can be proposed for *T. parvicornis*, even though the pest belongs to a different family of scale insects (Coccidae).

Inspection would ensure that the pest is absent or that the population is low or at an early stage of infestation. Dipping the whole plant in horticultural oils (summer oils or botanical oils) or insecticidal soap will ensure the elimination of the pest under such low pest population. The EPPO PRA on *C. pinifoliae* states that '*When the pest population is low or not detected, treating the whole plant by summer oils (Liang et al., 2010; Tansey et al., 2015; Tomkins et al., 1996; Khalid et al., 2012; Chueca et al., 2009; McKenna et al., 2007), botanical oils (Ciriminna et al., 2017; El Aalaoui et al., 2021)), or insecticidal soap (Walufa et al., 2017; Ralston et al., 1941; Parry & Rose, 1983), would kill most if not all of hidden eggs, crawlers and adults. Surviving adults, or eggs still protected by the scale, would be most probably detected by visual inspection when performed on small plants. The EWG recommended dipping the whole plant in [or similar approach guarantying that all the needles are covered by] these generalist products, which also makes this option mainly available for small plants because of practicality. For plants for planting, this option generally requires that there is no soil attached. Plant protection products (other than horticultural oils) against* C. pinifoliae *are available but the life stages that have a scale covering are difficult to kill with these products. Such life stages can be present on the plants throughout the year and thus, the pest cannot be eliminated from consignments with these insecticides.*'

In addition, storage and transportation conditions of the consignment should prevent new infestations, i.e. outside of the crawler active period, or not in/through areas infested with the pest, or with a suitable packaging (i.e. solid material, not a net).

Measures upon entry of the consignments:
Inspection or treatment are not sufficient alone (see above).
Post entry quarantine for one year.

The following measures related to consignments are not considered efficient:
Pest-free place of production / pest-free production site were not considered in non-protected conditions as the pest can be transported by wind.

Treatment of plants with plant protection products will likely reduce the population of *T. parvicornis.*

Possible measures for cut branches of *Pinus* spp. (including Christmas trees)

Measures related to the crop or to places of production:
Pest free area.

Measures related to consignments:
Inspection of cut branches of *Pinus* spp. (including Christmas trees) alone is not reliable as early infections of *T. parvicornis* are difficult to detect if only a small number of nymphs are present and the pest has never been intercepted during quarantine inspections.

In PRA for *Chionaspis pinifoliae* (Diaspididae) (EPPO, 2022b) a systems approach is also proposed. The Panel on Phytosanitary Measures considered that similar measures can be proposed for *T. parvicornis*, even though the pest belongs to a different family of scale insects (Coccidae) (see plants for planting).

Measures upon entry of the consignments:
Inspection or treatment are not sufficient alone (see above).

The following measures related to consignments are not considered efficient:
Treatment of cut branches of *Pinus* spp. (including Christmas trees) with plant protection products will likely reduce the population of *T. parvicornis.* However, efficacy of insecticide treatments (sprays) is questioned.

EVALUATION OF THE MEASURES IDENTIFIED IN RELATION TO THE RISKS PRESENTED BY THE PATHWAYS

The pest would be difficult to eradicate or contain if introduced therefore measures should be taken to prevent its further entry and spread in the PRA area. In general, scale insects are difficult to control (e.g., see Boberg & Björklund [2022] for mealybugs [Pseudococcidae]).

Degree of uncertainty: Uncertainties in the management part are:
– host plants, in particular the host status of *P. sylvestris*,
– efficacy of insecticide treatments,
– volume of trade of plants for planting, cut branches (including Christmas trees).

IDENTIFICATION OF POSSIBLE MEASURES

Pathway	**Measures identified for the exporting country**
Plants for planting of *Pinus* spp. (except seeds, tissue culture and pollen)	Pest free area (PFA) (ISPM 4, ISPM 29) (see requirements below) **OR** Plants should be produced in a pest-free place of production / pest-free production site[1] for *Toumeyella parvicornis*, established according to EPPO Standard PM 5/8 Guidelines on the phytosanitary measure 'Plants grown under physical isolation' **OR** Systems approach combining all three of the following measures: • Absence of *Toumeyella parvicornis* after visual inspection of the consignment, • Dipping the whole plant in horticultural oils (summer oils or botanical oils) or insecticidal soap, • Storage and transportation in conditions preventing new infestation, i.e. outside the crawler active period, or not in/through areas infested with the pest, or with a suitable packaging (i.e. solid material, not a net) **OR** Post-entry quarantine for 1 year (in the framework of a bilateral agreement)
Cut branches of *Pinus* spp. (including Christmas trees)	PFA (ISPM 4, ISPM 29) (see requirements below) **OR** Systems approach combining all three of the following measures: • Absence of *Toumeyella parvicornis* after visual inspection of the consignment, • Dipping the whole plant in horticultural oils (summer oils or botanical oils) or insecticidal soap, • Storage and transportation in conditions preventing new infestation, i.e. outside the crawler active period, or not in/through areas infested with the pest, or with a suitable packaging (i.e. solid material, not a net)

[1]: *The choice between pest-free place of production and pest-free production site is a decision to be taken by the NPPO based on the operational capacities of the producers and biological elements.*

Requirements for establishing a PFA:

• Data available is not sufficient to recommend a minimum distance between a PFA and the closest area where the pest is present. Possible long-distance natural spread by wind might be of many kilometers (i.e. > 15 km). Wind dispersal of crawlers has been recorded up to a distance of 4.8 km from a severe infestation site in North America (Rabkin and Le Jeune, 1954). Natural and human-assisted spread was estimated to have speed of 7–15 km per year in Italy (Somma et al., 2023).

• To establish and maintain the PFA (ISPM 4, ISPM 29), a general surveillance in the area for 2 years prior to establishment of the PFA and continued every year at suitable periods may be sufficient. Specific surveys (ISPM 4) should also be carried out in the zone between the PFA and known infestation to demonstrate pest freedom. The surveys should be targeted for the pest, they should be based on visual examination of host trees and they should include high risk locations, including places where potentially infested material may have been imported.

• There should be restrictions on the movement of host material (originating from areas where the pest is known to be present) into the PFA, and into the area surrounding the PFA, especially the area between the PFA and the closest area of known infestation.

Containment and eradication of the pest and application of effective phytosanitary measures would be possible (including trunk injections with insecticides [Bertin et al., 2022; Di Sora et al., 2022, 2023b] and the release of biocontrol agents). Clarke et al. (1992) found pyrethroids were toxic to *T. parvicornis*, though less so than organophosphorus insecticides. In general, scale insects are difficult to control and eradicate, but examples of successful eradication campaigns are known (EPPO, 2022b, Annex 2).

In Italy (Ministero, 2021) the following phytosanitary measure to control *T. parvicornis* were developed:

- Eradication measures:

- annual regional investigations (surveys) with reporting to the central phytosanitary service,
- reporting of the suspected cases, establishment of delimited areas (infested areas and buffer zones [at least 5 km]),
- eradication measures (*a*, removal of a part or the whole infested host (felling) and its destruction [burning on site or transport to identified sites for destruction or other adequate treatment], *b*, treatment with authorized plant protection products [not specified] taking into account phenological phases of the plant and the pest, *c*, silvicultural operations to strengthen the resistance and health of hosts, *d*, prohibition of moving the material resulting from felling or pruning (referred to in *a*, and *c*) from the delimited area to outside or from infested area to buffer zone [movement is permitted, subject to control by the regional phytosanitary service or under its supervision, only in cases where the material has been subjected to appropriate treatments to eliminate the pest or the transport conditions guarantee that the pest spreading is prevented up to the sites authorized for destruction or other adequate treatment]; *e*, monitoring of the presence of the pest in the delimited area through periodic surveys;

- Containment measures:

- monitoring for the presence of the pest in the buffer zone (visual inspections, sampling and analysis),
- removal of a part or the whole infested host (felling) and destruction (burning on site or transport to identified sites for destruction or other adequate treatment),
- treatment with plant protection products authorized against *T. parvicornis* [not specified] taking into account phenological phases of the plant and the pest,
- silvicultural operations in the entire delimited area to strengthen the resistance/tolerance/health of host,
- prohibiting the movement of the material resulting from felling or pruning from the delimited area outside or from the infested zone to the buffer zone [movement is permitted, subject to control by the regional phytosanitary service or under its supervision, only in cases where the material has been subjected to appropriate treatments to eliminate the pest or the transport conditions guarantee that the pest spreading is prevented up to the sites authorized for destruction or other adequate treatment].

Movement of hosts from demarcated areas outwards and from infested zone to the buffer zone is prohibited. By derogation, movement of plants is permitted only after official control by regional phytosanitary service and after suitable treatment of plant protection products authorized against *T. parvicornis* (not specified).

In Italy (Ministero, 2021), for application of plant protection products, endotherapeutic techniques (stem injections) are recommended and in a period from late winter to early autumn. Active substances used for endotherapy in Italy (abamectin and acetamiprid) had only temporary authorizations in the country and are no longer authorized in Italy by the Ministry of Health (S. Infantino, 2024, pers. comm.). Another option is foliar insecticide sprays against early nymphal stages (1st and 2nd instars) from end of April to end of May. To eliminate sooty mould and facilitate contact between the insecticide and the insect, treatments should be carried out with high pressure jets, preceded by washing the branches and foliage with water and authorized surfactants (not specified) or potassium salts. Washes must be carried out ten days apart with the possible addition of copper-based products.

As EFSA pest categorisation (EFSA PLH Panel, 2022) reports, in its native area of distribution, *T. parvicornis* populations are usually regulated by predators and parasitoids. In North America, several species of natural enemies have been observed (DAFM, 2022; EPPO, 2024). The larvae of the scale-feeding snout moth, *Laetilia coccidivora* (Lepidoptera: Pyralidae) have been recorded to severely reduce heavy infestations of *T. parvicornis* (Clarke, 2013). The larvae of flies of the genus *Leucopis* (Diptera: Chamaemyiidae) have also been found to develop beneath the settled *T. parvicornis* females, ingesting their body contents (Malumphy et al., 2012; Clarke, 2013). Ant control may also help reduce the pest's populations (EFSA PLH Panel, 2022). Chalcidoid parasitoid

wasps (Hymenoptera: Chalcididae) recorded to attack *T. parvicornis* include aphelinids of the genus *Aphytis*, and the species *Coccophagus albicoxa*, *C. lycimnia*, *C. immaculatus* and *C. quaestor* as well as the encyrtid *Microterys fuscicornis* (Hymenoptera: Encyrtidae) (Malumphy et al., 2012). In Italy, there was a recorded shift in natural predators feeding habits towards outbreaks of *T. parvicornis*; however, the level of predation has not been high enough to prevent the spread or proliferation of the pest (Garonna *et al*., 2018). One species of parasitoid wasp, *Metaphycus flavus*, was shown to prey upon *T. parvicornis*, particularly immature males (Garonna et al., 2018). A parasitic wasp *Metaphycus flavus* (Hymenoptera: Encyrtidae), of Nearctic origin, but established in the EPPO region, is a commercially available biocontrol agent in the EU (promoted for greenhouses; e.g., https://www.koppert.fr/metaphycus-flavus/), which can be used to control *T. parvicornis* (Garonna et al., 2018; EFSA PLH Panel, 2022). This parasitoid is listed as a biological control agent safe for use in the EPPO region (EPPO, 2021). The scale-eating ladybird, *Rhyzobius lophanthae* (Coleoptera: Coccinellidae) is another possible biological control agent, listed as safe for use in the EPPO region (EPPO, 2021).

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