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Pest categorisation of *Anthonomus signatus*

EFSA Panel on Plant Health (PLH),

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Abstract

The Panel on Plant Health performed a pest categorisation of the strawberry bud weevil, *Anthonomus signatus* Say, (Coleoptera: Curculionidae), for the EU. *A. signatus* is a well-defined and distinguishable species, recognised as a pest of strawberry (*Fragaria*) fruit production in eastern North America where it is also a pest of *Rubus*. There are reports of *A. signatus* associated with non-rosaceous plants such as *Mentha*, *Nepeta*, *Rhododendron* and *Solidago* although whether such plants are true hosts is uncertain. This pest categorisation focuses on *Fragaria* and *Rubus* as hosts. *Anthonomus signatus* is not known to occur in the EU. It is listed in Annex IIAI of Council Directive 2000/29/EC. The international trade in *Fragaria* and *Rubus* plants for planting provides a potential pathway to introduce *A. signatus* from North America. Considering climatic similarities between North America and the EU, the thermal biology of *A. signatus* and host distribution in the EU, *A. signatus* has the potential to establish within the EU. There would be one generation per year, as in North America. As a pest of field grown *Fragaria* and *Rubus*, *A. signatus* would not be expected to establish in EU glasshouses. In North America, adults clip developing buds, preventing fruit development and reducing yield. Losses are variable and depend on the cultivars attacked. Severe crop losses have been reported. However, some *Fragaria* cultivars can compensate the loss of buds, e.g. by increasing the weight of fruits developing on remaining buds. Phytosanitary measures are available to reduce the likelihood of introduction of *A. signatus* from North America. All criteria assessed by EFSA for consideration as a potential Union quarantine pest are met. As *A. signatus* is not known to occur in the EU, this criterion assessed by EFSA to consider it as a Union regulated non-quarantine pest is not met.

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Keywords: Curculionidae, European Union, pest risk, plant health, plant pest, quarantine, strawberry bud weevil

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1. Introduction

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

1.1.1. Background

Council Directive 2000/29/EC on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community establishes the present European Union plant health regime. The Directive lays down the phytosanitary provisions and the control checks to be carried out at the place of origin on plants and plant products destined for the Union or to be moved within the Union. In the Directive's 2000/29/EC annexes, the list of harmful organisms (pests) whose introduction into or spread within the Union is prohibited, is detailed together with specific requirements for import or internal movement.

Following the evaluation of the plant health regime, the new basic plant health law, Regulation (EU) 2016/2031 on protective measures against pests of plants, was adopted on 26 October 2016 and will apply from 14 December 2019 onwards, repealing Directive 2000/29/EC. In line with the principles of the above mentioned legislation and the follow-up work of the secondary legislation for the listing of EU regulated pests, EFSA is requested to provide pest categorizations of the harmful organisms included in the annexes of Directive 2000/29/EC, in the cases where recent pest risk assessment/ pest categorisation is not available.

1.1.2. Terms of Reference

EFSA is requested, pursuant to Article 22(5.b) and Article 29(1) of Regulation (EC) No 178/2002, to provide scientific opinion in the field of plant health.

EFSA is requested to prepare and deliver a pest categorisation (step 1 analysis) for each of the regulated pests included in the appendices of the annex to this mandate. The methodology and template of pest categorisation have already been developed in past mandates for the organisms listed in Annex II Part A Section II of Directive 2000/29/EC. Slight changes have been made to the template to better align with Regulation 2016/2031.

The list of the harmful organisms included in the annex to this mandate comprises 133 harmful organisms or groups. A pest categorisation is expected for these 133 pests or groups and the delivery of the work would be stepwise at regular intervals through the year as detailed below. First priority covers the harmful organisms included in Appendix 1, comprising pests from Annex II Part A Section I and Annex II Part B of Directive 2000/29/EC. The delivery of all pest categorisations for the pests included in Appendix 1 is June 2018. The second priority is the pests included in Appendix 2, comprising the group of Cicadellidae (non-EU) known to be vector of Pierce's disease (caused by *Xylella fastidiosa*), the group of Tephritidae (non-EU), the group of potato viruses and virus-like organisms, the group of viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L. and the group of Margarodes (non-EU species). The delivery of all pest categorisations for the pests included in Appendix 2 is end 2019. The pests included in Appendix 3 cover pests of Annex I part A section I and all pests categorisations should be delivered by end 2020.

For the above mentioned groups, each covering a large number of pests, the pest categorisation will be performed for the group and not the individual harmful organisms listed under 'such as' notation in the Annexes of the Directive 2000/29/EC. The criteria to be taken particularly under consideration for these cases, is the analysis of host pest combination, investigation of pathways, the damages occurring and the relevant impact.

Finally, as indicated in the text above, all references to 'non-European' should be avoided and replaced by 'non-EU' and refer to all territories with exception of the Union territories as defined in Article 1 point 3 of Regulation (EU) 2016/2031.

1.1.2.1. Terms of Reference: Appendix 1

List of harmful organisms for which pest categorisation is requested. The list below follows the annexes of Directive 2000/29/EC.

Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

<i>Aleurocantus</i> spp.	<i>Numonia pyrivorella</i> (Matsumura)
<i>Anthonomus bisignifer</i> (Schenkling)	<i>Oligonychus perditus</i> Pritchard and Baker
<i>Anthonomus signatus</i> (Say)	<i>Pissodes</i> spp. (non-EU)
<i>Aschistonyx eppoi</i> Inouye	<i>Scirtothrips aurantii</i> Faure
<i>Carposina niponensis</i> Walsingham	<i>Scirtothrips citri</i> (Moultx)
<i>Enarmonia packardi</i> (Zeller)	<i>Scolytidae</i> spp. (non-EU)
<i>Enarmonia prunivora</i> Walsh	<i>Scrobipalopsis solanivora</i> Povolny
<i>Grapholita inopinata</i> Heinrich	<i>Tachypterellus quadrigibbus</i> Say
<i>Hishomonus phycitis</i>	<i>Toxoptera citricida</i> Kirk.
<i>Leucaspis japonica</i> Ckll.	<i>Unaspis citri</i> Comstock
<i>Listronotus bonariensis</i> (Kuschel)	

(b) Bacteria

Citrus variegated chlorosis	<i>Xanthomonas campestris</i> pv. <i>oryzae</i> (Ishiyama) Dye and pv. <i>oryzicola</i> (Fang. et al.) Dye
<i>Erwinia stewartii</i> (Smith) Dye	

(c) Fungi

<i>Alternaria alternata</i> (Fr.) Keissler (non-EU pathogenic isolates)	<i>Elsinoe</i> spp. Bitanc. and Jenk. Mendes
<i>Anisogramma anomala</i> (Peck) E. Müller	<i>Fusarium oxysporum</i> f. sp. <i>albedinis</i> (Kilian and Maire) Gordon
<i>Apiosporina morbosa</i> (Schwein.) v. Arx	<i>Guignardia piricola</i> (Nosa) Yamamoto
<i>Ceratocystis virescens</i> (Davidson) Moreau	<i>Puccinia pittieriana</i> Hennings
<i>Cercoseptoria pini-densiflorae</i> (Hori and Nambu) Deighton	<i>Stegophora ulmea</i> (Schweinitz: Fries) Sydow & Sydow
<i>Cercospora angolensis</i> Carv. and Mendes	<i>Venturia nashicola</i> Tanaka and Yamamoto

(d) Virus and virus-like organisms

Beet curly top virus (non-EU isolates)	Little cherry pathogen (non- EU isolates)
Black raspberry latent virus	Naturally spreading psorosis
Blight and blight-like	Palm lethal yellowing mycoplasma
Cadang-Cadang viroid	Satsuma dwarf virus
Citrus tristeza virus (non-EU isolates)	Tatter leaf virus
Leprosis	Witches' broom (MLO)

Annex IIB

(a) Insect mites and nematodes, at all stages of their development

<i>Anthonomus grandis</i> (Boh.)	<i>Ips cembrae</i> Heer
<i>Cephalcia lariciphila</i> (Klug)	<i>Ips duplicatus</i> Sahlberg
<i>Dendroctonus micans</i> Kugelán	<i>Ips sexdentatus</i> Börner
<i>Gilpinia hercyniae</i> (Hartig)	<i>Ips typographus</i> Heer
<i>Gonipterus scutellatus</i> Gyll.	<i>Sternochetus mangiferae</i> Fabricius
<i>Ips amitinus</i> Eichhof	

(b) Bacteria

<i>Curtobacterium flaccumfaciens</i> pv. <i>flaccumfaciens</i> (Hedges) Collins and Jones

(c) Fungi

<i>Glomerella gossypii</i> Edgerton	<i>Hypoxylon mammatum</i> (Wahl.) J. Miller
<i>Gremmeniella abietina</i> (Lag.) Morelet	

1.1.2.2. Terms of Reference: Appendix 2

List of harmful organisms for which pest categorisation is requested per group. The list below follows the categorisation included in the annexes of Directive 2000/29/EC.

Annex IAI

(a) Insects, mites and nematodes, at all stages of their development

Group of Cicadellidae (non-EU) known to be vector of Pierce's disease (caused by *Xylella fastidiosa*), such as:

- 1) *Carneocephala fulgida* Nottingham
- 2) *Draeculacephala minerva* Ball
- 3) *Graphocephala atropunctata* (Signoret)

Group of Tephritidae (non-EU) such as:

- 1) *Anastrepha fraterculus* (Wiedemann)
- 2) *Anastrepha ludens* (Loew)
- 3) *Anastrepha obliqua* Macquart
- 4) *Anastrepha suspensa* (Loew)
- 5) *Dacus ciliatus* Loew
- 6) *Dacus curcurbitae* Coquillett
- 7) *Dacus dorsalis* Hendel
- 8) *Dacus tryoni* (Froggatt)
- 9) *Dacus tsuneonis* Miyake
- 10) *Dacus zonatus* Saund.
- 11) *Epochra canadensis* (Loew)
- 12) *Pardalaspis cyanescens* Bezzi
- 13) *Pardalaspis quinaria* Bezzi
- 14) *Pterandrus rosa* (Karsch)
- 15) *Rhacochlaena japonica* Ito
- 16) *Rhagoletis completa* Cresson
- 17) *Rhagoletis fausta* (Osten-Sacken)
- 18) *Rhagoletis indifferens* Curran
- 19) *Rhagoletis mendax* Curran
- 20) *Rhagoletis pomonella* Walsh
- 21) *Rhagoletis suavis* (Loew)

(c) Viruses and virus-like organisms

Group of potato viruses and virus-like organisms such as:

- 1) Andean potato latent virus
- 2) Andean potato mottle virus
- 3) Arracacha virus B, oca strain
- 4) Potato black ringspot virus
- 5) Potato virus T
- 6) non-EU isolates of potato viruses A, M, S, V, X and Y (including Yo, Yn and Yc) and Potato leafroll virus

Group of viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L., such as:

- 1) Blueberry leaf mottle virus
- 2) Cherry rasp leaf virus (American)
- 3) Peach mosaic virus (American)
- 4) Peach phony rickettsia
- 5) Peach rosette mosaic virus
- 6) Peach rosette mycoplasma
- 7) Peach X-disease mycoplasma
- 8) Peach yellows mycoplasma
- 9) Plum line pattern virus (American)
- 10) Raspberry leaf curl virus (American)
- 11) Strawberry witches' broom mycoplasma
- 12) Non-EU viruses and virus-like organisms of *Cydonia* Mill., *Fragaria* L., *Malus* Mill., *Prunus* L., *Pyrus* L., *Ribes* L., *Rubus* L. and *Vitis* L.

Annex IIAI

(a) Insects, mites and nematodes, at all stages of their development

Group of *Margarodes* (non-EU species) such as:

- 1) *Margarodes vitis* (Phillipi)
- 2) *Margarodes vredendalensis* de Klerk
- 3) *Margarodes prieskaensis* Jakubski

1.1.2.3. Terms of Reference: Appendix 3

List of harmful organisms for which pest categorisation is requested. The list below follows the annexes of Directive 2000/29/EC.

Annex IAI

(a) Insects, mites and nematodes, at all stages of their development

<i>Acleris</i> spp. (non-EU)	<i>Longidorus diadecturus</i> Eveleigh and Allen
<i>Amauromyza maculosa</i> (Malloch)	<i>Monochamus</i> spp. (non-EU)
<i>Anomala orientalis</i> Waterhouse	<i>Myndus crudus</i> Van Duzee
<i>Arrhenodes minutus</i> Drury	<i>Nacobbus aberrans</i> (Thorne) Thorne and Allen
<i>Choristoneura</i> spp. (non-EU)	<i>Naupactus leucoloma</i> Boheman
<i>Conotrachelus nenuphar</i> (Herbst)	<i>Premnotrypes</i> spp. (non-EU)
<i>Dendrolimus sibiricus</i> Tschetverikov	<i>Pseudopityophthorus minutissimus</i> (Zimmermann)
<i>Diabrotica barberi</i> Smith and Lawrence	<i>Pseudopityophthorus pruinus</i> (Eichhoff)
<i>Diabrotica undecimpunctata howardi</i> Barber	<i>Scaphoideus luteolus</i> (Van Duzee)
<i>Diabrotica undecimpunctata undecimpunctata</i> Mannerheim	<i>Spodoptera eridania</i> (Cramer)
<i>Diabrotica virgifera zea</i> Krysan & Smith	<i>Spodoptera frugiperda</i> (Smith)
<i>Diaphorina citri</i> Kuway	<i>Spodoptera litura</i> (Fabricus)
<i>Heliothis zea</i> (Boddie)	<i>Thrips palmi</i> Karny
<i>Hirschmanniella</i> spp., other than	<i>Xiphinema americanum</i> Cobb sensu lato (non-EU populations)
<i>Hirschmanniella gracilis</i> (de Man) Luc and Goodey	
<i>Liriomyza sativae</i> Blanchard	<i>Xiphinema californicum</i> Lamberti and Bleve-Zacheo

(b) Fungi

<i>Ceratocystis fagacearum</i> (Bretz) Hunt	<i>Mycosphaerella larici-leptolepis</i> Ito et al.
<i>Chrysomyxa arctostaphyli</i> Dietel	<i>Mycosphaerella populorum</i> G. E. Thompson
<i>Cronartium</i> spp. (non-EU)	<i>Phoma andina</i> Turkensteen
<i>Endocronartium</i> spp. (non-EU)	<i>Phyllosticta solitaria</i> Ell. and Ev.
<i>Guignardia laricina</i> (Saw.) Yamamoto and Ito	<i>Septoria lycopersici</i> Speg. var. <i>malagutii</i> Ciccarone and Boerema
<i>Gymnosporangium</i> spp. (non-EU)	<i>Thecaphora solani</i> Barrus
<i>Inonotus weirii</i> (Murril) Kotlaba and Pouzar	<i>Trechispora brinkmannii</i> (Bresad.) Rogers
<i>Melampsora farlowii</i> (Arthur) Davis	

(c) Viruses and virus-like organisms

Tobacco ringspot virus	Pepper mild tigré virus
Tomato ringspot virus	Squash leaf curl virus
Bean golden mosaic virus	Euphorbia mosaic virus
Cowpea mild mottle virus	Florida tomato virus
Lettuce infectious yellows virus	

(d) Parasitic plants

Arceuthobium spp. (non-EU)

Annex IAI

(a) Insects, mites and nematodes, at all stages of their development

<i>Meloidogyne fallax</i> Karssen	<i>Rhizoecus hibisci</i> Kawai and Takagi
<i>Popillia japonica</i> Newman	

(b) Bacteria

<i>Clavibacter michiganensis</i> (Smith) Davis et al. ssp. <i>sepedonicus</i> (Spieckermann and Kotthoff) Davis et al.	<i>Ralstonia solanacearum</i> (Smith) Yabuuchi et al.
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(c) Fungi

<i>Melampsora medusae</i> Thümen	<i>Synchytrium endobioticum</i> (Schilbersky) Percival
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Annex IB

(a) Insects, mites and nematodes, at all stages of their development

Leptinotarsa decemlineata Say

Liriomyza bryoniae (Kaltenbach)

(b) Viruses and virus-like organisms

Beet necrotic yellow vein virus

1.2. Interpretation of the Terms of Reference

Anthonomus signatus is one of a number of pests listed in the Appendices to the Terms of Reference (ToR) to be subject to pest categorisation to determine whether it fulfils the criteria of a quarantine pest or those of a regulated non-quarantine pest (RNQP) for the area of the European Union (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.

2. Data and methodologies

2.1. Data

2.1.1. Literature search

A search of literature (1997–2017) in Web of Science and Scopus was conducted at the beginning of the categorisation. The search focussed on *A. signatus* and its geographic distribution, life cycle, host plants and the damage it causes. The following search terms (TS) and combinations were used: TS = ("*Anthonomus signatus*" OR "Strawberry bud weevil") AND TS = (geograph* OR distribution OR "life cycle" OR lifecycle OR host OR hosts OR plant* OR damag*)

Further references and information were obtained from experts, from citations within the references and grey literature.

2.1.2. Database search

Pest information, on host(s) and distribution, was retrieved from the EPPO Global Database (EPPO 2017)

Data about import of commodity types that could potentially provide a pathway for the pest to enter the EU were obtained from EUROSTAT and from the EU Seventh Framework Programme project ISEFOR (Increasing Sustainability of European Forests, 2007–2013 KBBE 2009-3 grant agreement 245268). The ISEFOR project examined the plant nursery trade and, for some EU Member States, collected import data on plants for planting at a much more detailed level than is made publically available via EUROSTAT. While it is recognised that the ISEFOR data is not comprehensive, it does contain some data on imports of plants for planting of *A. signatus* hosts, such as *Fragaria* and *Rubus*.

Statistics about the area of hosts grown in the EU were obtained from EUROSTAT.

2.2. Methodologies

The Panel performed the pest categorisation for *A. signatus* following guiding principles and steps presented in the EFSA guidance on the harmonised framework for pest risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standard for Phytosanitary Measures No 11 (FAO, 2013) and No 21 (FAO, 2004).

In accordance with the guidance on a harmonised framework for pest risk assessment in the EU (EFSA PLH Panel, 2010), this work was initiated following an evaluation of the EU's plant health regime. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a Union quarantine pest and for a Union RNQP in accordance with Regulation (EU) 2016/2031 on protective measures against pests of plants, and includes additional information required as per the specific terms of reference received by the European Commission. In addition, for each conclusion, the Panel provides a short description of its associated uncertainty.

Table 1 presents the Regulation (EU) 2016/2031 pest categorisation criteria on which the Panel bases its conclusions. All relevant criteria have to be met for the pest to qualify either as a

quarantine pest or as a RNQP. If one of the criteria is not met, the pest will not qualify. In such a case, the working group should consider the possibility to terminate the assessment early and be concise in the sections preceding the question for which the negative answer is reached. Note that a pest that does not qualify as a quarantine pest may still qualify as a regulated non-quarantine pest which needs to be addressed in the opinion. For the pests regulated in the protected zones only, the scope of the categorisation is the territory of the protected zone, thus the criteria refer to the protected zone instead of the EU territory.

It should be noted that the Panel’s conclusions are formulated respecting its remit and particularly with regards to the principle of separation between risk assessment and risk management (EFSA founding regulation¹); therefore, instead of determining whether the pest is likely to have an unacceptable impact, the Panel will present a summary of the observed pest impacts. Economic impacts are expressed in terms of yield and quality losses and not in monetary terms, while addressing social impacts is outside the remit of the Panel, in agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
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?	Is the identity of the pest established, or has it been shown to produce consistent symptoms and to be transmissible?	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!	Is the pest present in the EU territory? If not, it cannot be a protected zone quarantine organism.	Is the pest present in the EU territory? If not, it cannot be a regulated non-quarantine pest. (A regulated non-quarantine pest must be present in the risk assessment area).
Regulatory status (Section 3.3)	If the pest is present in the EU but not widely distributed in the risk assessment area, it should be under official control or expected to be under official control in the near future.	The protected zone system aligns with the pest free area system under the International Plant Protection Convention (IPPC). The pest satisfies the IPPC definition of a quarantine pest that is not present in the PRA area (i.e. protected zone).	Is the pest regulated as a quarantine pest? If currently regulated as a quarantine pest, are there grounds to consider its status could be revoked?
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!	Is the pest able to enter into, become established in, and spread within, the protected zone areas? Is entry by natural spread from EU areas where the pest is present possible?	Is spread mainly via specific plants for planting, rather than via natural spread or via movement of plant products or other objects? Clearly state if plants for planting is the main pathway!

¹ Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety. OJ L 31/1, 1.2.2002, p. 1–24.

Criterion of pest categorisation	Criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Criterion in Regulation (EU) 2016/2031 regarding protected zone quarantine pest (articles 32–35)	Criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest
Potential for consequences in the EU territory (Section 3.5)	Would the pests' introduction have an economic or environmental impact on the EU territory?	Would the pests' introduction have an economic or environmental impact on the protected zone areas?	Does the presence of the pest on plants for planting have an economic impact, as regards the intended use of those plants for planting?
Available measures (Section 3.6)	Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?	Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated? Is it possible to eradicate the pest in a restricted area within 24 months (or a period longer than 24 months where the biology of the organism so justifies) after the presence of the pest was confirmed in the protected zone?	Are there measures available to prevent pest presence on plants for planting such that the risk becomes mitigated?
Conclusion of pest categorisation (Section 4)	A statement as to whether (1) all criteria above for consideration as a potential quarantine pest were met and (2) if not, which one(s) were not met.	A statement as to whether (1) all criteria above for consideration as potential protected zone quarantine pest were met, and (2) if not, which one(s) were not met.	A statement as to whether (1) all criteria above for consideration as a potential regulated non-quarantine pest were met, and (2) if not, which one(s) were not met.

The Panel will not indicate in its conclusions of the pest categorisation whether to continue the risk assessment process, but, following the agreed two-step approach, will continue only if requested by the risk managers. However, during the categorisation process, experts may identify key elements and knowledge gaps that could contribute significant uncertainty to a future assessment of risk. It would be useful to identify and highlight such gaps so that potential future requests can specifically target the major elements of uncertainty, perhaps suggesting specific scenarios to examine.

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 to be transmissible?

Yes, the identity of the pest is established.

A. signatus Say, 1831 is an insect in the Order Coleoptera (beetles) and the family Curculionidae (weevils). Clark (1991) provides a key to the *Anthonomus-Curvirostris* species group which includes *A. signatus*.

Three junior synonyms are known, *Anthonomus bisignatus* Gyllenhal, 1836; *Anthonomus pallidus* Dietz, 1891; and *Anthonomus scutellatus* Gyllenhal, 1836.

3.1.2. Biology of the pest

A. signatus has one generation per year. Adults can overwinter beneath strawberry plants and plant debris within fields, although most literature reports adults overwintering within the vegetation of

adjacent field boundaries and under plant debris in wooded areas (Metcalf and Metcalf, 1993; Smith et al., 1997; Kovach et al., 1999). Adults emerge in the spring and can be found when daytime temperatures are consistently over 16°C, typically from mid-March in the southern USA to mid-May in Canada, coinciding with those hosts that have early season bud development (Schaeffers, 1978 – cited by Mailloux and Bostanian, 1993; Metcalf and Metcalf, 1993; McPhie and Burrack, 2016). The weevils emerge in spring and feed on young leaves of *Fragaria* and *Rubus* and possibly other plants, but most extensively on their flower buds, which provide them the necessary pollen to reach sexual maturity. Afterwards, adults mate and females search for *Fragaria* and *Rubus* plants to oviposit and continue feeding.

An adult gravid female will chew a hole in the side of an unopened host flower bud then deposit an egg in the hole. She will then eat about halfway through the pedicel, between 3 and 6 mm below the bud, partially severing the bud from the stem, creating the bud clip effect. This prevents the bud from further development and provides a protected environment for the egg to hatch and for a larva to develop within. The bud can hang from the plant for a few days but will eventually wilt and drop to the ground (Clarke & Howitt, 1975; Mailloux and Bostanian, 1993; Kovach et al., 1999). Each female can lay about 80 eggs, depending on the temperature and they can be seen mating throughout the oviposition period (Baerg, 1923; cited in Smith et al., 1997).

Most feeding occurs at field edges (Campbell et al., 1989; Kovach et al., 1993 in Kovach et al., 1999) up to 15 m in from the field edge (Handley and Dill, 2009) suggesting that adults do not move far or quickly. Foord et al. (2017) reported that *A. signatus* rarely fly or walk more than 30 feet (approx. 10 m) while looking for food or places to lay eggs.

The egg hatches in 6–14 days and the larva feeds on the immature pollen within the bud for 3–4 weeks. There are three larval instars (Mailloux and Bostanian, 1993). Even when the buds are completely severed from the plant, the buds contain enough nutrients for larvae to complete their development. Pupation occurs within the dry bud and takes 5–8 days. Adult weevils emerge during May and June and feed for a few weeks on pollen and flower petals before searching for overwintering sites in late July and August (Baerg, 1923; cited in Sorensen, 1993; Smith et al., 1997).

On cool, cloudy days, the adults are slow-moving but in bright warm conditions they can fly short distances (Smith et al., 1997; CSL, 1998).

3.1.3. Detection and identification of the pest

Are detection and identification methods available for the pest?

Yes, the organism can be detected by visual searching, often after damage symptoms are seen. The species can be identified by examining morphological features, for which keys exist, e.g. Ahmad and Burke (1972); Burke (1968) and Clark (1991).

In North America, there are no generally accepted sampling techniques to monitor for *A. signatus* (Bostanian et al., 1999). Methods, such as the sticky traps, pheromone traps, sweep nets and beat cloths, to monitor *A. signatus* are not effective at predicting population size or bud damage (Howard, 2007). In regions with a history of *A. signatus* damage, monitoring for bud damage should begin at the time of bud emergence and continue once or twice weekly throughout the period of flowering (Handley and Dill, 2009).

A. signatus is noticed when the damage symptoms (clipped buds) are detected, either hanging from the plants or laying on the ground.

Eggs are 0.5 mm long, glassy-white.

Larvae are 3–4 mm long, off-white becoming greyish with age. They remain in the bud to pupate.

Pupae are yellowish-white (2–3 mm × 1–2 mm).

Larva and pupa of *A. signatus* are well described, keyed by Ahmad and Burke (1972). Adults are about 2.5 mm long. The head is brownish black with an elongated curved rostrum. The elytrae are pale brown to dark reddish brown. A large black spot is often present on each elytron although some adults do not have these spots. Legs are brown. Careful examination is required to reliably distinguish adult and immature stages of these species from those of *Anthonomus rubi*, the strawberry blossom weevil, which occurs in Europe (CSL, 1998).

3.2. Pest distribution

3.2.1. Pest distribution outside the EU

A. signatus is only present in North America and has not been reported in the EU (Smith et al, 1997; EPPO Global database, 2017; Figure 1 and Table 2).

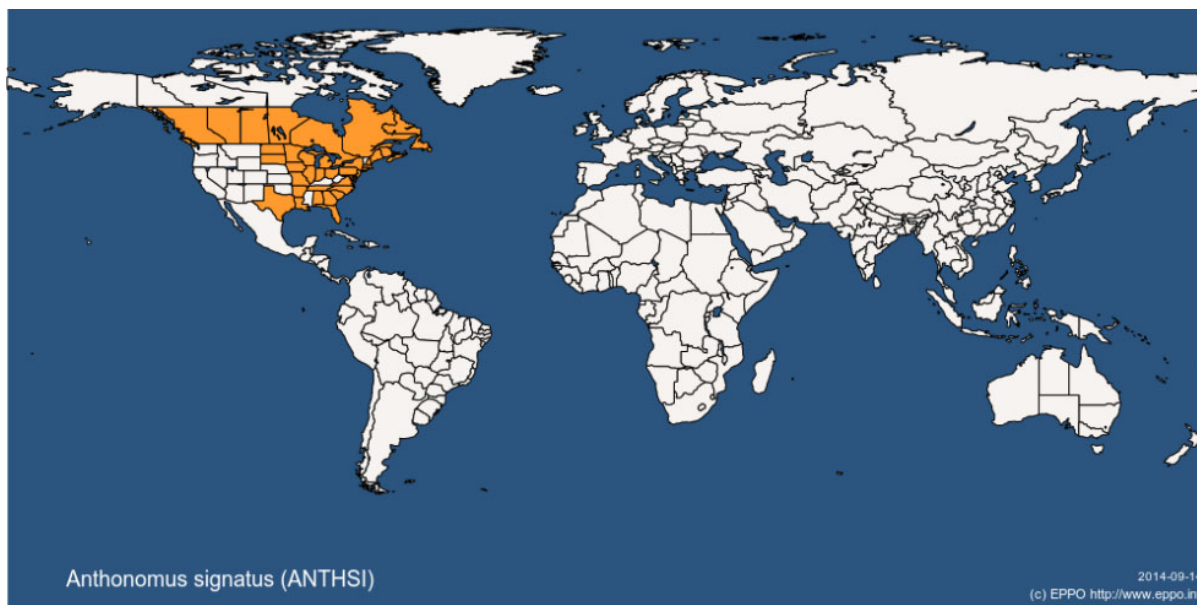


Figure 1: Global distribution map for *Anthonomus signatus* (extracted from EPPO global database accessed on 20 March 2017)

Table 2: Current distribution of *Anthonomus signatus* in North America based on the information from the EPPO Global Database and other sources

Country	Subnational distribution (e.g. States/Provinces)	References
Canada	Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, Ontario Prince Edward Island, Quebec, Saskatchewan	Bousquet (1991); EPPO GD (Last update: 23/1/2013 Last accessed: 20/3/2017)
United States of America	Alabama, Arkansas, Connecticut, Delaware, District of Columbia, Florida, Georgia, Illinois, Iowa, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, Wisconsin	EPPO GD (Last update : 23/1/2013 Last accessed: 20/3/2017)

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?

No, *Anthonomus signatus* is not known to occur in the EU.

3.3. Regulatory status

3.3.1. Council Directive 2000/29/EC

A. signatus is listed in Council Directive 2000/29/EC. Details are shown in Tables 3 and 4.

Table 3: The listing of *Anthonomus signatus* within Council Directive 2000/29/EC

Annex II, Part A	Harmful organisms whose introduction into, and spread within, all Member States shall be banned if they are present on certain plants or plant products	
Section I	Harmful organisms not known to occur in the community and relevant for the entire community	
(a)	Insects, mites and nematodes, at all stages of their development	
	Species	Subject of contamination
4.	<i>Anthonomus signatus</i>	Plants of <i>Fragaria</i> L., intended for planting, other than seeds

3.3.2. Legislation addressing plants and plant parts on which *Anthonomus signatus* is regulated

Table 4: Regulated hosts and commodities that may involve *Anthonomus signatus* in Annexes III, IV and V of Council Directive 2000/29/EC

Annex III, Part A	Plants, plant products and other objects the introduction of which shall be prohibited in all Member States	
18	Plants of <i>Cydonia</i> Mill., <i>Malus</i> Mill., <i>Prunus</i> L. and <i>Pyrus</i> L. and their hybrids, and <i>Fragaria</i> L., intended for planting, other than seeds	Without prejudice to the prohibitions applicable to the plants listed in Annex III A (9), where appropriate, non-European countries, other than Mediterranean countries, Australia, New Zealand, Canada, the continental states of the USA
Annex IV, Part A	Special requirements which must be laid down by all Member States for the introduction and movement of plants, plant products and other objects into and within all Member States	
Section I	Plants, plant products and other objects originating outside the community	
	Plants, plant products and other objects	Special requirements
21.3.	Plants of <i>Fragaria</i> L., intended for planting other than seeds	Without prejudice to the provisions applicable to the plants listed in Annex III(A)(18), and Annex IV(A)(I)(19.2), (21.1) and (21.2), official statement that the plants originate in an area known to be free from <i>Anthonomus signatus</i> Say and <i>Anthonomus bisignifer</i> (Schenkling)
Annex V	Plants, plant products and other objects which must be subject to a plant health inspection (at the place of production if originating in the Community, before being moved within the Community – in the country of origin or the consignor country, if originating outside the Community) before being permitted to enter the Community	
Part A	Plants, plant products and other objects originating in the Community	
Section II	Plants, plant products and other objects produced by producers whose production and sale is authorised to persons professionally engaged in plant production, other than those plants, plant products and other objects which are prepared and ready for sale to the final consumer, and for which it is ensured by the responsible official bodies of the Member States, that the production thereof is clearly separate from that of other products	
2.1	Plants intended for planting other than seeds of the genera <i>Abies</i> Mill., <i>Apium graveolens</i> L., <i>Argyranthemum</i> spp., <i>Aster</i> spp., <i>Brassica</i> spp., <i>Castanea</i> Mill., <i>Cucumis</i> spp., <i>Dendranthema</i> (DC) Des Moul., <i>Dianthus</i> L. and hybrids <i>Exacum</i> spp., <i>Fragaria</i> L., <i>Gerbera</i> Cass., <i>Gypsophila</i> L., all varieties of New Guinea hybrids of <i>Impatiens</i> L., <i>Lactuca</i> spp., <i>Larix</i> Mill., <i>Leucanthemum</i> L., <i>Lupinus</i> L., <i>Pelargonium</i> l'Hérit. ex Ait., <i>Picea</i> A. Dietr., <i>Pinus</i> L., <i>Platanus</i> L., <i>Populus</i> L., <i>Prunus laurocerasus</i> L., <i>Prunus lusitanica</i> L., <i>Pseudotsuga</i> Carr., <i>Quercus</i> L., <i>Rubus</i> L., <i>Spinacia</i> L., <i>Tanacetum</i> L., <i>Tsuga</i> Carr. and <i>Verbena</i> L.	

3.4. Entry, establishment and spread in the EU

3.4.1. Host range

Much North American literature refers to *A. signatus* as a pest primarily of strawberry (*Fragaria*) but it is also known as a pest of *Rubus* fruit such as blackberry (*Rubus fruticosus*), black raspberry (*Rubus*

occidentalis), dewberry (a group of species in the genus *Rubus*, closely related to the blackberries) and raspberry (*Rubus idaeus*).

Campbell et al. (1989) records earlier literature that reports *A. signatus* occurring on redbud (*Cercis* sp.), rhododendron (*Rhododendron* sp.), rambler rose (*Rosa multiflora*), cinquefoil (*Potentilla* sp.), apple (*Malus* sp.), milkweed (*Asclepias* sp.), goldenrod (*Solidago* sp.), basswood (*Tilia americana*), wild bergamot (*Monarda fistulosa*), mint (*Mentha* sp.), catnip (*Nepeta cataria*) and heal-all (*Prunella vulgaris*). Whether these are true hosts on which the organism can complete its life cycle is unknown. CABI (2017) regard such reports as incidental occurrences. This categorisation will focus on *Fragaria* and *Rubus* because these are the hosts which the US and Canadian literature reports feeding damage and life stage development on.

Current EU legislation (2000/29/EC) only regulates *A. signatus* on *Fragaria* plants for planting, other than seed. However, as noted above, *A. signatus* does have other hosts, at least within the genus *Rubus*. Given that imports of *Rubus* plants for planting are permitted from the USA and Canada, *A. signatus* could potentially be carried into the EU via pathways other than *Fragaria* plants for planting.

3.4.2. Entry

Is the pest able to enter into the EU territory?

Yes, *A. signatus* could potentially enter the EU at least via *Fragaria* and *Rubus* plants for planting.

The EU can import *A. signatus* host plants for planting from North America, including from regions where the pest occurs. 'Green' strawberry plants are field grown plants grown to be transplanted as plants for planting for fruit production. Rooted plants can be traded in bags with or without growing medium. Due to the growing and shipping conditions, such plants could potentially be contaminated by a range of pests, including *A. signatus* (EPPO, 2008).

International trade statistics describing the trade in plants for planting are not sufficiently detailed as to allow for the amount of trade in individual plant species to be determined. The CN code that includes strawberry plants for planting is 0602 90 30 (vegetable and strawberry plants). A search of EUROSTAT indicated that there were no EU imports of CN 0602 90 30 materials from Canada during the period 2010–2015; however, there were imports from the USA, shown below in Table 5:

Table 5: EU imports of vegetable and strawberry plants (CN 0602 90 30) from the USA 2010–2015 (hundreds of kilograms) (Source: EUROSTAT accessed 20/3/2017)

Year	2010	2011	2012	2013	2014	2015	Total
Sum	6,875	8,373	8,031	8,408	8,449	6,188	46,324

Although EUROSTAT cannot be used to distinguish strawberry plants from vegetable plants for planting, data collected during the ISEFOR project indicate that there was international movement of strawberry plants for planting from the USA into the EU between 2000 and 2012 hence a possible pathway for entry exists (Table 6).

Rubus spp. plants for planting can also be imported from North America into the EU. *Rubus* plants for planting are categorised within CN imports code CN 0602 2090 (trees, shrubs and bushes, grafted or not, of kinds which bear edible fruit or nuts (excl. vine slips).

Table 6: EU MS imports of CN 0602 2090 (trees, shrubs and bushes, grafted or not, of kinds which bear edible fruit or nuts) from the USA and Canada. An unknown proportion of these imports could be *Rubus* (hundreds of kilograms)

Source	2010	2011	2012	2013	2014	2015	Total
United States	858	602	688	632	1,055	508	9,598
Canada		29			2	1	33

ISEFOR data indicate that there have been imports of *Rubus* plants for planting from the USA into the EU. Field grown *Rubus* plants grown in the USA or Canada to be shipped to the EU and transplanted for fruit production could potentially be contaminated by a range of pests, including *A. signatus* (Smith et al., 1997).

A. signatus is not known to have spread or been introduced anywhere outside of its native distribution within the eastern USA and Canada.

Up to March 2017, there were zero records of interception of *A. signatus* in the Europhyt database.

3.4.3. Establishment

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

Yes, biotic factors (host availability) and abiotic factors (climate suitability) suggest that *A. signatus* would find large parts of the EU suitable for establishment.

3.4.3.1. EU distribution of main host plants

A global distribution map of the area of strawberry harvest is provided as Figure 2, available at CAPRA project website. The map is based on Monfreda et al. (2008) with additional data handling conducted during the EU funded project PRATIQUE (Baker, 2012). The maximum in the legend (dark green) represents the top 5% of the world strawberry distribution (the 95% quantile).

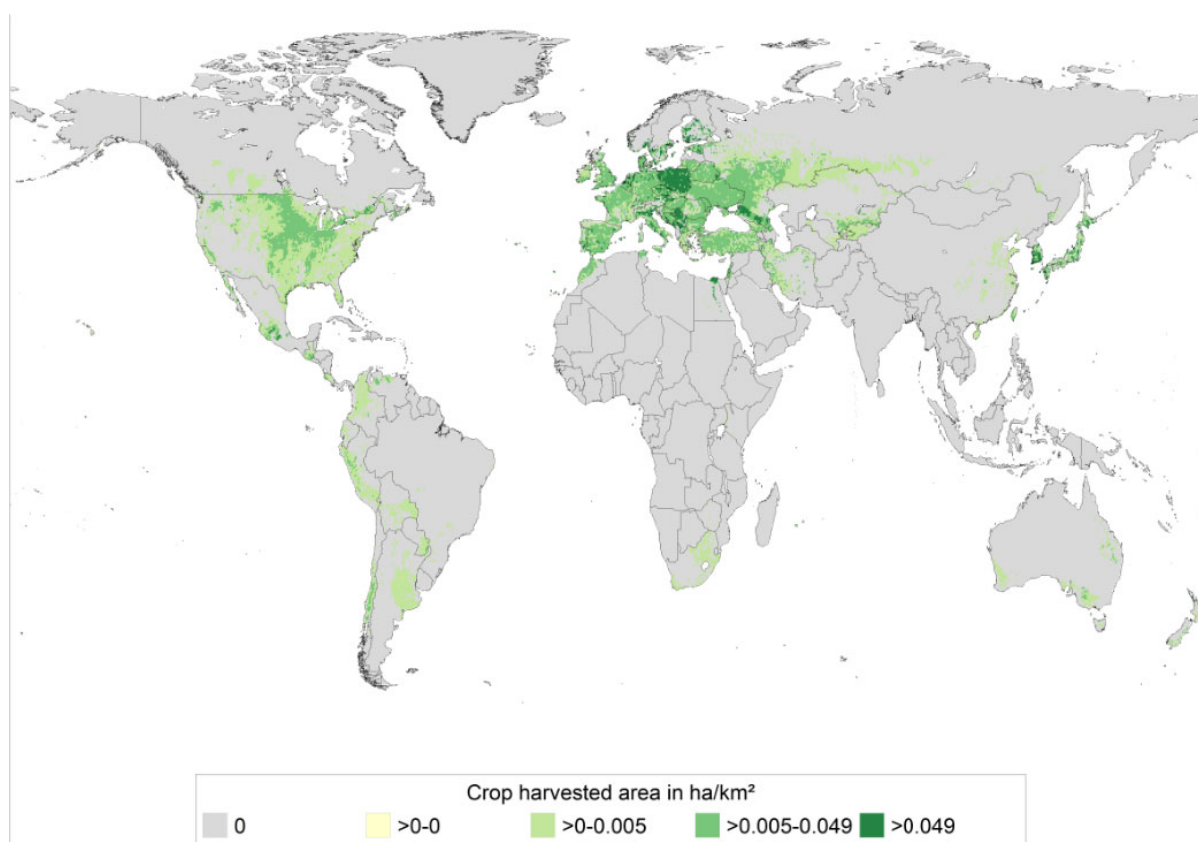


Figure 2: Global distribution of the density of harvested strawberry (ha crop/km²) (source CAPRA database accessed on 20 March 2017)

As indicated in Figure 2, some of the world’s greatest density of strawberry production occurs in Europe. Table 7 indicates the top three EU countries of strawberry production by area harvested, together with total EU area. Poland grows the largest area of strawberries of any other EU MS. Approximately 70% of the annual area of EU strawberry production occurs in Poland, Germany and Spain. Typically, approximately half of the total EU strawberry area is usually grown in Poland.

Table 7: EU area of strawberry production 2011–2015 (thousands of hectares) ranked by area

	2011	2012	2013	2014	2015	5-year mean	Mean %
European Union sum	101.07	103.00	97.10	109.48	107.43	103.62	100.0
Poland	50.60	50.60	40.20	52.90	52.30	49.32	47.6

	2011	2012	2013	2014	2015	5-year mean	Mean %
Germany	13.49	15.00	15.58	15.35	14.72	14.83	14.2
Spain	6.86	7.65	7.97	7.79	7.21	7.50	7.2
Other EU MS	30.14	29.75	33.37	33.46	33.20	31.98	30.9

Table 8 indicates the top three EU countries of raspberry production by area harvested, together with the total EU area. Poland grows more raspberries than all other EU Member States combined. Typically over 80% of the total EU raspberry area occurs in Poland, Bulgaria and Spain.

Table 8: EU area of raspberry production 2011–2015 (thousands of hectares)

	2011	2012	2013	2014	2015	5-year mean	Mean %
European Union sum	35.32	37.09	37.63	37.07	38.73	37.17	100.0
Poland	27.10	28.40	28.80	28.30	27.40	28.00	75.3
Bulgaria	1.60	1.37	1.33	1.19	1.52	1.40	3.8
Spain	1.04	1.44	1.35	1.49	1.85	1.43	3.9
Other EU MS	5.58	5.88	6.15	6.09	7.96	6.33	17.0

3.4.3.2. Climatic conditions affecting establishment

A. signatus is distributed in the eastern USA and across Canada (See Figure 1) within a variety of Köppen–Geiger climate zones. The global Köppen–Geiger climate zones (Kottek et al., 2006) describe terrestrial climate in terms of average minimum winter temperatures and summer maxima, amount of precipitation and seasonality (rainfall pattern). In North America, *A. signatus* occurs in zones Cfa (warm temperate, fully humid hot summer), Cfb (warm temperate, fully humid, warm summer) and Dfb (snow, fully humid, warm summer); climate zones that also cover large portions of the EU where *Fragaria* and/or *Rubus* are grown.

Development and phenology studies suggest a temperature threshold for development of *A. signatus* to be around 8.3°C (Clarke & Howitt, 1975); thresholds below 10°C are typical for species in northern Europe.

Considering its distribution in North America, availability of hosts outdoors in Europe and its threshold temperature for development, *A. signatus* has the potential to establish in many parts of the EU.

As a pest of field grown strawberries and *Rubus*, *A. signatus* would not be expected to establish in glasshouses.

3.4.4. Spread

Is the pest able to spread within the EU territory following establishment? (Yes or No) How?

Yes, as a free living organism, adults can disperse naturally, e.g. by walking and, or flying.

Foord et al. (2017) reported that adult *A. signatus* rarely fly or walk more than 10 m while looking for food or places to lay eggs, hence spread is likely to be relatively slow. However, if accidentally transported with plants for planting, or as a hitchhiker, the pest could spread over greater distances in a short time.

3.5. Potential or observed impacts in the EU

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

Yes, the introduction of *A. signatus* could cause yield losses to susceptible *Fragaria* and / or *Rubus* crops.

3.5.1. Potential pest impacts

3.5.1.1. Direct impacts of the pest

Clarke & Howitt (1975) described *A. signatus* as one of the most important insect pests in Michigan strawberries between 1972 and 1975, after the withdrawal of organochlorine pesticides. *A. signatus* remained a major pest (Bostanian et al., 1999) and is still regarded as one of key insect pests of strawberries in north eastern North America (McPhie and Burrack, 2016, 2017). Yield loss is quite variable and depends on which buds are cut and which cultivars are fed upon (Kovach et al., 1999). Severe crop loss can be caused by high *A. signatus* infestations (Pritts et al., 1999). Early cultivars are more susceptible than late cultivars (Dorval, 1938; cited by Mailloux and Bostanian, 1993). Yield losses can have a 'devastating effect' on fruit growers because the loss occurs to the early season fruit which are the most valuable (Mailloux and Bostanian, 1993). Studies in the early 20th century cited in later literature quantify losses and note that reductions of 75% were not uncommon (Headlee, 1918; cited by Smith et al., 1997). Other quantified losses in strawberry are reported in Table 9.

Table 9: Impacts of *A. signatus* on strawberry fruit production reported in US and Canadian literature

Impact	Location	References
Damaging up to 60% of the buds	Manitoba	MacNay (1950) in Campbell et al. (1989)
Damaged 39% of the buds	South-western Quebec	Paradis et al. (1977) in Campbell et al. (1989)
10–64% of 800 inflorescences surveyed in 4 strawberry fields had injury from strawberry bud weevil	Maine	Handley et al. (2000)
Yield losses of 10–70%	Quebec	Paradis (1979) in Mailloux and Bostanian (1993)
Yield reduction 50–100%	New York	Schaefer (1978) in Mailloux and Bostanian (1993)

Later literature reports strawberry cultivars compensating the loss of buds by increasing fruit weight from remaining buds and increasing the number of higher order buds matured (English-Loeb et al., 1999; McPhie and Burrack, 2016, 2017). However, whether compensating growth sufficiently recovers losses from impacts on early season fruit is doubtful. Harvest timing may be affected by *A. signatus* damage (McPhie and Burrack, 2017) and additional impact, e.g. on quality, cannot be discarded.

As insecticides are the only management tool available against *A. signatus* (McPhie and Burrack, 2016), and the insect activity period coincides with strawberry bloom, pesticide applications targeting the weevil would coincide with bees and other pollinators visiting *Fragaria* (as they have entomophilous pollination). As a consequence, negative impacts on pollination services could occur.

3.5.1.2. Indirect pest impacts (e.g. by bacteria or viruses transmitted by the pest)

Whilst a comprehensive literature review was not conducted, of the literature that was used for this categorisation, there was no suggestion that *A. signatus* transmits any plant pathogens.

3.6. Availability and limits of mitigation measures

Are there measures available to prevent the entry into, establishment within or spread of the pest within the EU such that the risk becomes mitigated?

Yes. The likelihood of pest entry can be mitigated if host plants for planting are sourced from pest free areas. Host plants for planting, such as strawberry plants, should be inspected prior to export to the EU and found free from *A. signatus*. In places where the pest occurs, insecticides are the only management tool available against *A. signatus* (McPhie and Burrack, 2016).

3.6.1. Biological or technical factors affecting the feasibility and effectiveness of measures to prevent the entry, establishment and spread of the pest

Factors favouring the feasibility and effectiveness of measures to prevent entry, establishment and spread:

- Symptoms of the pest, i.e. cut buds, are visible during field inspections.
- Adults can be detected by visual inspection.
- Strawberry cuttings (stolons) traded as plants for planting without soil or growing media reduces the likelihood that overwintering stages will be present at pathway origin.
- Biological factors (one generation per year, sexual reproduction) hinder the likelihood of *A. signatus* establishing; sluggish movement would hinder its rate of spread in the EU.

Factors disfavouring the feasibility and effectiveness of measures to prevent entry, establishment and spread:

- If whole plants for planting are harvested with a little soil, rather than taking aerial runners (stolons), overwintering adults sheltering under older plants could be transported along the pathway.
- Larvae develop and pupate inside buds where they are protected from contact insecticides and natural enemies.

3.6.2. Control methods

- Growers use chemical insecticides to control *A. signatus* populations (Bostanian et al., 1999; McPhie and Burrack, 2016, 2017).
- Populations are suppressed by removing strawberry plants at the end of the season, to remove in field overwintering sites.
- Fields are kept weeds free and plant debris removed.
- Tolerant varieties are used in areas where the pest has a history of causing damage.
- Mixing staminate varieties (i.e. those with only male flowers) with pistillate varieties (only female flowers) in a ratio of 1:5 can lessen impacts (Metcalf and Metcalf, 1993).

3.7. Uncertainty

Although there are uncertainties, for example regarding the possible impacts that would result from *A. signatus* establishing within the EU, the uncertainties are not sufficient as to cast doubt as to whether *A. signatus* satisfies the criteria necessary for it to be regarded as a Union quarantine pest (Table 10).

4. Conclusions

A. signatus meets the criteria assessed by EFSA for consideration as a potential Union quarantine pest.

Table 10: 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	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Identity of the pest (Section 3.1)	The identity of the pest is well established; it can be identified to species using conventional entomological keys	The identity of the pest is well established; it can be identified to species using conventional entomological keys	Species identity is key for validity of the categorisation. Although the species may be renamed, its identity would not change
Absence/presence of the pest in the EU territory (Section 3.2)	The pest is not known to occur in the EU	The pest is not known to occur in the EU and therefore does not meet this criterion to qualify as a Union RNQP	Pest may be present in the EU at non damaging densities and therefore remain undetected
Regulatory status (Section 3.3)	For Union quarantine pests, regulatory status is not an explicit criterion to consider within 2016/2031 (but see below regarding feasible measures) The pest is currently officially regulated on <i>Fragaria</i> plants for planting by Dir 2000/29/EC	The criteria on pest presence, to be considered as potential regulated non - quarantine pest, is not met, therefore other criteria for consideration as RNQP do not need to be assessed	NONE
Pest potential for entry, establishment and spread in the EU territory (Section 3.4)	The pest could potentially enter, establish and spread in the EU At least two pathways, <i>Rubus</i> and <i>Fragaria</i> are possible for the pest to enter the EU	The pest is not present in the EU and therefore other criteria for consideration as an RNQP do not need to be assessed	The following uncertainties affect the likelihood of entry, establishment or spread but do not change the conclusion that entry, establishment and spread is possible: a) Are plants other than <i>Fragaria</i> and <i>Rubus</i> true hosts? b) Will industry practices change the way plants for planting are handled or the quality of imported plants change and facilitate entry? c) Is entry with fruit possible? d) What is the rate of natural spread? e) Will biotic factors inhibit establishment – e.g. competition from <i>A. rubi</i> ?
Potential for consequences in the EU territory (Section 3.5)	The establishment of the pest in the EU could cause yield losses to strawberry and <i>Rubus</i> fruit grown outdoors. The related European species <i>Anthonomus rubi</i> is regarded as a serious pest of strawberries and <i>A. signatus</i> could cause similar impacts	The pest is not present in the EU; therefore, other criteria for consideration as an RNQP do not need to be assessed	Much of the literature reporting yield losses is many years old, but it is still relevant today Some US <i>Fragaria</i> cultivars compensate damage to buds by increasing the size of remaining fruit. Would EU cultivars react in the same way?

Criterion of pest categorisation	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union quarantine pest	Panel's conclusions against criterion in Regulation (EU) 2016/2031 regarding Union regulated non-quarantine pest	Key uncertainties
Available measures (Section 3.6)	Phytosanitary measures are available to inhibit the likelihood of entry into the EU, e.g. sourcing host plants for planting from pest free areas; prohibiting soil from being carried with host plants for planting	The pest is not present in the EU; therefore, other criteria for consideration as an RNQP do not need to be assessed	The possibility that the pest is actually present in wider areas than thought may hinder the validity of the strategies including measures such as PFA, or PFPF
Conclusion on pest categorisation	<i>Anthonomus signatus</i> meets all of the criteria assessed by EFSA above for consideration as a potential Union quarantine pest	<i>Anthonomus signatus</i> is not known to occur in the EU and therefore does not meet at least one of the criteria assessed by EFSA for consideration as a Union regulated non quarantine pest	NONE
Aspects of assessment to focus on/scenarios to address in future if appropriate	While <i>Fragaria</i> and <i>Rubus</i> are recognised hosts, there is uncertainty over the status of other plants on which <i>A. signatus</i> has been found. Research is required to confirm whether such plants are truly hosts There is little uncertainty about the suitability of the abiotic environment in Europe for establishment but work is necessary to better understand the likelihood of entry. Of lesser priority is the clarification of the susceptibility of European host varieties to this pest		

References

- Ahmad M and Burke HR, 1972. Larvae of the weevil tribe Anthonomini (Coleoptera, Curculionidae). Miscellaneous Publications of the Entomological Society of America, 8, 31–81.
- Baerg WJ, 1923. The strawberry weevil. Arkansas Agricultural Experiment Station Bulletin, 185, 3–29.
- Baker RHA, 2012. An introduction to the PRATIQUÉ Research Project. EPPO Bulletin, 42, 1–2. <https://doi.org/10.1111/j.1365-2338.2011.02522.x>
- Bostanian NJ, Binns M, Kovach J, Racette G and Mailloux G, 1999. Predictive model for strawberry bud weevil (Coleoptera: Curculionidae) adults in strawberry fields. Environmental Entomology, 28, 398–406.
- Bousquet Y, 1991. *Checklist of beetles of Canada and Alaska*. Research Branch Agriculture Canada Publication, Ottawa, Canada.
- Burke HR, 1968. Pupae of the weevil tribe Anthonomini (Coleoptera: Curculionidae). Technical Monographs, Texas Agricultural Experiment Station, 5, 1–92.
- CABI, 2017. *Anthonomus signatus* (strawberry bud weevil). Cabi Crop Protection Compendium Datasheet, CABI Wallingford. Available online: <http://www.cabi.org/cpc/datasheet/5731> [Accessed: 27 March 2017]
- Campbell JM, Sarazin MJ and Lyons DB, 1989. Canadian beetles (Coleoptera) injurious to crops, ornamentals, stored products and buildings. Research Branch Agriculture Canada, Public No. 1826. 491 p.
- Clark WE, 1991. The *Anthonomus-Curvirostris* species group (Coleoptera, Curculionidae). Transactions of the American Entomological Society, 117, 39–66.
- Clarke RG and Howitt AJ, 1975. Development of the strawberry weevil under laboratory and field conditions. Annals of the Entomological Society of America 68, 715–718.
- CSL, 1998. *Strawberry weevils*. Quarantine Identification Card No. 33. Central Science Laboratory, York, UK.
- EFSA PLH Panel (EFSA Panel on Plant Health), 2010. PLH Guidance on a harmonised framework for pest risk assessment and the identification and evaluation of pest risk management options by EFSA. EFSA Journal 2010;8(2):1495, 66 pp. <https://doi.org/10.2093/j.efsa.2010.1495>
- English-Loeb G, Pritts M, Kovach J, Rieckenberg R and Kelly MJ, 1999. Compensatory ability of strawberries to bud and flower removal: Implications for managing the strawberry bud weevil (Coleoptera: Curculionidae). Journal of Economic Entomology, 92, 915–921.
- EPPO, 2008. Draft commodity-specific phytosanitary procedure: consignment inspection of *Fragaria* plants for planting. Bulletin OEPP/EPPO Bulletin, 38, 396–406.
- EPPO, 2017. EPPO Global Database. Available online: <https://gd.eppo.int>
- FAO (Food and Agriculture Organization of the United Nations), 2004. ISPM (International Standards for Phytosanitary Measures) 21—Pest risk analysis of regulated non-quarantine pests. FAO, Rome, 30 pp. Available online: https://www.ippc.int/sites/default/files/documents/1323945746_ISPM_21_2004_En_2011-11-29_Refor.pdf
- FAO (Food and Agriculture Organization of the United Nations), 2013. ISPM (International Standards for Phytosanitary Measures) 11—Pest risk analysis for quarantine pests. FAO, Rome, 36 pp. Available online: https://www.ippc.int/sites/default/files/documents/20140512/ispm_11_2013_en_2014-04-30_201405121523-494.65%20KB.pdf
- Foord K, Hahn J and Grabowski M, 2017. Strawberry bud weevil. Pest management for the home strawberry patch. University of Minnesota Extension. Available online: <http://www.extension.umn.edu/garden/yard-garden/fruit/pest-management-in-the-home-strawberry-patch/strawberry-bud-weevil/> [Accessed: 28 March 2017].
- Handley DT and Dill JF, 2009. A strawberry integrated pest management program for a cold climate, direct-marketing region. Acta Horticulturae, 842, 645–648.
- Handley DT, Wheeler A and Dill JF, 2000. A Survey of Strawberry Inflorescence Injury Caused by Strawberry Bud Weevil, *Anthonomus signatus*. Abstracts. 97th Annual International Conference of the American Society for Horticultural Science, Disney's Coronado Spring Resort, Lake Buena Vista, Florida, USA 23–26 July 2000.
- Howard CS, 2007. The Impact of the Strawberry Bud Weevil (*Anthonomus signatus*) on Raspberry (*Rubus idaeus*) in Maine. University of Maine MSc Thesis, Electronic Theses and Dissertations. Paper 623.
- ISEFOR. Available online: <http://www.isefor.com/index.php>
- Kottek M, Grieser J, Beck C, Rudolf B and Rubel F, 2006. World map of Köppen- Geiger climate classification updated. Meteorologische Zeitschrift, 15, 259–263.
- Kovach J, Wilcox W, Agnello A and Pritts M, 1993. *Strawberry IPM scouting procedures: a guide to sampling for common pests in New York State*. NY IPM No. 203b. Cornell Cooperative Extension, Cornell University, Ithaca, NY.
- Kovach J, Rieckenberg R, English-Loeb G and Pritts M, 1999. Oviposition patterns of the strawberry bud weevil (Coleoptera : Curculionidae) at two spatial scales and implications for management. Journal of Economic Entomology, 92, 1358–1363.
- Mailloux G and Bostanian NJ, 1993. Development of the strawberry bud weevil (Coleoptera: Curculionidae) in strawberry fields. Annals of the Entomological Society of America, 86:384–393.

- McPhie D and Burrack HJ, 2016. Effects of microbial, organically acceptable, and reduced risk insecticides on *Anthonomus signatus* (Curculionidae: Coleoptera) in strawberries (*Fragaria ananassa*). *Crop Protection*, 89, 255–258. <https://doi.org/10.1016/j.cropro.2016.07.034>
- McPhie D and Burrack HJ, 2017. Effect of Simulated *Anthonomus signatus* (Coleoptera: Curculionidae) Injury on Strawberries (*Fragaria* × *ananassa*) Grown in Southeastern Plasticulture Production. *Journal of Economic Entomology*, 110, 208–212. <https://doi.org/10.1093/jee/tow266>
- Metcalf RL and Metcalf RA, 1993. *Destructive & Useful Insects*, 5th Edition. McGraw-Hill, New York.
- Monfreda C, Ramankutty N. and Foley JA, 2008. Farming the planet: 2. Geographic distribution of crop areas, yields, physiological types, and net primary production in the year 2000. *Global Biogeochemical Cycles*, 22, 1–19.
- Pritts MP, Kelly MG and English-Loeb G, 1999. Strawberry Cultivars Compensate for Simulated Bud Weevil (*Anthonomus signatus* Say) Damage in Matted Row Plantings', *HortScience*, 34, 109–111.
- Schaefer G, 1978. Efficacy of Lorsban brand insecticides for the reduction of strawberry 'bud' weevil, *Anthonomus signatus* Say, damage in strawberries. *Down to Earth*, 35, 1–3.
- Smith IM, McNamara DG, Scott PR and Holderness M, 1997. *Anthonomus signatus*. In *Quarantine Pests for Europe*, 2nd Edition. CABI / EPPO, Wallingford, 1425 pp.
- Sorensen KA, 1993. The strawberry weevil. Available online: http://ipm.ncsu.edu/small_fruit/Strawberry_Weevil.html [Accessed: 28 March 2017]

Abbreviations

EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization of the United Nations
IPPC	International Plant Protection Convention
ISEFOR	Increasing Sustainability of European Forests
MS	Member State
PLH	EFSA Panel on Plant Health
RNQP	regulated non-quarantine pest
TFEU	Treaty on the Functioning of the European Union
ToR	Terms of Reference