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Pest categorisation of *Atalodera andina*

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Abstract

The EFSA Panel on Plant Health performed a pest categorisation of *Atalodera andina* (Nematoda: Heteroderidae) for the European Union (EU) territory. *A. andina* belongs to the order Rhabditida, subfamily Ataloderinae. This species has not been reported from the EU. It is not included in the EU Commission Implementing Regulation 2019/2072. It is present in the area of the Lake Titicaca of both Peru and Bolivia and in valleys of the region. There is a report in literature stating that specimens were obtained from Chile and identified as *A. andina* but details on their geographical origin were not given. The identity of *A. andina* is well established and methods of its identification are available. Natural hosts include the tuber crops *Ullucus tuberosus*, *Oxalis tuberosa* and the Andean potato (*Solanum tuberosum* subsp. *andigenum*). Experimental hosts include plants of the genus *Brassica* (such as *B. oleracea*, *B. napus*, *B. campestris*), sugar beet, tomato and clover. Pathways of entry are host plants for planting including seed tubers, subterranean parts of plants intended for consumption, soil as such or attached to plants for planting, machinery or footwear, soil in packaging (bags). Suitable climates exist in the EU but their extent is uncertain and depends on assumptions made on the occurrence of the pest around Lake Titicaca. In the EU, potato, which is grown on about 1,500,000 ha annually, is expected to be the main host of the nematode. Soil and plants for planting are prohibited from import to the EU from third countries where the pest is known to occur. However, this does not cover hosts of *A. andina* other than species of Solanaceae. The nematode has been reported to damage Andean potato crops, although this has not been quantified. Following its introduction in the EU, *A. andina* is expected to cause impacts on potato (*S. tuberosum* subsp. *tuberosum*), although there is uncertainty on the magnitude of this impact. Also damage on other hosts cannot be excluded. Therefore, the Panel concludes that *A. andina* satisfies all the criteria that are within the remit of EFSA to assess for it to be regarded as a potential Union quarantine pest.

Keywords: plant pest, potato, quarantine, round cystoid nematode

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1. Introduction

1.1. Background and Terms of Reference as provided by the requestor

1.1.1. Background

The new Plant Health Regulation (EU) 2016/2031, on the protective measures against pests of plants, is applying from 14 December 2019. Conditions are laid down in this legislation in order for pests to qualify for listing as Union quarantine pests, protected zone quarantine pests or Union regulated non-quarantine pests. The lists of the EU regulated pests together with the associated import or internal movement requirements of commodities are included in Commission Implementing Regulation (EU) 2019/2072. Additionally, as stipulated in the Commission Implementing Regulation 2018/2019, certain commodities are provisionally prohibited to enter in the EU (high risk plants, HRP). EFSA is performing the risk assessment of the dossiers submitted by exporting to the EU countries of the HRP commodities, as stipulated in Commission Implementing Regulation 2018/2018. Furthermore, EFSA has evaluated a number of requests from exporting to the EU countries for derogations from specific EU import requirements.

In line with the principles of the new plant health law, the European Commission with the Member States are discussing monthly the reports of the interceptions and the outbreaks of pests notified by the Member States. Notifications of an imminent danger from pests that may fulfil the conditions for inclusion in the list of the Union quarantine pest are included. Furthermore, EFSA has been performing horizon scanning of media and literature.

As a follow-up of the above-mentioned activities (reporting of interceptions and outbreaks, HRP, derogation requests and horizon scanning), a number of pests of concern have been identified. EFSA is requested to provide scientific opinions for these pests, in view of their potential inclusion by the risk manager in the lists of Commission Implementing Regulation (EU) 2019/2072 and the inclusion of specific import requirements for relevant host commodities, when deemed necessary by the risk manager.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinions in the field of plant health.

EFSA is requested to deliver 53 pest categorisations for the pests listed in Annex 1A, 1B, 1D and 1E (for more details see mandate M-2021-00027 on the Open.EFSA portal). Additionally, EFSA is requested to perform pest categorisations for the pests so far not regulated in the EU, identified as pests potentially associated with a commodity in the commodity risk assessments of the HRP dossiers (Annex 1C; for more details see mandate M-2021-00027 on the Open.EFSA portal). Such pest categorisations are needed in the case where there are not available risk assessments for the EU.

When the pests of Annex 1A are qualifying as potential Union quarantine pests, EFSA should proceed to phase 2 risk assessment. The opinions should address entry pathways, spread, establishment, impact and include a risk reduction options analysis.

Additionally, EFSA is requested to develop further the quantitative methodology currently followed for risk assessment, in order to have the possibility to deliver an express risk assessment methodology. Such methodological development should take into account the EFSA Plant Health Panel Guidance on quantitative pest risk assessment and the experience obtained during its implementation for the Union candidate priority pests and for the likelihood of pest freedom at entry for the commodity risk assessment of High Risk Plants.

1.2. Interpretation of the Terms of Reference

Atalodera andina is one of a number of pests listed in Annex 1 to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a potential Union quarantine pest for the area of the EU excluding Ceuta, Melilla and the outermost regions of Member States referred to in Article 355(1) of the Treaty on the Functioning of the European Union (TFEU), other than Madeira and the Azores, and so inform EU decision-making as to its appropriateness for potential inclusion in the lists of pests of Commission Implementing Regulation (EU) 2019/ 2072. If a pest fulfils the criteria to be potentially listed as a Union quarantine pest, risk reduction options will be identified.

2. Data and methodologies

2.1. Data

2.1.1. Information on the pest and hosts from the NPPO of Peru (SENASA)

EFSA contacted SENASA in Peru, to obtain information on the biology and occurrence of *A. andina* and its hosts in order to decrease the uncertainties of this pest categorisation.

2.1.2. Literature search

A literature search on *Atalodera andina* was conducted at the beginning of the categorisation in the ISI Web of Science bibliographic database, using the scientific name of the pest and the synonym *Thecavermiculatus andinus* as search term. Papers relevant for the pest categorisation were reviewed, and further references and information were obtained from experts, as well as from citations within the references and grey literature.

2.1.3. Database search

Pest information, on host(s) and distribution, was retrieved from the European and Mediterranean Plant Protection Organization (EPPO) Global Database (EPPO, online), the CABI databases and scientific literature databases as referred above in Section 2.1.1.

Data about the import of commodity types that could potentially provide a pathway for the pest to enter the EU and about the area of hosts grown in the EU were obtained from EUROSTAT (Statistical Office of the European Communities).

The Europhyt and TRACES databases were consulted for pest-specific notifications on interceptions and outbreaks. Europhyt is a web-based network run by the Directorate General for Health and Food Safety (DG SANTÉ) of the European Commission as a subproject of PHYSAN (Phyto-Sanitary Controls) specifically concerned with plant health information. TRACES is the European Commission's multilingual online platform for sanitary and phytosanitary certification required for the importation of animals, animal products, food and feed of non-animal origin and plants into the European Union, and the intra-EU trade and EU exports of animals and certain animal products. Up until May 2020, the Europhyt database managed notifications of interceptions of plants or plant products that do not comply with EU legislation, as well as notifications of plant pests detected in the territory of the Member States and the phytosanitary measures taken to eradicate or avoid their spread. The recording of interceptions switched from Europhyt to TRACES in May 2020.

GenBank was searched to determine whether it contained any nucleotide sequences for *A. andina* which could be used as reference material for molecular diagnosis. GenBank® (www.ncbi.nlm.nih.gov/genbank/) is a comprehensive publicly available database that as of August 2019 (release version 227) contained over 6.25 trillion base pairs from over 1.6 billion nucleotide sequences for 450,000 formally described species (Sayers et al., 2020).

In the GeneBank, sequences of *A. andina* do not occur.

2.2. Methodologies

The Panel performed the pest categorisation for *A. andina*, following guiding principles and steps presented in the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018), the EFSA guidance on the use of the weight of evidence approach in scientific assessments (EFSA Scientific Committee, 2017) and the International Standards for Phytosanitary Measures No. 11 (FAO, 2013) and No. 21 (FAO, 2004).

The criteria to be considered when categorising a pest as a potential Union quarantine pest (QP) is given in Regulation (EU) 2016/2031 Article 3 and Annex I, Section 1 to this Regulation. Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. In judging whether a criterion is met the Panel uses its best professional judgement (EFSA Scientific Committee, 2017) by integrating a range of evidence from a variety of sources (as presented above in Section 2.1) to reach an informed conclusion as to whether or not a criterion is satisfied.

The Panel's conclusions are formulated respecting its remit and particularly with regard to the principle of separation between risk assessment and risk management (EFSA founding regulation (EU)

No 178/2002); therefore, instead of determining whether the pest is likely to have an unacceptable impact, deemed to be a risk management decision, the Panel will present a summary of the observed impacts in the areas where the pest occurs, and make a judgement about potential likely impacts in the EU. Whilst the Panel may quote impacts reported from areas where the pest occurs in monetary terms, the Panel will seek to express potential EU impacts in terms of yield and quality losses and not in monetary terms, in agreement with the EFSA guidance on quantitative pest risk assessment (EFSA PLH Panel, 2018). Article 3 (d) of Regulation (EU) 2016/2031 refers to unacceptable social impact as a criterion for quarantine pest status. Assessing social impact is outside the remit of the Panel.

Table 1: Pest categorisation criteria under evaluation, as defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest (article 3)
Identity of the pest (Section 3.1)	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?
Absence/presence of the pest in the EU territory (Section 3.2)	Is the pest present in the EU territory? If present, is the pest widely distributed within the EU? Describe the pest distribution briefly
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	Is the pest able to enter into, become established in, and spread within, the EU territory? If yes, briefly list the pathways
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?
Available measures (Section 3.6)	Are there measures available to prevent the entry into the EU such that the likelihood of introduction becomes mitigated? If already present in the EU are measures available to slow spread or facilitate eradication?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria assessed by EFSA above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Identity and taxonomy

Is the identity of the pest established, or has it been shown to produce consistent symptoms and/or to be transmissible?

Yes, the identity of the pest is well established.

The pest belongs to the order Rhabditida, family Heteroderidae, subfamily Ataloderinae, genus *Atalodera* and the species *A. andina*. The genus *Atalodera* has, based on molecular data, a clearly supported position within the subfamily Ataloderinae and the family Heteroderidae (Subbotin et al., 2017). The genus *Atalodera* contains nine species (De Souza and Huang, 1994). *A. andina* can be distinguished on morphological characters, i.e. body shape, vulva–anus distance and stylet length (Golden et al., 1983). So far, no molecular sequences are available for the diagnosis of the species *A. andina*.

The EPPO code[1] (Griessinger and Roy, 2015; EPPO, 2019) for *A. andina* (syn. *Thecavermiculatus andinus*) is: ATADAN (EPPO, online).

[1] An EPPO code, formerly known as a Bayer code, is a unique identifier linked to the name of a plant or plant pest important in agriculture and plant protection. Codes are based on genus and species names. However, if a scientific name is changed, the EPPO code remains the same. This provides a harmonised system to facilitate the management of plant and pest names in computerised databases, as well as data exchange between IT systems (Griessinger and Roy, 2015; EPPO, 2019)

3.1.2. Biology of the pest

The life cycle of *A. andina* consists of egg, four juvenile and adult stages (either females or males). The eggs spontaneously hatch inside the female body at the end of the reproductive cycle and remain there, in the swollen females (Franco and Main, 2008). During the first juvenile stage (J1), individuals develop inside the egg where they moult into second-stage juveniles (J2). The J2 is the infective stage, which hatches from egg. After emerging from the body of the dead female, J2 individuals move through the soil water films and locate the roots of suitable host plants. The details of the histopathological relationship between *A. andina* and its hosts are so far not studied in detail. However, it is most likely similar to that reported for *A. ucri* and *A. lonicerae* (Mundo-Campo and Baldwin, 1983). The J2 juveniles infect the roots and induce in the cortex multinucleate and confluent feeding sites, i.e. syncytia, as a result of cell hypertrophy and cell wall dissolution. After undergoing a series of three moults (J3 and J4 juvenile stages), they develop into swollen round–oval females; adult males remain vermiform. Females disrupt the root cortex and protrude from root surface (Golden et al., 1983). In the valleys of Lake Titicaca region (Puno province, Peru and La Paz department, Bolivia), *A. andina* coexists with the nematode *Nacobbus aberrans* and share the same host plants (Franco and Main, 2008). There is no information on the possible inhibition of *A. andina* through competition from *N. aberrans. A. andina* has two generations per year. Tubers of host plants are considered to be a means of spread (*Thecavermiculatus andinus* Pest Information (unl.edu)) but there is no robust evidence that tubers of host crops are invaded by the pest.

The biology of the pest is summarised in Table 2.

Table 2: Important features of the life-history strategy of *A. andina*

Life stage	Phenology and relation to host	Other relevant information
Egg	Eggs hatch in the spring for the first generation, and later in the season for the second generation.	Eggs occur in the body of the mature female. The first juvenile stage J1 moults to the second stage J2 inside the egg, and this stage leaves the body of the dead female.
Juvenile	The J2 juveniles hatch from the eggs in the spring and invade host plant roots and induce a feeding structure (syncytium) from which they feed A second infection occurs later in the season.	In the spring, the J2 stage infects the roots of host plants and induces a syncytial feeding structure (syncytium) in the root cortex. J2, J3, J4 and the adult stages are for their development dependent on the syncytium.
Adult	Adults feed from the syncytium induced by the J2 juveniles.	In experiments, a reproduction factor of 10–19 has been noted on *Oxalis tuberosa*, 8 on *Ullucus tuberosus* and 5 on *Solanum tuberosum* subsp. *andigenum*. J2 stages disperse in soil by active movement. The adults *A. andina* and juveniles are spread in soil and possibly with tubers of their host plants, as well as root debris.

3.1.3. Host range/species affected

Nine natural hosts i.e. *Oxalis tuberosa, Medicago hispida, Chenopodium quinoa, Ullucus tuberosus, Solanum tuberosum subsp. andigenum, Capsella bursa-pastoris, Solanum melongena, Malvastrum coroman-delianum* and *Lupinus mutabilis* were reported by Golden et al. (1983). Twenty-three experimental hosts including *Brassica oleracea*, *B. napus*, *B. campestris,* sugar beet, tomato and clover were reported by Franco and Mosquera (1993). Among the hosts (natural and experimental) are weed species which are widely distributed in the EU such as *Capsella bursa-pastoris* and *Senecio vulgaris*. The host range (natural and experimental) of *A. andina* is listed in Appendix A. For sedentary endoparasitic nematodes, experimental hosts would most probably serve as natural hosts also under field conditions. This is because the interaction of sedentary endoparasitic nematodes with their hosts requires a high degree of compatibility both at the tissue and the cell level.

3.1.4. Intraspecific diversity

The intraspecific diversity in *A. andina* has not been studied.

3.1.5. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, methods for the identification of *A. andina* are available.

Identification keys based on morphology are available for *A. andina* (Golden et al., 1983; De Souza and Huang, 1994).

The nematode is detected by the white and round to oval female bodies (diameter 0.5 mm) protruding from the root surface. The genus *Atalodera* includes nine species. *A. andina* can be distinguished on morphological characters, i.e. body shape, vulva–anus distance and stylet length. So far, no molecular sequences are available in GeneBank for the molecular diagnosis of *A. andina*.

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

The pest occurs on farmland in the area of the Lake Titicaca on the border of Peru and Bolivia (Golden et al., 1983; Franco, 2003) and in valleys in that area (Franco and Main, 2008). The area overlaps with major potato-growing areas and potato seed production in Peru. This was confirmed by the Peruvian NPPO. The exact geographic distribution of the nematode is unknown. However, *A. andina* has been reported to reproduce within the temperature range of 14.7–18.9°C (Franco and Mosquera, 1993). Given that the optimal temperatures for reproduction of plant parasitic nematodes are between 10°C and 35°C (Wallace, 1963), it can be assumed that *A. andina* could occur over a wider geographical area, but the exact distribution of *A. andina* in South America outside Bolivia and Peru and in the rest of the world is unknown.

3.2.2. Pest distribution in the EU

Is the pest present in the EU territory? If present, is the pest widely distributed within the EU?

The pest has not been reported from the EU territory.

3.3. Regulatory status

3.3.1. Commission implementing regulation 2019/2072

Atalodera andina is not listed in Annex II of the Commission Implementing Regulation (EU) 2019/2072 of Regulation (EU) 2016/2031.

3.3.2. Hosts or species affected that are prohibited from entering the union from third countries

Regulated plants and products and other relevant items are given in Table 3.

Table 3: List of plants, plant products and other objects that are *Atalodera andina* hosts whose introduction into the Union from certain third countries is prohibited (Source: Commission Implementing Regulation (EU) 2019/2072, Annex VI). The host plant *Ullucus tuberosus* is included in the Commission Implementing Regulation (EU) 2018/2019 on high-risk plants

List of plants, plant products and other objects whose introduction into the Union from certain third countries is prohibited			
	Description	**CN Code**	**Third country, group of third countries or specific area of third country**
15.	Tubers of *Solanum tuberosum* L., seed potatoes	0701 10 00	Third countries other than Switzerland

16.	Plants for planting of stolon- or tuber-forming species of *Solanum* L. or their hybrids, other than those tubers of *Solanum tuberosum* L. as specified in entry 15	ex 0601 10 90 ex 0601 20 90 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries other than Switzerland
17.	Tubers of species of *Solanum* L., and their hybrids, other than those specified in entries 15 and 16	ex 0601 10 90 ex 0601 20 90 0701 90 10 0701 90 50 0701 90 90	Third countries other than: (a) Algeria, Egypt, Israel, Libya, Morocco, Syria, Switzerland, Tunisia and Turkey; or (b) those which fulfil the following: (i) they are one of the following. . . (ii) they fulfil one of the following: - they are recognised of being free from *Clavibacter sepedonicus*. . . - their legislation is recognised as equivalent to the Union rules concerning protection against *Clavibacter sepedonicus*. . . or (c) the United Kingdom (1), provided . . .
18.	Plants for planting of *Solanaceae* other than seeds and the plants covered by entries 15, 16 or 17	ex 0602 90 30 ex 0602 90 45 ex 0602 90 46 ex 0602 90 48 ex 0602 90 50 ex 0602 90 70 ex 0602 90 91 ex 0602 90 99	Third countries* other than Albania, ...and Ukraine.
19.	Soil as such consisting in part of solid organic substances	ex 2530 90 00 ex 3824 99 93	Third countries other than Switzerland
20.	Growing medium as such, other than soil, consisting in whole or in part of solid organic substances, other than that composed entirely of peat or fibre of *Cocos nucifera* L., previously not used for growing of plants or for any agricultural purposes	ex 2530 10 00 ex 2530 90 00 ex 2703 00 00 ex 3101 00 00 ex 3824 99 93	Third countries other than Switzerland

*: Bolivia, Peru and Chile are included in the third countries from where the introduction into the EU of Solanaceae plants for planting is prohibited.

3.4. Entry, establishment and spread in the EU

3.4.1. Entry

Is the pest able to enter into the EU territory?

Yes, the pest can enter the EU territory. Plants for planting (tubers) are a main pathway.

The Panel identified the following main pathways for the entry of the pathogen into the EU territory:

- host plants for planting including tubers for planting,
- soil as such or attached to plants for planting, machinery or footwear, soil in packaging (bags).

Alternative pathways are subterranean parts of plants like tubers intended for consumption, and tubers of host plants used for breeding or scientific purposes originating in infested countries and imported according to the Commission Delegated Regulation (EU) 2019/829 of 14 March 2019 that supplements Regulation (EU) 2016/2031, providing for temporary derogations in view of official testing, scientific or educational purposes, trials, varietal selections or breeding.

Table 4 provides and overview on the potential pathways for *A. andina*.

Table 4: Potential pathways for *A. andina* into the EU 27

Pathways	Life stage	Relevant mitigations [e.g. prohibitions (Annex VI), special requirements (Annex VII) or phytosanitary certificates (Annex XI) within Implementing Regulation 2019/2072]
Host plants (including tubers) for planting	Infective juveniles (J2) and developing juvenile stages J3–J4 and young females.	The introduction into the EU of seed potatoes and plants for planting of stolon- or tuber-forming species of *Solanum* spp. or their hybrids from third countries is prohibited (Annex VI, 15. & 16.). The introduction into the EU of *Solanum* tubers and their hybrids and plants for planting of Solanaceae other than seeds is prohibited from certain third countries, among which Bolivia, Peru and Chile are included (Annex VI, 17. & 18.) Special requirements exist for plants for planting of *Solanum melongena* other than seeds (Annex VII, 22. 23.) for other pests which might also mitigate the risk of entry of *A. andina*. The host plant *Ullucus tuberosus* is regulated under Commission Implementing Regulation (EU) 2018/2019. However, no prohibitions or special requirements exist in Implementing Regulation 2019/2072 for the introduction into the EU of *Oxalis tuberosa*. Pathway partly open.
Subterranean parts of plants like tubers intended for consumption.	Infective juveniles (J2) and developing juvenile stages J3–J4 and young females.	The introduction into the EU of tubers of *Solanum* species and their hybrids is prohibited from certain third countries, among which are Bolivia, Peru and Chile (Annex VI, 17.) Pathway partly closed because subterranean parts of plants other than Solanum are not prohibited.
Propagation material of host plants (e.g. seed potatoes) originating from Bolivia, Peru and Chile	Infective juveniles (J2) and developing juvenile stages J3–J4 and young females.	Commission delegated regulation 2019/829 regulates the import of plant pests and plants and plant products for official testing, scientific or educational purposes, trials, varietal selections or breeding
Soil as such, or attached to plants for planting	Invasive juveniles J2	Soil as such is a closed pathway (Annex VI, 19) Soil attached to plants for planting is partly closed through the restrictions of the import of plants and tubers of the Solanaceae family. The pathway is still open for other plants for planting where soil is attached.
Machinery and vehicles which have been operated for agricultural purposes in infested areas	Invasive juveniles J2	Annex VII (2.) requires official statement that the machinery or vehicles are cleaned and free from soil and plant debris. Annex XI, A (1.) requires phytosanitary certificate for the introduction into the Union territory of machinery and vehicles for agricultural purposes from third countries other than Switzerland and therefore this pathway is considered closed

Import statistics for EU of fresh produce of hostplants for *A. andina* are listed in Table 5. Further details on imports can be found in Appendix B.

Table 5: EU 27 annual imports of fresh produce of main hosts from countries where *Atalodera andina* is present, 2016–2020 (in 100 kg). The data are for imports from Peru and Chile. There is no import of these products from Bolivia recorded in EUROSTAT. Source: Eurostat accessed on 26/7/2021

Commodity	HS code	2016	2017	2018	2019	2020
Potatoes (fresh or chilled)	0701	9.75	34.69	18.91	62.45	3.6
Root vegetables*	0706	25.82	62.61	82.96	49.8	23.32
	Sum	35.57	97.3	101.87	112.25	26.92

*: Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled.

Notifications of interceptions of harmful organisms began to be compiled in Europhyt in May 1994 and in TRACES in May 2020. As on 16 November 2021, there were no records of interception of *Atalodera andina* in the Europhyt and TRACES databases.

3.4.2. Establishment

Is the pest able to become established in the EU territory?

Yes, the pest is able to become established.

Should the pest enter the EU, establishment would be possible. This is because temperatures in EU member states are suitable. Experimental temperatures varying from 14.7°C to 18.9°C were reported in green house experiments (Franco and Mosquera, 1993), and hosts like potato, beet, oilseed crops, clover and beans, peas and tomato are widely cultivated crops (Appendix C). The pest may also infect weeds like *Capsella bursa-pastoris* and *Senecio vulgaris* that are both very common throughout most European areas. The transfer from the identified pathways to potential host plants is possible within short distances by active movement of the juveniles of *A. andina* and for longer distances through infested soil attached to machinery, equipment, footwear or soil in packaging material (bags).

There is high uncertainty on the climates and the corresponding areas of the EU potentially suitable for the establishment of *A. andina* (see Figures 1–4). Depending on the assumptions of the occurrence of *A. andina* around Lake Titicaca (i.e. 50, 100 or 200 km from the border of the lake), suitable climates can be found either in small areas in the EU (e.g. in Spain, Italy, Greece, Romania) or in larger areas including most of Europe (see Section 3.4.2.2).

3.4.2.1. Distribution of main host plants

Table 6 gives the acreage for host plants potatoes, tomatoes and eggplants cultivated in the EU. Further details on the cultivation in each EU Member State are provided in Appendix C.

Potato is grown intensively in all EU MS. The acreage reaches between 1,536,390 ha in 2020 and 1,603,700 ha in 2019 Table 6.

Table 6: Harvested area of *Atalodera andina* main hosts in EU 27, 2016–2020 (1,000 ha). Source EUROSTAT (accessed 12 October 2021) https://ec.europa.eu/eurostat/databrowser/view/apro_cpsh1/default/table?lang=en

Crop	2016	2017	2018	2019	2020
Potatoes	1,550.51	1,601.18	1,562.85	1,603.70	1,536.39
Tomatoes	253.95	247.95	239.48	242.52	233.20
Eggplants	21.48	20.73	21.24	20.61	21.14

No Eurostat data are available on quinoa production in Europe. However, there is information that the area under quinoa cultivation in Europe has increased from 0 in 2008 to 5,000 ha in 2015, mainly in France and Spain (Bazile et al., 2015; Bazile et al., 2016).

3.4.2.2. Climatic conditions affecting establishment

A. andina is known to occur around Lake Titicaca. No other detailed information is available on the presence of *A. andina*. Different distances from Lake Titicaca are indicated in Figure 1. Depending on the assumptions on the presence of *A. andina* at a certain distance from Lake Titicaca different

Köppen–Geiger climates which also occur in Europe are covered (Kottek et al., 2006). The areas in Europe with those climates are provided in Figures 2, 3 and 4. The distance of 50 km from Lake Titicaca includes only the climate BSk, while at a distance of 100 km, the climates BSk, BSh, Cfb are included and the climates BSk, BSh, Cfa, Cfb and Cfc can be found within a distance of 200 km from Lake Titicaca. This leads also to substantial differences in the areas in Europe with potentially suitable climates for establishment of *A. andina*. Overall, there is high uncertainty on the areas in Europe which are potentially suitable for establishment of *A. andina*.

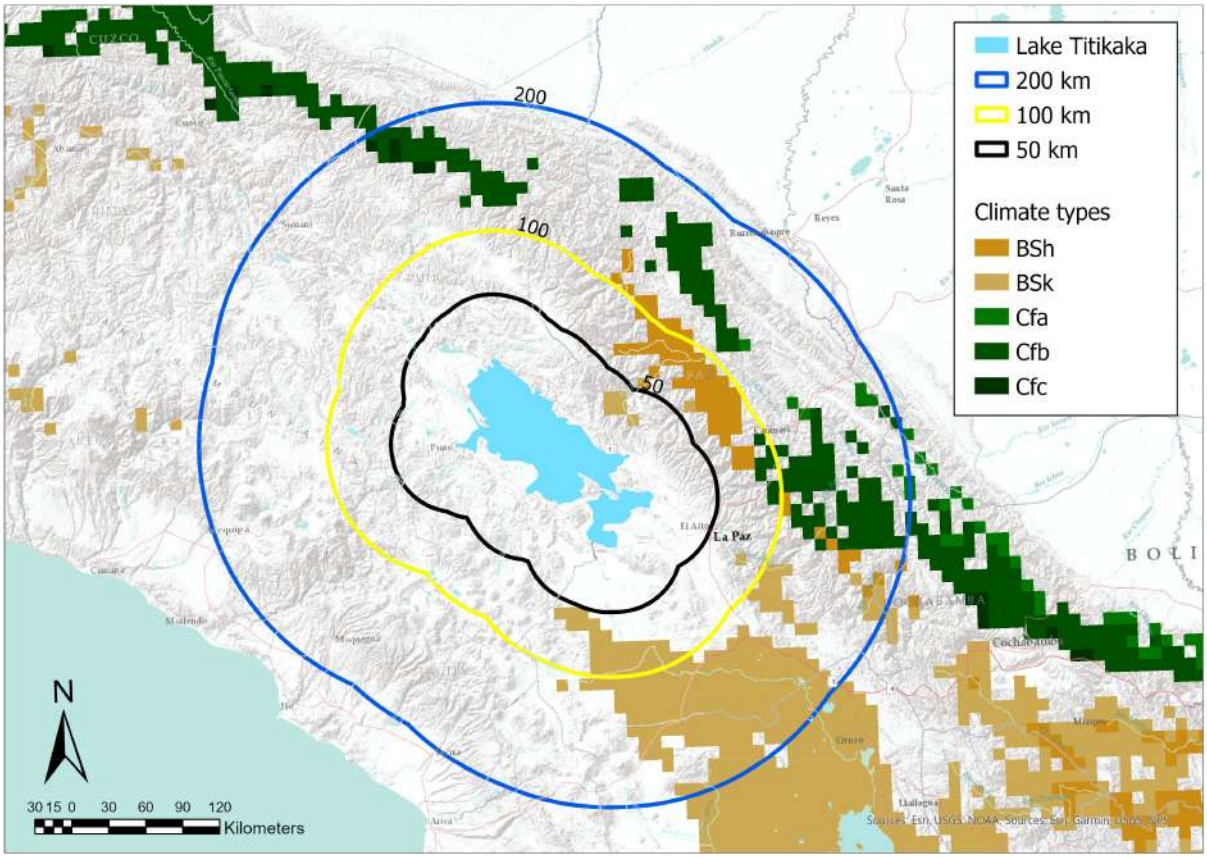

Figure 1: Area around Lake Titicaca showing the distribution of climate types occurring within 50 km, 100 km and 200 km from the lake. This includes climate types also occurring in EU and Europe

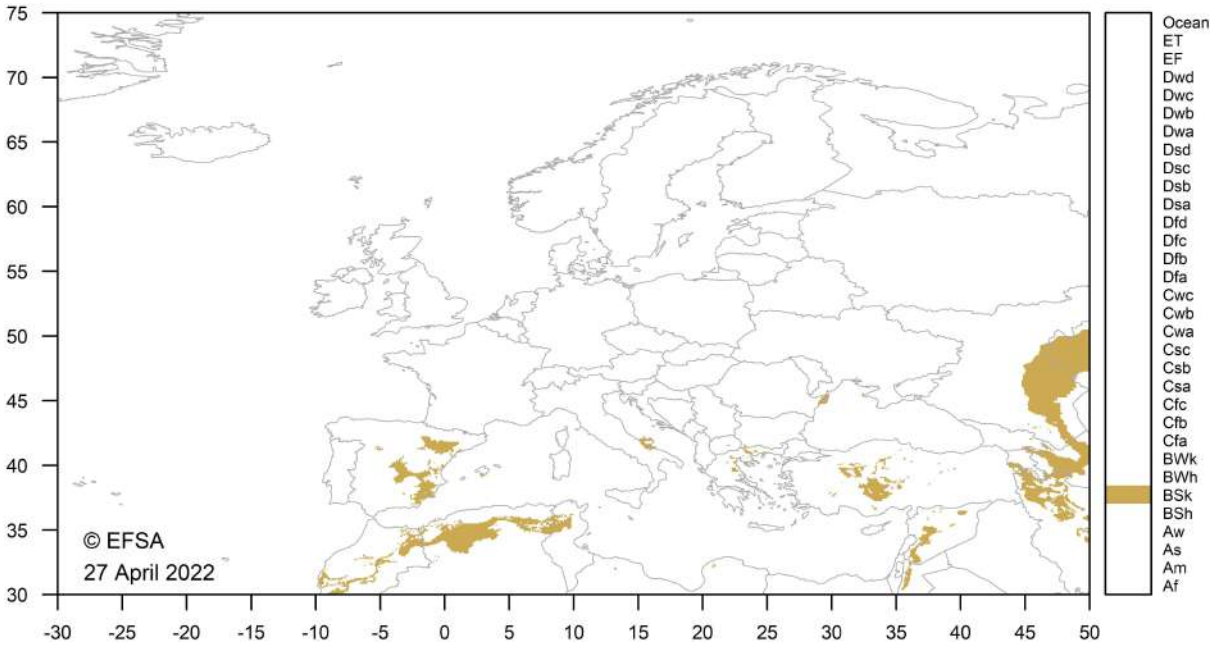

Figure 2: Distribution of Köppen–Geiger BSk climate zone particularly in the EU. The BSk climate occurs within 50 km around Lake Titicaca

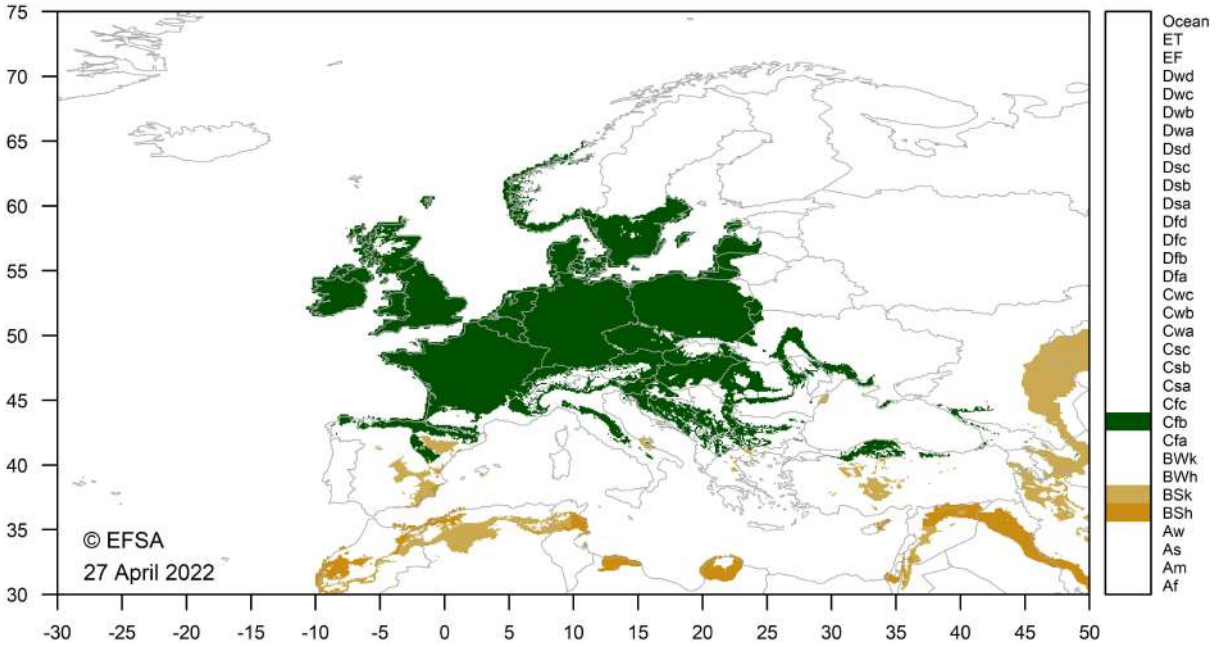

Figure 3: Distribution of Köppen–Geiger BSk, BSh, Cfb climate zones particularly in the EU. The BSk, BSh and Cfb climates occur within 100 km around Lake Titicaca

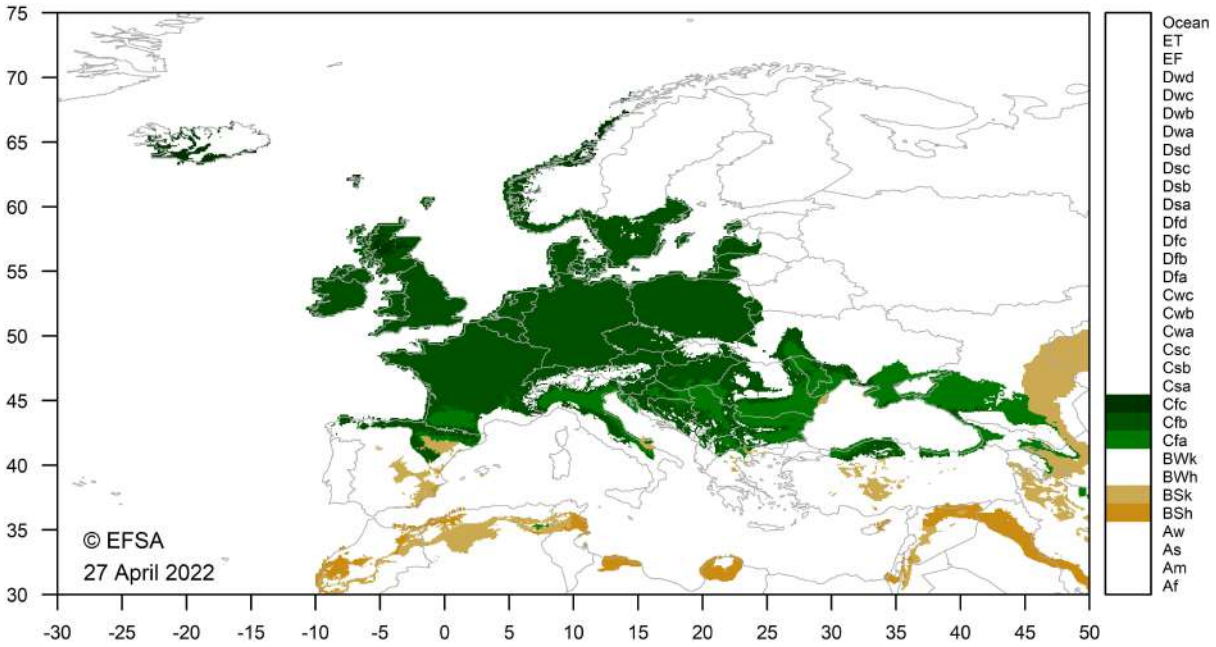

Figure 4: Distribution of Köppen–Geiger BSk, BSh, Cfa, Cfb, Cfc climates particularly in the EU. The BSk, BSh, Cfa, Cfb, Cfc climates occur within 200 km around Lake Titicaca

3.4.3. Spread

Describe how the pest would be able to spread within the EU territory following establishment?

Host plants for planting (including tubers) is one of the main means of spread. In addition, the pest may spread through movement of soil as such and soil attached to machinery, equipment, footwear and packaging material.

Like most plant parasitic nematodes living in soil the active spread, by movement of juveniles, is only around 1 m in a year. Following its establishment in the EU, the pest can spread with soil as such and with soil adhering to tubers and roots of its host plants. The pest could also spread with surface irrigation water, soil attached to non-host plants, machinery, footwear, packaging material such as bags, etc.

3.5. Impacts

Would the pests' introduction have an economic or environmental impact on the EU territory?

Yes, an economic impact is likely if the pest would become established in the EU territory.

In Peru and Bolivia, the nematode is mentioned to damage Andean potato (*Solanum tuberosum* subsp. *andigenum*) (Franco and Mosquera, 1993, Franco and Main, 2008), but the impact has not been quantified (Jatala and Bridge, 1990). The low temperatures in the highlands of Peru are considered to reduce nematode damage to crops as stated in additional information provided by SENASA to EFSA on 7 July 2020 (EFSA, 2021). Common potato (*Solanum tuberosum* subsp. *tuberosum*) is an important crop in the EU (Table 6). Although the common potato is a different subspecies of the potato cultivated in Peru and Bolivia, it seems very likely that common potato and other crops (e.g. *Brassica* spp., sugar beet, tomato, aubergine, quinoa, clover) will also be affected by *A. andina* considering the wide host range of the pest. Therefore, if the pest would become established in the EU, an economic impact can be expected. However, there is uncertainty on the magnitude of this impact.

3.6. Available measures and their limitations

Are there measures available to prevent the entry into the EU (and spread for pests already present) such that the risk becomes mitigated?

Yes, measures are available (see Sections 3.3.2, 3.6.1.1 and 3.6.1.2).

3.6.1. Identification of potential additional measures

Although, phytosanitary measures are currently applied to some host plants for planting (see Sections 3.3.2 and 3.4.1), some tuber forming non-Solanaceae hosts of *A. andina* like *Oxalis tuberosa* (Oxalidaceae) and *Tropaeolum tuberosum* (Tropaeolaceae) are not regulated.

3.6.1.1. Additional potential risk reduction options

Potential additional control measures are listed in Table 7.

Table 7: Selected control measures (a full list is available in EFSA PLH Panel, 2018) for pest entry/establishment/spread/impact in relation to currently unregulated hosts and pathways. Control measures are measures that have a direct effect on pest abundance

Control measure/ Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/ establishment/spread/ impact)
Require pest freedom	Host plants or plant products must originate in a country officially free from the pest, or from a pest-free area or from a pest-free place of production.	Entry/Spread
Growing plants in isolation	Description of possible exclusion conditions that could be implemented to isolate the crop from pests and if applicable relevant vectors. E.g. a dedicated structure such as glass or plastic greenhouses. Growing host plants in isolation would in principle be an effective risk reduction measure. However, *A. andina* occurs in small rural farm lands in the area of the Lake Titicaca without physical isolation and hence it may be difficult to apply	Entry (reduce contamination/ infestation)/Spread
Crop rotation, associations and density, weed/ volunteer control	Crop rotation, associations and density, weed/volunteer control are used to prevent problems related to pests and are usually applied in various combinations to make the habitat less favourable for pests. The measures deal with (1) allocation of crops to field (over time and space) (multi-crop, diversity cropping) and (2) to control weeds and volunteers as hosts of pests/vectors. Crop rotation with non-host plants and weed and volunteer control can reduce the risk. However, crop rotations in Bolivia and Peru include many hosts of *A. andina,* and probably weeds which may render this measure less effective in reducing the risk.	Entry/Establishment/Impact
Chemical treatments on crops including reproductive material	Chemical treatments against nematodes exist (including fumigation of seed tubers and soil fumigation, included bio-fumigation). Applied, as for Nacobbus aberrans and Globodera spp.	Entry/Establishment/Impact
Chemical treatments on consignments or during processing	Use of chemical compounds that may be applied to plants or to plant products after harvest, during process or packaging operations and storage. These include:	Entry/ Spread

Control measure/ Risk reduction option (Blue underline = Zenodo doc, Blue = WIP)	RRO summary	Risk element targeted (entry/ establishment/spread/ impact)
	• fumigation; • spraying/dipping pesticides; • surface disinfectants; • process additives; • protective compounds Chemical treatment if applicable of tubers for export would reduce the risk. However, the efficacy of this measure is uncertain as for another nematode (*Nacobbus aberans*) with similar life-history post-harvest chemical control has been ineffective.	
Physical treatments on consignments or during processing	This information sheet deals with the following categories of physical treatments: irradiation/ ionisation; mechanical cleaning (brushing, washing); sorting and grading, and; removal of plant parts (e.g. debarking wood). This information sheet does not address: heat and cold treatment (information sheet 1.14); roughing and pruning (information sheet 1.12). Brushing/cleaning of the tubers will remove adherent soil infested with females and J2 juveniles of *A. andina*.	Entry/Spread
Cleaning and disinfestation of facilities, tools and machinery	The physical and chemical cleaning and disinfection of facilities, tools, machinery, transport means, facilities and other accessories (e.g. boxes, pots, pallets, palox, supports, bags, hand tools). The measures addressed in this information sheet are washing, sweeping and fumigation. Cleaning and disinfection of facilities, tools and machinery would be an effective measure	Entry/Spread
Limits on soil	Limits on soil would be an effective measure.	Entry/Spread
Soil treatment	The control of soil organisms by chemical and physical methods listed below: a) Fumigation; b) Heating; c) Solarisation; d) Flooding; e) Soil suppression; f) Augmentative Biological control; g) Biofumigation. Soil treatment would be an effective measure.	Entry/Establishment/Impact
Waste management	• Treatment of the waste (deep burial, composting, incineration, chipping, production of bio-energy…) in authorised facilities and official restriction on the movement of waste. Waste management is an effective measure.	Establishment/ Spread

3.6.1.2. Additional supporting measures

Potential additional supporting measures are listed in Table 8.

Table 8: Selected supporting measures (a full list is available in EFSA PLH Panel, 2018) in relation to currently unregulated hosts and pathways. Supporting measures are organisational measures or procedures supporting the choice of appropriate risk reduction options that do not directly affect pest abundance

Supporting measure	Summary	Risk element targeted (entry/ establishment/ spread/impact)
Inspection and trapping	Inspection is defined as the official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (ISPM 5). The effectiveness of sampling and subsequent inspection to detect pests may be enhanced by including trapping and luring techniques. Pest surveys of Andean tubers are based on a series of periodic visits by official inspectors in order to detect symptoms and take samples for further analyses by a diagnostic laboratory. Visual inspection of plants is an effective measure to detect the pest in the field.	Entry/Spread
Laboratory testing	Examination, other than visual, to determine if pests are present using official diagnostic protocols. Diagnostic protocols describe the minimum requirements for reliable diagnosis of regulated pests. Laboratory diagnostics is an effective measure for reliable diagnosis of *A. andina*.	Entry, Establishment/ Spread
Sampling	According to ISPM 31, it is usually not feasible to inspect entire consignments, so phytosanitary inspection is performed mainly on samples obtained from a consignment. It is noted that the sampling concepts presented in this standard may also apply to other phytosanitary procedures, notably selection of units for testing. For inspection, testing and/or surveillance purposes the sample may be taken according to a statistically based or a non-statistical sampling methodology. The sampling and inspection of 2% of Andean tubers for symptoms would detect *A. andina*.	Entry, Establishment/ Spread
Phytosanitary certificate and plant passport	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (ISPM 5) a) export certificate (import) b) plant passport (EU internal trade). This would be an effective measure against *A. andina*.	Entry
Certified and approved premises	Mandatory/voluntary certification/approval of premises is a process including a set of procedures and of actions implemented by producers, conditioners and traders contributing to ensure the phytosanitary compliance of consignments. It can be a part of a larger system maintained by the NPPO in order to guarantee the fulfilment of plant health requirements of plants and plant products intended for trade. Key property of certified or approved premises is the traceability of activities and tasks (and their components) inherent the pursued phytosanitary objective. Traceability aims to provide access to all trustful pieces of information that may help to prove the compliance of consignments with phytosanitary requirements of importing countries. This would be an effective measure against *A. andina*.	Entry, Establishment, Spread

Supporting measure	Summary	Risk element targeted (entry/ establishment/ spread/impact)
Certification of reproductive material (voluntary/official)	Plants come from within an approved propagation scheme and are certified pest free (level of infestation) following testing; Used to mitigate against pests that are included in a certification scheme. This would be an effective measure against *A. andina*.	Entry, Establishment, Spread
Delimitation of Buffer zones	ISPM 5 defines a buffer zone as 'an area surrounding or adjacent to an area officially delimited for phytosanitary purposes in order to minimize the probability of spread of the target pest into or out of the delimited area, and subject to phytosanitary or other control measures, if appropriate' (ISPM 5). The objectives for delimiting a buffer zone can be to prevent spread from the outbreak area and to maintain a pest-free production place (PFPP), site (PFPS) or area (PFA). This would be an effective measure against *A. andina*.	Spread
Surveillance	This would be an effective measure against *A. andina*. The only information available is that *A. andina* is distributed in farm lands in the area of the Lake Titicaca. Specific surveys for this species in Peru, Bolivia and Chile appear to be missing.	Spread

3.6.1.3. Biological or technical factors limiting the effectiveness of measures

The symptoms caused by *A. andina* are mainly on the roots where white spherical females (diameter 0.5 mm) are visible. However, the absence of females on the invaded plant parts would be possible especially when infections are recent and the female body has not swollen enough to be visible. Hence, in visual inspections, the presence of *A. andina* can be overlooked.

3.7. Uncertainty

Uncertainty exists on the geographic distribution of *A. andina* in South America.

Suitable climates for establishment exist in the EU, but there is uncertainty on the extent of these areas in the EU.

There is uncertainty on whether the pathogen infects tubers of host plants.

The host range of *A. andina* might be wider than currently documented.

There is some uncertainty on the magnitude of impact of *A. andina* on potato and other host plants once it enters the EU.

The degree to which soil humidity affects nematode activity.

4. Conclusions

A. andina has not been reported from the EU. It can potentially damage common potato (*Solanum tuberosum* spp. *tuberosum*), which is widely grown in EU. Climatic conditions exist in the EU which are suitable for establishment, and many potential host plants are grown over wide areas.

A. andina therefore meets the criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest.

The categorisation criteria are given in Table 9.

Table 9: The Panel's conclusions on the pest categorisation criteria defined in Regulation (EU) 2016/2031 on protective measures against pests of plants (the number of the relevant sections of the pest categorisation is shown in brackets in the first column)

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest is well established.	None
Absence/presence of the pest in the EU (Section 3.2)	The pest is not reported to be present in the EU	None
Regulatory status (Section 3.3)	The pest is not regulated in the EU	None
Pest potential for entry, establishment and spread in the EU (Section 3.4)	The pathogen can enter, become established, and spread within the EU territory. The main pathways are host plants for planting including tubers for planting, soil as such or attached to plants for planting, machinery or footwear, soil in packaging (bags). Other pathways are subterranean parts of plants like tubers intended for consumption, and tubers of host plants used for breeding or scientific purposes originating in infested countries.	There is uncertainty on whether the pathogen infects tubers of host plants and on the extent of areas in the EU with suitable climates.
Potential for consequences in the EU (Section 3.5)	The pest can potentially damage crops in the EU	Uncertainty on the magnitude of impact of *A. andina* on *Solanum tuberosum* subsp. *tuberosum* and other hosts in the EU.
Available measures (Section 3.6)	Although not specifically targeted against *A. andina*, existing phytosanitary measures mitigate the likelihood of the pest's entry into the EU territory. Potential additional measures also exist to further mitigate the risk of entry into, establishment within, or spread of *A. andina* within the EU.	None
Conclusion (Section 4)	*A, andina* meets all criteria that are within the remit of EFSA to assess for this species to be regarded as a potential Union quarantine pest.	None
Aspects of assessment to focus on/scenarios to address in future if appropriate:	Studies should be conducted on the potential yield/quality losses caused by *A. andina*, on common potato (*Solanum tuberosum* subsp. *tuberosum*).	

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Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
MS	Member State

PLH	EFSA Panel on Plant Health
PZ	Protected Zone
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference

Glossary

Containment (of a pest)	Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 2018).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO, 2018).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO, 2018).
Eradication (of a pest)	Application of phytosanitary measures to eliminate a pest from an area (FAO, 2018).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO, 2018).
Greenhouse	A walk-in, static, closed place of crop production with a usually translucent outer shell, which allows controlled exchange of material and energy with the surroundings and prevents release of plant protection products (PPPs) into the environment.
Hitchhiker	An organism sheltering or transported accidentally via inanimate pathways including with machinery, shipping containers and vehicles; such organisms are also known as contaminating pests or stowaways (Toy and Newfield, 2010).
Impact (of a pest)	The impact of the pest on the crop output and quality and on the environment in the occupied spatial units.
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO, 2018).
Pathway	Any means that allows the entry or spread of a pest (FAO, 2018).
Phytosanitary measures	Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO, 2018).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO, 2018).
Risk reduction option (RRO)	A measure acting on pest introduction and/or pest spread and/or the magnitude of the biological impact of the pest should the pest be present. A RRO may become a phytosanitary measure, action or procedure according to the decision of the risk manager.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO, 2018).

Appendix A – *Atalodera andina* host plants/species affected

Host status	Host name	Plant family	Common name	Reference
Cultivated hosts	*Ullucus tuberosus*	Basellaceae		Golden et al. (1983)
	Oxalis tuberosa	Oxalidaceae	oca, yam	Golden et al. (1983)
	Solanum tuberosum	Solanaceae	potato	Golden et al. (1983)
	Solanum melongena	Solanaceae	eggplant, aubergine	Golden et al. (1983)
	Chenopodium quinoa	Amaranthaceae	quinoa	Golden et al. (1983)
	Lupinus mutabilis	Fabaceae		Golden et al. (1983)
	Medicago polymorpha (syn. *Medicago hispida*)	Fabaceae		Golden et al. (1983)
Wild weed hosts	*Capsella bursa-pastoris*	Brassicaceae	Shepherd's purse	Golden et al. (1983)
	Malvastrum coromandelianum	Malvaceae	Threelobe false mallow	Golden et al. (1983)
Artificial experimental host	*Amaranthus peruvianus*	Amaranthaceae		Franco and Mosquera (1993)
	Beta vulgaris	Amaranthaceae		Franco and Mosquera (1993)
	Chenopodium giganteum (syn. *Chenopodium amaranthicolor)*	Amaranthaceae		Franco and Mosquera (1993)
	Brassica oleracea	Brassicaceae		Franco and Mosquera (1993)
	Brassica napus	Brassicaceae		Franco and Mosquera (1993)
	Brassica campestris	Brassicaceae		Franco and Mosquera (1993)
	Cereus candelabrus	Cactaceae		Franco and Mosquera (1993)
	Cereus geometricus	Cactaceae		Franco and Mosquera (1993)
	Opuntia sp.	Cactaceae		Franco and Mosquera (1993)
	Senecio vulgaris	Asteraceae		Franco and Mosquera (1993)
	Pisum sativum	Fabaceae		Franco and Mosquera (1993)
	Vicia faba	Fabaceae		Franco and Mosquera (1993)
	Phaseolus vulgaris	Fabaceae		Franco and Mosquera (1993)
	Trifolium repens	Fabaceae		Franco and Mosquera (1993)
	Trifolium pratense	Fabaceae		Franco and Mosquera (1993)
	Trifolium hybridum	Fabaceae		Franco and Mosquera (1993)
	Salvia sp.	Lamicaceae		Franco and Mosquera (1993)
	Oxalis megalorrhiza (syn. *Oxalis solarensis*)	Oxalidaceae		Franco and Mosquera (1993)
	Solanum pimpinellifolium (syn. *Lycopersicon pimpinellifolium*)	Solanaceae		Franco and Mosquera (1993)

Host status	Host name	Plant family	Common name	Reference
	Lycopersicum esculentum	Solanaceae		Franco and Mosquera (1993)
	Physalis peruviana	Solanaceae		Franco and Mosquera (1993)
	Nicotiana paniculata	Solanaceae		Franco and Mosquera (1993)
	Tropaeolum tuberosum	Solanaceae		Franco and Mosquera (1993)

Appendix B – EU 27 annual imports of fresh produce of hosts from countries where *Atalodera andina* is present, 2016–2020 (in 100 kg)

Source: Eurostat accessed on 12 October 2021

		2016	2017	2018	2019	2020
Potatoes, fresh or chilled	Bolivia					
	Chile			0.08		
	Peru	9.75	34.69	18.83	62.45	3.60
	Sum	9.75	34.69	18.91	62.45	3.60
		2016	**2017**	**2018**	**2019**	**2020**
Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled	Bolivia					
	Chile	25.82	62.61	82.96	49.80	22.67
	Peru					0.65
	Sum	25.82	62.61	82.96	49.8	23.32

Appendix C – EU 27 and member state cultivation/harvested/production area of *Atalodera andina hosts* (in 1,000 ha)

Source EUROSTAT (accessed 12 October 2021).

Potatoes	**2016**	**2017**	**2018**	**2019**	**2020**
EU 27	1,550.51	1,601.18	1,562.85	1,603.70	1,536.39
Belgium	89.21	92.85	93.33	98.19	97.34
Bulgaria	8.38	12.81	14.10	9.29	9.95
Czechia	23.41	23.42	22.89	22.89	23.88
Denmark	46.10	49.70	52.00	56.70	62.80
Germany	242.50	250.50	252.20	271.60	273.50
Estonia	3.71	3.45	3.27	3.40	3.38
Ireland	9.04	9.18	8.23	8.67	8.89
Greece	19.13	18.82	16.83	15.95	15.73
Spain	72.14	70.88	67.49	66.65	65.40
France	179.13	194.06	199.56	207.16	214.50
Croatia	9.87	9.83	9.27	9.39	9.33
Italy	48.14	48.57	46.43	46.81	47.35
Cyprus	5.04	4.22	4.54	3.88	3.80
Latvia	10.90	21.50	9.90	10.00	8.50
Lithuania	21.64	18.88	18.69	18.22	18.87
Luxembourg	0.62	0.62	0.63	0.60	0.62
Hungary	16.41	14.66	13.51	13.29	10.27
Malta	0.77	0.69	0.69	0.69	0.57
Netherlands	155.59	160.79	164.60	165.73	164.50
Austria	21.22	22.99	23.76	23.97	24.26
Poland	300.70	321.26	290.97	302.48	225.74
Portugal	23.30	23.74	20.80	17.99	17.53
Romania	186.24	171.39	173.30	174.12	174.99
Slovenia	3.16	3.17	2.81	2.80	2.94
Slovakia	8.26	7.45	7.76	8.19	7.00
Finland	21.70	21.20	21.40	21.40	20.70
Sweden	24.21	24.57	23.91	23.65	24.07
Eggplants	**2016**	**2017**	**2018**	**2019**	**2020**
EU 27	21.48	20.73	21.24	20.61	21.14
Belgium	0.02	0.02	0.02	0.02	0.03
Bulgaria	0.31	0.48	0.44	0.39	0.37
Czechia	0.00	0.00	0.00	0.00	:
Denmark	0.00	0.00	0.00	0.00	0.00
Germany	0.00	0.00	0.00	0.00	0.00
Estonia	0.00	0.00	0.00	0.00	0.00
Ireland	0.00	0.00	0.00	0.00	0.00
Greece	1.75	1.70	1.67	1.35	1.50
Spain	3.75	3.58	3.62	3.47	3.70
France	0.73	0.73	0.80	0.71	0.81
Croatia	0.00	0.00	0.00	0.00	0.00
Italy	10.03	9.45	9.56	9.55	9.51
Cyprus	0.04	0.03	0.03	0.02	0.02
Latvia	0.00	0.00	0.00	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00
Luxembourg	0.00	0.00	0.00	0.00	0.00

Eggplants	2016	2017	2018	2019	2020
Hungary	0.05	0.05	0.05	0.04	0.04
Malta	0.00	0.00	0.00	0.00	0.00
Netherlands	0.11	0.10	0.11	0.12	0.13
Austria	0.01	0.01	0.01	0.01	0.01
Poland	0.00	0.00	0.00	0.00	0.20
Portugal	0.10	0.14	0.11	0.08	0.09
Romania	4.56	4.42	4.80	4.81	4.71
Slovenia	0.02	0.02	0.02	0.03	0.03
Slovakia	0.00	0.01	0.01	0.00	0.01
Finland	0.00	0.00	0.00	0.00	0.00
Sweden	0.00	0.00	0.00	0.00	0.00

: data not available.

Tomatoes	2016	2017	2018	2019	2020
EU 27	253.95	247.95	239.48	242.52	233.20
Belgium	0.51	0.52	0.55	0.57	0.62
Bulgaria	4.20	5.01	4.52	5.15	3.09
Czechia	0.34	0.24	0.30	0.16	0.26
Denmark	0.03	0.03	0.03	0.03	0.03
Germany	0.34	0.37	0.40	0.39	0.38
Estonia	0.01	0.00	0.00	0.00	0.01
Ireland	0.01	0.01	0.01	0.01	0.01
Greece	14.01	13.32	16.02	15.01	15.82
Spain	62.72	60.85	56.13	56.94	55.47
France	5.65	5.75	5.74	5.66	5.95
Croatia	0.37	0.45	0.49	0.32	0.40
Italy	103.94	99.75	97.09	99.02	99.78
Cyprus	0.22	0.26	0.29	0.28	0.26
Latvia	0.00	0.00	0.00	0.00	0.00
Lithuania	0.57	0.55	0.57	0.56	0.68
Luxembourg	0.00	0.00	0.00	0.00	0.00
Hungary	2.08	2.19	2.50	2.41	1.82
Malta	0.00	0.00	0.00	0.00	0.00
Netherlands	1.78	1.79	1.79	1.80	1.87
Austria	0.18	0.18	0.20	0.20	0.20
Poland	12.42	12.64	13.11	13.50	8.40
Portugal	20.85	20.87	15.83	15.89	15.04
Romania	22.71	22.21	22.97	23.78	22.47
Slovenia	0.21	0.20	0.19	0.22	0.26
Slovakia	0.68	0.60	0.59	0.48	0.22
Finland	0.11	0.11	0.10	0.09	0.10
Sweden	0.04	0.04	0.04	0.04	0.05

: data not available.