Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

SLU Risk Assessment of Plant Pests

SLU ua 2020.2.6-4656

January 18, 2021

Quick assessments of the potential for establishment in Sweden for a selection of quarantine pests

Table of contents

Terms of reference

Following the EU plant health regulation, Member States shall carry out regular surveys for plant pests listed as Union quarantine pests, (EU 2016/2031, Article 22). However, the regulation further states that:

> "Those surveys shall not be required to be carried out for pests for which it is unequivocally concluded that they cannot become established or spread in the Member State concerned due to its ecoclimatic conditions or to the absence of the host species."

It is currently uncertain whether the ecoclimatic conditions or host availability in Sweden allow an establishment of some of the quarantine pests. SLU Risk Assessment of Plant Pests was therefore requested by the Swedish Board of Agriculture to make a quick assessment of a selection of quarantine pests with regard to the pests' likelihood of establishment in Sweden.

Assessments – methods and definitions

The assessments of the potential for establishment of the quarantine pests were based on the likelihood for the species to survive and reproduce in Sweden. It should be noted that the likelihood of introduction of the pest was not taken into consideration. Both establishment outdoors and in protected cultivation were assessed. The following factors were considered; i) the presence of host plants, ii) the presence, or potential establishment, of vectors if necessary for the transmission of pathogens and iii) the prevailing ecoclimatic conditions. The assessments were based on the definition of establishment according to FAO (2019)[1], i.e. "Perpetuation, for the foreseeable future, of a pest within an area after entry".

Specifically, an assessment of the degree to which conditions are suitable for establishment in Sweden was performed for each quarantine pest using the following scale:

- "Not suitable", i.e. the conditions does not support establishment.
- "Unlikely to be suitable", i.e. the conditions are unlikely to support establishment.
- "Likely to be suitable", i.e. the conditions are likely to support establishment.
- "Very likely to be suitable", i.e. the conditions are very likely to support establishment.

The most likely option was selected for each pest and the uncertainty was also assessed and presented as the plausible minimum and maximum options.

[1] FAO (2019). Glossary of phytosanitary terms. International Standard for Phytosanitary Measures No. 5. Rome. Published by FAO on behalf of the Secretariat of the International Plant Protection Convention (IPPC). 35 pp. Licence: CC BY-NC-SA 3.0 IGO. LINK [Accessed 2020-10-27].

Overview of the assessments

Quick assessments were performed for in total 73 individual quarantine pests species or species groups belonging to the organism groups bacteria, nematodes, viruses, viroids, phytoplasmas, insects and mites. An overview of the assessments is provided in Table 1 and a description of the assessment, the associated uncertainty together with the supporting literature is provided for each species/species group in the following sections. The assessments were performed very rapidly and for some of the species / groups the assessments are associated with a very high uncertainty. In some of those cases, further analysis may decrease the uncertainty.

Table 1. Overview of assessments of the degree to which the conditions are suitable for the establishment of individual pests in Sweden. For a description of the scale used for the assessments, see the section entitled "Assessments – methods and definitions". The most likely assessment is denoted in the table with a cross and the uncertainty (the range between the plausible minimum and maximum options) is depicted with a grey shade. The EPPO-code is provided within parenthesis after the scientific name of each pest.

Pest	Page	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Quarantine pests - bacteria	7				
Candidatus Liberibacter africanus (LIBEAF)	7	x			
Candidatus Liberibacter americanus (LIBEAM)	8	x			
Candidatus Liberibacter asiaticus (LIBEAS)	9	x			
Ralstonia syzygii subsp. *celebesensis* (RALSSC)	9	x			
Xanthomonas citri pv. *aurantifolii* (XANTAU)	11	x			
Xanthomonas citri pv. *citri* (XANTCI)	12	x			
Xanthomonas oryzae pv. *oryzae* (XANTOR)	13	x			
Xanthomonas oryzae pv. *oryzicola* (XANTTO)	14	x			
Quarantine pests - nematodes	15				
Hirschmanniella spp. (1HIRSG)	15			x	
Longidorus diadecturus (LONGDI)	16		x		
Xiphinema bricolense (XIPHBC)	17		x		
Xiphinema californicum (XIPHCA)	19		x		
Xiphinema inaequale (XIPHNA)	20		x		
Xiphinema intermedium (XIPHIM)	21	x			
Xiphinema tarjanense (XIPHTA)	23	x			
Quarantine pests – viruses, viroids and phytoplasmas	24				
Citrus leprosis viruses (CILV00):	24	x			
Citrus tristeza virus (non-EU isolates) (CTV000)	25	x			
Coconut cadang-cadang viroid (CCCVD0)	25	x			
Cowpea mild mottle virus (CPMMV0)	26	x			
Grapevine flavescence dorée phytoplasma (PHYP64)	27		x		
Lettuce infectious yellows virus (LIYV00)	29		x		
Palm lethal yellowing phytoplasmas (PHYP56)	29	x			
Peach mosaic virus (PCMV00)	30		x		
Sweet potato chlorotic stunt virus (SPCSV0)	31	x			

Pest	Page	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Viruses, viroids and phytoplasmas of Cydonia	32				x
Viruses, viroids and phytoplasmas of *Vitis*	34			x	
Witches' broom disease of lime phytoplasma (PHYPAF)	35	x			
Quarantine pests – Insects and mites	36				
Anastrepha fraterculus (ANSTFR)	36	x			
Anastrepha obliqua (ANSTOB)	37	x			
Anastrepha suspensa (ANSTSU)	38	x			
Anthonomus eugenii (ANTHEU)	39	na*			
Anthonomus grandis (ANTHGR)	39	x			
Aleurocanthus spiniferus (ALECSN)	40	x			
Aleurocanthus woglumi (ALECWO)	41	x			
Aschistonyx eppoi (ASCXEP)	41	x			
Bemisia tabaci (BEMITA)	42				x
Bactrocera dorsalis (DACUDO)	43	x			
Bactrocera tryoni (DACUTR)	44	x			
Bactrocera tsuneonis (DACUTS)	45	x			
Bactrocera zonata (DACUZO)	46	x			
Ceratitis quinaria (formerly *Pardalaspis quinaria*) (CERTQU)	47	x			
Ceratitis rosa (formerly *Pterandrus rosa*)(CERTRO)	48	x			
Dacus ciliatus (DACUCI)	49	x			
Diabrotica barberi (DIABLO)	50			x	
Diabrotica undecimpunctata howardi (DIABUH)	51			x	
Diabrotica undecimpunctata undecimpunctata (DIABUN)	52	x			
Diabrotica virgifera zeae (DIABVZ)	53	x			
Diaphorina citri (DIAACI)	54	x			
Draeculacephala minerva (DRAEMI)	54	x			
Eotetranychus lewisi (EOTELE)	55			x	
Euphranta japonica (formerly *Rhacochlaena japonica*) (RHACJA)	56	x			
Graphocephala atropunctata (GRCPAT)	57	x			
Haplaxius crudus (formerly *Myndus crudus*)(MYNDCR)	58	x			
Helicoverpa zea (formerly *Heliothis zea*)(HELIZE)	59	x			
Hishimonus phycitis (HISHPH)	60	x			
Homalodisca vitripennis (HOMLTR)	61	x			
Keiferia lycopersicella (GNORLY)	62			x	
Liriomyza sativae (LIRISA)	63				x
Margarodes vitis (MARGVI)	64	x			
Margarodes vredendalensis (MARGVR)	65	x			
Neoceratitis cyanescens (formerly *Pardalaspis cyanescens*) (CERTCY)	66		x		
Neoleucinodes elegantalis (NEOLEL)	67	x			
Pityophthorus juglandis (PITOJU)	68	x			
Rhagoletis suavis (RHAGSU)	69	x			
Rhynchophorus palmarum (RHYCPA)	70	x			
Scirtothrips aurantii (SCITAU)	70		x		
Scirtothrips dorsalis (SCITDO)	71				x

Pest	Page	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Spodoptera eridania (PRODER)	73		x		
Spodoptera litura (PRODLI)	74	x			
Thaumatotibia leucotreta (ARGPLE)	75		x		
Toxoptera citricidus (formerly *Toxoptera citricida*) (TOXOCI)	76	x			
Trioza erytreae (TRIZER)	77	x			
Unaspis citri (UNASCI)	77	x			
Xyphon fulgida (formerly *Carneocephala fulgida*) (CARNFU)	78	x			

* Not assessed here (previous assessment available in in the report "Potential establishment of the priority pest *Anthonomus eugenii* in Sweden" by Björklund and Boberg (2020)).

Quarantine pests - bacteria

Candidatus Liberibacter africanus (LIBEAF)

Candidatus *Liberibacter africanus* is one of the causal agents of the disease Huanglongbing (or citrus greening). The bacteria is transmitted by psyllid vectors, e.g. *Trioza erytreae* and possibly also *Diaphorina citri*, *Cacopsylla citrisuga* and *Diaphorina communis* (EPPO, 2020). The bacteria may also spread via infected vegetative propagation material but transmission by seed or fruit has not been observed (EPPO 2020). None of these vectors are listed as present in Sweden (Dyntaxa, 2020). The main hosts for *Candidatus* Liberibacter africanus are different *Citrus* sp. but other plants within the Rutaceae are also infected (EPPO 2020). None of the host species listed by EPPO (2020) is classified as established in Sweden (Dyntaxa, 2020). The bacterium is currently reported from many countries in Africa, Saudi Arabia and Yemen (EPPO, 2020). In a recent study where the potential distribution of the bacteria was modelled based on the ecoclimatic factors the habitat was predicted to be unsuitable in Sweden (Ajene et al. 2020).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Ajene, IJ, Khamis, F, van Asch, B, et al. (2020) Habitat suitability and distribution potential of Liberibacter species ("*Candidatus* Liberibacter asiaticus" and "*Candidatus* Liberibacter africanus") associated with citrus greening disease. Divers Distrib. 26: 575– 588. LINK

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-15].

EPPO (2020) *'Candidatus Liberibacter africanus'*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int [Accessed 2020-10-15]

Candidatus Liberibacter americanus (LIBEAM)

Candidatus Liberibacter americanus is one of the causal agents of the disease Huanglongbing (or citrus greening). The bacteria is transmitted by *Diaphorina citri* (EPPO, 2020), which appear adapted to tropical and subtropical conditions and not found in Sweden (EPPO, 2020a,b; Dyntaxa, 2020). The conditions in Sweden for the vector is assessed as not suitable, see assessment for *D. citri*. The bacteria may also spread via infected vegetative propagation material but transmission by seed or fruit has not been observed (EPPO 2020). The host list for this bacteria is more limited than for *Candidatus* Liberibacter africanus and the following species are listed as hosts; *Citrus sinensis*, *C. reticulata*, *C. reticulata* x *C. sinensis* and *M. paniculata* (EPPO, 2020a). None of the host species listed by EPPO (2020) is classified as established in Sweden (Dyntaxa, 2020). The bacteria is currently reported only from Brazil (EPPO, 2020a). The ecoclimatic conditions in Sweden were predicted to be unsuitable for the closely related species *Candidatus* Liberibacter africanus (Ajene et al. 2020) and we therefore expect that the same apply to *Candidatus* Liberibacter americanus.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Ajene, IJ, Khamis, F, van Asch, B, et al. (2020) Habitat suitability and distribution potential of Liberibacter species ("*Candidatus* Liberibacter asiaticus" and "*Candidatus* Liberibacter africanus") associated with citrus greening disease. Divers Distrib. 26: 575– 588. LINK

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-15].

EPPO (2020a) *'Candidatus Liberibacter americanus'*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int [Accessed 2020-10-15]

EPPO (2020b) *Diaphorina citri*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int [Accessed 2020-11-09]

Candidatus Liberibacter asiaticus (LIBEAS)

Candidatus Liberibacter asiaticus is one of the causal agents of the disease Huanglongbing (or citrus greening). The bacteria is transmitted by psyllid vectors, e.g. *Diaphorina citri*, *Trioza erytreae* and possible also, *Cacopsylla citrisuga* and *Diaphorina communis* (EPPO, 2020). None of the vectors are listed as present in Sweden (Dyntaxa, 2020). The bacteria may also spread via infected vegetative propagation material but transmission by seed or fruit has not been observed (EPPO 2020). The main hosts for *Candidatus* Liberibacter africanus are different *Citrus* sp. but other plants within the Rutaceae are also infected (EPPO 2020). No species within the Rutaceae reproduces regularly in Sweden (Dyntaxa, 2020). The disease is found in southern Asia, Africa, southern parts of North America, Central and South America and Oceania (EPPO, 2020). The ecoclimatic conditions in Sweden were predicted to be unsuitable for the closely related species *Candidatus* Liberibacter africanus (Ajene et al. 2020) and we therefore expect that the same apply to *Candidatus* Liberibacter asiaticus.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Ajene, IJ, Khamis, F, van Asch, B, et al. (2020) Habitat suitability and distribution potential of Liberibacter species (“Candidatus Liberibacter asiaticus” and “Candidatus Liberibacter africanus”) associated with citrus greening disease. Divers Distrib. 26: 575– 588. LINK

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [accessed 2020-10-15].

EPPO (2020) *'Candidatus Liberibacter asiaticus'*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.inthttps://gd.eppo.int/taxon/LIBEAS/datasheet [Accessed 2020-10-15]

Ralstonia syzygii subsp. celebesensis (RALSSC)

Ralstonia syzygii subsp. *celebesensis* belongs to the *Ralstonia solanacearum* species complex and is a bacterium that causes banana blood disease (Blomme et al. 2017; EFSA 2019). The main host is banana (*Musa* sp.) (Safni et al. 2014; EFSA, 2019). Other hosts are also reported to be susceptible of which some are categorized as established in Sweden, i.e. *Solanum nigrum* (nattskatta) and *Datura stramonium* (spikklubba), although the latter is rare in Sweden (Safni et al. 2018 citing Baharuddin 1994; Dyntaxa 2020). Natural infection in the field has only been observed in *Musa* sp. (Drenth et al 2020) and according to CABI (2020) survival is limited in *S.*

nigrum (and *S. lycopersicum*). The bacterium spreads in soil and water, via tools and vehicles, in infected fruit and vegetative propagation material and by insects (Safni et al. 2018). The bacterium is reported to be able to survive on infected plant residues in soil for at least 1 year (Safni et al. 2018 citing Gäumann 1921). The bacterium is not present in areas that share ecoclimatic conditions with Sweden, i.e. the subspecies is only reported from Indonesia and Malaysia (Teng et al. 2016; Blomme et al. 2017). Another species/strain within the *R. solanacearum* species complex has been reported from Sweden, but has since been eradicated (Persson, 1998).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Blomme, G., Dita, M., Jacobsen, K.S., Vicente, L.P., Molina, A., et al.. (2017) Bacterial Diseases of Bananas and Enset: Current State of Knowledge and Integrated Approaches Toward Sustainable Management. Frontiers in Plant Science, Frontiers, 8:1290. LINK

CABI (2020) Blood disease bacterium (blood disease bacterium of banana) In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc. [Accessed 2020-11-13]

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-15].

Drenth, A., Ray, J. and Subandiyah, S. (2020) Reversing the impact of Banana Blood Disease in Indonesia. APBSF Project Final Report PBSF016:pp 22. LINK

EFSA PLH Panel (EFSA Panel on Plant Health), Bragard C, Dehnen-Schmutz K, Di Serio F, Gonthier P, Jaques Miret JA, Justesen AF, MacLeod A, Magnusson CS, Milonas P, Navas-Cortes JA, Parnell S, Potting R, Reignault PL, Thulke H-H, Van der Werf W, Vicent Civera A, Yuen J, Zappalà L, Van der Wolf J, Kaluski T, Pautasso M and Jacques M-A, (2019). Scientific Opinion on the pest categorisation of the *Ralstonia solanacearum* species complex. EFSA Journal 2019;17(2):5618, 28 pp. LINK

Persson, P. (1998). Successful eradication of *Ralstonia solanacearum* from Sweden. EPPO Bulletin, 28, 113-119. LINK

Safni, I., Cleenwerck, I., De Vos, P., Fegan, M., Sly, L., & Kappler, U. (2014). Polyphasic taxonomic revision of the *Ralstonia solanacearum* species complex: proposal to emend the descriptions of *Ralstonia solanacearum* and *Ralstonia syzygii* and reclassify current *R. syzygii* strains as *Ralstonia syzygii* subsp. *syzygii* subsp. nov., *R. solanacearum* phylotype IV strains as *Ralstonia syzygii* subsp. *indonesiensis* subsp. nov., banana blood disease bacterium strains as

Ralstonia syzygii subsp. *celebesensis* subsp. nov. and *R. solanacearum* phylotype I and III strains as *Ralstonia pseudosolanacearum* sp. nov. International journal of systematic and evolutionary microbiology, 64(9), 3087-3103. LINK

Safni, I., Subandiyah, S., & Fegan, M. (2018). Ecology, epidemiology and disease management of *Ralstonia syzygii* in Indonesia. Frontiers in microbiology, 9, 419. LINK

Teng, S.K., N.A.A. Aziz, M. Mustafa, R. Laboh, I.S. Ismail, S.R. Sulaiman, A.A. Azizan and S. Devi, (2016) The occurrence of blood disease of banana in Selangor, Malaysia. Int. J. Agric. Biol., 18: 92–97 LINK

Xanthomonas citri pv. *aurantifolii* (XANTAU)

Xanthomonas citri pv. *aurantifolii* causes citrus bacterial canker referred to as South-American canker (EFSA, 2019). The bacterium is dispersed by splash and windblown rain droplets as well as through human activities and infection occur via stomata or wounds (EFSA, 2019a). Primarily, *Citrus* and other genera of the Rutaceae are hosts (EFSA, 2014, 2019a,b). No species within the Rutaceae reproduces regularly in Sweden (Dyntaxa, 2020). Based on the current distribution, EFSA assess that the bacterium can potentially establish in areas with the global hardiness zones 8-10, which includes areas in the most southern part of Sweden (EFSA 2014). The potential distribution in the EU, assessed by EFSA for the purposes of assessing the impact and planning a pest survey, is equivalent to the distribution of *Citrus* spp., i.e. the most southern parts of the EU (EFSA, 2019a,b).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Family: Rutaceae – vinruteväxter, LINK [Accessed 2020-10-19]

EFSA PLH Panel (EFSA Panel on Plant Health), (2014). Scientific Opinion on the risk to plant health of *Xanthomonas citri* pv. *citri* and *Xanthomonas citri* pv. *aurantifolii* for the EU territory. EFSA Journal 2014;12(2):3556, 178 pp. doi:10.2903/j.efsa.2014.3556 LINK

EFSA (European Food Safety Authority), Vos S, Camilleri M and Diakaki M (2019a) Pest survey card on *Xanthomonas citri* pv. *citri* and pv. *aurantifolii*. EFSA supporting publication 2019:EN-1587. 25 pp. doi:10.2903/sp.efsa.2019.EN-1587 LINK

EFSA, Baker Richard, Gilioli Gianni, Behring Carsten, Candiani Denise, Gogin Andrey, … Tramontini Sara. (2019b). *Xanthomonas citri* −Pest Report and Datasheet to support ranking of EU candidate priority pests [Data set]. Zenodo. LINK

Xanthomonas citri pv. citri (XANTCI)

Xanthomonas citri pv. *citri* causes citrus bacterial canker referred to as Asiatic canker (EFSA, 2019. The bacterium is dispersed by splash and windblown rain droplets as well as through human activities and infection occur via stomata or wounds (EFSA, 2019a). Primarily, *Citrus* and other genera of the Rutaceae are hosts (EFSA, 2014; 2019a, b). No species within the Rutaceae reproduces regularly in Sweden (Dyntaxa, 2020). Based on the current distribution, EFSA assess that the bacterium can potentially establish in areas with the global hardiness zones 8-13, which includes areas in the most southern part of Sweden (EFSA, 2014). The potential distribution in the EU, assessed by EFSA for the purposes of assessing the impact and planning a pest survey, is equivalent to the distribution of *Citrus* spp., i.e. the most southern parts of the EU (EFSA, 2019 a, b).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Family: Rutaceae – vinruteväxter, LINK [accessed 2020-10-19]

EFSA PLH Panel (EFSA Panel on Plant Health), (2014). Scientific Opinion on the risk to plant health of *Xanthomonas citri* pv. *citri* and *Xanthomonas citri* pv. *aurantifolii* for the EU territory. EFSA Journal 2014;12(2):3556, 178 pp. doi:10.2903/j.efsa.2014.3556 LINK

EFSA (European Food Safety Authority), Vos S, Camilleri M and Diakaki M (2019a) Pest survey card on *Xanthomonas citri* pv. *citri* and pv. *aurantifolii*. EFSA supporting publication 2019:EN-1587. 25 pp. doi:10.2903/sp.efsa.2019.EN-1587 LINK

EFSA, Baker Richard, Gilioli Gianni, Behring Carsten, Candiani Denise, Gogin Andrey, … Tramontini Sara. (2019b). *Xanthomonas citri*−Pest Report and Datasheet to support ranking of EU candidate priority pests [Data set]. Zenodo. LINK

Xanthomonas oryzae pv. oryzae (XANTOR)

Xanthomonas oryzae pv. *oryzae* is a pathovar causing bacterial blight of rice (EFSA, 2018). No vector is reported, instead the bacteria are dispersed by water, rain droplets, water splash and infection occurs via stomata, pores or wounds (EFSA, 2018). The main host is rice (*Oryza sativa*), but other *Oryza* species may also be infected and other Poaceae species may host the bacteria during winter (EFSA, 2018). Two of the known hosts are classified as established in Sweden, i.e. *Echinochloa crus-galli* and *Leersia oryzoid* (EFSA 2018; Dyntaxa, 2020). Both are however rare in Sweden (Anderberg and Anderberg, 2020). The pathovar is currently found in the main rice producing areas of the world, but not in Europe (EFSA 2018; EPPO, 2020). Disease impact is mostly observed in countries with tropical and subtropical climate, but the bacteria is also found in temperate climate in Japan (EFSA, 2018). Based on its geographic distribution the bacterium is suggested to survive in Mediterranean regions (EPPO 1997).

Due to the combination of lack of the main hosts and unfavourable climate for the pathovar, the conditions are assessed to not support an establishment of the pest in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Anderberg, A. & Anderberg, A.-L. (2020) Den virtuella floran. Elektronisk publikation, Naturhistoriska riksmuseet, Stockholm. http://linnaeus.nrm.se/flora [Accessed 2020-10-19]

CABI, 2020. *Xanthomonas oryzae* pv. *oryzicola* (bacterial leaf streak of rice). In: Crop Protection Compendium. Wallingford, UK: CAB International. www.cabi.org/cpc. [Accessed 2020-10-19]

Dyntaxa (2020) Swedish Taxonomic Database. Visited at https://www.dyntaxa.se/Taxon/Info/935?changeRoot=True and https://www.dyntaxa.se/Taxon/Info/222425?changeRoot=True [accessed 2020-10-19]

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Niere, B, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Bragard, C, Szurek, B, Hollo, G and Caffier, D, 2018. Scientific Opinion on the pest categorisation of *Xanthomonas oryzae* pathovars *oryzae* and *oryzicola*. *EFSA Journal* 2018;16(1):5109, 25 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [Accessed 2020-10-19]

EPPO (1997) Data Sheet on Quarantine Pests *Xanthomonas oryzae*. Prepared by CABI and EPPO for the EU under Contract 90/399003. LINK Available online: [Accessed: 2020-11-09]

Xanthomonas oryzae pv. *oryzicola* (XANTTO)

Xanthomonas oryzae pv. *oryzicola* is a pathovar causing bacterial leaf streak of rice (EFSA, 2018). No vector is reported, instead the bacteria are dispersed by water, raindroplets, water splash and through the seed which has been confirmed for pathovar oryzicola and infection occurs via stomata, pores or wounds (EFSA, 2018). The main host is rice (*Oryza sativa*) and other *Oryza* species, but less is known of other host species, although some are reported (EFSA, 2018). None of the known hosts are established in Sweden (Anderberg and Anderberg, 2020; Dyntaxa, 2020). The pathovar is currently found in main rice producing countries in Asia, Africa and in Australia (EFSA 2018; EPPO, 2020). The pathovar has a more tropical distribution than the pathovar oryzae, is usually found during very wet seasons and the disease caused by it is considered less important than that caused by the other pathovar, (EPPO 1997; CABI, 2020; EPPO 2020).

Due to the combination of lack of the main hosts and unfavourable climate for the pathovar, our assessment is that the conditions do not support an establishment of the pest in Sweden.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Anderberg, A. & Anderberg, A.-L. (2020) Den virtuella floran. Elektronisk publikation, Naturhistoriska riksmuseet, Stockholm. http://linnaeus.nrm.se/flora [Accessed 2020-10-19]

CABI, 2020. *Xanthomonas oryzae* pv. *oryzicola* (bacterial leaf streak of rice). In: Crop Protection Compendium. Wallingford, UK: CAB International. www.cabi.org/cpc. [Accessed 2020-10-19]

Dyntaxa (2020) Swedish Taxonomic Database. Visited at https://www.dyntaxa.se/Taxon/Info/935?changeRoot=True and https://www.dyntaxa.se/Taxon/Info/222425?changeRoot=True [Accessed 2020-10-19]

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas

Navarro, M, Niere, B, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Bragard, C, Szurek, B, Hollo, G and Caffier, D, 2018. Scientific Opinion on the pest categorisation of *Xanthomonas oryzae* pathovars *oryzae* and *oryzicola*. *EFSA Journal* 2018;16(1):5109, 25 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [Accessed 2020-10-19]

EPPO (1997) Data Sheet on Quarantine Pests *Xanthomonas oryzae*. Prepared by CABI and EPPO for the EU under Contract 90/399003. LINK Available online: [Accessed: 2020-11-09]

Quarantine pests - nematodes

Hirschmanniella spp. (1HIRSG)

except *H. behningi, H. gracilis, H. halophila, H. loofi and H. zostericola*

Species in the genus *Hirschmanniella* are root endoparasites adapted to aquatic environments (EPPO, 2009; EFSA, 2018). In a pest categorization by EFSA (2018), 24 species within the genus (which are not present in the EU) were assessed. Most of these species are found in tropical regions and some are pests of rice (EPPO, 2009; EFSA, 2018). There are, however, a few species found in regions with a cold climate type. In Canada, *H. anchoryzae* was collected from the rhizosphere of submerged *Scirpus americanus* and *Zizania aquatica* in Quebec (Ebsary and Andersson 1982) and *H. pisquidensis* from *Z. aquatica* on Prince Edwards Island (Ebsary and Pharoah 1982). In China, *H. brassicae* was found on the roots of *Brassica oleracea* var. *capitata* in the Shandong province (Duan et al. 1996). There appears to be very limited data for these three *Hirschmanniella* species and the true host range and current distribution is unclear. Considering all species of the genus the known hosts are very variable and some species have been intercepted on bonsais (EPPO, 2009). Greenhouse production (also aquaponics systems) of e.g. tomato, would constitute suitable conditions for establishment (EFSA, 2018). Tomato (*Solanum lycopersicum*) is grown commercially in greenhouse conditions in Sweden (Jordbruksverket 2018). The nematodes are spread via soil and water, on tools and machinery and associated with plants (EFSA 2018).

At least some species within the genus are not expected to be limited by climatic conditions in Sweden, but whether susceptible hosts are available is not known. Conditions in greenhouse production could however be suitable. There appear to be very limited information, especially for the species found in cold climates mentioned above. The conditions in Sweden are likely to be suitable for establishment for at least some of the species, both outdoors and/or in greenhouse production. The uncertainty of the assessment is however very large.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☐	☒	☐
Uncertainty range	☒	☒	☒	☐

References

Duan, Y. X., Liu, W. Z., Liu, Y., & Zhao, H. H. (1996). A new species of *Hirschmanniella* (Pratylenchidae) associated with the Brassicae (*Brassica oleracea* var. capitata). *Journal of Shenyang Agricultural University*, *27*(1), 35-38. *[based on abstract only]*

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Anton, J, Miret, J, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2018). Scientific Opinion on the pest categorisation of *Hirschmanniella* spp.. *EFSA Journal* 2018;16(6):5297, 31 pp. LINK

EPPO (2009), PP 7/94(1): *Hirschmanniella* spp.. EPPO Bulletin, 39: 369-375. LINK

Esbary, B.A. and Andersson, R.V. (1982) Two new species of *Hirschmanniella* Luc and Goodey, 1963 (Nematoda: Pratylenchidae) with a key to the nominal species. *Canadian Journal of Zoology*. **60**(4): 530-535. LINK

Ebsary, B.A. and Pharoah, G. (1982) *Hirschmanniella pisquidensis* n. sp. (Nematoda: Pratylenchidae) from roots of wild rice in Prince Edward Island, Canada. Canadian Journal of Zoology 60(2), 165-167. LINK

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Longidorus diadecturus (LONGDI)

Longidorus diadecturus is an ectoparasite causing damage to host roots and is a vector of Peach rosette mosaic virus (EFSA, 2017). The nematodes are spread via soil and water, e.g. through soil associated with tools, machinery and plants (EFSA 2017). The plant host range is broad and ‘plants’ as well as ‘woody plants’ are listed as minor hosts (EPPO 2020). Some relevant hosts (the species or genus are grown) in Sweden are *Prunus persica, Vitis labrusca, Cucumis sativus, Vaccinium* spp, *Chenopodium quinoa, Petunia hybrida, Acer negundo, Ulmus americana* (EFSA 2017 and references therein). The nematode is found in Canada (EPPO, 2020), some states in the USA (with some uncertainty; EFSA, 2017 and references therein) and was recently reported from China (on roots of deciduous trees in Wuhan of Hubei Province) (Barsalote et al.

2018). The distribution in Canada is not known, only reports of the nematode from Essex County, southern Ontario, were found (e.g. Eveleigh and Allen, 1982). The climate in the regions where the nematode has been reported is classified as Köppen-Geiger climate zones temperate (China, Arkansas, Oklahoma) and cold (Canada) (see Beck et al. 2018). Whether the climate in Sweden is suitable for establishment is very uncertain. No reports were found of the nematode in greenhouse production, but some of the known hosts, e.g. *Petunia hybrida* and *Cucumis sativus* are cultivated commercially in greenhouses in Sweden.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☒	☐

References

Barsalote, E.M., Zhongling, T.I.A.N., Ruihang, C.A.I., Xiaolin, L.I., & Zheng, J. (2018). Description of two new records of genus Longidorus (Nematoda: Dorylaimida) in China. Journal of Zhejiang University (Agriculture and Life Sciences), 44(1), 31-40. *[based on abstract only]*

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Urek, G, Kaluski, T and Niere, B, 2017. Scientific Opinion on the pest categorisation of *Longidorus diadecturus*. *EFSA Journal* 2017;15(12):5112, 19 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [Accessed 2020-10-23]

Eveleigh, E.S. and Allen, W.R. (1982) Description of *longidorus diadecturus n.p. (Nematoda: Longidoridae),* a vector of the peach rosette mosaic virus in peach orchards on southwestern Ontario, Canada. Can. J. Zool. 60: 112-115 LINK

Xiphinema bricolense (XIPHBC)

Xiphinema bricolense (also known as *X. bricolensis*; EPPO, 2009) is an ectoparasitic nematode belonging to the *X. americanum* s.l. group and classified as a non-EU species able to vector

plant viruses (EFSA, 2018). Spread may occur in soil and with soil associated with tools, machinery, plants and packaging material (EFSA 2018). The host range is very broad and apart from 'plants' (EPPO 2020), the following have been listed as major hosts: *Juncus, Solanum lycopersicum, Nicotiana tabacum, Pelargonium, Prunus* and *Vitis* (UK Plant Health Risk Register, 2020). The species is reported from North America (EPPO, 2020). The nematode has for example been found in California and in apple orchards and vineyards in British Columbia (Graham et al. 1988; Robbins and Brown 1991; Robbins 1993). The *X. americanum* s.l. group assessed by EFSA (2017) occurs mainly in warm temperate climate. It is however unclear whether *X. bricolense* is present in regions with climate similar to that in Sweden and it is also unclear whether ecoclimatic factors would prevent establishment outdoors in Sweden. The species within the *X. americanum* s.l. group may also be difficult to distinguish and together with taxonomic revisions complicates the use of older literature (EPPO, 2009).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☒	☐

References

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2018). Scientific Opinion on the pest categorisation of *Xiphinema americanum* sensu lato. *EFSA Journal* 2018;16(7):5298, 43 pp. LINK

EPPO (2009), PM 7/95(1): *Xiphinema americanum* sensu lato. EPPO Bulletin, 39: 382-392. doi:10.1111/j.1365-2338.2009.02326.x

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [Accessed 2020-10-23]

Graham, M.B., Ebsary, B.A., Vrain, T.C. & Webster, J.M. (1988) Distribution of *Xiphinema bricolensis* and *X. pacificum* in vineyards of the Okanagan and Similkameen Valleys, British Columbia, Canadian Journal of Plant Pathology, 10:3, 259-262, DOI: 10.1080/07060668809501734

Robbins, R. T. and Brown, D. J. F. (1991). Comments on the taxonomy, occurrence and distribution of Longidoridae (Nematoda) in North America. Nematologica, 37(1-4), 395-419.

Robbins, R. T. (1993). Distribution of *Xiphinema americanum* and related species in North America. Journal of Nematology, 25(3), 344.

UK Plant Health Risk Register (2020) UK Risk Register Details for *Xiphinema bricolense*. Updated on 18/09/2020. Department for Environment, Food & Rural Affairs, UK. https://secure.fera.defra.gov.uk/phiw/riskRegister/viewPestRisks.cfm?cslref=7720 [Accessed 2020-10-23]

Xiphinema californicum (XIPHCA)

Xiphinema californicum is an ectoparasitic nematode belonging to the *X. americanum* s.l. group and classified as a non-EU species able to vector plant viruses (EFSA, 2018). Spread may occur in soil and with soil associated with tools, machinery, plants and packaging material (EFSA 2018). The host range is very broad and EPPO (2020) lists 'plants' as hosts. Major hosts that represents species or genera relevant for Sweden are *Abies concolor, Cupressus macnabiana, Cupressus macrocarpa, Ipomoea batatas, Juniperus osteosperma, Malus* sp., *Medicago sativa, Pelargonium, Pinus attenuata, Pinus coulteri, Pinus flexilis, Pinus jeffreyi, Pinus monophylla, Pinus monticola, Pinus ponderosa, Pinus radiata, Pinus sabiniana, Populus tremuloides, Prunus* spp., *Pseudotsuga menziesii, Quercus kelloggii, Rosa, Salix lutea, Vitis,* and *Zea mays* (EFSA 2017; UK Plant Health Risk Register, 2020). The species is reported from North, Central and South America (EPPO, 2020). EFSA (2017) assess that the pest occurs in warm temperate climate. There are also some occurrence reports from Pennsylvania and New York (Robbins 1993), which are represented by cold Köppen-Geiger climate types (see Beck et al. 2018). These reports are however uncertain due to identification difficulties. The species within the *X. americanum* s.l. group may also be difficult to distinguish which, together with taxonomic revisions, complicates the use of older literature (EPPO, 2009).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☒	☐

References

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Gregoire, J-C, Anton, J, Miret, J, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2017). Scientific Opinion on the pest categorisation of *Xiphinema californicum*. *EFSA Journal* 2017;15(12):5111, 24 pp. LINK

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2018). Scientific Opinion on the pest categorisation of *Xiphinema americanum* sensu lato. *EFSA Journal* 2018;16(7):5298, 43 pp. LINK

EPPO (2009), PM 7/95(1): *Xiphinema americanum* sensu lato. EPPO Bulletin, 39: 382-392. doi:10.1111/j.1365-2338.2009.02326.x

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [Accessed 2020-10-23]

Robbins, R. T. (1993). Distribution of *Xiphinema americanum* and related species in North America. Journal of Nematology, 25(3), 344.

UK Plant Health Risk Register (2020) UK Risk Register Details for *Xiphinema californicum*. Updated on 18/09/2020. Department for Environment, Food & Rural Affairs, UK. https://secure.fera.defra.gov.uk/phiw/riskRegister/viewPestRisks.cfm?cslref=10799 [accessed 2020-10-23]

Xiphinema inaequale (XIPHNA)

Xiphinema inaequale is an ectoparasitic nematode belonging to the *X. americanum* s.l. group and classified as a non-EU species able to vector plant viruses (EFSA, 2018). The name *X. neoamericanum* is the preferred name according to EPPO Global Database (2020), but in the IPPC key for *X. americanum* s.l. the species name has been omitted (FAO, 2016). Spread may occur in soil and with soil associated with tools, machinery, plants and packaging material (EFSA 2018). Very little information was found regarding the host range for this particular species, but it is likely very broad considering the host range of other *Xiphinema* spp. The species was reported from India around the roots of e.g. walnut (*Juglans regia*) trees and only at high elevation (Khan and Ahmad 1975; Lamberti et al 2000), Peru (Lamberti et al. 1987) and Chile in the rhizosphere of grapevine (Lamberti et al 1988). The *X. americanum* s.l. group was assessed by EFSA (2017) to occur mainly in warm temperate climate. The limited documentation of both host range and current distribution for *X. inaequale* makes the assessment very uncertain. The species within the *X. americanum* s.l. group may also be difficult to distinguish and is often referred to as a species complex. Taxonomic revisions further complicates the use of older literature (EPPO, 2009).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☒	☐	☐

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Uncertainty range	☒	☒	☐	☐

References

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2018). Scientific Opinion on the pest categorisation of *Xiphinema americanum* sensu lato. *EFSA Journal* 2018;16(7):5298, 43 pp. LINK

EPPO (2009), PM 7/95(1): *Xiphinema americanum* sensu lato. EPPO Bulletin, 39: 382-392. doi:10.1111/j.1365-2338.2009.02326.x

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [Accessed 2020-10-23]

FAO (2016) DP 11: *Xiphinema americanum* sensu lato. ISPM 27, Annex 11. Available online: https://www.ippc.int/static/media/files/publication/en/2016/05/DP_11_2016_En_2016-05-24.pdf [Accessed 2020-10-26]

Khan, S. H. and Ahmad, S. (1975). Longidoroidea (Thorne, 1935) n. rank. (Nematoda: Dorylaimina) with description of *Xiphinema americanum* n. sp. from India and proposal of a new name for *X. americanum* sensu Carvalho (1956) non Cobb, 1913. Nematologia Mediterranea.

Lamberti, F., Jatala, P., & Agostinelli, A. (1987). A report of some *Xiphinema* species occurring in Peru (Nematoda, Dorylaimida). Nematologia mediterranea.

Lamberti, F., & Bleve-Zacheo, T. (1979). Studies on *Xiphinema americanum* sensu lato with descriptions of fifteen new species (Nematoda, Longidoridae). Nematologia mediterranea.

Lamberti, F. D., Roca, F., & Agostinelli, A. (1988). On the identity of *Xiphinema americanum* in Chile with a key to the *Xiphinema* species occurring in Chile. Nematologia mediterranea.

Xiphinema intermedium (XIPHIM)

Xiphinema intermedium is an ectoparasitic nematode belonging to the *X. americanum* s.l. group and classified as a non-EU species able to vector plant viruses (EFSA, 2018). Spread may occur in soil and with soil associated with tools, machinery, plants and packaging material (EFSA 2018). Hosts reported are *Citrus*, Bermuda grass, *Vaccinium* spp. (in Florida) (Cho and Robbins

1991; Robbins and Brown 1991; Lamberti et al. 2000 and references therein). The species is reported from Florida and Mississippi (USA) and Pakistan (Robbins and Brown 1991; Lamberti et al. 2000 and references therein). The *X. americanum* s.l. group was assessed by EFSA (2017) to occur mainly in warm temperate climate. There appears to be very limited documentation of both the host range and current distribution for *X. intermedium* which makes the assessment uncertain. The species within the *X. americanum* s.l. group may also be difficult to distinguish and is often referred to as a species complex. Taxonomic revisions further complicates the use of older literature (EPPO, 2009).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Cho, M. R., & Robbins, R. T. (1991). Morphological variation among 23 *Xiphinema americanum* populations. Journal of Nematology, 23(1), 134.

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2018). Scientific Opinion on the pest categorisation of *Xiphinema americanum* sensu lato. *EFSA Journal* 2018;16(7):5298, 43 pp. LINK

EPPO (2009), PM 7/95(1): *Xiphinema americanum* sensu lato. EPPO Bulletin, 39: 382-392. doi:10

Lamberti, F., Molinari, S., Moens, M., & Brown, D. J. (2000). The *Xiphinema americanum* group. I. Putative species, their geographical occurrence and distribution, and regional polytomous identification keys for the group. Russian Journal of Nematology, 8(1), 65-84..1111/j.1365-2338.2009.02326.x

Robbins, R. T. and Brown, D. J. F. (1991). Comments on the taxonomy, occurrence and distribution of Longidoridae (Nematoda) in North America. Nematologica, 37(1-4), 395-419.

Xiphinema tarjanense (XIPHTA)

Xiphinema tarjanense is an ectoparasitic nematode belonging to the *X. americanum* s.l. group and classified as a non-EU species able to vector plant viruses (EFSA, 2018). Spread may occur in soil and with soil associated with tools, machinery, plants and packaging material (EFSA

2018). Hosts reported are *Medicago sativa* (Cho and Robbins 1991) and the nematode has also been reported from rhizosphere of oak trees in Florida (Lamberti and Bleve-Zacheo 1979). The species has only been reported from Florida, USA (e.g. Lamberti and Bleve-Zacheo 1979; Cho and Robbins 1991; EFSA 2018). There appears to be very limited documentation of both the host range and current distribution for *X. tarjanense*, which makes the assessment uncertain. The species within the *X. americanum* s.l. group may also be difficult to distinguish and is often referred to as a species complex. Taxonomic revisions further complicates the use of older literature (EPPO, 2009).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Cho, M. R., & Robbins, R. T. (1991). Morphological variation among 23 *Xiphinema americanum* populations. Journal of Nematology, 23(1), 134.

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Grégoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Kaluski, T and Niere, B, (2018). Scientific Opinion on the pest categorisation of *Xiphinema americanum* sensu lato. *EFSA Journal* 2018;16(7):5298, 43 pp. LINK

EPPO (2009), PM 7/95(1): *Xiphinema americanum* sensu lato. EPPO Bulletin, 39: 382-392. doi:10.1111/j.1365-2338.2009.02326.x

Lamberti, F., & Bleve-Zacheo, T. (1979). Studies on *Xiphinema americanum* sensu lato with descriptions of fifteen new species (Nematoda, Longidoridae). Nematologia mediterranea, 7, 51-106 LINK

Quarantine pests – viruses, viroids and phytoplasmas

Citrus leprosis viruses (CILV00):

Including CiLV-C, CiLV-C2, HGSV-2, Citrus strain of OFV and CiLV-N sensu novo

Five viruses of the 'Citrus leprosis viruses' are included in EFSAs pest categorisation (EFSA, 2017). These viruses are not systemic and are transmitted by *Brevipalpus* spp. mites, which is the main means of dispersal (EFSA, 2017). Hosts are e.g. *Citrus* spp., *Swinglea glutinosa*, *Commelina benghalensis* and, at least by inoculation, also e.g. *Hibiscus rosasinensis, Malvaviscus arboreus, Grevillea robusta, Bixa orellana, Arabidopsis, Phaseolus, Dieffenbachia, Solanum* spp. and *Capsicum annuum* (EFSA, 2017). Citrus leprosis virus s.l. is reported from central and south America, Hawaii (USA) and South Africa (EPPO, 2020). One of the known vectors *Brevipalpus obovatus,* and other species within the genus, appears to occur as a pest in greenhouse production of ornamental plants in Sweden (Jordbruksverket 2009, 2018), but does not appear to be found outdoors (Dyntaxa 2020). No direct constrains of ecoclimatic conditions on the viruses are expected (EFSA 2017). The viruses are not assessed to be able to establishment outdoors due to the lack of vectors and natural hosts. No information could be found of any production of the natural hosts in protected conditions in Sweden and most likely the viruses can not establish due to lack of hosts, but experimental hosts of e.g. *Capsicum annuum* increase the uncertainty.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-27].

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Dehnen-Schmutz, K, Gilioli, G, Gregoire, J-C, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Niere, B, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Chatzivassiliou, E, Winter, S, Catara, A, Duran-Vila, N, Hollo, G and Candresse, T, (2017). Scientific Opinion on the pest categorisation of Citrus leprosis viruses. EFSA Journal 2017;15(12):5110, 32 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-10-27]

Jordbruksverket (2009) Biologiskt växtskydd i prydnadsväxtodling. Jordbruksinformation 2-2009. Available online: http://www2.jordbruksverket.se/webdav/files/SJV/trycksaker/Pdf_jo/jo09_2.pdf [Accessed: 2020-10-26]

Jordbruksverket (2018) Bekämpning i yrkesmässig trädgårdsodling. Available online: https://www2.jordbruksverket.se/download/18.628f97e316796cb23a96b6d3/1544516032079/be8v6.pdf [Accessed: 2020-10-26]

Citrus tristeza virus (non-EU isolates) (CTV000)

The virus is transmitted by *Aphis* spp. and *Toxoptera* spp. or by infected vegetative propagation material (EFSA 2019). *Citrus* spp., *Fortunella* spp. and *Poncirus* spp. are the known natural hosts while experimental hosts are found in the genera *Aegle*, *Aeglopsis*, *Citropsis* and *Passiflora* (EFSA 2019). No species within the Rutaceae nor any species of *Passiflora* reproduces regularly in Sweden (Dyntaxa, 2020). The virus is found worldwide in most areas where citrus is grown and establishment is possible wherever hosts are present (EFSA 2019). No information could be found of any production of the natural hosts in protected conditions in Sweden and most likely the viruses can not establish due to lack of hosts.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-27].

EFSA (European Food Safety Authority), Schrader G, Camilleri M, Diakaki M and Vos S, (2019) Pest survey card on non-European isolates of citrus tristeza virus. EFSA supporting publication (2019):EN-1600. 21 pp. doi:10.2903/sp.efsa.2019.EN-1600 LINK

Coconut cadang-cadang viroid (CCCVD0)

Coconut cadang-cadang viroid is transmitted by seed, pollen and vegetative propagation material, perhaps also by vectors and tools (EFSA 2017). Coconut is the main host, but the viroid can also infect other species within the Arecaceae (EFSA 2017). The viroid is found across the Philippines, possibly also in Sri Lanka and Malaysia (EFSA 2017; EPPO 2020). No species within the Arecaceae reproduces regularly in Sweden (Dyntaxa, 2020). No information could be found of any commercial production in protected cultivation in Sweden and most likely the viruses can not establish due to lack of hosts

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [accessed 2020-10-27].

EFSA Panel on Plant Health (PLH), Jeger M, Bragard C, Caffier D, Candresse T, Dehnen-Schmutz K, Gilioli G, Gregoire J-C, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Chatzivassiliou E, Winter S, Hollo G and Can dresse T, (2017). Scientifc Opinon on the pest categorisation of Cadang-Cadang viroid. EFSA Journal 2017;15(7):492 8, 23 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-10-27]

Cowpea mild mottle virus (CPMMV0)

The virus is transmitted by *Bemisia tabaci*, its only known vector, and it may also be seed transmitted (CABI 2020; EPPO, 1997). The virus is only retained in the vector for 20-60 min (EPPO 1997). The virus affects mainly Fabaceae and some other hosts. Hosts relevant for Swedish conditions are e.g. *Phaseolus vulgaris*, *Solanum lycopersicum*, *Solanum melongena* (EPPO 2020b). In Sweden, beans (*Phaseolus vulgaris*) are cultivated as an annual crop (Jordbruksverket 2018). None of the other known hosts reproduces regularly in Sweden (Dyntaxa 2020). Tomato (*Solanum lycopersicum*), and to a very limited extent aubergine (*Solanum melongena*), are grown commercially in greenhouse conditions (Jordbruksverket 2018; Karlsson 2019). The virus is reported from central and south America, Africa, Asia and Oceania (EPPO 2020). The virus could be a threat to legume crops in temperate areas with mild climate (CABI 2020). Since host plants and the vector are absent during at least parts of the year in Sweden the virus will not be able to persist, although reintroduction with infected seed could be possible. Only in protected cultivation of tomato and aubergine would the virus, at least theoretically, be able to persist but only if the vector *B. tabaci*, which also is a quarantine pest, is established and the crop is available throughout the year in the greenhouse.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

CABI (2020) Cowpea mild mottle virus (angular mosaic of beans) [Reviewed by JK Brown 05/07/20]. In: Crop Protection Compendium. Wallingford, UK: CAB International. www.cabi.org/cpc. [accessed 2020-10-27]

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [accessed 2020-10-27].

EPPO (1997) Data Sheet on Quarantine Pests Cowpea mild mottle 'carlavirus'. Prepared by CABI and EPPO for the EU under Contract 90/399003. LINK [accessed 2020-10-27]

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-10-27]

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Karlsson, M. (2019). Solanaceae i svenska växthus: förutsättningar för kommersiell odling av asiatisk aubergine och kapkrusbär. First cycle, G2E. Alnarp: SLU, Department of Biosystems and Technology. LINK

Grapevine flavescence dorée phytoplasma (PHYP64)

The disease Grapevine flavescence dorée is caused by the phytoplasmas 16SrV-C and 16SrV-D transmitted by the vector *Scaphoideus titanus* (EFSA 2016). Vegetative propagation material may spread the disease over long distances (EFSA 2016). The phytoplasmas are found in several hosts but the vector is strictly associated with *Vitis* spp. and is the only known vector to spread the phytoplasma between plants of *Vitis* (EFSA 2016; EFSA 2020). The phytoplasmas are found in *Vitis* spp. (main host), but also in *Ailanthus altissima*, *Alnus* spp. and *Clematis vitalba* (EFSA 2016). 16SrV-C is found in Alders all over Europe and vectored by *Oncopsis alni* (EFSA 2016). The phytoplasmas are also found in *C. vitabla* in Italy and Serbia and then transmitted by *Dictyophara europaea* (EFSA 2016). The leafhopper *Oncopsis alni* is established in Sweden, but appears to be limited to *Alnus* spp., and *Dictyophara europaea* is not found in Sweden (Dyntaxa, 2020).

Vitis sp. are cultivated in Sweden but to a limited extent. In total, commercial production is reported to occur on 56 or 100 ha, depending on the source (Jordbruksverket 2018; LRF 2018). The distribution in Sweden according to Jordbruksverket (2018) is as follows; Skåne län 20 ha, Kalmar län 14 ha, Hallands län 8 ha, Gotlands län 7 ha, Stockholms län 2 ha, Jönköpings län 1 ha, och Västa götalands län 1 ha). *Vitis* sp. are also grown as ornamentals in private gardens. The main vector *Scaphoideus titanus* is an introduced non-regulated species in EU, which is not present in Sweden (Dyntaxa 2020; EFSA 2016; EPPO 2020). EFSA predicted the

environmental suitability for the vector *S. titanus* using CLIMEX and climate data for the period 1999-2010, and the Ecoclimatic Index was >0 in some parts of southern Sweden (along the west coast, Skåne, Blekinge, Öland, Gotland, Stockholm) (EFSA 2016). This overlaps with the locations of grapevine production to a large extent and suggests that the climatic conditions would not prevent the establishment of the vector. Although the availability of the main host is low, there is an example of an introduced pest specific on *Vitis* that has become established in Sweden (*Golomerus vitis*), see assessment for 'Viruses, viroids and phytoplasmas of *Vitis*'. EFSA recommends that surveys for both the phytoplasma and *S. titanus* should be performed in MS where none of them are known to be established (EFSA 2020).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☒	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-29].

EFSA Panel on Plant Health (PLH), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Jaques Miret, JA, MacLeod, A, Navajas Navarro, M, Niere, B, Parnell, S, Potting, R, Rafoss, T, Urek, G, Rossi, V, Van Bruggen, A, Van Der Werf, W, West, J, Winter, S, Bosco, D, Foissac, X, Strauss, G, Hollo, G, Mosbach-Schulz, O and Grégoire, J-C, (2016). Scientific opinion on the risk to plant health of Flavescence dorée for the EU territory. *EFSA Journal* 2016; 14(12):4603, 83 pp. doi:10.2903/j.efsa.2016.4603 LINK

EFSA (European Food Safety Authority), Tramontini S, Delbianco A and Vos S, 2020. Pest survey card on flavescence dorée phytoplasma and its vector *Scaphoideus titanus*. EFSA supporting publication (2020):EN-1909. 36 pp. doi:10.2903/sp.efsa.2020.EN-1909 LINK

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

LRF (2018). Sveriges Vingårdar 2018. Rapport från Föreningen Svenskt Vin och Lantbrukarnas Riksförbund. LINK Accessed 2020-11-25.

Lettuce infectious yellows virus (LIYV00)

The lettuce infectious yellows virus is transmitted by *Bemisia tabaci*, and not by seeds or by mechanical means (CABI 2020). The virus is only retained in the insect for 3-4 days and reservoir host plants are important in the epidemiology (CABI 2020). Major hosts are melons (*Cucumis melo*), marrows (*Cucurbita pepo*) and lettuces (*Lactuca sativa*) while beetroots (*Beta*

vulgaris) and carrots (*Daucus carota*) are minor hosts (EPPO 2020). The virus is reported from Mexico and USA (California, Arizona, Texas and Pennsylvania, the latter in hydroponically cultivated lettuce) (EPPO 2020). Some of the host plants are found in Sweden, mainly cultivated as annual crops (Jordbruksverket 2018). The only known vector *B. tabaci* can not establish outdoors (see assessment for '*Bemisia tabaci'*) and subsequently the virus will not be able to persist outdoors. In protected cultivation of lettuce the virus would be able to persist, but only if the vector is established and the crop is available throughout the year in the greenhouse. Lettuce (in pots) are grown in 32 100 m^2 (Jordbruksverket 2019).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

CABI (2020) Lettuce infectious yellows virus (infectious yellows of lettuce). In: Crop Protection Compendium. Wallingford, UK: CAB International. www.cabi.org/cpc. [Accessed 2020-11-01]

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-11-01]

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Jordbruksverket (2019) Jordbruksverkets officiella statistic. Köksväxter i växthus. Antal företag, areal, skördad mängd. År 1999, 2002-2019. Län/riket. Jordbruksverkets statistikdatabas http://statistik.sjv.se/PXWeb/pxweb/sv/?rxid=5adf4929-f548-4f27-9bc9-78e127837625 [Accessed 2020-11-01]

Palm lethal yellowing phytoplasmas (PHYP56)

This refers to a group of phytoplasma strains causing a lethal disease of palms (EFSA 2017). It is regulated as Palm lethal yellowing phytoplasmas and EFSA (2017) specify which strains they include in this group. It is however unclear if all those strains are included under the EPPO Code "PHYP56" (EPPO 2020). The only confirmed vector is the planthopper *Haplaxius crudus* syn. *Myndus crudus*, which has been confirmed to transmit only one of the strains, but the phytoplasmas are found in areas where this vector is believed to be absent (EFSA 2017). The phytoplasma may also spread via vegetative propagation material (EFSA 2017). The phytoplasmas are found in USA (Florida, Louisiana), Central America, Africa and Oceania (EFSA 2017; EPPO 2020). Hosts are only found in Arecaceae and coconut (*Cocus nucifera*) is

the major host (EFSA 2017). No species within the Arecaceae reproduces regularly in Sweden (Dyntaxa, 2020). No information could be found of any production of host plants in protected cultivation in Sweden. In conclusion, most likely the viruses can not establish due to lack of hosts.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-27].

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Gregoire J-C, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Winter S, Dickinson M, Marzachi C, Hollo G and Caffier D, (2017). Scientific Opinion on pest categorisation of Palm lethal yellowing phytoplasmas. EFSA Journal 2017;15(10):5028, 27 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-11-01]

Peach mosaic virus (PCMV00)

Peach mosaic virus is transmitted by the eriophyid mite *Eriophyes insidiosus*, with vegetative propagation material but not by seed or pollen (EFSA 2019). Known hosts are only species within the genus *Prunus* and EFSA (2019) state that: “Woody host-infecting betaflexiviruses generally have narrow host ranges so that the existence of natural hosts outside of the Prunus genus is considered unlikely". The main host is *Prunus persica* while e.g. *P. domestica* is listed as an incidental host (EPPO 2020). The virus has been reported from Canada, Mexico and USA (in the southern states) (EFSA 2019; EPPO 2020). No environmental constraints are expected on the virus (EFSA 2019). The vector *Eriophyes insidiosus* is reported from USA, Mexico, China, Chile, Morocco (EFSA 2019 and references therein). The distribution of the virus in Canada and how it is transmitted there is unclear. There are several *Eriophyes* species in Sweden and some are found infesting *Prunus* spp. (SLU Artdatabanken 2020). It is uncertain whether the known vector could establish in Sweden or if any of the native *Eriophyes* species would be able to act as vectors.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☒	☐

References

SLU Artdatabanken (2020) Artfakta, available online https://artfakta.se/artbestamning [Accessed 2020-11-01]

EFSA PLH Panel (EFSA Plant Health Panel), Bragard, C, Dehnen-Schmutz, K, Gonthier, P, Jacques, M-A, Jaques Miret, JA, Justesen, AF, MacLeod, A, Magnusson, CS, Milonas, P, Navas-Cortes, JA, Parnell, S, Potting, R, Reignault, PL, Thulke, H-H, Van der Werf, W, Vicent Civera, A, Yuen, J, Zappalà, L, Candresse, T, Chatzivassiliou, E, Finelli, F, Winter, S, Bosco, D, Chiumenti, M, Di Serio, F, Kaluski, T, Minafra, A and Rubino, L, (2019). Pest categorisation of non-EU viruses and viroids of Prunus L. EFSA Journal 2019;17(9):5735, 84 pp. https://doi.org/10.2903/j.efsa.2019.5735

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-11-10]

Gispert, C., Perring T.M., and Oldfield, G.N. (1997) Rearing *Eriophyes insidiosus* Keifer and Wilson (Acari: Eriophyoidea), a fastidious bud mite, International Journal of Acarology, 23:4, 227-231, DOI: 10.1080/01647959708683570 LINK

Sweet potato chlorotic stunt virus (SPCSV0)

The virus is vector transmitted by whitefly species *Bemisia tabaci*, *B. afer* and *Trialeurodes abutilonea* (Gamarra and Fuentes 2010; CABI 2020 and references therein). The virus is not seedborne but may be spread via infected vegetative propagation material (CABI 2020). The vector species are not found in Sweden (Dyntaxa 2020) and *B. tabaci* can not establish outdoors (see assessment for '*Bemisia tabaci*'). The virus is found in America, Asia, Africa and Europe (Spain, Canary Islands, Portugal). (CABI 2020; EPPO 2020). Sweet potato (*Ipomoea batatas*) is the main host and the only host observed to be infected under natural conditions (CABI 2020; EPPO 2020). Experimental hosts are *Ipomoea* spp. and *Nicotiana* spp. is reported by CABI (2020). Sweet potato cultivation in Sweden is limited and appear to mainly occur as experimental and hobby cultivation (Elgerud 2016). It is uncertain whether some of the known vectors could establish in Sweden or if any native species would be able to act as vectors. Most likely the viruses can not establish outdoors due to lack of hosts. *Nicotiana x sanderae* is produced as an ornamental plant in Sweden (Jordbruksverket 2018). In protected cultivation the

virus could potentially persist, but only if the vector *B. tabaci*, which also is a quarantine pest, becomes established and susceptible crops are available.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

CABI (2020) Sweet potato chlorotic stunt virus. In: Crop Protection Compendium. Wallingford, UK: CAB International. www.cabi.org/cpc. [Accessed 2020-11-01]

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-27].

Elgerud, E. (2016) Effekt av pluggstorlek, plantålder och planteringsdjup på kvalitativ och kvantitativ skörd av två olikasorterssötpotatis Ipomoea batatas(L.) Lam., under svenska odlingsförhållanden. [Effect of size age planting depth and cultivar on qualitative and quantitative yield of two different cultivars of sweet potato, Ipomoea batatas(L.) Lam., under Swedish cultivation conditions.]. Kandidatuppsats. SLU, Sveriges lantbruksuniversitet. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-11-01]

Gamarra, H. A., Fuentes, S., Morales, F. J., Glover, R., Malumphy, C., & Barker, I. (2010). *Bemisia afer* sensu lato, a vector of Sweet potato chlorotic stunt virus. *Plant disease*, *94*(5), 510-514.

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Viruses, viroids and phytoplasmas of Cydonia

Two viruses are listed by EFSA (2019) to be able to infect Cydonia; Apple green crinkle-associated virus (AGCaV) and Tomato ringspot virus (ToRSV). Apple green crinkle-associated virus is most likely included in "(h) Non-European viruses, viroids and phytoplasmas of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L." while tomato ringspot virus is regulated separately (EU 2019/2072) and not considered further here. AGCaV infects *Malus* and *Cydonia*, but may have additional hosts (EFSA 2019). The virus may be transmitted by vegetative propagation material but transmission is not known to occur by seed, pollen nor vectors (EFSA 2019). *Cydonia oblonga* is cultivated to a limited

degree in Sweden, is mainly found in private gardens but is also used as rootstock for pear trees, which is common in commercial pear production (Nybom 2012). Pears are produced on 128 ha in Sweden (Jordbruksverket 2018). Apples are cultivated to a large extent with around 1 532 ha of commercial production (Jordbruksverket 2018) and commonly found in private gardens. The virus is reported from Canada, Australia, New Zealand, Spain and Italy (EFSA 2019 and references therein). There are no direct eco-climatic constrains on the virus (EFSA 2019).

For viruses limited to the host *Cydonia* the conditions in Sweden would most likely not be suitable for establishment due to lack of hosts, but the assessment is uncertain. The assessment below is based on the Apple green crinkle-associated virus which also infects *Malus*.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☐	☐	☒
Uncertainty range	☐	☐	☒	☒

References

EFSA PLH Panel (EFSA Plant Health Panel), Bragard, C, Dehnen-Schmutz, K, Gonthier, P, Jacques, M-A, Jaques Miret, JA, Justesen, AF, MacLeod, A, Magnusson, CS, Milonas, P, Navas-Cortes, JA, Parnell, S, Potting, R, Reignault, PL, Thulke, H-H, Van der Werf, W, Vicent Civera, A, Yuen, J, Zappalà, L, Candresse, T, Chatzivassiliou, E, Finelli, F, Winter, S, Chiumenti, M, Di Serio, F, Kaluski, T, Minafra, A and Rubino, L, (2019). Scientific Opinion on the pest categorisation of non-EU viruses and viroids of Cydonia Mill., Malus Mill. and Pyrus L. EFSA Journal 2019;17(9):5590, 81 pp. LINK

EU (2019/2072) COMMISSION IMPLEMENTING REGULATION (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019.

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Nybom, H. (2012) Nya päronsorter från Sverige och Norge. LTJ-fakultetens faktablad 2012:20. Fakta från Växtförädling och bioteknik – Balsgård. Fakulteten för landskapsplanering, trädgårds- och jordbruksvetenska. SLU, Alnarp LINK

Viruses, viroids and phytoplasmas of *Vitis*

In EFSAs categorization of non-EU viruses and viroids of *Vitis*, 27 species of viruses are included (EFSA 2019). The species fulfilling the criteria for a Union quarantine pests in the former group is most likely included in, and regulated as, "(h) Non-European viruses, viroids and phytoplasmas of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L." except Blueberry leaf mottle virus and Peach rosette mosaic virus which are regulated separately (EU 2019/2072). For some of the viruses, *Vitis* spp. are likely the only susceptible hosts while other susceptible hosts may exist for other species (EFSA 2019). *Vitis* sp. are cultivated in Sweden but to a limited extent. In total, commercial production is reported to occur on 56 or 100, depending in the source (Jordbruksverket 2018; LRF 2018). The distribution in Sweden accordning to Jordbruksverket (2018) is as follows; Skåne län 20 ha, Kalmar län 14 ha, Hallands län 8 ha, Gotlands län 7 ha, Stockholms län 2 ha, Jönköpings län 1 ha, och Västa götalands län 1 ha. The genus is also grown as ornamentals in private gardens.

All these viruses are transmitted by vegetative propagation material and some are spread by pollen, seeds and vectors (EFSA 2019). At least one of the known vectors *Colomerus vitis* (Vingallkvalster), transmitting Grapevine berry inner necrosis virus, is classified as established in Sweden (Coulianos and Karlsson 2014; Dyntaxa 2020). It could be noted that this mite is found on *Vitis* spp. (with a few records on persimmons (*Diospyros* spp) (CABI 2020), was introduced into Sweden and able to establish despite the limited availability of hosts. There are no direct eco-climatic constrains on the virus (EFSA 2019).

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☐	☒	☐
Uncertainty range	☒	☒	☒	☐

References

CABI (2020) *Colomerus vitis* (grape erineum mite (USA)). In: Crop Protection Compendium. Wallingford, UK: CAB International. www.cabi.org/cpc. [Accessed 2020-11-10]

Coulianos, C. C., & Karlsson, T. (2014). Some plant galls new to Sweden, and new provincial records. Svensk Botanisk Tidskrift, 108(6), 297-301.

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-11-02].

EFSA PLH Panel (EFSA Plant Health Panel), Bragard, C, Dehnen-Schmutz, K, Gonthier, P, Jacques, M-A, Jaques Miret, JA, Justesen, AF, MacLeod, A, Magnusson, CS, Milonas, P, Navas-Cortes, JA, Parnell, S, Potting, R, Reignault, PL, Thulke, H-H, Van der Werf, W, Vicent Civera, A, Yuen, J, Zappalà, L, Candresse, T, Chatzivassiliou, E, Finelli, F, Martelli, GP, Winter, S, Bosco, D, Chiumenti, M, Di Serio, F, Kaluski, T, Minafra, A and Rubino, L, (2019).

Scientific Opinion on the pest categorisation of non-EU viruses and viroids of *Vitis* L.. *EFSA Journal* 2019;17(9):5669, 94 pp. LINK

EU (2019/2072) COMMISSION IMPLEMENTING REGULATION (EU) 2019/2072 of 28 November 2019 establishing uniform conditions for the implementation of Regulation (EU) 2016/2031 of the European Parliament and the Council, as regards protective measures against pests of plants, and repealing Commission Regulation (EC) No 690/2008 and amending Commission Implementing Regulation (EU) 2018/2019.

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

LRF (2018). Sveriges Vingårdar 2018. Rapport från Föreningen Svenskt Vin och Lantbrukarnas Riksförbund. LINK Accessed 2020-11-25.

Witches' broom disease of lime phytoplasma (PHYPAF)

The phytoplasma is a strain in the *Candidatus* Phytoplasma aurantifolia species group (EFSA 2017a). It is listed under the name "*Candidatus* Phytoplasma aurantifolia" by EPPO (2020), but this 'species-group' appears to include several different strains of phytoplasmas (EFSA 2017a). The phytoplasma is reported from Asia (India, Iran, Oman, Saudi Arabia, United Arab Emirates) (EFSA 2017a). The phytoplasma is transmitted by the leafhopper *Hishimonus phycitis* (not known to occur in the EU) and via vegetative propagation material (EFSA 2017a). *Hishimonus phycitis* is not known to occur in the EU and establishment is most likely to be restricted to areas around the Mediterranean Sea (see assessment of '*Hishimonus phycitis*; EFSA 2017b). No *Hishimonus* species are found in Sweden (Dyntaxa 2020). *Citrus aurantifolia* is the most important host, but other *Citrus* spp. and *Poncirus trifoliata* may also be infected (EFSA 2017a and reference therein). No species within the Rutaceae reproduces regularly in Sweden (Dyntaxa, 2020) and most likely the phytoplasma can not establish due to lack of hosts.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-11-01].

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger M, Bragard C, Candresse T, Chatzivassiliou E, Dehnen-Schmutz K, Gilioli G, Gregoire J -C, Jaques Miret JA, MacLeod A, Navajas Navarro M, Niere B, Parnell S, Potting R, Rafoss T, Rossi V, Urek G, Van Bruggen A, Van der Werf W, West J, Winter S, Dickinson M, Marzachi C, Hollo G and Caffier D, (2017a).

Scientific Opinion on pest categorisation of Witches' broom disease of lime (*Citrus aurantifolia*) phytoplasma. EFSA Journal 2017;15(10):5027, 22 pp. LINK

EFSA PLH Panel (EFSA Panel on Plant Health), Jeger, M, Bragard, C, Caffier, D, Candresse, T, Chatzivassiliou, E, Dehnen-Schmutz, K, Gilioli, G, Gregoire, J-C, Jaques Miret, JA, Navarro, MN, Niere, B, Parnell, S, Potting, R, Rafoss, T, Rossi, V, Urek, G, Van Bruggen, A, Van der Werf, W, West, J, Winter, S, Gardi, C, Aukhojee, M, Bergeretti, F and MacLeod, A, (2017b). Scientific opinion on the pest categorisation of Hishimonus phycitis. EFSA Journal 2017;15(10):5030, 26 pp. LINK

EPPO (2020) EPPO Global Database (available online). https://gd.eppo.int [accessed 2020-11-01].

Quarantine pests – Insects and mites

Anastrepha fraterculus (ANSTFR)

The South American fruit fly *Anastrepha fraterculus* is an important pest species in subtropical areas of South America and considered to constitute a threat to other subtropical areas of the world (CABI 2020). According to EPPO (1997), the climate in the northern and central part of the EPPO-region is not warm enough to allow survival of *A. fraterculus.* Similarily, a "risk of invasion" assessment put potential post-invasion EU distributions of *A. fraterculus* at a significant distance from Sweden; the assessment was that the species would only find climatic suitability in regions directly adjacent to the Mediterranean Sea (Godefroid et al. 2015). *Malus* spp. and *Prunus* spp. are the host genera available for *A. fraterculus* in Sweden. The production area of *Malus* and *Prunus* is 1532 ha and 69 ha, respectively (Jordbruksverket 2018). Both genera are commonly found in private gardens and occur naturally in Sweden. Six species of *Prunus* occur in Sweden, e.g. two cherry species *P. cerasus* and *P. avium*, that may be suitable hosts for *A. fraterculus* (Anderberg and Anderberg 2020). *Malus* has two naturally occurring representatives: *M. sylvestris* and *M. domestica* (Anderberg and Anderberg 2020). These species are very common in the southern half of the country (Artdatabanken 2015).

There appears to be no greenhouse cultivation of any of the host species in Sweden (Jordbruksverket 2018; Jordbruksverket 2017).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Anderberg, A. and Anderberg, A.-L. (2020) Malus – Mill, Aplar. Den Virtuella Floran. Elektronisk publikation, Naturhistoriska Riksmuseet, Stockholm. LINK Accessed 2020-11-24.

Artdatabanken (2015). Artfakta: *Prunus cerasus*, *Prunus avium*, *Malus sylvestris*, *Malus domestica*. SLU. LINK Accessed 2020-11-24.

CABI (2020). CABI, Invasive Species Compendium, *Anastrepha fraterculus* (South American fruit fly), Data sheet, LINK Accessed 2020-11-24.

EPPO (1997). EPPO Global Database, Data Sheets on Quarantine Pests, *Anastrepha fraterculus*, LINK Accessed 2020-11-24.

Godefroid, M., Cruaud, A., Rossi, J. P., & Rasplus, J. Y. (2015). Assessing the risk of invasion by Tephritid fruit flies: intraspecific divergence matters. PloS one, 10(8), e0135209.

Jordbruksverket (2017). Trädgårdsundersökningen 2016: Kvantiteter och värden avseende 2016 års produktion. Statistiska Meddelanden JO 28 SM 1701.

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Anastrepha obliqua (ANSTOB)

The West Indian fruit fly *Anastrepha obliqua* is an important pest of mango but also attacks many other plants species (CABI 2020). None of the main host genera (Mangifera) occur naturally or are cultivated in Sweden. The whole family of Anacardiaceae mainly occurs in warm and tropical regions, with a few species found in southern Europe only.

Anastrepha obliqua is highly unsuited for the current climatic conditions in Sweden. It occurs in the Neotropics from northern Mexico to southern Brazil as well as in the Caribbean islands, which share no Köppen-Geiger climate zones with Sweden (Beck et al. 2018; EPPO 2020). EPPO (1997) states that ”the direct risk of establishment of *A. obliqua* in most of the EPPO region is minimal, though populations might enter and multiply during the summer months”. Climate modelling using CLIMEX determined that only 2 % of Europe’s area is potentially climatically suitable for *A. obliqua* under current climate conditions. This area was predicted, by the model, to increase with climate change in the 2020’s; however, the parts of Europe predicted to become suitable do not reach further north than Brittany in France (Fu et al. 2014).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

CABI (2020). CABI, Invasive Species Compendium, *Anastrepha obliqua* (West Indian fruit fly), Datasheet, LINK Accessed 2020-11-24.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18*(1), e05931.

EPPO (1997). EPPO Global Database, Data Sheets on Quarantine Pests, *Anastrepha obliqua*, LINK Accessed 2020-11-24

EPPO (2020). EPPO Global Database, *Anastrepha obliqua* (ANSTOB), LINK Accessed 202012-11.

Fu, L., Li, Z. H., Huang, G. S., Wu, X. X., Ni, W. L., & Qü, W. W. (2014). The current and future potential geographic range of West Indian fruit fly, *Anastrepha obliqua* (Diptera: Tephritidae). *Insect science*, *21*(2), 234-244.

Godefroid, M., Cruaud, A., Rossi, J. P., & Rasplus, J. Y. (2015). Assessing the risk of invasion by Tephritid fruit flies: intraspecific divergence matters. PloS one, 10(8), e0135209.

Anastrepha suspensa (ANSTSU)

The Caribbean fruit fly *Anastrepha suspensa* is a pest on plants belonging to the Myrtaceae (EPPO 1997). None of the main host genera (*Annona, Psidium, Eugenia, Terminalia, Syzygium, Citrus*) occur naturally or are cultivated in Sweden. According to EPPO (1997) the temperatures in the northern and central part of the EPPO region is not sufficiently high to allow survival.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EPPO (1997). EPPO Global Database, Data Sheets on Quarantine Pests, *Anastrepha suspensa*, LINK Accessed 2020-11-24.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18* (1), e05931.

Anthonomus eugenii (ANTHEU)

The potential for establishment of *Anthonomus eugenii* in Sweden was assessed in May 2020 (Björklund and Boberg 2020). No new information seems to have been published since then. However, EFSA published a Pest Survey Card on *Anthonomus eugenii* in June 2020 (EFSA 2020).

References

Björklund, N. and Boberg, J. (2020). Potential establishment of the priority pest *Anthonomus eugenii* in Sweden, SLU ua 2020.2.6-1707, May 13, 2020, LINK Accessed 2020-11-10.

European Food Safety Authority (EFSA), van der Gaag, D. J., Schenk, M., Loomans, A., Delbianco, A., & Vos, S. (2020). Pest survey card on *Anthonomus eugenii*. *EFSA Supporting Publications*, *17*(6), 1887E. LINK

Anthonomus grandis (ANTHGR)

It should be noted that the EU-regulation refer to "*Anthonomus grandis*" and EFSA (2017) accordingly regard *A. grandis grandis* and *A. grandis thurberiae* as subspecies. However, EPPO (2020) consider *A. grandis grandis* and *A. grandis thurberiae* as separate species and the EPPO Code "ANTHGR" which is used in the regulation only refers to *A. grandis grandis.* Both species of weevils are however considered to be subtropical pests and the conditions may be suitable for establishment in Mediterranean countries where cotton is grown (EPPO 1997; EFSA 2017).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EPPO (1997). EPPO Global Database, Data Sheets on Quarantine Pests, *Anthonomus grandis*, LINK Accessed 2020-11-24.

EFSA Panel on Plant Health (PLH), Jeger, M., Bragard, C., Caffier, D., Candresse, T., Chatzivassiliou, E., Dehnen-Schmutz, K., ... & Niere, B. (2017). Pest categorisation of *Anthonomus grandis*. *EFSA Journal*, *15*(12). LINK

Aleurocanthus spiniferus (ALECSN)

The citrus spiny whitefly, *Aleurocanthus spiniferus* originates in South-East Asia (China) but it has extended its distribution to tropical and subtropical Asia (Kapantaidaki et al. 2019). In 2008 it arrived in Europe and is currently present in restricted areas in Albania, Croatia, Greece, Italy, and Montenegro (EPPO 2020). The main/major host for *A. spiniferus* is citrus but e.g. *Pyris communis* and *Rosa* are listed as minor hosts (EFSA 2018; EPPO 2020). Similarily to *A. woglumi*, it may survive temporarly on non-citrus hosts but require citrus plants for long term establishment (c.f. Steinberg and Dowell (1980)). EPPO (2020) concludes that, based on its current distribution and the distribution of citrus species in the EPPO region, the limits of the potential distribution is restricted to the southern part of the EPPO region. *Aleurocanthus spiniferus* has not been recorded as a glasshouse pest but according to EFSA (2018) it could conceivably become a pest in heated greenhouses in temperate countries. No information could be found of any commercial production of citrus plants in protected conditions in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Miret, J. A. J., ... & Parnell, S. (2018). Pest categorisation of *Aleurocanthus* spp. *Efsa Journal*, *16*(10).

EPPO (2020). *Aleurocanthus spiniferus*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Kapantaidaki, D. E., Antonatos, S., Kontodimas, D., Milonas, P., & Papachristos, D. P. (2019). Presence of the invasive whitefly *Aleurocanthus spiniferus* (Hemiptera: Aleyrodidae) in Greece. EPPO Bulletin, 49(1), 127-131.

Steinberg, B., & Dowell, R. V. (1980). Suitability of native or naturalized plants as long-term hosts of the citrus blackfly. Annals of the Entomological Society of America, 73(6), 662-664. Based on the Abstract only. LINK

Aleurocanthus woglumi (ALECWO)

Aleurocanthus woglumi is a polyphagous species, but is primarily a pest of citrus and has been shown to only survive three generations on other hosts than citrus plants (EFSA 2018). *Aleurocanthus woglumi* has not been recorded as a glasshouse pest but according to EFSA (2018) it conceivably become a pest in heated greenhouses in temperate countries. No

information could be found of any commercial production of citrus plants in protected conditions in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Miret, J. A. J., ... & Parnell, S. (2018). Pest categorisation of *Aleurocanthus* spp. *Efsa Journal*, *16*(10).

Steinberg, B., & Dowell, R. V. (1980). Suitability of native or naturalized plants as long-term hosts of the citrus blackfly. Annals of the Entomological Society of America, 73(6), 662-664. Based on the Abstract only. LINK

Aschistonyx eppoi (ASCXEP)

The juniper gall midge *Aschistonyx eppoi* is only present in the Korean peninsula and in the southern part of the Honshu island in Japan (EFSA 2018; EPPO 2020). According to EFSA (2018) impact outdoors would be restricted to the southern parts of the EU since the pest originates from areas with warm climates. The only known host is *Juniperus chinensis*, which is grown in gardens and as bonsai in Europe (Baker 1995). It is not known whether any of the other juniper species grown in Europe are suitable as hosts (Baker 1995; EFSA 2018).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Baker RHA, (1995). *Aschistonyx eppoi*. Data Sheets on Quarantine Pests and summary pest risk assessment. Ministry of Agriculture, Fisheries and Food, Central Science Laboratory, Sand Hutton, York, PPR Point 4.3, 97/7020.

EPPO (2020). EPPO Global Database, *Aschistonyx eppoi* (ASCXEP), LINK Accessed 2020-11-24.

EFSA Panel on Plant Health (EFSA PLH Panel), Jeger, M., Bragard, C., Caffier, D., Candresse, T., Chatzivassiliou, E., ... & Navajas Navarro, M. (2018). Pest categorisation of *Aschistonyx eppoi*. *EFSA Journal*, *16*(2), e05186. LINK

Bemisia tabaci (BEMITA)

Bemisia tabaci (tobacco whitefly), which is considered to consist of a species complex, cause considerable agricultural damage due to its ability to transmit multiple damaging plant viruses. According to EFSA (2013), all *B. tabaci* species can transmit viruses and the current assessment is based on the whole species complex of *B. tabaci*. Open-field occurrences of *B. tabaci* in Europe do not reach further north than southern France (EFSA 2013). EFSA (2013) concludes, regarding outdoor expansion of *B. tabaci* in Europe, "An expansion of the outdoor area currently invaded by *B. tabaci*, as well as an increase in its population density, is expected only if the average temperatures in Europe increase. However, even considering a climate change scenario with an increase of on average +2 °C, the northern most limit of distribution of *B. tabaci* will expand, but the insect will still not establish outdoors in northern EU countries, including those with protected zone status." (EFSA 2013, Gilioli et al. 2014). This conclusion is further supported by later modelling work (Ramos et al. 2018).

CABI (2020) points out that *B. tabaci* MEAM1, which is the species of main concern for Nordic countries, is exclusively a glasshouse pest in Canada, and it has not established outdoors there. This is here taken as indication that it is likely that the pest would hold the same status in Sweden. Presence of hosts will not prevent establishment in Swedish greenhouses since major crops such as tomato and cucurbit crops are available almost throughout the year in greenhouses of the northern EU countries (EFSA 2013). Outbreaks of *B. tabaci* has been recorded in Sweden (Jordbruksverket 2016; EPPO 2020)

In conclusion: Our assessment is that the conditions are not suitable for the establishment of *B. tabaci* outdoors in Sweden but it is very likely that the conditions are suitable in greenhouses.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☐	☐	☒
Uncertainty range	☐	☐	☒	☒

References

CABI (2020). CABI Invasive Species Compendium, Datasheet, *Bemisia tabaci* (MEAM1) (silverleaf whitefly). LINK Accessed 2020-11-10.

EFSA Panel on Plant Health (PLH). (2013). Scientific opinion on the risks to plant health posed by *Bemisia tabaci* species complex and viruses it transmits for the EU territory. *EFSA Journal*, *11*(4), 3162. LINK

EPPO (2019) EPPO Platform on PRAs Evaluation of the Regulated non-quarantine pest (RNQP) status for *Bemisia tabaci* LINK Accessed 2020-12-07.

EPPO (2020) EPPO Global Database, *Bemisia tabaci*, LINK

Gilioli, G., Pasquali, S., Parisi, S., & Winter, S. (2014). Modelling the potential distribution of *Bemisia tabaci* in Europe in light of the climate change scenario. *Pest Management Science*, *70*(10), 1611-1623. LINK

Jordbruksverket (2016). Övervakning av förekomst av växtskadegörare, Rapport 2016:15, LINK Accessed 2020-11-13.

Ramos, R. S., Kumar, L., Shabani, F., & Picanço, M. C. (2018). Mapping global risk levels of *Bemisia tabaci* in areas of suitability for open field tomato cultivation under current and future climates. *PloS one*, *13*(6), e0198925. LINK

Bactrocera dorsalis (DACUDO)

The fruit fly *Bactrocera dorsalis* is endemic to Southeast Asia but its current geographic distribution range also includes e.g. countries in Africa (CABI 2020). A climatic modelling scenario using CLIMEX put both current and possible future (2080's) distributions very far from Sweden (Stephens et al. 2007). Later modelling, which included the influence of seasonal phenology and irrigation, also resulted in a potential distribution that is very far from Sweden (De Villiers et al. 2016, EFSA 2019). *Bactrocera dorsalis* has not been recorded in glasshouses and the risk of infestations in greenhouses in Northern Europe was assessed to be so unlikely that it was not considered further in a PRA by EPPO (2010). Despite a broad host range, i.e. 124 host species across 42 families (EFSA 2019), it is questionable if any of them are grown in Swedish greenhouses at an extent that would allow an establishment.

In conclusion: Our assessment is that the conditions are not suitable for establishment of *B. dorsalis* neither outdoors nor indoors in Sweden.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

CABI (2020). CABI Crop Protection Compendium *Bactrocera dorsalis* (Oriental fruit fly), Datasheet full, LINK Accessed 2020-10-23

EPPO (2010). Pest risk analysis for *Bactrocera invadens*, Ref. 20-25979 (10- 16120), LINK Accessed 2020-11-10.

EFSA (European Food Safety Authority), Baker, R., Gilioli, G., Behring, C., Candiani, D., Gogin, A., Kaluski, T., ... & Rosace, M. C. (2019) *Bactrocera dorsalis* Pest Report to support ranking of EU candidate priority pests. LINK

Guitian Castrillon, J. M., Catalan Ruescas, D., De Meyer, M., Zulma, D. F., Guichard, C., MacLeod, A., ... & Vayssières, J. F. (2010). Pest risk analysis for *Bactrocera invadens* LINK

Stephens, A.E.A., Kriticos, D.J., Leriche, A. 2007. The current and future potential geographical distribution of the oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae). Bulletin of Entomological Research 97: 369-378. LINK

De Villiers, M., Hattingh, V., Kriticos, D. J., Brunel, S., Vayssières, J. F., Sinzogan, A., ... & Salah, F. E. E. (2016). The potential distribution of Bactrocera dorsalis: considering phenology and irrigation patterns. *Bulletin of entomological research*, *106*(1), 19-33. LINK

Bactrocera tryoni (DACUTR)

The Queensland fruit fly *Bactrocera tryoni* is a pest of a wide variety of fruit crops (EPPO 1997). It is only present in Oceania (EPPO 2020). According to EPPO (1997) it is only in the southern areas of the EPPO-region that populations may survive one or several winters. In a review of the overwintering of *B. tryoni* they conclude that the historical evidence show that *B. tryoni*, a predominantly tropical and subtropical insect, can survive in regions with cold winters since the adults shelter in protected areas and occasionally forage on warm days and females gain additional nutrition through resorbing their eggs (Clarke et al. 2018).

Malus spp., *Pyrus* spp. and *Prunus* spp. are the hosts of *B. tryoni* that cover the largest area in Sweden. The commercial production of *Malus* covers an area of 1476 ha (Widenfalk et al. 2018). The production area of *Pyrus* was 128 ha in 2017, and the area for *Prunus* (plums and cherries) was 69 ha in 2017 (Jordbruksverket 2018). Both *Malus* and *Prunus* occurs naturally in Sweden and are common in private gardens. Six species of *Prunus* occur in Sweden, e.g. two cherry species, i.e. *P. cerasus* and *P. avium*, that may be suitable hosts for *B. tryoni* (Anderberg and Anderberg 2020). *Malus* has two naturally occurring representatives: *M. sylvestris* and *M. domestica* (Anderberg and Anderberg 2020). These species are all very common in the southern half of the country (Artdatabanken 2015). None of the other major host plant species of *B. tryoni* appear to be cultivated (not in open-field nor in greenhouses) in Sweden (Jordbruksverket 2018).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Anderberg, A. and Anderberg, A.-L. (2020) Malus – Mill, Aplar. Den Virtuella Floran. Elektronisk publikation, Naturhistoriska Riksmuseet, Stockholm. LINK Accessed 2020-11-24.

Artdatabanken (2015). Artfakta: *Prunus cerasus*, *Prunus avium*, *Malus sylvestris*, *Malus domestica*. SLU. LINK Accessed 2020-11-24.

Clarke, A. R., Merkel, K., Hulthen, A. D., & Schwarzmueller, F. (2019). *Bactrocera tryoni* (Froggatt)(Diptera: Tephritidae) overwintering: an overview. *Austral Entomology*, *58*(1), 3-8. LINK

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18*(1), e05931.

EPPO (1997). EPPO Global Database, Data Sheets on Quarantine Pests, *Bactrocera tryoni*, LINK Accessed 2020-11-24.

EPPO (2020) EPPO Global Database, *Bactrocera tryoni* (DACUTR), LINK Accessed 2020-11-24.

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Bactrocera tsuneonis (DACUTS)

The Japanese orange fruit fly *Bactrocera tsuneonis* is only present in China (Guangdong, Guangxi, Guizhou, Hunan, Jiangsu, Sichuan, Yunnan) and Japan (Kyushu, Ryukyu Archipelago) (EPPO 2020). According to Biosecurity Australia (2009) “pupation under subtropical conditions prior to winter suggests that this species is unlikely to be cold tolerant.” *Bactrocera tsuneonis* is restricted to Rutaceae, such as *Citrus*, especially mandarin (*C. reticulata*), and *Fortunella* spp. (EPPO 2020). None of the host plant species of *B. tsuneonis* are commercially cultivated (not in open-field nor in greenhouses) in Sweden (Jordbruksverket 2018).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Biosecurity Australia. 2009. Final import risk analysis report for fresh unshu mandarin fruit from Shizuoka Prefecture in Japan. Biosecurity Australia, Canberra. LINK Accessed 2020-11-24.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18*(1), e05931.

EPPO (2020) *Bactrocera tsuneonis*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Bactrocera zonata (DACUZO)

The oriental fruit fly *Bactrocera zonata* has over 300 host species and it is present in at least 65 countries, including parts of America and Oceania, and most of continental Africa (CABI 2020). A study where the current and future potential geographical distribution of *B. zonata* was modelled using CLIMEXindicated that the climate in Sweden is unsuitable for establishment both now and in the 2070s (Ni et al. 2012). Further, EFSA (2007) notes that *B. zonata* requires a continuous supply of fresh ripe fruit, which is not available in cooler areas. According to EFSA (2019), the region where *B. zonata* can establish is limited to the southern parts of the EU. *Bactrocera zonata* is not noted as a greenhouse pest in the literature and EFSA (2019) does not include damage in greenhouses in their estimation of its potential impact. However, there does not appear to be anything specifically that dispute that it could infest greenhouse populations of e.g. tomatoes. To take this into account the maximum of this estimate is set to “unlikely”.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

CABI (2020) CABI Invasive Species Compendium, *Bactrocera dorsalis* (Oriental fruit fly), Datasheet, LINK Accessed 2020-11-24.

European Food Safety Authority (EFSA), Baker, R., Caffier, D., Choiseul, J. W., de Clercq, P., Dormannsne-Simon, E., Gerowitt, B., ... & Manici, M. L. (2007). Opinion of the scientific panel on plant health on the pest risk analysis made by Spain on *Batrocera zonata*. LINK

European Food Safety Authority (EFSA), Baker, R., Gilioli, G., Behring, C., Candiani, D., Gogin, A., Kaluski, T., ... & Rosace, M. C. (2019) *Bactrocera zonata* - Pest Report to support ranking of EU candidate priority pests. LINK Accessed 2020-11-24.

Ni, W. L., Li, Z. H., Chen, H. J., Wan, F. H., Qu, W. W., Zhang, Z., & Kriticos, D. J. (2012). Including climate change in pest risk assessment: the peach fruit fly, Bactrocera zonata (Diptera: Tephritidae). *Bulletin of Entomological Research*, *102*(2), 173-183. LINK

Ceratitis quinaria (regulated as *Pardalaspis quinaria*) (CERTQU)

The Zimbabwean fruit fly *Ceratitis quinaria* is a pest mainly on apricots (*Prunus armeniaca*) and peaches (*Prunus persica*) (EPPO 2020). There is limited knowledge about the biology of *C. quinaria* but it presumably resembles that of *C. capitata* but in view of its essentially tropical distribution it is expected to be even less tolerant to cold winters than *C. capitate*, which will not survive sub-zero winter temperatures (EPPO 1997a, b). No information about establishments in greenhouses were found, and EFSA (2020) did not include damage in greenhouses in their impact assessment of non-EU Tephritidae, therefore we assess that the conditions in greenhouses are not suitable for establishment.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18*(1), e05931. LINK Accessed 2020-12-09.

EPPO (1997a) Data Sheets on Quarantine Pests *Ceratitis quinaria*, LINK Accessed 2020-11-26.

EPPO (1997b) Data Sheets on Quarantine Pests *Ceratitis capitata*, LINK Accessed 2020-12-09.

EPPO (2020) EPPO Global Database, *Ceratitis quinaria* (CERTQU), LINK Accessed 2020-11-26.

Ceratitis rosa (regulated as *Pterandrus rosa*) (CERTRO)

EPPO (2020) states that "Recent taxonomic studies have shown that *C. rosa* belongs to a species complex (including at least *C. fasciventris*, *C. anonae*, *C. rosa* and *C. quilicii*) and that *C. rosa* sensu lato includes 2 species (*C. rosa* and *C. quilicii*). Many past records for *C. rosa* sensu lato have now been attributed to other species of the complex.". *Ceratitis rosa* is regulated within the group Non-EU Tephritidae. EPPO (1997) concludes that "the potential of *C. rosa* to establish in the southern part of the EPPO region may be limited to subtropical areas, where it could cause direct damage.". A life-cycle simulation model indicate that the conditions in Sweden are unsuitable for permanent establishment (Tanga et al. 2018). Ecological niche modelling indicated that suitable habitats for *C. rosa* could be found in southern Europe, adjacent to the Mediterranean; e.g. high suitability was found around the Bay of Biscay (De Meyer et al. 2008).

The Natal fruit fly *Ceratitis rosa* has hosts that are present in Sweden. *Malus*, *Prunus* and *Pyrus* are the hosts of *C. rosa* that cover the biggest area in Sweden (Artdatabanken 2015; Anderberg and Anderberg 2020). None of the other major host plant species of *C. rosa* appear to be cultivated (neither open-field nor greenhouse) in Sweden (Jordbruksverket 2018). No information about establishments in greenhouses were found, and EFSA (2020) did not include damage in greenhouses in their impact assessment of non-EU Tephritidae, therefore we assess that the conditions in greenhouses are not suitable for establishment.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Anderberg, A. and Anderberg, A.-L. (2020) *Prunus* L. – Prunusar. Den Virtuella Floran. Elektronisk publikation, Naturhistoriska Riksmuseet, Stockholm. LINK Accessed 2020-11-26.

Artdatabanken. (2015). Artfakta: *Prunus cerasus*, *Prunus avium*, *Malus sylvestris*, *Malus domestica*. SLU. LINK Accessed 2020-11-26.

De Meyer, M., Robertson, M. P., Peterson, A. T., & Mansell, M. W. (2008). Ecological niches and potential geographical distributions of Mediterranean fruit fly (*Ceratitis capitata*) and Natal fruit fly (*Ceratitis rosa*). *Journal of Biogeography*, *35*(2), 270-281. LINK Accessed 2020-11-26.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18*(1), e05931. LINK Accessed 2020-12-09.

EPPO (1997). Data Sheets on Quarantine Pests *Ceratitis rosa*, LINK Accessed 2020-11-26.

EPPO (2020). EPPO Global Database, *Ceratitis rosa* (CERTRO) LINK Accessed 2020-12-09.

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Tanga, C. M., Khamis, F. M., Tonnang, H. E., Rwomushana, I., Mosomtai, G., Mohamed, S. A., & Ekesi, S. (2018). Risk assessment and spread of the potentially invasive *Ceratitis rosa* Karsch and *Ceratitis quilicii* De Meyer, Mwatawala & Virgilio sp. Nov. using life-cycle simulation models: Implications for phytosanitary measures and management. *PloS one*, *13*(1), e0189138. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Dacus ciliatus (DACUCI)

The Ethiopian fruit fly *Dacus ciliates* appears to be Afrotropical in origin, and is found throughout Africa, as well as the Arabian peninsula, the Near and Middle East and the Indian subcontinent (Meyer and Ekesi 2016). EPPO (1997) states that “the risk of establishment in most of the EPPO area is minimal”. *Dacus ciliates* has been recorded as a pest in greenhouse environments in Southern Israel (Nestel et al. 2019). The pest is however established outdoors in Israel (EPPO 2020) and it is questionable if it can establish in greenhouses in areas where the pest is not established outdoors since no re-establishments from outdoor populations can occur in those areas. *Dacus ciliates* can develop in the fruits of a wide range of cucurbit crops and wild Cucurbitaceae (EPPO 1997). In Sweden open field cultivation of cucumber covered 126 ha and squash/pumpkin 191 ha in 2017 (Jordbruksverket 2018). Greenhouse cultivation of cucumber covers 66 ha and melon was cultivated in greenhouses on 0.3 ha in 2017 (Widenfalk et al. 2018; Jordbruksverket 2018).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. *Efsa Journal*, *18*(1), e05931.

EPPO (1997). EPPO Global Database, Data Sheets on Quarantine Pests, *Dacus ciliates*, LINK Accessed 2020-11-25.

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Meyer, M.D. and Ekesi, S. (2016). Exotic Invasive Fruit Flies (Diptera: Tephritidae): In and Out of Africa. Chapter in: Fruit Fly Research and Development in Africa - Towards a Sustainable Management Strategy to Improve Horticulture pp 127-150.

Nestel, D., Cohen, Y., Shaked, B., Alchanatis, V., Nemny-Lavy, E., Miranda, M. A., ... & Papadopoulos, N. T. (2019). An Integrated Decision Support System for environmentally-friendly management of the Ethiopian fruit fly in greenhouse crops. *Agronomy*, *9*(8), 459. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Diabrotica barberi (DIABLO)

The distribution range of the beetle *Diabrotica barberi*, also known as the northern corn rootworm beetle, largely overlap Köppen-Geiger climate zones that occurs in Sweden (EPPO 2020 and see Beck et al 2018 for the climate zones). Sweden received a climate suitability rating of 100% for *D. barberi* (climate suitability was defined as the match between the physiological tolerance of the species and the climatic conditions of the country) by Bacon et al. (2013). EPPO (1997) states that all the maize-growing areas of the EPPO-region are at risk of establishment, but "particularly those in the more continental areas of Central Europe, where conditions most resemble those of mid-western USA.". Further, EFSA (2019) mention that *D. barberi* exhibits some adaptability to environmental conditions. The species appears to be fairly cold hardy, e.g. Ellsbury et al. (1998) note that "in spite of the rigors of the winter soil environment, a sufficient proportion of eggs laid each fall survive winter conditions in corn-growing areas of North America to produce economically significant infestations.". Hosts are widely distributed in Sweden, e.g. *Zea mays* is grown on 22 006 ha (Jordbruksverket 2019). Our assessment is the conditions are likely to be suitable for the establishment of *D. barberi* in Sweden, at least in the southern parts.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☐	☒	☐
Uncertainty range	☐	☒	☒	☒

References:

Bacon, S. J., Aebi, A., Calanca, P., & Bacher, S. (2014). Quarantine arthropod invasions in Europe: the role of climate, hosts and propagule pressure. *Diversity and distributions*, *20*(1), 84-94.

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

Ellsbury, M.M., Pikul Jr., J.L. and Woodson, W.D. (1998). A review of insect survival in frozen soils with particular reference to soil-dwelling stages of corn rootworms. Cold Regions Science and Technology 27: 49-56. LINK

EPPO (1997). Data Sheets on Quarantine Pests *Diabrotica barberi* and *Diabrotica virgifera* LINK Accessed 2020-11-03.

EPPO (2020). EPPO Global Database, *Diabrotica barberi* (DIABLO), LINK Accessed 2020-11-10.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2019). Pest categorisation of *Diabrotica barberi*. *Efsa Journal*, *17*(11), e05857. LINK

Jordbruksverket (2019) Jordbruksverkets officiella statistik. LINK Accessed 2020-12-04.

Diabrotica undecimpunctata howardi (DIABUH)

The distribution range of the southern corn rootworm, *Diabrotica undecimpunctata howardi* (EPPO 2020) to a large degree include Köppen-Geiger climate zones that occurs in Sweden (see Beck et al. 2018). A modeling effort to map regions at risk of invasion from different *Diabrotica* species also labeled areas in the southern part of Sweden as “optimal, host present” (Marchioro and Krechemer 2018). Hosts are widely distributed in Sweden, e.g. *Zea mays* is grown on 22 006 ha (Jordbruksverket 2019). Our assessment is that conditions are likely to be suitable for establishment of *Diabrotica undecimpunctata howardi*, at least in the southern parts of Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☐	☒	☐
Uncertainty range	☐	☒	☒	☒

References:

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

EPPO (2020). EPPO Global Database, *Diabrotica undecimpunctata howardi* (DIABUH). LINK Accessed 2020-11-10.

Jordbruksverket (2019) Jordbruksverkets officiella statistik. LINK Accessed 2020-12-04.

Marchioro, C.A. and Krechemer, F.S. 2018. Potential global distribution of *Diabrotica* species and the risks for agricultural production. Pest Management Science 74: 2100-2109. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Diabrotica undecimpunctata undecimpunctata (DIABUN)

The distribution of the corn budworm, *Diabrotica undecimpunctata undecimpunctata* (EPPO 2020) mainly covers areas that does not include Köppen-Geiger climate zones that occurs in Sweden (see Beck et al. 2018). A modeling effort to map regions at risk of invasion from different *Diabrotica* species labeled Sweden as unsuitable (Marchioro and Krechemer 2018). There is no evidence that *Diabrotica undecimpunctata undecimpunctata* can establish in greenhouses (EFSA (2020). Hosts are available but we assess that the conditions are not suitable for establishment in Sweden due to the fact that the larvae mainly feeds on maize, which is grown outdoors, whereas the adults mainly feeds on cucurbits, that mainly is cultivated in greenhouses (EPPO 2020).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

EFSA Panel on Plant Health (PLH), Bragard, C.,... and MacLeod, A. (2020). Pest categorisation of *Diabrotica undecimpunctata undecimpunctata*. *EFSA Journal*, 18(10):6291. LINK

EPPO (2020) EPPO Global Database, *Diabrotica undecimpunctata undecimpunctata* (DIABUN), LINK Accessed 2020-11-26.

Marchioro, C.A. and Krechemer, F.S. 2018. Potential global distribution of *Diabrotica* species and the risks for agricultural production. Pest Management Science 74: 2100-2109. LINK

Diabrotica virgifera zeae (DIABVZ)

The Mexican corn rootworm *Diabrotica virgifera zeae* is a univoltine pest of corn (Woodson and Chandler 2000). The only "breeding hosts" are maize (main host), sorghum, and rusty flat sedge. Maize is grown on 1524 ha (for grain) and 15 162 ha (for fodder) annually in Sweden, totaling 16 686 ha (Widenfalk et al. 2018). Development from hatch to adult emergence requires 473 DD with a threshold temperature of 10 °C (Woodson and Chandler 2000) which is a criterion that is fulfilled in large parts of Sweden (cf. Boberg and Björklund 2020). However, in an EFSA pest categorization from 2019 the authors go through the pests climatic requirements (i.e. Köppen-Geiger climate zones and frost days) and conclude that the climate may allow establishment in southern EU (EFSA 2019).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Boberg, J. and Björklund, N. (2020) Potential establishment of the priority pest *Conotrachelus nenuphar* in Sweden. LINK Accessed 2020-11-25.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2019). Pest categorisation of *Diabrotica virgifera zeae*. *Efsa Journal*, *17*(11), e05858. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Woodson, W. D., & Chandler, L. D. (2000). Effects on development of immature Mexican corn rootworm (Coleoptera: Chrysomelidae). *Annals of the Entomological Society of America*, *93*(1), 55-58. LINK

Diaphorina citri (DIAACI)

The Asian citrus psyllid *Diaphorina citri* is restricted to host plants within the Rutaceae and occurs on both wild hosts and on cultivated *Citrus* sp. (EPPO 2020). None of the host plant species of *D. citri* are commercially cultivated (not in open-field nor in greenhouses) in Sweden (Jordbruksverket 2018). *Diaphorina citri* seems to be poorly adapted to cope with cold temperatures and average and minimum temperatures, as well as the duration of cold periods, are important factors in limiting its distribution. For example, the species appears to need a mean overwintering temperature of over 6 °C (Yang et al. 2006) and adults will survive only a few hours at temperatures of -6 °C (Hall et al. 2012). According to EPPO (2020) *D. citri* could, however, probably establish in Mediterranean countries.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EPPO (2020) *Diaphorina citri*. EPPO datasheets on pests recommended for regulation. Available online. https://gd.eppo.int Accessed 2020-11-25.

Hall, D. G., Richardson, M. L., Ammar, E. D., & Halbert, S. E. (2013). Asian citrus psyllid, *Diaphorina citri*, vector of citrus huanglongbing disease. *Entomologia Experimentalis et Applicata, 146*(2), 207-223. LINK

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Trädgårds-undersökningen (2019). Kvantiteter och värden avseende 2019 års produktion LINK eller LINK

Yang, Y., Huang, M., C. Beattie, G. A., Xia, Y., Ouyang, G., & Xiong, J. (2006). Distribution, biology, ecology and control of the psyllid *Diaphorina citri* Kuwayama, a major pest of citrus: a status report for China. *International Journal of Pest Management*, *52*(4), 343-352. LINK

Draeculacephala minerva (DRAEMI)

An EFSA Pest categorisation concludes that the distribution of the sharpshooter *Draeculacephala minerva* includes the Köppen-Geiger climate zone Cfb which also occurs in Sweden (EFSA (2019). However, the climate zone Cfb constitute a marginal proportion of the states/ provinces in North America where *D. minerva* has been observed and there seems to be no evidence that *D. minerva* occurs in that climate zone (Purcell and Frazier 1985; Wilson et al. 2009). The distribution does not appear to be well studied but an expert on the species group

states that “I would be very surprised if *D. minerva* could thrive in Sweden- it is recorded only from the Neotropics.” (M. Wilson, National Museum of Wales, personal communication). Most of the hosts listed by EPPO (2020) does not occur in Sweden but the broad category Poaceae is also listed as hosts.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2019). Pest categorisation of non-EU Cicadomorpha vectors of Xylella spp. *Efsa Journal*, *17*(6), e05736. LINK

EPPO (2020). EPPO Global Database, *Draeculacephala Minerva* (DRAEMI), LINK Accessed 2020-11-10.

Purcell, A. H., & Frazier, N. W. (1985). *Habitats and dispersal of the principal leafhopper vectors of Pierce's disease bacterium in the San Joaquin Valley*. California Agricultural Experiment Station. LINK

Wilson M. R., Turner, J. A. & McKamey, S. H. (2009). *Sharpshooter Leafhoppers of the World* (Hemiptera: Cicadellidae subfamily Cicadellinae). Amgueddfa Cymru - National Museum Wales. LINK Accessed 2020-11-03.

Eotetranychus lewisi (EOTELE)

The spider mite *Eotetranychus lewisi* is believed to be native in the tropical area of Central America, but is also reported from North and south America, Africa, Asia and Europe (only in Maderia; (EFSA 2014; EPPO 2020). The outdoor distribution is uncertain, e.g. all findings in Canada appear to be from greenhouses (EPPO 2020; Migeon and Dorkeld (2020). *E. lewisi* do not enter diapause in the fall and winter (Floriculture Production Guide 2020). A quantitative PRA has been performed where it was concluded that ”Under current EU phytosanitary requirements, there is around a one in ten chance that *E. lewisi* will establish outdoors over the next 10 years. Although unlikely, establishment would most likely occur in southern Europe where environmental conditions, temperature and host density, are most suitable.” (EFSA 2017). In conclusion, our assessment is that the conditions are not suitable for establishment of *E. lewisi* outdoors in Sweden.

Hosts are available in Swedish greenhouses, e.g. 6 million pieces of poinsettia were produced in 2010 (EFSA 2017). Outbreaks of *E. lewisi* has occurred in greenhouses on a number of occations but according to EFSA (2017) treatments, detection of symptoms and eradication

measures applied to the quarantine pest is very likely to prevent the pest from establishing under glass in the EU. Without eradication measures, however, our assessment is that the conditions are likely to be suitable for establishment of *E. lewisi* in Swedish greenhouses although the uncertainty is large.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☐	☒	☐
Uncertainty range	☐	☒	☒	☒

References

EFSA Panel on Plant Health (PLH). (2014). Scientific Opinion on the pest categorisation of *Eotetranychus lewisi*. *EFSA Journal*, *12*(7), 3776. LINK

EFSA Panel on Plant Health (PLH), et al. (2017). Pest risk assessment of *Eotetranychus lewisi* for the EU territory. EFSA Journal; 15(10):4878, 122 pp. LINK

Floriculture Production Guide (2020) British Columbia, Ministry of Agriculture, February 2020. LINK Accessed 2020-11-03.

Migeon, A. and Dorkeld, F. (2020) Spider Mites Web: a comprehensive database for the Tetranychidae. LINK Accessed 2020-11-03.

Ortíz Ortíz, C. J. (2020). *Efecto in vitro del extracto de Clinopodium tomentosum para el control de Eotetranychus lewisi y Oligonychus coffeaee (Acari: Tetranychidae)* (Bachelor's thesis). LINK

Vasquez, C., Davila, M., Telenchana, N., Mangui, J., & Navas, D. (2017). First report of *Eotetranychus lewisi* in the Andean region from Ecuador on Arracacia xanthorrhiza (white carrot), Tropaeolum tuberosum (mashua). *Revista Mexicana de Biodiversidad*, *88*(4), 992-994. LINK

Euphranta japonica (regulated as *Rhacochlaena japonica*) (RHACJA)

The current distribution of *Euphranta japonica* is limited to Japan (EPPO 2020). Qin et al. (2015) aimed to predict the likelihood of establishment for 180 economically significant fruit fly species in different countries. They used a self-organising map (SOM), which is a type of artificial neural network, to obtain an index of establishment (a value between 0 and 1) for each species in each country. For Sweden, *E. japonica* obtained a SOM Index value of only 0.04 and was ranked as the 19th most likely fruit fly pest species to establish in Sweden. As a comparison, *Bactrocera invadens*, for which the conditions in Sweden was assessed as “Not suitable” in this this report, received a SOM Index value of 0.07. *Prunus cerasifera* is listed as the only host by EPPO 2020, but also *Prunus avium* is listed as a host by EPPO (1997) citing Hardy (1983).

Prunus cerasifera is listed as a non-native species in Sweden, considered established, but mainly occur as an ornamental plant in urban environments in the southern parts (Artfakta 2020). *Prunus avium* is common in southern Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Artfakta (2020) SLU, SLU Artdatabanken, Artfakta. Körsbärsplommon *Prunus cerasifera*, LINK Accessed 2020-12-17.

EPPO (2020). EPPO Global Database, *Euphranta japonica* (RHACJA), LINK Accessed 2020-11-10.

Hardy, D. E. (1983). The fruit flies of the tribe Euphrantini of Indonesia New Guinea, and adjacent islands (Trephritidae; Diptera). *International journal of entomology*, *25*(2-3), 152-205. LINK

Qin, Y., Paini, D. R., Wang, C., Fang, Y., & Li, Z. (2015). Global establishment risk of economically important fruit fly species (Tephritidae). *PloS one*, *10*(1), e0116424.

Strand, M., Aronsson, M., & Svensson, M. 2018. Klassificering av främmande arters effekter på biologisk mångfald i Sverige – ArtDatabankens risklista. ArtDatabanken Rapporterar 21. ArtDatabanken SLU, Uppsala. LINK Accessed 2020-11-03.

Graphocephala atropunctata (GRCPAT)

The distribution of the sharpshooter *Graphocephala atropunctata* is restricted to California according to CABI (2020) whereas it extends from California to Nicaragua according to Ballman et al. (2011). According to Wilson et al. (2009) the recorded distribution covers United States, Mexico and Nicaragua. There is almost no overlap between the Köppen-Geiger climate zones that occur in the region extending from California to Nicaragua and those that occur in Sweden (Beck et al. 2018). In a field study in northern California, where the coldest temperature recorded during the eight year long study period was 2.4 °C, Gruber and Daugherty (2013) noted that *G. atropunctata* trap catches were negatively associated with dry, very cold overwinter to spring conditions. This implies poor climatic suitability in Sweden, even in southern Sweden. EPPO (2020) lists *Vitis vinifera* and *Poaceae* as hosts.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Ballman, E. S., Rugman-Jones, P. F., Stouthamer, R., & Hoddle, M. S. (2011). Genetic structure of *Graphocephala atropunctata* (Hemiptera: Cicadellidae) populations across its natural range in California reveals isolation by distance. *Journal of economic entomology*, *104*(1), 279-287.

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

CABI (2020). CABI Crop Protection Compendium, Datasheet *Graphocephala atropunctata* (blue-green sharpshooter), LINK Accessed 2020-11-03.

EPPO (2020). EPPO Global Database, *Graphocephala atropunctata* (GRCPAT) LINK Accessed 2020-11-10.

Gruber, B.R. and Daugherty, M.P. (2013). Understanding the effects of multiple sources of seasonality on the risk of pathogen spread to vineyards: vector pressure, natural infectivity, and host recovery. Plant Pathology 62: 194-204. LINK

Wilson M. R., Turner, J. A. & McKamey, S. H. (2009). *Sharpshooter Leafhoppers of the World* (Hemiptera: Cicadellidae subfamily Cicadellinae). Amgueddfa Cymru - National Museum Wales. LINK Accessed 2020-12-10.

Haplaxius crudus (regulated as *Myndus crudus*) (MYNDCR)

The pallid cane leafhopper *Haplaxius crudus* is the vector of one of the phytoplasma strains causing the disease coconut lethal yellowing (EFSA 2017). The species occurs from Brazil to Texas (EPPO 2020). The adults requires palms (Arecaceae) for feeding (EFSA 2020). No species within the Arecaceae reproduces regularly in Sweden (Dyntaxa, 2020). According to EFSA (2020) the climatic conditions and availability of susceptible hosts in the EU may provide conditions for a limited establishment in e.g. eastern Cyprus and south-western Spain.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se [Accessed 2020-10-27].

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of *Haplaxius crudus*. *EFSA Journal*, *18*(7), e06224. LINK

EPPO (2020). EPPO Global Database, *Haplaxius crudus* (MYNDCR), LINK Accessed 2020-11-26.

Helicoverpa zea (regulated as *Heliothis zea*) (HELIZE)

The American cotton bollworm *Helicoverpa zea* is present from the southern tip of South America to Canada (EPPO 2020). It is, however, genereally accepted that overwintering survival is limited to areas south of 40° N latitude and that infestations north of that are due to mass migrations during the growing season (Westbrook & López 2010). The reason for that overwintering survival is limited to areas south of 40° N latitude is not due to temporary occurrences of low soil temperatures but it due to that the pest is exposed to extremely low temperatures for much longer periods north of 40° N latitude (Olmstead et al. 2016). *Helicoverpa zea* overwinters as a diapausing pupa and a 50 % mortality was observed after exposure to 0°C for 47 days and almost 100 % mortality was observed after exposure for 83 days (Morey et al. 2012). This sensitivity to extended periods of cold temperatures is expected to prevent establishment in Sweden since the mean daily temperature is projected to range between 0-4°C in southern Sweden during three months of the year (Dec-Feb), (during the time period 2021-2050; SMHI, 2020).

Helicoverpa zea feeds on over 100 plant species (EFSA 2020) and several of them are grown in Sweden, e.g *Zea mays* is grown on 16 792 ha in Sweden (Jordbruksverket 2018; Widenfalk et al. 2018). Peas (*Pisum sativum*) are grown on 17 414 ha, tomatoes on 39 ha (greenhouse) and*Vicia faba* on 21 756 ha (Widenfalk et al. 2018).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of *Helicoverpa zea*. *EFSA Journal*, *18*(7), e06177. LINK

EPPO (2020). EPPO Global Database, *Helicoverpa zea* (HELIZE) LINK Accessed 2020-11-25.

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Morey, A. C., Hutchison, W. D., Venette, R. C., & Burkness, E. C. (2012). Cold hardiness of *Helicoverpa zea* (Lepidoptera: Noctuidae) pupae. Environmental entomology, 41(1), 172-179.

Olmstead, D. L., Nault, B. A., & Shelton, A. M. (2016). Biology, ecology, and evolving management of Helicoverpa zea (Lepidoptera: Noctuidae) in sweet corn in the United States. *Journal of Economic Entomology*, *109*(4), 1667-1676. LINK

SMHI (2020). Swedish Meteorological and Hydrological Institute. Länsvisa klimatanalyser. LINK (Accessed 16 June 2020).

Westbrook, J. K., & López, J. D. (2010). Long-distance migration in *Helicoverpa zea*: What we know and need to know. *Southwestern Entomologist*, *35*(3), 355-360. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Hishimonus phycitis (HISHPH)

The leafhopper *Hishimonus phycitis* occurs in tropical and subtropical Asian countries (EFSA 2017). EFSA (2017) conclude that any establishment in EU is likely to be limited to the warmest areas around the Mediterranean. *Hishimonus phycitis* is a polyphagous species but hosts of particular relevance to the EU include *Citrus* spp. and *Solanum melongena* (EFSA 2017). In Sweden, these species are only grown to a very limited extent (Jordbruksverket 2018; Karlsson 2019).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

EFSA Panel on Plant Health (PLH), Jeger, M., Bragard, C., Caffier, D., Candresse, T., Chatzivassiliou, E., ... & Navarro, M. N. (2017). Pest categorisation of *Hishimonus phycitis*. *EFSA Journal*, *15*(10), e05037. LINK

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Karlsson, M. (2019). Solanaceae i svenska växthus: förutsättningar för kommersiell odling av asiatisk aubergine och kapkrusbär. First cycle, G2E. Alnarp: SLU, Department of Biosystems and Technology. LINK

Homalodisca vitripennis (HOMLTR)

Hosts for the sharpshooter *Homalodisca vitripennis* are available in Sweden, e.g. *Medicago sativa* (EPPO 2020). The climate in Sweden is, however, not suitable for establishment according to a study using CLIMEX to model the pest's potential geographic range (Hoddle 2004). CABI (2020) states that the greatest threats are to regions with mild winters.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

CABI (2020) CABI Crop Protection Compendium, Datasheet *Homalodisca vitripennis* (glassy winged sharpshooter). LINK Accessed 2020-11-02.

EPPO (2006) Mini data sheet on Homalodisca coagulata LINK

EPPO (2020) EPPO Global database, *Homalodisca vitripennis* (HOMLTR). LINK Accessed 2020-11-10

Hoddle, M. S. (2004). The potential adventive geographic range of glassy-winged sharpshooter, *Homalodisca coagulata* and the grape pathogen *Xylella fastidiosa*: implications for California and other grape growing regions of the world. *Crop Protection*, *23*(8), 691-699.

Wilson M. R., Turner, J. A. & McKamey, S. H. (2009). *Sharpshooter Leafhoppers of the World* (Hemiptera: Cicadellidae subfamily Cicadellinae). Amgueddfa Cymru - National Museum Wales. LINK Accessed 2020-11-03.

Keiferia lycopersicella (GNORLY)

The tomato pinworm *Keiferia lycopersicella* does not undergo diapause (Simmons et al. 2018) and according to EPPO (2012) it is only in the Mediterranean Basin that the conditions are suitable for establishment of sustainable field populations. However, the conditions under protected conditions are appropriate for survival of the pest throughout the EPPO region (e.g. based on experience from glasshouses in Ontario, Canada) (EPPO 2012). The problems with this pest in greenhouses are frequently cited and damage on tomato crops was considered serious enough that specific control strategies have been developed (Simmons et al. 2018; Ministry of Agriculture Food and Rural Affairs 2020). *Keiferia lycopersicella* is restricted to *Solanum* sp. (EPPO 2020). Host are available in Sweden, e.g. the greenhouse cultivation of tomatoes was ca 40 ha in 2017 (Jordbruksverket 2018) whereas aubergine were grown to a very limited extent (Jordbruksverket 2018; Karlsson 2019). Potato (*Solanum tuberosum*) is also reported as a host but it is only occasionally reported as attacked in the field (EPPO 2011). In Sweden the annual production area of potato cultivation is 23 942 ha (Widenfalk et al. 2018).

In conclusion, our assessment is that the conditions outdoors in Sweden are not suitable for the establishment of *K. lycopersicella*. The conditions for establishment in greenhouses are, however, likely to be suitable.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☐	☒	☐
Uncertainty range	☐	☒	☒	☒

References

EPPO (2012) Final Pest Risk Analysis for *Keiferia lycopersicella*, 12-17836 (12-17584, 11-17314) LINK

EPPO (2020) EPPO Global Database, *Keiferia lycopersicella* (GNORLY), LINK Accessed 2020-11-25.

Jordbruksverket (2018) Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB. LINK

Karlsson, M. (2019). Solanaceae i svenska växthus: förutsättningar för kommersiell odling av asiatisk aubergine och kapkrusbär. First cycle, G2E. Alnarp: SLU, Department of Biosystems and Technology. LINK

Ministry of Agriculture Food and Rural Affairs (2020). Tomato Pinworm - Biology and Control Strategies for Greenhouse Tomato Crops, Factsheet, LINK Accessed 2020-11-25.

Simmons, A. M., Wakil, W., Qayyum, M. A., Ramasamy, S., Kuhar, T. P., & Philips, C. R. (2018). Lepidopterous Pests: Biology, Ecology, and Management. In *Sustainable Management of Arthropod Pests of Tomato* (pp. 131-162). Academic Press.

Liriomyza sativae (LIRISA)

The cabbage leaf miner *Liriomyza sativae* has been reported from open fields and greenhouses in many regions, i.e. it is reported from North-, Central and South America, Africa, Asia, Oceania and Europe (in Turkey; EPPO 2020). EFSA (2020) claims that the distribution of *L. sativae* in its native range in the Americas extends from Canada to Argentina and covers an area where all climate types also occurring in the EU can be found and therefore assume that the climatic conditions in the EU would not limit the ability of *L. sativae* to establish. However, EFSA (2020) does not provide any support for the statement of such a wide native distribution range and for example EPPO (2020) states that the findings in Canada only refer to findings in glasshouses (citing McClanahan (1974)). A fast literature search did not result in any findings of populations of *L. sativae* established in climate types occurring in Sweden.

CABI (2020) states that *L. sativae* will spread in any suitable habitat with a warm temperature and in a review article of the role of thermal adaptation for the geographical distribution of *Liriomyza* they state that "Cold tolerance limits the distribution of leafminers in the temperate areas under natural conditions; however, they could be pests in greenhouse conditions." (Kang et al. 2009). Accordingly, it has for example been shown experimentally that all pupae of *L. sativae* die after exposure to 0°C for 13 days (Zhao and Kang 2000). Later work, that combined experimental data and field investigations, suggest that the -2°C isotherm of the minimum mean temperature of January constitute the overwintering range limit of *L. sativae*. (Chen and Kang 2005). Temperature data from Sweden, for the period 1961-1990, (SMHI 2020) show that such temperature requirements would not allow *L. sativae* to establish in Sweden. However, *Liriomyza sativae* can establish in greenhouses (EPPO 2020). The ability of *L. sativae* to establish in Swedish greenhouses should not be limited by a lack of hosts since some of the hosts of *L. sativae* include plants that are grown at a large scale in greenhouses in Sweden, e.g. tomato (*Solanum lycopersicum*) is produced on 386 000 m^2 (Widenfalk et al. 2018; EPPO 2020).

In conclusion, our assessment is that the conditions are not suitable for the establishment of *L. sativae* outdoors in Sweden but that the conditions are very likely to be suitablein greenhouses.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☐	☐	☒
Uncertainty range	☐	☐	☒	☒

References

CABI (2020) CABI Crop Protection Compendium, Datasheet, *Liriomyza sativae* (vegetable leaf miner) LINK Accessed 2020-10-21

Chen, B., & Kang, L. (2005). Implication of pupal cold tolerance for the northern over-wintering range limit of the leafminer Liriomyza sativae (Diptera: Agromyzidae) in China. *Applied Entomology and Zoology*, *40*(3), 437-446. LINK

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of *Liriomyza sativae*. *EFSA Journal*, *18*(3), e06037. LINK

EPPO (2020) EPPO Global Database, *Liriomyza sativae* (LIRISA), LINK Accessed 2020-10-21.

Kang, L., Chen, B., Wei, J. N., & Liu, T. X. (2009). Roles of thermal adaptation and chemical ecology in Liriomyza distribution and control. Annual review of entomology, 54, 127-145. LINK

SMHI (2020) the Swedish Meteorological and Hydrological Institute, Normal medeltemperatur i januari som underskrids i genomsnitt vart 10:de år, LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Zhao, Y. X., & Kang, L. (2000). Cold tolerance of the leafminer *Liriomyza sativae* (Dipt., Agromyzidae). *Journal of Applied Entomology*, *124*(3-4), 185-189. LINK

Margarodes vitis (MARGVI)

Margarodes vitis is a pest on the roots of grapevine (EPPO 1997). *Vitis vinifera* is the only major host and the total area of commercial grapevine cultivation in Sweden in 2017 was 100 ha (LRF 2018; EPPO 2020). In addition, the list of hosts include e.g. Poaceae (EPPO 2020) but the possible utilization of non-grapevine plant species is poorly understood. The distribution of *M. vitis* is restricted to South America and no records could be found of occurences in areas with Köppen Geiger climate zones that also occurs in Sweden, e.g. the records from Chile appear to be restricted to the area around Santiago (García Morales 2016; EFSA 2019). Apparently the adult female of *M. vitis* can survive 17 years of cyst dormancy (EFSA 2019).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EFSA Panel on Plant Health (EFSA PLH Panel), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Miret, J. A. J., ... & Parnell, S. (2019). Pest categorisation of non-EU Margarodidae. *Efsa Journal*, *17*(4). LINK

EPPO (1997) Data Sheets on Quarantine Pests *Margarodes prieskaensis*, *Margarodes vitis* and *Margarodes vredendalensis*, LINK Accessed 2020-11-26.

García Morales M, Denno BD, Miller DR, Miller GL, Ben-Dov Y, Hardy NB. (2016). *ScaleNet: A literature-based model of scale insect biology and systematics*. Database. doi: 10.1093/database/bav118. LINK. Accessed 2020-11-26.

LRF (2018). Sveriges Vingårdar 2018. Rapport från Föreningen Svenskt Vin och Lantbrukarnas Riksförbund. LINK Accessed 2020-11-25.

Margarodes vredendalensis (MARGVR)

Margarodes vredendalensis lives in the roots of its only known host, i.e. *Vitis vinifera* (EFSA 2019). The total area of commercial *V. vinifera* cultivation in Sweden in 2017 was 100 ha (LRF 2018). *Margarodes vredendalensis* has only been reported from South Africa (García Morales 2016; EFSA 2019; EPPO 2020) and according to De Klerk (1985) the distribution of the pest in South Africa does not include any Köppen-Geiger zone that occurs in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

De Klerk, C. A. (1985). Occurrence of South African species of *Margarodes* Guilding (Homoptera: Coccordea: Margarodidae) with special reference to vine infesting species. *Phytophylactica*, *17*(4), 215-216.LINK

EFSA Panel on Plant Health (EFSA PLH Panel), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Miret, J. A. J., ... & Parnell, S. (2019). Pest categorisation of non-EU Margarodidae. *Efsa Journal*, *17*(4). LINK

EPPO (1997) Data Sheets on Quarantine Pests *Margarodes prieskaensis*, *Margarodes vitis* and *Margarodes vredendalensis*, LINK Accessed 2020-11-26.

EPPO (2020) EPPO Global Database, *Margarodes vredendalensis* (MARGVR). LINK Accessed 2020-11-26.

LRF (2018). Sveriges Vingårdar 2018. Rapport från Föreningen Svenskt Vin och Lantbrukarnas Riksförbund. LINK Accessed 2020-11-25.

García Morales M, Denno BD, Miller DR, Miller GL, Ben-Dov Y, Hardy NB. (2016). *ScaleNet: A literature-based model of scale insect biology and systematics*. Database. doi: 10.1093/database/bav118. LINK. Accessed 2020-11-26.

Neoceratitis cyanescens (regulated as *Pardalaspis cyanescens*) (CERTCY)

The tomato fruit fly, *Neoceratitis cyanescens*, is present only in countries in south-eastern Africa. According to EFSA (2020) it is present in Madagascar, Reunion, Mauritius and Comoro Islands and according to EPPO (2020) it is also present in Mayotte and the Seychelles. However, CABI (2020) state that it should be considered absent in the Comoros and the Seychelles due to unconfirmed presence record(s).

In habitats where fruiting wild and cultivated hosts are present throughout the year populations of *N. cyanescens* have the potential to build up rapidly (Shylesha et al. 2012). Such habitats are not present outdoors in Sweden and there is no overlap between the Köppen-Geiger climate types occurring in the pests current distribution and the climate types occurring in Sweden (Beck et al. 2018; EPPO 2020). EPPO (1997) states that *N. cyanescens* could possibly become established in field-grown tomatoes in the southern part of the EPPO region. Our assessment is that the outdoor conditions in Sweden are not suitable for an establishment of *N. cyanescens*. No reports of observations of *N. cyanescens* in greenhouses were found and according to EPPO (1997) the large size of the insect (4-5 mm) and its requirements for soil in which to pupate "…rule out any likelihood of establishment in glasshouse tomatoes in more northerly areas.". However, in Sweden, about 20% of the tomato production area consist of organic farming where the tomatoes are grown in soil (Hansson and Ögren 2018; Ögren and Ascard 2019). Our assessment is therefore that the conditions for establishment in glasshouses are unlikely to be suitable.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

CABI (2020) CABI Crop Protection Compendium, *Neoceratitis cyanescens* (tomato fruit fly), Datasheet full, LINK

EPPO (1997) Data Sheets on Quarantine Pests *Trirhithromyia cyanescens*, Prepared by CABI and EPPO for the EU under Contract 90/399003 LINK Accessed 2020-11-18.

EPPO (2020) EPPO Global Database, *Neoceratitis cyanescens* (CERTCY), LINK Accessed 2020-11-18.

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of non-EU Tephritidae. Efsa Journal, 18(1), e05931. LINK

Hansson, T. and Ögren, E. (2018). Ekologisk odling av tomat, Jordbruksverket, P9:6. LINK Accessed 2020-11-16.

Ögren E. and Ascard, J. (2019). Ekologisk växthusodling i Sverige, Jordbruksverket, P9:2, LINK Accessed 2020-11-16.

Shylesha, A. N., Bhumannavar, B. S., & Kumar, N. K. (2012). Classical biological control initiatives for the impending invasive pests of India. *Society for Biocontrol Advancement*, *26*(2), 101-124. LINK

Neoleucinodes elegantalis (NEOLEL)

The likelihood of establishment of the fruit borer, *Neoleucinodes elegantalis*, outdoors in Sweden was assessed to be very unlikely with a low uncertainty in a PRA by EPPO (2013). Establishment under protected conditions in Sweden was assessed as very unlikely with a moderate uncertainty (EPPO 2013; F. Grousset personal communication 2020). It should be noted that it is uncertain whether *N. elegantalis* could adapt to glasshouse conditions and that the likelihood of establishment indoors was assessed to be lower in e.g. Sweden than in areas where the pest can establish outdoors because outdoor populations may facilitate reintroductions into glasshouses (EPPO 2013). More recently, the climate in Sweden was assessed to be unsuitable for *N. elegantalis* based on CLIMEX modelling approach (Silva et al. 2017). This was the case also when the future climate was modelled (i.e. until year 2100) (Silva et al. 2017). The ability of *N. elegantalis* to establish in Swedish greenhouses should not be limited by a lack of hosts since tomato (*Solanum lycopersicum*) is grown at a large scale in greenhouses in Sweden, i.e. it is produced on 386 000 m^2 (Widenfalk et al. 2018, EPPO 2020).

In conclusion, our assessment is that the conditions are not suitable for establishment of *N. elegantalis* neither outdoors nor indoors in Sweden. The former assessment has a low uncertainty while the later has a moderate uncertainty.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EPPO (2013) Pest Risk Analysis for *Neoleucinodes elegantalis*, September 2014, EPPO, 21 Boulevard Richard Lenoir, 75011 Paris, www.eppo.int, hq@eppo.int LINK

EPPO (2020) EPPO Global Database, *Neoleucinodes elegantalis* (NEOLEL), LINK Accessed 2020-10-21.

da Silva, R. S., Kumar, L., Shabani, F., & Picanço, M. C. (2017). Potential risk levels of invasive *Neoleucinodes elegantalis* (small tomato borer) in areas optimal for open-field Solanum lycopersicum (tomato) cultivation in the present and under predicted climate change. *Pest Management Science*, *73*(3), 616-627. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Pityophthorus juglandis (PITOJU)

The walnut twig beetle, *Pityophthorus juglandis*, can establish throughout the EPPO region where *Juglans* species occur (climate was not considered a limiting factor) (EPPO 2015; 2020). There are four established species of *Juglans* in Sweden but all are non-native (SLU Artdatabanken 2020) and the occurrences of them are expected to be infrequent. We assess that the conditions for establishment of *P. juglandis* in Sweden are not suitable but there is some uncertainty with regard to whether or not there are dense enough populations of *Juglans* in Sweden to allow an establishment.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EPPO 2015. Express PRA for *Geosmithia morbida* and *Pityophthorus juglandis*. EPPO: Paris, France. LINK Accessed 2020-10-31.

EPPO 2020. EPPO Study on the Risk of Bark and Ambrosia Beetles Associated with Imported Non-Coniferous Wood; EPPO Technical Document No. 1081; EPPO: Paris, France, 2020. LINK. Accessed 2020-10-31.

SLU Artdatabanken (2020) Artfakta, Valnötter *Juglans*, LINK Accessed 2020-11-03.

Rhagoletis suavis (RHAGSU)

Rhagoletis suavis, the walnut husk maggot, have been reported from states in North America with Köppen-Geiger climate zones that also occurs in Sweden (EPPO 2020). However, it is only *Juglans* species that are listed as hosts (EPPO 2020) and although there are four established species of *Juglans* in Sweden all of them are non-native (SLU Artdatabanken 2020) and the occurrence is expected to be infrequent. We assess that the conditions for establishment of *R. suavis* in Sweden are not suitable but threre is uncertainty with regard to whether or not there are dense enough populations of *Juglans* in Sweden to allow an establishment.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EPPO (2020) EPPO Global database, *Rhagoletis suavis* (RHAGSU) LINK Accessed 2020-11-03.

SLU Artdatabanken (2020) Artfakta, Valnötter Juglans, LINK Accessed 2020-11-03.

Rhynchophorus palmarum (RHYCPA)

The giant palm weevil *Rhynchophorus palmarum* is a pest on oil palms, coconuts, and ornamental palms (EPPO 2020). Breeding is restricted to palms (Arecaceae) and *Saccharum officinarum* (sugar cane) (EPPO 2020). No species within the Arecaceae reproduces regularly in Sweden (Dyntaxa, 2020) and no information could be found of any commercial production in protected cultivation of these hosts in Sweden.

An EPPO PRA from 2006 concludes that the climatic conditions are favourable in the Mediterranean countries (EPPO 2006). In an EPPO Datasheet, last updated in Sept. 2020 the pest significance was assessed to be restricted to the native range of the palm *Phoenix canariensis*, which is the Mediterranean region and in the Canary Islands (EPPO 2020).

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Visited at www.dyntaxa.se Accessed 2020-10-27.

EPPO (2006) PRA for *Rhynchophorus palmarum*, LINK Accessed 2020-11-03.

EPPO (2020) *Rhynchophorus palmarum*. EPPO datasheets on pests recommended for regulation. Available online. LINK Accessed 2020-11-26.

Scirtothrips aurantii (SCITAU)

The South African citrus thrips *Scirtothrips aurantii* is a polyphagous pest currently found in several countries in Africa and in Yemen (EPPO 2020). EPPO (1997) assessed that *S. aurantii* could probably establish on *Citrus* plants in southern Europe, but that its potential effect on other hosts in the EPPO region is of no particular concern. EFSA (2018; 2019) also assessed that establishment outdoors to be restricted to areas where the climate allows citrus cultivation but further state that, given the pest's polyphagy, its establishment under protected cultivation north of this area may be possible. However, no information was found that this pest have established under protected conditions. Further, it is uncertain whether hosts are present in Swedish greenhouses. None of the species grown in Swedish greenhouses are specifically listed as hosts but since the pest is highly polyphagous and *Kalanchoe tubiflora* is a known host (Rafter et al. 2008) the pest may also be able to reproduce on the ornamental *Kalanchoe* cultivars that are produced in Sweden (i.e. presumably mostly cultivars of *Kalanchoe blossfeldiana*). About 1400 000 pots of such culitvars were produced in Sweden in 2017 (Jordbruksverket 2020).

Our assessment is that the conditions outdoors in Sweden are not suitable for *S. aurantii*. Further, based on that no reports were found of earlier establishments in protected conditions and that we are not aware of that any of the known hosts are grown to any significant extent in Swedish greenhouses we assess it as unlikely that the conditions there are suitable. However, the uncertainty range is assessed to also include “Likely to be suitable” since experts have stated that establishement in greenhouses may be possible (i.e. EFSA 2018) and since plant species closely related to known host species are grown in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☒	☐

References

EFSA PLH Panel (EFSA Panel on Plant Health). (2018). Scientific Opinion on the pest categorisation of *Scirtothrips aurantii*. *EFSA Journal*, *16*(3). LINK

European Food Safety Authority (EFSA), Schrader, G., Camilleri, M., Diakaki, M., & Vos, S. (2019). Pest survey card on *Scirtothrips aurantii*, *Scirtothrips citri* and *Scirtothrips dorsalis*. *EFSA Supporting Publications*, *16*(2). LINK

EPPO (1997) Data Sheets on Quarantine Pests *Scirtothrips aurantii*, LINK Accessed 2020-11-26.

Jordbruksverket (2020) Jordbruksverkets officiella statistik. Krukväxter, exkl. lökblommor, LINK Accessed 2020-12-09.

Rafter, M. A., Gillions, R. M., & Walter, G. H. (2008). Generalist herbivores in weed biological control—A natural experiment with a reportedly polyphagous thrips. *Biological Control*, *44*(2), 188-195. LINK

Scirtothrips dorsalis (SCITDO)

The climate in central and northern Europe is unfavourable for the establishment of *Scirtothrips dorsalis* despite host availability according to a PRA by MacLeod and Collins (2006). Accordingly, EFSA (2014) states that only the southern areas of the EU are potentially suitable for outdoor establishment. *Scirtothrips dorsalis* has been reported from three glasshouses in a botanical garden in southern England (EPPO 2020) and in the PRA by MacLeod and Collins (2006), establishment in protected environments in EU was assessed as very likely. Accordingly, Vierbergen and van der Gaag (2009) concluded that *S. dorsalis* probably can establish in Dutch greenhouses (but they note that it most likely is easy to control it and that there are no examples of it causing significant damage in greenhouse crops in temperate regions). Hosts are available in Swedish greenhouses for this very polyphagous species, which has been recorded from more than 100 plant species in 40 families. Among those, both *Solanum lycopersicum* (tomato) and *Cucumis sativus* (cucumber) are produced at large scale in Swedish greenhouses (Widenfalk et al. 2018, CABI 2020).

In conclusion, our assessment is that the conditions are not suitable for establishment of *S. dorsalis* outdoors in Sweden but that the conditions in greenhouses are very likely to be suitable for establishment.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☐	☐	☐	☒
Uncertainty range	☐	☐	☒	☒

References

CABI (2020). Crop Protection Compendium, Datasheet, *Scirtothrips dorsalis* (chilli thrips) LINK Accessed 2020-12-07.

EFSA Panel on Plant Health (PLH). (2014). Scientific Opinion on the pest categorisation of *Scirtothrips dorsalis*. *EFSA Journal*, *12*(12), 3915. LINK

EPPO (2020). EPPO Global Database, *Scirtothrips dorsalis* (SCITDO) LINK Accessed 2020-12-07.

Kumar, V., Seal, D. R., & Kakkar, G. (2014). Chilli thrips Scirtothrips dorsalis Hood (Insecta: Thysanoptera: Thripidae). *University of Florida IFAS Extension publication EENY463. Gainesville, Florida: University of Florida*. LINK

MacLeod A and Collins D, 2006. CSL pest risk analysis for *Scirtothrips dorsalis*. CSL (Central Science Laboratory), 8 pp. LINK

Nietschke, B. S., Borchert, D. M., Magarey, R. D., & Ciomperlik, M. A. (2008). Climatological potential for *Scirtothrips dorsalis* (Thysanoptera: Thripidae) establishment in the United States. Florida Entomologist, 91(1), 79-86. LINK

Vierbergen GB and van der Gaag DJ, 2009. Pest risk assessment *Scirtothrips dorsalis*. Plant Protection Service, Ministry of Agriculture, Nature and Food Quality, Wageningen, the Netherlands, 9 pp. LINK

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Spodoptera eridania (PRODER)

The armyworm *Spodoptera eridania* is essentially a subtropical species (CABI 2020). The pest cannot diapause and thus is unable to survive during extended periods of near- or sub-freezing temperatures (Mitchell and Tumlins 1994). All parts of Sweden experienced at least 100 frost days per year on average for the period 1988-2017 (EFSA 2019). In USA, permanent populations occur only in the south (Florida, South Carolina, North Carolina, to southern Kansas and Texas), however, during the summer, populations fly north and can reach into New England (EFSA 2020). Permanent populations does not seem to occur in Köppen-Geiger

climate types that also occur in Sweden (see Beck et al. 2018). However, although the climatic conditions does not seem to allow establishment in Sweden, migratory populations may arrive during the summer (van der Gaag DJ and van der Straten 2017).

In northern areas, far away from overwintering sites, *S. eridania* is not expected to become important greenhouse pests since there appears to be no reports that the pest overwinters in greenhouses in cooler climates (van der Gaag DJ and van der Straten 2017). According to CABI (2020), *S. eridania* is not recorded as a glasshouse pest, but in a new location (e.g. the EPPO region) it might become so. Hosts are available in Swedish greenhouses, e.g. tomato is grown at a large scale in greenhouses in Sweden, i.e. it is produced on 386 000 m^2 (Widenfalk et al. 2018; EFSA 2020).

In conclusion, our assessment is that most likely the conditions are not suitable for establishment of *S. eridania* outdoors in Sweden and we assess that the conditions are unlikely to be suitable in greenhouses.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☒	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

CABI (2020) Invasive Species Compendium, *Spodoptera eridania* (southern armyworm), Datasheet, LINK Accessed 2020-10-31

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Miret, J. A. J., ... & Parnell, S. (2019). Pest categorisation of *Spodoptera litura*. *EFSA Journal*, *17*(7). LINK

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., ... & Navas-Cortes, J. A. (2020). Pest categorisation of *Spodoptera eridania*. EFSA Journal, 18(1), e05932. LINK

EPPO Data Sheets on Quarantine Pests, Prepared by CABI and EPPO for the EU under Contract, 90/399003 LINK Accessed 2020-10-30.

van der Gaag D.J. and van der Straten M (2017). Assessment of the potential impact of American *Spodoptera* species for the European Union. November 2017. Netherlands Food and

Consumer Product Safety Authority (NVWA), Utrecht, Catharijnesingel 59, 3511 GG Utrecht, the Netherlands. LINK

Sampaio, F., Krechemer, F. S., & Marchioro, C. A. (2020). Temperature-dependent development models describing the effects of temperature on the development of *Spodoptera eridania*. Pest Management Science. LINK

Mitchell, E. R., & Tumlinson, J. H. (1994). Response of *Spodoptera exigua* and *S. eridania* (Lepidoptera: Noctuidae) males to synthetic pheromone and *S. exigua* females. *Florida Entomologist*, 237-237. LINK

Spodoptera litura (PRODLI)

The cotton leafworm *Spodoptera litura* have a host range that covers over 40 families (EPPO 1997). Hosts are available in Sweden both outdoors and indoors. *Zea mays* is the only host that is considered to be a major host that is grown in Sweden and it is grown on 16 686 ha, but e.g. *Capsicum annuum* is also listed as a host and *Capsicum* sp. are grown in Swedish greenhouses on approximately 7 000 m^2 (Jordbruksverket 2018; Widenfalk et al. 2018; EPPO 2020).

EFSA (2019) assess that *S. litura* would only be able to establish in limited areas of the southern parts of the EU which are climatically suitable. Outbreaks of *S. litura* have occurred several times in EU glasshouses (EFSA 2019). EPPO (1997) highlight that the pest constitute a phytosantitary risk for production in glasshouses in most parts of Europe. However, a more recent assessment by EFSA (2019), suggest that that establishment in glasshouses may depend on established populations of *S. litura* outdoors, which can re-invade the glasshouses.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

EFSA Panel on Plant Health (PLH), Bragard, C., Dehnen-Schmutz, K., Di Serio, F., Gonthier, P., Jacques, M. A., Miret, J. A. J., ... & Parnell, S. (2019). Pest categorisation of *Spodoptera litura*. *EFSA Journal*, *17*(7). LINK

EPPO (1997) Data Sheets on Quarantine Pests *Spodoptera littoralis* and *Spodoptera litura*, LINK Accessed 2020-11-26.

EPPO (2020). EPPO Global Database, *Spodoptera litura* (PRODLI), LINK Accessed 2020-12-09.

Widenfalk, O., Jakobsson, M., Hammarström, A., Widenfalk, L. (2018). Trade and production of plants and plant products in Sweden - A knowledge base for pest risk analysis. Technical Report, External project leaders Björklund, N., Boberg, J. Greensway and SLU, pp 40. LINK

Thaumatotibia leucotreta (ARGPLE)

The codling moth *Thaumatotibia leucotreta* is a tropical pest which lacks the capacity for diapause and only areas near the Mediterranean were considered to be clearly climatically suitable in a PRA by EPPO (2013). Similarily, EFSA (2019) concludes that the potential distribution only includes areas near the Mediterranean coast and EFSA (2020) states that establishment year-round in northern Europe is unlikely because of the absence of fruit in certain periods of the year.

Thaumatotibia leucotreta has been found in greenhouses and EPPO (2013) conclude that establishment is unlikely to moderately likely since control of the pest is more likely to be effective in greenhouses and since there generally are periods with no host production (i.e. the production is stopped during a given period). According to a German PRA establishment in protected cultivation is possible but due to control measures and seasonal interruption of the production it was assessed to be less likely (JKI 2015). Hosts are grown in Swedish greenhouses, e.g. *Capsicum* sp. is produced in about 7 000 m^2 (Jordbruksverket 2018; EPPO 2020).

In conclusion: Our assessment is that the conditions are not suitable for establishment of *Thaumatotibia leucotreta* outdoors in Sweden and that the conditions in greenhouses are unlikely to be suitable.

	Not suitable	**Unlikely to be suitable**	**Likely to be suitable**	**Very likely to be suitable**
Most likely	☐	☒	☐	☐
Uncertainty range	☐	☒	☐	☐

References

Adom, M., Fening, K. O., Billah, M. K., Wilson, D. D., Hevi, W., Clottey, V. A., ... & Bruce, A. Y. (2020). Pest status, bio-ecology and management of the false codling moth, *Thaumatotibia leucotreta* (Meyrick)(Lepidoptera: Tortricidae) and its implication for international trade. *Bulletin of Entomological Research*, 1-14. LINK

EFSA, Baker Richard, Gilioli Gianni, Behring Carsten, Candiani Denise, Gogin Andrey, … Tramontini Sara. (2019). *Thaumatotibia leucotreta*–Pest Report and Datasheet to support ranking of EU candidate priority pests [Data set]. Zenodo. LINK Accessed 2020-10-31

EFSA, Loomans, A., van Noort, T., Schenk, M., Delbianco, A., & Vos, S. (2020). Pest survey card on Thaumatotibia leucotreta. *EFSA Supporting Publications*, *17*(8), 1916E. LINK

EPPO (2013). PRA for *Thaumatotibia leucotreta* LINK

EPPO (2020). EPPO Global Database, *Thaumatotibia leucotreta* (ARGPLE) LINK Accessed 2020-12-07.

JKI (2015). Julius Kühn-Institut, Express–PRA zu *Thaumatotibia leucotreta* LINK

Jordbruksverket (2018). Trädgårdsproduktion 2017. Korrigerad version 2018-06-20. Sveriges officiella statistik. Statistiska meddelanden JO 33 SM 1801. SCB.

Ostojá-Starzewski JC, Allen D, Anderson H, Eyre D and Korycinska A (2017). False Codling moth, *Thaumatotibia leucotreta*. Plant Pest Factsheet, UK Department for Environment, Food and Rural affairs. LINK Accessed 2020-10-31.

Svensson, I. (2002). Remarkable records of Microlepidoptera in Sweden during 2001. *Entomologisk Tidskrift, 123*(1/2), 1-11. LINK

Toxoptera citricidus (regulated as *Toxoptera citricida*) (TOXOCI)

The principal host plant for the tropical citrus aphid *Toxoptera citricidus* is *Citrus* spp. but other Rutaceae are occasionally attacked (EPPO 1997). EFSA (2018) assessed that climatic conditions are likely to be conducive for establishement in citrus-growing areas in the EU. There does not appear to be any commercial production of citrus plants in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Jeger, M., Bragard, C., Caffier, D., Candresse, T., Chatzivassiliou, E., Dehnen-Schmutz, K., ... & Niere, B. (2018). Pest categorisation of *Toxoptera citricida*. *EFSA Journal*, *16*(1). LINK

EPPO (1997) Data Sheets on Quarantine Pests *Toxoptera citricidus*, LINK Accessed 2020-11-26.

Trioza erytreae (TRIZER)

The African citrus psyllid *Trioza erytreae* only attack plant species of the family Rutaceae (EPPO 2020). No species within the Rutaceae reproduces regularly in Sweden (Dyntaxa, 2020). *Trioza erytreae* is established in Portugal and Spain and EPPO (2020) assess that it would probably be able to spread and establish also in other Mediterranean countries.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References

Dyntaxa (2020). Swedish Taxonomic Database. Family: Rutaceae – vinruteväxter, LINK (Accessed 2020-10-19).

EFSA (European Food Safety Authority), Parnell, S., Camilleri, M., Diakaki, M., Schrader, G., & Vos, S. (2019). Pest survey card on Huanglongbing and its vectors. *EFSA Supporting Publications*, *16*(4), 1574E. LINK

EPPO (2020) *Trioza erytreae*. EPPO datasheets on pests recommended for regulation. Available online. LINK Accessed 2020-11-26.

Unaspis citri (UNASCI)

The citrus snow scale *Unaspis citri* is essentially a pest of Citrus plants but occasionally it also occurs on other plants, e.g. *Vitis vinifera* (EFSA 2018; UK Plant Health Register 2020). EPPO (1997) considered that *U. citri* constituted a certain threat to the citrus industry throughout the Mediterranean area. Similarily, EFSA (2018) states that regions where *U. citri* occurs includes Köppen-Geiger zones also found in countries around the Mediterranean Basin, but that it is uncertain whether the pest would be able to establish widely. Hosts are available in Swedish greenhouses since *Capsicum* sp. are grown in on approximately 7 000 m^2 (Jordbruksverket 2018; EPPO 2020). Many scale insects from tropical and subtropical areas have established in greenhouses in countries with temperate climate (Burger and Ulenberg 1990). However, no information about establishments of *U. citri* in greenhouses was found, and EFSA (2018) did not include damage in greenhouses in their impact assessment for *U. citri*.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☒	☐	☐

References

Burger, H.C. and Ulenberg, S.A.(1990). Chapter 3.2 Quarantine Problems and Procedures in Armored scale insects their biology, natural enemies and control, Volume B. edited by Rosen, D. World Crop Pests, 4B Editor in Chief, Helle, W. LINK

EFSA Panel on Plant Health (PLH), Jeger, M., Bragard, C., Caffier, D., Candresse, T., Chatzivassiliou, E., Dehnen-Schmutz, K., ... & Niere, B. (2018). Pest categorisation of *Unaspis citri*. *EFSA Journal*, *16*(3). LINK

EPPO (1997) Data Sheets on Quarantine Pests *Unaspis citri*, LINK Accessed 2020-11-26.

UK Plant Health Risk Register (2020). Department for Environment, Food & Rural Affairs, UK Plant Health Risk Register, UK Risk Register Details for *Unaspis citri*, LINK Accessed 2020-11-26.

Xyphon fulgidum (regulated as *Carneocephala fulgida*) (CARNFU)

DeLong and Serverin (1949) states that records indicate that the sharpshooter *Xyphon fulgidum* is known only from California. According to Wilson et al. (2009) it is present in the United States and according to the UK Plant Health Risk Register (2020) it is present in Mexico and United States (limited) (no references for the distributions are provided). In a review article from 2004 of the xylem fluid–feeding insect vectors of *Xylella fastidiosa* they claim that the distribution of *X. fulgidum* is limited to California (Redek et al. 2004). Assuming that the distribution is limited to California and Mexico there is no overlap with the Köppen-Geiger zones that occurs in Sweden (see Beck et al. 2018 for the climate zones). This distribution indicate that the climatic conditions in Sweden is not suitable for establishment. The conditions in greenhouses in Sweden are also assessed to be unsuitable since *Vitis vinifera* and other known hosts are not produced to any extent in greenhouses in Sweden.

	Not suitable	Unlikely to be suitable	Likely to be suitable	Very likely to be suitable
Most likely	☒	☐	☐	☐
Uncertainty range	☒	☐	☐	☐

References:

Beck, H. E., Zimmermann, N. E., McVicar, T. R., Vergopolan, N., Berg, A., & Wood, E. F. (2018). Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Scientific data*, *5*, 180214. LINK

DeLong DM, Severin HHP. (1949). Characters, distribution, and food plants of leafhopper vectors of virus causing Pierce's disease of grapevines. Hilgardia 19:171–86.

UK Plant Health Risk Register (2020). UK Risk Register Details for *Carneocephala fulgida*, Department for Environment, Food & Rural Affairs, LINK Accessed 2020-11-10.

Redak, R. A., Purcell, A. H., Lopes, J. R., Blua, M. J., Mizell Iii, R. F., & Andersen, P. C. (2004). The biology of xylem fluid–feeding insect vectors of *Xylella fastidiosa* and their relation to disease epidemiology. *Annual Reviews in Entomology*, *49*(1), 243-270.

Wilson M. R., Turner, J. A. & McKamey, S. H. (2009). *Sharpshooter Leafhoppers of the World* (Hemiptera: Cicadellidae subfamily Cicadellinae). Amgueddfa Cymru - National Museum Wales. LINK Accessed 2020-12-10.

Acknowledgement

We would like to thank M. Wilson (National Museum of Wales, UK), F. Grousset and M. Suffert (both at EPPO).

Authors

This report was prepared by SLU Risk Assessment of Plant Pests at the Swedish University of Agricultural Sciences:

Niklas Björklund, Dept. of Ecology, Swedish University of Agricultural Sciences, P.O. Box 7044, SE-750 07 Uppsala, Sweden. Visiting address: Ullsväg 16, E-mail: Niklas.Bjorklund@slu.se

Johanna Boberg, Dept. of Forest Mycology and Plant Pathology, Swedish University of Agricultural Sciences, PO Box 7026, SE-750 07 Uppsala, Sweden. Visiting address: Almas allé 5, E-mail: Johanna.Boberg@slu.se