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SCIENTIFIC OPINION

Scientific Opinion on pest categorisation of *Circulifer haematoceps* and *C. tenellus*[1]

EFSA Panel on Plant Health (PLH)[2, 3]

European Food Safety Authority (EFSA), Parma, Italy

ABSTRACT

The Panel on Plant Health performed a pest categorisation of *Circulifer tenellus* (Ct) and *C. haematoceps* (Ch) (Hemiptera, Cicadellidae) for the European Union (EU) territory. They are well-defined insect species that can be identified on the basis of external morphology and male genitalia. Ch and Ct are considered to originate from the Old World; Ct is also present in North America and the Caribbean. In the EU, Ch is reported in 11 Member States, mostly in southern or central Europe, and Ct is reported in Spain, France, Italy and Greece. Neither species is harmful by itself, but they are vectors of *Spiroplasma citri*, the causal agent of, for example, citrus stubborn disease. The major impact of Ct in North America results from the transmission of *Beet curly top virus* to sugarbeet. Ct also transmits '*Candidatus* Phytoplasma trifolii' and Ch transmits '*Ca* P. asteris'. There is no transovarial transmission of the pathogens. Ch and Ct are regulated harmful organisms in the EU and listed in Annex II, Part A, Section II, of Council Directive 2000/29/EC together with *Spiroplasma citri* and with respect to plants of *Citrus*, *Fortunella*, *Poncirus* and their hybrids, other than fruit and seeds, despite the fact that Ct and Ch have a larger host range. Ch and Ct are likely to be disseminated by plants for planting (the eggs are laid into the leaf veins and petioles), they have also been observed to hitch-hike on terrestrial vehicles, and Ct is known for its very high flight capacity. Both species have many hosts, in particular in the Chenopodiaceae, Brassicaceae and Asteraceae. Ecological conditions in the risk assessment area are suitable for the establishment and spread of *S. citri*, at least where citrus is currently grown.

KEY WORDS

Circulifer tenellus (Ct), *C. haematoceps* (Ch), *Spiroplasma citri*, pest categorisation, *Beet curly top virus*, quarantine pest

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[1] On request from the European Commission, Question Nos EFSA-Q-2014-00268 and EFSA-Q-2014-00269, adopted on 30 December 2014.

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BACKGROUND AS PROVIDED BY THE EUROPEAN COMMISSION

The current European Union plant health regime is established by 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 (OJ L 169, 10.7.2000, p. 1).

The Directive lays down, amongst others, the technical phytosanitary provisions to be met by plants and plant products 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, the list of harmful organisms whose introduction into or spread within the Union is prohibited and the control measures to be carried out at the outer border of the Union on arrival of plants and plant products.

The Commission is currently carrying out a revision of the regulatory status of organisms listed in the Annexes of Directive 2000/29/EC. This revision targets mainly organisms which are already locally present in the EU territory and that in many cases are regulated in the EU since a long time. Therefore it is considered to be appropriate to evaluate whether these organisms still deserve to remain regulated under Council Directive 2000/29/EC, or whether, if appropriate, they should be regulated in the context of the marketing of plant propagation material, or be deregulated. The revision of the regulatory status of these organisms is also in line with the outcome of the recent evaluation of the EU Plant Health Regime, which called for a modernisation of the system through more focus on prevention and better risk targeting (prioritisation).

In order to carry out this evaluation, a recent pest risk analysis is needed which takes into account the latest scientific and technical knowledge on these organisms, including data on their agronomic and environmental impact, as well as their present distribution in the EU territory. In this context, EFSA has already been asked to prepare risk assessments for some organisms listed in Annex IIAII. The current request concerns 23 additional organisms listed in Annex II, Part A, Section II as well as five organisms listed in Annex I, Part A, Section I, one listed in Annex I, Part A, Section II and nine organisms listed in Annex II, Part A, Section I of Council Directive 2000/29/EC. The organisms in question are the following:

Organisms listed in Annex II, Part A, Section II:

- *Ditylenchus destructor* Thome
- *Circulifer haematoceps*
- *Circulifer tenellus*
- *Helicoverpa armigera* (Hübner)
- *Radopholus similis* (Cobb) Thome (could be addressed together with the HAI organism *Radopholus citrophilus* Huettel Dickson and Kaplan)
- *Paysandisia archon* (Burmeister)
- *Clavibacter michiganensis* spp. *insidiosus* (McCulloch) Davis *et al.*
- *Erwinia amylovora* (Burr.) Winsl. *et al.* (also listed in Annex IIB)
- *Pseudomonas syringae* pv. *persicae* (Prunier *et al.*) Young *et al.*
- *Xanthomonas campestris* pv. *phaseoli* (Smith) Dye
- *Xanthomonas campestris* pv. *pruni* (Smith) Dye
- *Xylophilus ampelinus* (Panagopoulos) Willems *et al.*
- *Ceratocystis fimbriata* f. sp. *platani* Walter (also listed in Annex IIB)
- *Cryphonectria parasitica* (Murrill) Barr (also listed in Annex IIB)
- *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili
- *Verticillium albo-atrum* Reinke and Berthold
- *Verticillium dahliae* Klebahn
- Beet leaf curl virus
- Citrus tristeza virus (European isolates) (also listed in Annex IIB)
- Grapevine flavescence dorée MLO (also listed in Annex IIB)

- Potato stolbur mycoplasma
- *Spiroplasma citri* Saglio *et al.*
- Tomato yellow leaf curl virus

Organisms listed in Annex I, Part A, Section I:

- *Rhagoletis cingulata* (Loew)
- *Rhagoletis ribicola* Doane
- Strawberry vein banding virus
- Strawberry latent C virus
- Elm phloem necrosis mycoplasm

Organisms listed in Annex I, Part A, Section II:

- *Spodoptera littoralis* (Boisd.)

Organisms listed in Annex II, Part A, Section I:

- *Aculops fuchsiae* Keifer
- *Aonidiella citrina* Coquillet
- Prunus necrotic ringspot virus
- Cherry leafroll virus
- *Radopholus citrophilus* Huettel Dickson and Kaplan (could be addressed together with IIAII organism *Radopholus similis* (Cobb) Thome)
- *Scirtothrips dorsalis* Hendel
- *Atropellis* spp.
- *Eotetranychus lewisi* McGregor
- *Diaporthe vaccinii* Shaer.

TERMS OF REFERENCE AS PROVIDED BY EUROPEAN COMMISSION

EFSA is requested, pursuant to Article 29(1) and Article 22(5) of Regulation (EC) No 178/2002, to provide a pest risk assessment of *Ditylenchus destructor* Thome, *Circulifer haematoceps*, *Circulifer tenellus*, *Helicoverpa armigera* (Hübner), *Radopholus similis* (Cobb) Thome, *Paysandisia archon* (Burmeister), *Clavibacter michiganensis* spp. *insidiosus* (McCulloch) Davis *et al*, *Erwinia amylovora* (Burr.) Winsl. *et al*, *Pseudomonas syringae pv. persicae* (Prunier *et al)* Young *et al. Xanthomonas campestris* pv. *phaseoli* (Smith) Dye, *Xanthomonas campestris* pv. *pruni* (Smith) Dye, *Xyîophilus ampelinus* (Panagopoulos) Willems *et al*, *Ceratocystis fimbriata* f. sp. *platani* Walter, *Cryphonectria parasitica* (Murrill) Barr, *Phoma tracheiphila* (Petri) Kanchaveli and Gikashvili, *Verticillium alboatrum* Reinke and Berthold, *Verticillium dahliae* Klebahn, Beet leaf curl virus, Citrus tristeza virus (European isolates), Grapevine flavescence dorée MLO, Potato stolbur mycoplasma, *Spiroplasma citri* Saglio *et al*, Tomato yellow leaf curl virus, *Rhagoletis cingulata* (Loew), *Rhagoletis ribicola* Doane, Strawberry vein banding virus, Strawberry latent C virus, Elm phloem necrosis mycoplasma, *Spodoptera littoralis* (Boisd.), *Aculops fuchsiae* Keifer, *Aonidiella citrina* Coquillet, Prunus necrotic ringspot virus, Cherry leafroll virus, *Radopholus citrophilus* Huettel Dickson and Kaplan (to address with the IIAII *Radopholus similis* (Cobb) Thome), *Scirtothrips dorsalis* Hendel, *Atropellis* spp., *Eotetranychus lewisi* McGregor *md Diaporthe vaccinii* Shaer., for the EU territory.

In line with the experience gained with the previous two batches of pest risk assessments of organisms listed in Annex II, Part A, Section II, requested to EFSA, and in order to further streamline the preparation of risk assessments for regulated pests, the work should be split in two stages, each with a specific output. EFSA is requested to prepare and deliver first a pest categorisation for each of these 38 regulated pests (step 1). Upon receipt and analysis of this output, the Commission will inform EFSA for which organisms it is necessary to complete the pest risk assessment, to identify risk reduction options and to provide an assessment of the effectiveness of current EU phytosanitary requirements (step 2). *Clavibacter michiganensis* spp. *michiganensis* (Smith) Davis *et al.* and *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye, from the second batch of risk assessment requests for Annex IIAII organisms requested to EFSA (ARES(2012)880155), could be used as pilot cases for this approach, given that the working group for the preparation of their pest risk assessments has been constituted and it is currently dealing with the step 1 “pest categorisation”. This proposed modification of previous request would allow a rapid delivery by EFSA by May 2014 of the first two outputs for step 1 “pest categorisation”, that could be used as pilot case for this request and obtain a prompt feedback on its fitness for purpose from the risk manager's point of view.

As indicated in previous requests of risk assessments for regulated pests, in order to target its level of detail to the needs of the risk manager, and thereby to rationalise the resources used for their preparation and to speed up their delivery, for the preparation of the pest categorisations EFSA is requested, in order to define the potential for establishment, spread and impact in the risk assessment area, to concentrate in particular on the analysis of the present distribution of the organism in comparison with the distribution of the main hosts and on the analysis of the observed impacts of the organism in the risk assessment area.

ASSESSMENT

1. Introduction

1.1. Purpose

This document presents a pest categorisation prepared by the EFSA Scientific Panel on Plant Health (hereinafter referred to as the Panel) for the species *Circulifer haematoceps* and *Circulifer tenellus* in response to a request from the European Commission (EC). The original request was to present a separate opinion for each of the two species. However, as the species have many common features regarding their biology, the organisms they vector, their impact and the risk reduction options that can be applied against them, the Panel considered that treating both species together would spare a large amount of unnecessary duplication.

1.2. Scope

This pest categorisation is for *Circulifer haematoceps* and *Circulifer tenellus*. The terms Ch and Ct will also be used in this opinion and refer, respectively, to *Circulifer haematoceps* and *Circulifer tenellus*.

The pest risk assessment area is the territory of the European Union (hereinafter referred to as the EU) with 28 Member States (hereinafter referred to as EU MS), restricted to the area of application of Council Directive 2000/29/EC, which excludes Ceuta and Melilla, the Canary Islands and the French overseas departments.

2. Methodology and data

2.1. Methodology

The Panel performed the pest categorisation for Ch and Ct, 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 as result of the review or revision of phytosanitary policies and priorities. As explained in the background of the European Commission request, the objective of this mandate is to provide updated scientific advice to European risk managers to take into consideration when evaluating whether those organisms listed in the annexes of Council Directive 2000/29/EC deserve to remain regulated under Council Directive 2000/29/EC, or whether they should be regulated in the context of the marketing of plant propagation material, or should be deregulated. Therefore, to facilitate the decision-making process, in the conclusions of the pest categorisation, the Panel addresses explicitly each criterion for a quarantine pest in accordance with ISPM 11 (FAO, 2013) but also for a regulated non-quarantine pest (RNQP) in accordance with ISPM 21 (FAO, 2004) 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 ISPM 11 (FAO, 2013) and ISPM 21 (FAO, 2004) pest categorisation criteria on which the Panel bases its conclusions. 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 regulation[4]); 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, in

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[4] 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.

agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

Table 1: International Standards for Phytosanitary Measures ISPM 11 (FAO, 2013) and ISPM 21 (FAO, 2004) pest categorisation criteria under evaluation

Pest categorisation criteria	**ISPM 11 for being a potential quarantine pest**	**ISPM 21 for being a potential regulated non-quarantine pest**
Identity of the pest	The identity of the pest should be clearly defined to ensure that the assessment is being performed on a distinct organism, and that biological and other information used in the assessment is relevant to the organism in question. If this is not possible because the causal agent of particular symptoms has not yet been fully identified, then it should have been shown to produce consistent symptoms and to be transmissible	The identity of the pest is clearly defined
Presence (ISPM 11) or absence (ISPM 21) in the PRA area	The pest should be **<u>absent from all or a defined part of the PRA area</u>**	The pest is **<u>present</u>** in the PRA area
Regulatory status	If the pest is present but not widely distributed in the PRA area, it should be under official control or expected to be under official control in the near future	The pest is under official control (or being considered for official control) in the PRA area with respect to the specified plants for planting
Potential for establishment and spread in the PRA area	The PRA area should have ecological/climatic conditions including those in protected conditions suitable for the establishment and spread of the pest and, where relevant, host species (or near relatives), alternative hosts and vectors should be present in the PRA area	–
Association of the pest with the plants for planting and the effect on their intended use	–	Plants for planting are a pathway for introduction and spread of this pest
Potential for consequences (including environmental consequences) in the PRA area	There should be clear indications that the pest is likely to have an unacceptable economic impact (including environmental impact) in the PRA area	–
Indication of impact(s) of the pest on the intended use of the plants for planting	–	The pest may cause severe economic impact on the intended use of the plants for planting

Pest categorisation criteria	ISPM 11 for being a potential quarantine pest	ISPM 21 for being a potential regulated non-quarantine pest
Conclusion	If it has been determined that the pest has the potential to be a quarantine pest, the PRA process should continue. If a pest does not fulfil all of the criteria for a quarantine pest, the PRA process for that pest may stop. In the absence of sufficient information, the uncertainties should be identified and the PRA process should continue	If a pest does not fulfil all the criteria for an regulated non-quarantine pest, the PRA process may stop

In addition, in order to reply to the specific questions listed in the terms of reference, three issues are specifically discussed only for pests already present in the EU: the analysis of the present EU distribution of the organism in comparison with the EU distribution of the main hosts, the analysis of the observed impacts of the organism in the EU and the pest control and cultural measures currently implemented in the EU.

The Panel will not indicate in its conclusions of the pest categorisation whether to continue the PRA process as it is clearly stated in the terms of reference that at the end of the pest categorisation the European Commission will indicate if further risk assessment work is required following its analysis of the Panel's scientific opinion.

2.2. Data

2.2.1. Literature search

A literature search on *Circulifer haematoceps* and *Circulifer tenellus* was conducted at the beginning of the mandate. The search was conducted for the scientific name of the pest together with the most frequently used common names and old synonyms such as beet leafhopper or *Euttetix tenella* for Ct or *Neoaliturus haematoceps* for Ch on the ISI Web of Knowledge database. Further references and information were obtained from experts, from citations within the references and grey literature.

2.2.2. Data collection

To complement the information concerning the current situation of the pest provided by the literature and online databases on pest distribution, damage and management, the PLH Panel sent a short questionnaire on the current situation at country level, based on the information available in the European and Mediterranean Plant Protection Organization (EPPO) Plant Quarantine Retrieval (PQR) to the National Plant Protection Organisation (NPPO) contacts of all the EU MS. A summary table on the pest status based on EPPO PQR and MS replies is presented in Table 2.

3. Pest categorisation

3.1. Identity and biology of the vector organisms *Circulifer haematoceps* and *Circulifer tenellus*

3.1.1. Taxonomy

Kingdom: Animalia
  Phylum: Arthropoda
    Class: Insecta
      Order: Hemiptera
        Family: Cicadellidae
          Sub-family: Deltocephalinae
            Genus: *Circulifer*
              Species:

              Circulifer haematoceps (Mulsant and Rey, 1855) and
              Circulifer tenellus (Baker 1896)

3.1.2. Biology of *C. haematoceps* and *C. tenellus*

Ch and Ct belong to the family Cicadellidae, sub-family Deltocephalinae. Insects from this sub-family are typically phloem sap feeders and many of them are known vectors of phloem-limited wall-less bacteria and plant viruses. *Circulifer* spp. have piercing–sucking mouthparts, are heterometabolous and have an egg, five nymphal instars and a winged adult stage. They have a variable number of generations per year depending on the geographic area (from one to six) and overwintering is sustained by the adult stage, mainly mated females (Meyerdirk and Hessein, 1985; Bindra and Deol, 1972), largely in uncultivated areas (Calavan and Bové, 1989). Life cycle, developmental time, fecundity and longevity have been studied in more detail for Ct than for Ch. However, available data seem to suggest that the two species have a similar biology. Developmental time from egg to adult is strongly dependent on temperature and may vary from 19 to 119 days for Ct (Harris and Douglass, 1948, in Meyerdirk and Hessein, 1985). Each female can lay from 1 to 200 eggs in the leaf veins and petioles of the host plants (Meyerdirk and Moratorio, 1987). Adult males and females may live up to three and five months, respectively (Bindra and Deol, 1972), but average longevity is shorter: about two months on beet plants (Meyerdirk and Moratorio, 1987). Both Ch (Frazier, 1953; Young and Frazier, 1954; Fos et al., 1985; Klein and Raccah, 1991; Baspinar et al., 1993; Sertkaya and Cinar, 2002) and Ct (Severin, 1933; Hills, 1935; Frazier, 1953; Meyerdirk and Hessein, 1985; Golino et al., 1988; Bayoun et al., 2008; Munyaneza and Upton, 2005) are highly polyphagous, feeding on a variety of herbaceous plants (weeds and cultivated) and shrubs. The most common host plants belong to the Chenopodiaceae (*Salsola kali*, *Salsola pestifer*, *Chenopodium album*), Brassicaceae (*Mathiola incana*, *M. sinuata*), Amaranthaceae (*Atriplex* sp.) and Fabaceae (*Alhagi mannifera*) families (Frazier, 1953). Plant species from other families can also host immature stages, thus broadening the host range. Adults have been found on an even broader range of plant species (Severin, 1933).

The dispersal and migration capabilities of Ct have been described in the USA. Spring dispersal from the uncultivated plains and foothills into the cultivated areas and autumn return flights from the cultivated areas to the uncultivated plains and foothills are documented in California. These seasonal dispersals occur over relatively long distances, in the range of tens of miles. Migrations over even longer distances have also been documented, from the desert weeds in Utah, on which Ct breeds, to the sugarbeet areas up to 300 km away that are annually invaded. The same applies to migrations from the southwestern part of the USA or northern Mexico to Miami, Florida (Severin, 1933; Dorst and Davis, 1937). DeLong (1971) describes mass migrations, presumably wind-borne, with ‘piling up’ at weather fronts and usually associated with large populations. Glick (1957) reports catching a Ct individual at an altitude of 2 000 feet (610 m) from an aeroplane in Texas. During the massive dispersal of Ct, adults were observed on cars (Severin, 1933) and, therefore, the transportation of Ct via vehicles may also be an important factor. The dispersal capacity of Ch is not documented.

Ct and Ch are reported to be vectors of *Spiroplasma citri* (Rana et al., 1975; Fos et al., 1985), the agent of stubborn disease of citrus and of other yellowing diseases of plants (EFSA, 2014). Ct can also transmit strains of '*Candidatus* Phytoplasma trifolii', and Ch can transmit a strain of '*Ca.* P. asteris' (Munyaneza et al., 2006; Salehi et al., 2010). All these phloem-limited bacteria colonise their insect vectors after an acquisition access period and are transmitted in a persistent manner over the lifespan of the insect but are not transmitted transovarially (Liu et al., 1983; Weintraub and Beanland, 2006).

A range of viruses in the family Geminiviridae are transmitted by *Circulifer* spp. (see section 3.2.3.2). The most studied interaction is that between Ct and *Beet curly top virus* (BCTV) but results obtained with other virus–vector combinations provide a similar picture (Harrison, 1985; Soleimani et al., 2009). The virus is acquired after a relatively short acquisition period, and following a short latent period it is retained for up to several weeks (Magyarosi and Sylvester, 1979; Soto and Gilbertson, 2003). There is evidence of trans-stadial transmission but not of transovarial transmission to the progeny of viruliferous insects (Soto and Gilbertson, 2003). All of these properties are compatible with a circulative, non-propagative mode of transmission, in which the virus circulates extensively through the insect body before accumulating in the salivary glands, but does not replicate in the insect (Soto and Gilbertson, 2003).

3.1.3. Intraspecific diversity

The existence of intraspecific variants has been claimed for both Ch (Klein and Raccah, 1991) and Ct (Young and Frazier, 1954; Oman, 1970; Klein and Raccah, 1987; de Almeida et al., 1997) but their distinction has not been fully substantiated. It is possible that these morphs belong to different species that are difficult to distinguish on the basis of male genitalia (Oman, 1970; Klein and Raccah, 1992). For this reason, the term 'species complex' or 'species group' has been repeatedly used (Frazier, 1953; Oman, 1970; Klein and Raccah, 1991, 1992; de Almeida et al., 1997).

3.1.4. Detection and identification of *C. haematoceps* and *C. tenellus*

Species identification relies mainly on the examination of male genitalia; however, owing to the wide range of morph variation and of morphological convergence between species, the identification of *Circulifer* spp. at the species level is challenging, particularly for the two closely related species Ch and *C. opacipennis*. Intergradation between members of a given population and between populations is extremely common in the *Circulifer* genus. The females are particularly difficult to separate (Young and Frazier, 1954). However, identification based on external morphology and male genitalia is routinely applied for both Ch and Ct.

3.2. Current distribution of the vectors *C. haematoceps* and *C. tenellus*

3.2.1. Global distribution of *C. haematoceps* and *C. tenellus*

Ch is a species restricted to the Old World and, according to EPPO (Figure 1) and Fauna Europaea data (de Jong, 2013), it is present in several European countries, in northern Africa and in the Middle East, including the Arabian peninsula and Iran. Ct has a wider geographical distribution, including North America, the Caribbean, European and North African Mediterranean countries, Sudan, Angola, South Africa as well as the Middle East, Iran, a few Central Asia countries and India (Figure 2). The area of origin of Ct is debated. According to Severin (1933), it is native to North America, from Canada to Mexico. Other authors, based on the evidence that Ct is the only species of this genus represented in North America, suggest an Old World origin (Oman, 1948; Young and Frazier, 1954). From what is known of the ecology of *Circulifer* species, all appear to inhabit regions that are relatively dry (Young and Frazier, 1954).

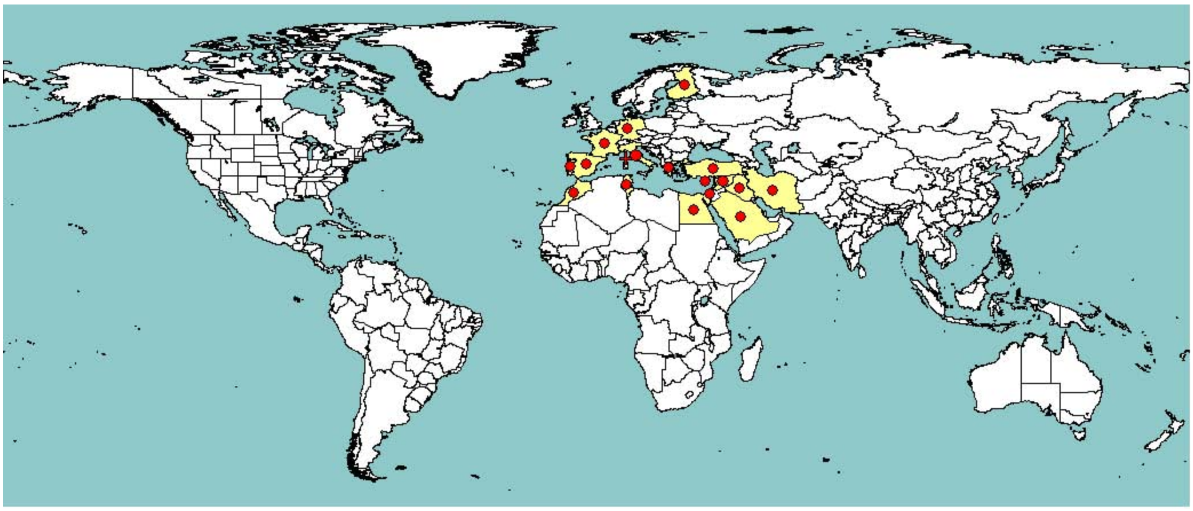

Figure 1: Global distribution of *C. haematoceps* (extracted from EPPO PQR, version 5.3.1, accessed November 2014). Red circles represent pest presence as national records and red crosses represent pest presence as sub-national records (note that this figure combines information from different dates, some of which could be out of date)

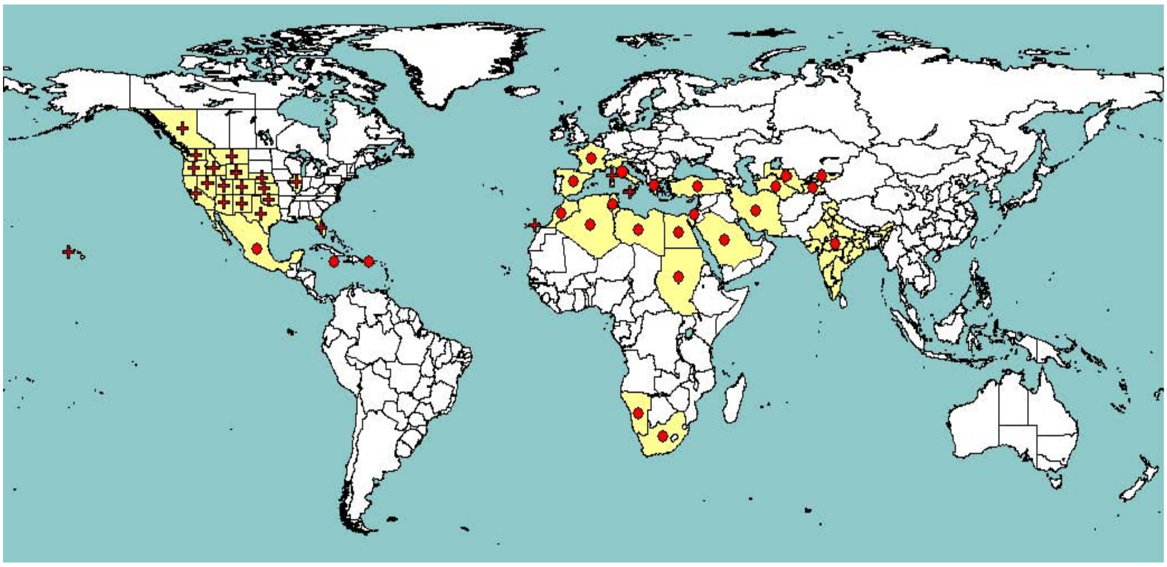

Figure 2: Global distribution of *C. tenellus*, (extracted from EPPO PQR, version 5.3.1, accessed November 2014). Red circles represent pest presence as national records and red crosses represent pest presence as sub-national records (note that this figure combines information from different dates, some of which could be out of date)

3.2.2. *C. haematoceps* and *C. tenellus*, distribution in the EU

Ch is reported from the following European countries: Portugal, Spain, France (including Corsica), Switzerland, Germany, the Czech Republic, Hungary, Finland Italy, former Yugoslavia, Romania, Greece and Cyprus (Fauna Europaea, de Jong, 2013; EPPO PQR, 2014; Nickel and Remane, 2002). It is not possible to infer from the Fauna Europaea database the detailed reported presence in the countries of the former Yugoslavia: therefore the term 'former Yugoslavia' was used, without trying to disentangle the information for individual countries. There are discrepancies between the information available in Fauna Europaea or in the EPPO PQR and answers received to the EFSA questionnaire from individual MS for Germany, Hungary and Finland.

Ct is reported from the following European countries: Spain (including Canary Islands), France, Italy (including Sicily) and Greece.

According to Frazier (1953), in all the Mediterranean countries Ch is more common, more abundant and found on a greater variety of host plants than Ct.

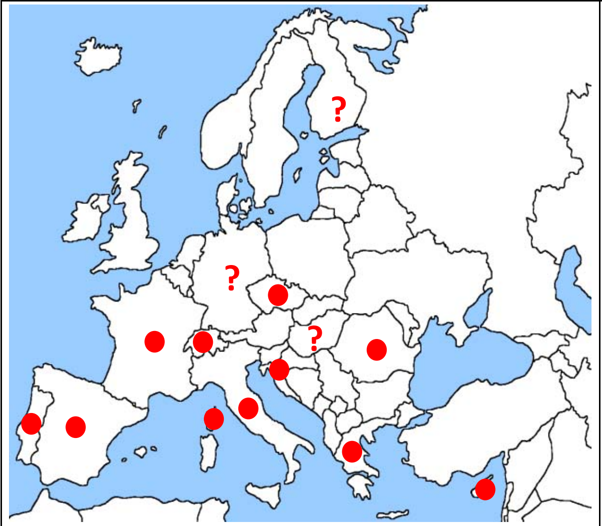

Figure 3: European distribution of *C. haematoceps* extracted from de Jong (2013), EPPO PQR (2014) and Nickel and Remane (2002). Germany: present according to Nickel and Remane (2002), absent according to EPPO PQR and de Jong (2013); Finland: absent according to de Jong (2013) and present, but invalid record according to EPPO PQR; Hungary: absent according to EPPO PQR (2014), present according to de Jong (2013)

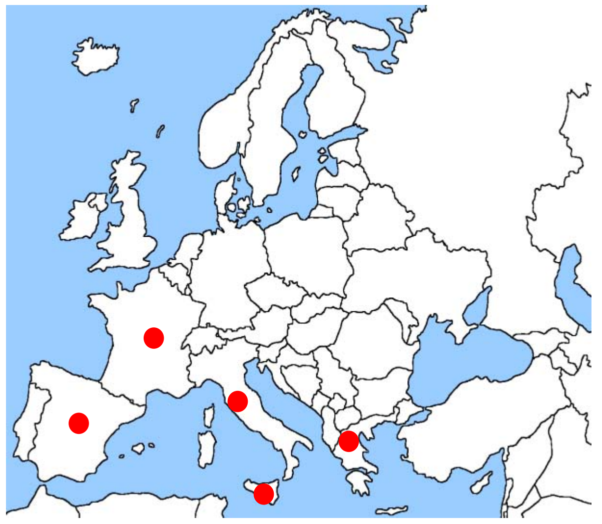

Figure 4: European distribution of *C. tenellus* extracted from de Jong (2013) and EPPO PQR (2014)

Table 2: Current distribution *C. haematoceps* and C. *tenellus* in the 28 EU MS, Iceland and Norway, based on answers received via email from NPPOs or, in the absence of a reply, on information from EPPO PQR (2014), and other sources if relevant

Country	**NPPO answers**		**Other sources**
	C. haematoceps	*C. tenellus*	
Austria	Absent, no pest records	Absent, no pest records	
Belgium	Absent, confirmed by survey	Absent, confirmed by survey	
Bulgaria	Absent	Absent	
Croatia	Absent, no pest records	Absent, no pest records	
Cyprus			*C. haematoceps*: "Present, no details" (EPPO PQR, 2014)
Czech Republic	Present, few occurrences	Absent, no record	
Denmark	Not known to occur	Not known to occur	
Estonia	Absent: no pest records	Absent: no pest records	
Finland	Present, invalid records	Absent, no record	*C. haematoceps*: "Present, no details" (EPPO PQR, 2014)
France	Present, restricted distribution	Present, restricted distribution	
Germany	Absent, pest no longer present	Absent, no record	*C. haematoceps*: present (Nickel and Remane, 2002)
Greece	–	-	-
Hungary	Absent: no pest records	Absent: no pest records	*C. haematoceps*: no record in EPPO PQR (2014), present according to de Jong (2013).
Ireland	Absent: no pest records	Absent: no pest records	
Italy	Present, restricted distribution	Present, restricted distribution	*C. haematoceps*: "Present, restricted distribution" (mainland) (EPPO PQR, 2014). *C. tenellus*: "Present, restricted distribution" (mainland); "Present, no details" (Sicily) (EPPO PQR, 2014)
Latvia	–	–	–
Lithuania	–	–	–
Luxembourg	–	–	–
Malta	Present, restricted distribution	Present, restricted distribution	
Poland	Absent: no pest records	Absent: no pest records	
Portugal	Present	No records	
Romania	–	–	–
Slovak Republic	Absent, no pest record	Absent, no pest record	
Slovenia	Absent on *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf.: confirmed by monitoring 2000–2004	Absent on *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf.: confirmed by monitoring 2000–2004	

Country	**NPPO answers**		**Other sources**
Spain	Present	Present	*C. haematoceps*: “Present, no details” (EPPO PQR, 2014). *C. tenellus*: “Restricted distribution” (mainland); “Present, no details” (Canary Islands) (EPPO PQR, 2014)
Sweden	Absent: no pest records	Absent: no pest records	
The Netherlands	Absent, confirmed by survey	Absent, confirmed by survey	
United Kingdom	Absent	Absent	
Iceland	–	–	–
Norway	–	–	–
Switzerland^(a)	–	–	–

(a): Switzerland was not included in the NPPO consultation.
–, no information available; EPPO PQR, European and Mediterranean Plant Protection Organization Plant Quarantine Data Retrieval System; NPPO, National Plant Protection Organisation.

In the Europhyt database no interception of Ct and Ch has been reported so far, up to December 2014.

3.2.3. Organisms vectored by *Circulifer* spp. and their distribution in the EU

3.2.3.1. Spiroplasmas and phytoplasmas vectored by *Circulifer* spp. and their distribution in the EU

Ct and Ch are known vectors of *S. citri*, the agent responsible for the stubborn disease of citrus (Rana et al., 1975; Fos et al., 1985), also reported as ‘little leaf disease’ of citrus in Palestine by Reichert in 1928 (reviewed by Calavan and Bové, 1989).

S. citri is a regulated organism for which EFSA has recently performed a pest categorisation (EFSA, 2014; see section 3.3). After acquiring *S. citri* by feeding on infected plants, the midgut, haemocoel and salivary glands of Ct and Ch are colonised and they transmit *S. citri* in a persistent manner through infected saliva (Liu et al., 1983). As reported in EFSA (2014) and in Figure 3, *S. citri* is present only in Cyprus, France (Corsica only, detected on infectious insects), Italy and Spain, although no recent extensive survey has been carried out in the EU.

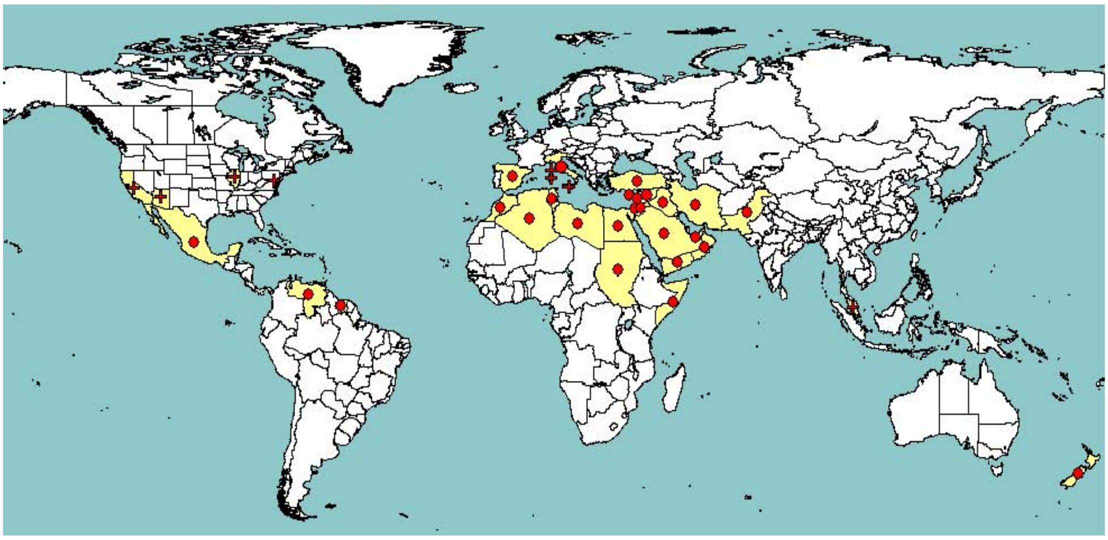

Figure 5: Global distribution of *Spiroplasma citri* (extracted from EPPO PQR, 2014). Red circles represent pest presence as national records and red crosses represent pest presence as sub-national records (note that this figure combines information from different dates, some of which could be out of date)

Ct also transmits the beet leafhopper-transmitted virescence agent (BLTVA; Oldfield et al., 1977), a strain of '*Candidatus* Phytoplasma trifolii' (Hiruki and Wang, 2004) that damages potato production in the USA (Munyaneza et al., 2006; Munyaneza, 2010) and causes tomato big bud disease in California (Shaw et al., 1993). In the EU, '*Ca.* P. trifolii' has been reported in Spain, France, Italy, Austria, the Czech Republic and Poland (Castro and Romero, 2002; Faggioli et al., 2004; Fernandez et al., 2007; Pribylova et al., 2009). However, European isolates have not been reported to affect potato or tomato plants, and it is not known if they can be vectored by Ct.

The transmission of an Iranian strain of '*Candidatus* Phytoplasma asteris' responsible for the phyllody of rapeseed disease (*Brassica rapa*) by Ct has been reported in Iran (Salehi et al., 2010). This phytoplasma is widespread in Europe but different leafhopper vectors have been reported in Europe (Lee et al., 2004; Weintraub and Beanland, 2006).

3.2.3.1. Viruses vectored by *Circulifer* spp. and their distribution in the EU

Ct is the only known North American vector of the *Beet curly top virus* (BCTV; Stafford et al., 2009) and of the related *Beet mild curly top virus* (BMCTV) and *Beet severe curly top virus* (BSCTV), which were previously regarded as strains of BCTV (Stenger, 1998). BCTV has also been reported to be also transmitted by *C. opacipennis* (Thomas and Mink, 1979). BCTV is the type member of the genus *Curtovirus* in the family *Geminiviridae* (Brown et al., 2012) and is the virus with the widest host range in the genus (Thomas and Mink, 1979; Briddon et al., 1998). It infects more than 300 host species in 44 plant families (Thomas and Mink, 1979) and causes important diseases in the USA in a range of crops, such as sugarbeet and other beet types including Swiss chard, tomato, pepper, bean, cucurbits (e.g. squash, melon, cucumber) and spinach (Thomas and Mink, 1979; Wisler and Duffus, 2000; Soto and Gilbertson, 2003). Non-European isolates of BCTV are regulated in the EU (see section 3.3). BCTV is widely present in the USA and is also present in the eastern Mediterranean region, including Egypt and Turkey. It is also reported from Iran and Iraq (Figure 6). In the EU, BCTV is reported, with a restricted distribution, in Italy and Cyprus (EPPO PQR, 2014; Figure 6).

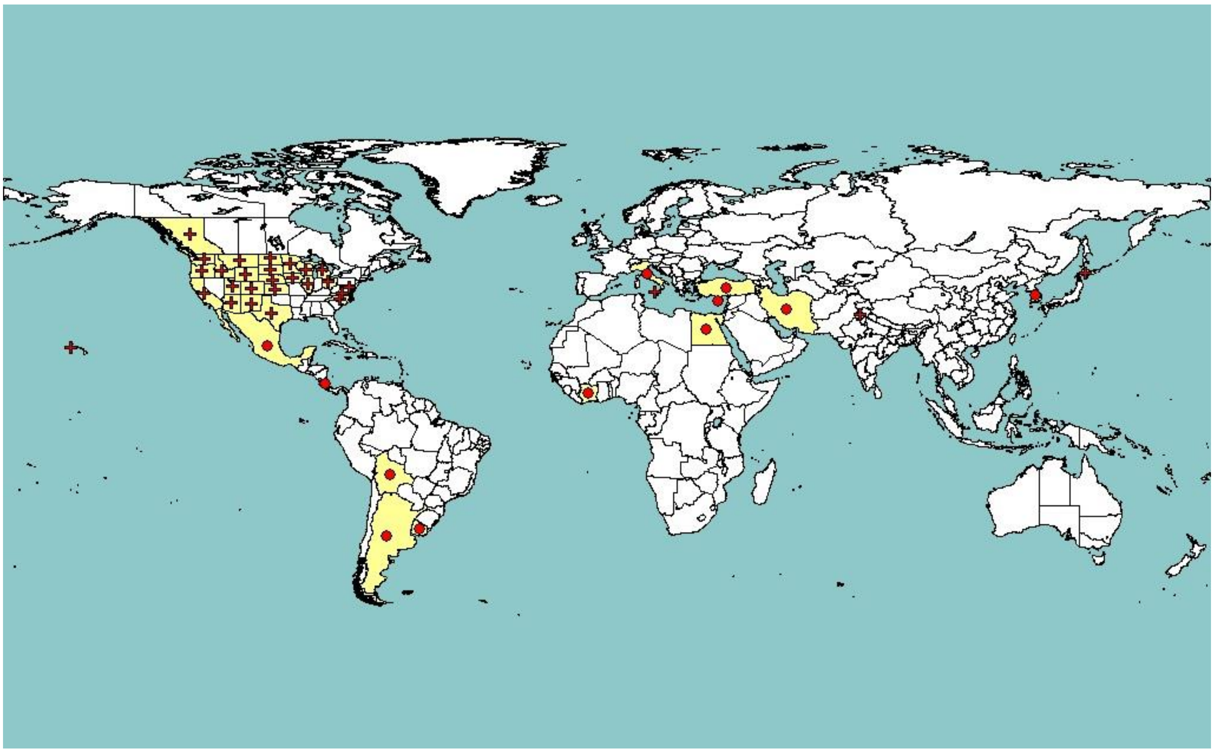

Figure 6: Global distribution of *Beet curly top virus* (extracted from EPPO PQR, 2014). Red circles represent pest presence as national records and red crosses represent pest presence as sub-national records (note that this figure combines information from different dates, some of which could be obsolete)

There is no information about the precise geographic distribution in the EU of the BMCTV and BSCTV species which were previously considered to be strains of BCTV.

In addition to BCTV, BSCTV and BMCTV, Ct could potentially also transmit several other members of the genus *Curtovirus*, including *Horseradish curly top virus* (Klute et al., 1996; Brown et al., 2012), *Pepper curly top virus* (Brown et al., 2012) and *Spinach curly top virus* (Hernandez and Brown, 2010; Brown et al., 2012). These three viruses have been described in North America and are not known to occur in the EU. Given the limited information available on these agents, there are altogether very significant uncertainties concerning the transmission and the distribution of these agents.

Ch is the vector of two *Geminiviridae* species, *Beet curly top Iran virus* (BCTIV; Soleimani et al., 2009; Taheri et al., 2010) and *Turnip curly top virus* (TCTV; Briddon et al., 2010; Razavinejad et al., 2013). BCTIV is known to infect several crops, including sugarbeet, spinach, tomato and pepper (Soleimani et al., 2009; Heydarnejad et al., 2013) while TCTV has been reported to infect turnip, sugarbeet and cowpea (Razavinejad et al., 2013). Given that they show a high degree of divergence from other *Geminiviridae*, BCTIV and TCTV are now considered to typify new genera in the family, *Becurtovirus* (BCTIV) and *Turncurtovirus* (TCTV), respectively (Varsani et al., 2014). So far, these two viruses have been reported only from Iran, but given their recent discovery there is significant uncertainty about their precise geographic distribution.

3.3. Regulatory status

Ch and Ct are regulated harmful organisms in the EU and are currently listed in Council Directive 2000/29/EC.

3.3.1. Legislation addressing *C. haematoceps* and *C. tenellus* (Directive 2000/29/EC)

Table 3: *C. haematoceps* and *C. tenellus* in Council Directive 2000/29/EC.

Annex II, Part A	Harmful organisms whose introduction into, and whose spread within, all Member States shall be banned if they are present on certain plants or plant products,	
Section II	Harmful organisms 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
5. **6.**	*C. haematoceps* *C. tenellus*	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds

3.3.2. Legislation addressing plants and plant parts on which *C. haematoceps* and *C. tenellus* are regulated

Ch and Ct have many more potential hosts than those for which they are regulated (see Table 3). Although some of these hosts may be regulated in a general way, these plants are not specifically considered in Directive 2000/29/EC as hosts of Ch and Ct. Specific requirements of Annex III and Annex V of the Council Directive 2000/29/EC that directly concern particular hosts and commodities that may involve Ch and Ct are presented in Table 4.

Table 4: Regulated hosts and commodities that may involve *C. haematoceps* and *C. tenellus* in Annexes III and V of Council Directive 2000/29/EC

Annex III, Part A	Plants and plant products and other objects the introduction of which shall be prohibited in all Member States
Description	Country of origin
16. Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds	Third countries
Annex V, Part A	Plants, plant products and other objects originating in the Community
Section I	Plants, plant products and other objects which are potential carriers of harmful organisms of relevance for the entire Community and which must be accompanied by a plant passport
1.4	Plants of *Fortunella* Swingle, *Poncirus* Raf. and their hybrids and of *Citrus* L., other than fruit and seeds.
1.5	Plants of *Citrus* L. and their hybrids other than fruit and seeds.

3.3.3. Legislation addressing the organisms vectored by *C. haematoceps* and *C. tenellus* (Directive 2000/29/EC)

Ch and Ct are vectors of *S. citri* and of BCTV, which are also considered as harmful organisms in the EU and listed in Council Directive 2000/29/EC. Detailed analysis of the legislation addressing *S. citri* is found in EFSA (2014).

Table 5: Non-European isolates of Beet curly top virus are regulated in Annex II/A/I.

Annex II, Part A	Harmful organisms whose introduction into, and whose 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,
(d)	Virus and virus like organisms

	Species	**Subject of contamination**
1.	*Beet curly top virus* (non-European isolates)	Plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds

3.3.4. Marketing directives

Council Directive 2008/90/EC[5] explicitly mentions only a few species which are regulated hosts of Ch and Ct: *Citrus* sp., […], *Fortunella* Swingle, […], *Poncirus* Raf., […]

3.4. Elements to assess the potential for establishment and spread in the EU

3.4.1. Host range

The host plants of Ch were studied by Baspinar et al. (1993) and Sertkaya and Cinar (2002) in Turkey, by Klein and Raccah (1991) in Israel and by Fos et al. (1985) in Syria. Although focusing on Ct, Frazier (1953) also collected Ch during a seven-month trip around the Mediterranean (Algeria, Tunisia, Egypt, Syria, Lebanon, Cyprus, Turkey, Greece, Italy (including Sardinia and Sicily), Tripolitania and Spain). He observed that their most common host plants were Cruciferae, Chenopodiaceae, Amaranthaceae and several species of *Cistus*. Other hosts included *Thymus vulgaris* and *Rosmarinus officinalis*, as well as *Plantago*, *Artemisia*, *Portulaca*, *Euphorbia*, *Marrubium*, *Micromeria*, *Prosopis* and *Erodium* species. Baspinar et al. (1993) collected Ch on plant species belonging to 13 families: Brassicaceae (five species, among which *Brassica napus* and *Sinapis arvensis*); Solanaceae (five species, among which *Solanum tuberosum* and *Lycopersicon lycopersicum*); Chenopodiaceae (four species, among which *Beta vulgaris*); Amaranthaceae (two species); Cucurbitaceae (two species, among which *Cucumis sativus*); Poaceae (two species: *Sorghum halepense* and *Zea mays*); Apocynaceae (one species); Asteraceae (one species.: *Helianthus annuus*); Cyperaceae (one species); Malvaceae (one species); Mimosaceae (one species); Pedaliaceae (one species); and Portulaceae (one species).

Records on the host plants of Ct are provided by Severin (1933) and Bayoun et al. (2008) in California, by Frazier (1953) around the Mediterranean and by Hills (1935) in Washington State and Oregon. In his detailed study, Severin (1933) collected insects on 30 species of wild plant belonging to 13 families, among which Chenopodiaceae was the most represented family (18 species, with very high populations on seven *Atriplex* species and on *Salsola kali*). He also bred Ch from eggs deposited in 38 species of wild plants mainly belonging to the Chenopodiaceae (11 species) and Asteraceae (six species), but also to 11 other families.

Golino et al. (1988) caged Ct infected with BLTVA on 69 potential host plants species or cultivars belonging to 21 families and observed symptoms on 50 species or cultivars, belonging to 14 families.

Further indirect evidence is provided by Munyaneza and Upton (2005, and references therein), who report more than 300 plant species affected by the BCTV (and hence very likely to be at least adult hosts of Ct, the only known vector of BCTV). This list includes *Phaseolus vulgaris* L., *Beta vulgaris* L., *Cucumis melo* L., *Cucumis sativus* L., *Capsicum annuum* L., *Spinacia oleracea* L., *Cucurbita maxima* Lam., *Lycopersicon esculentum* Mill. and *Citrullus lanatus* Thunb.

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[5] Council Directive 2008/90/EC of 29 September 2008 on the marketing of fruit plant propagating material and fruit plants intended for fruit production. OJ L 267/8, 8.10.2008, p. 8–22.

Thomas and Martin (1971) report intraspecific variation in suitability within host plants. They released leafhoppers on plants of six tomato cultivars susceptible to beet curly top virus and six resistant cultivars, and recorded that the insects spent less time on certain resistant cultivars than on the remaining resistant and susceptible cultivars.

3.4.2. EU distribution of main host plants

The broad range of plant species that are hosts for either or both species (see section 3.4.1) suggests that the insects would find suitable hosts wherever they are in the EU. Sugarbeet, on the other hand, occupied 1 577 649 ha in the EU in 2013 (FAOSTAT, accessed December 2014), of which 491.745 ha was in the four countries where Ct species are present. Citrus orchards occupied 542 543 ha in Croatia, Cyprus, France, Greece, Italy, Malta, Portugal and Spain.

3.4.3. Analysis of the potential distribution of *C. haematoceps* and *C. tenellus* in the EU

Ch is widespread in Europe; however, it is not reported from a number of EU countries. Owing to the small size of the insect, it may be overlooked in the absence of systematic surveys. Given the availability of many common host plant species, (see section 3.4.1), it is very likely that the actual distribution of this leafhopper is more widespread than reported. However, it has to be noted that the species is native to the Old World and therefore its area of distribution should reflect its ecological preferences/requirements and colonisation of new areas is less likely to be expected as a result of an invasion.

Ct distribution in the EU is limited to a few Mediterranean countries. It is possible that Ct is already present (but not reported) in a few southern EU countries, such as Portugal, Slovenia, Croatia. If it is still absent from these countries, its present known distribution makes it conceivable that it could spread into these so far uncolonised areas.

According to the literature, these two species have a preference for dry environments, which might limit their spread into areas characterised by high levels of precipitation.

However, it has to be noted that the potential distribution of these two leafhoppers can only be envisaged with some uncertainty, related to the lack of information on their ecological requirements.

3.4.4. Spread capacity

Natural dispersal, plants for planting and hitch-hiking constitute three pathways for Ch and Ct spread.

The dispersal and migration capabilities of Ct, the beet leafhopper, have been described in the USA. In California, spring dispersal from the uncultivated plains and foothills into the cultivated areas, and autumn return flights from the cultivated areas to the uncultivated plains and foothills have been described by Severin (1933). These seasonal movements occur over relatively long distances, in the range of tens of miles. Migrations over longer distances have also been documented for this species, which breeds on desert weeds in Utah, but annually invades the sugarbeet areas up to 300 km away and, similarly, migrates from the south-western part of the USA or northern Mexico to Miami, Florida (Severin, 1933; Dorst and Davis, 1937). According to the Texas invasive species database, (Texasinvasives.org, 2014), Ct is capable of flying over hundreds of miles, enabling the leafhopper to travel across geographic barriers without human assistance. However, the dispersal and migration capabilities of Ct have not been analysed in the Old World and therefore there is some uncertainty. The dispersal capacity of Ch is not documented, and there is thus some uncertainty regarding this capacity.

As the eggs are inserted in the leaf veins and petioles of a large number of plants species, plants for planting do constitute a pathway if they are transported with leaves. The various organisms vectored by Ch and Ct are not transmitted transovarially, and therefore plants infested with eggs would not carry any of the diseases vectored by Ct or Ch unless they were infected themselves. The association of nymphs and adults with plants for planting is likely to be loose. Overall, the use of plants for planting can result in the spread of Ch and Ct to uncontaminated areas but movement of the vectored organisms necessitates infection by these organisms of the plants for planting.

During massive dispersal, Ct adults were also observed assembled on cars (Severin, 1933) and therefore the transportation of insects via vehicles should also be taken into account. Nothing similar has been observed with C. *haematoceps*, which adds some uncertainty to the capacity of this species to hitch-hike.

3.5. Elements to assess the potential for consequences in the EU

This section encompasses the possible direct effects of the insects themselves (section 3.5.1.1), and the effects of the bacterial (section 3.5.1.2) and viral diseases (section 3.1.5.3) they transmit.

3.5.1. Pest effects of *C. haematoceps* and *C. tenellus*

3.5.1.1. Direct effect of *C. haematoceps* and *C. tenellus*

There are no reports of direct damage due to the feeding activity of Ch and Ct on cultivated host plants. Very high populations of Ct were observed in California in an area where there was an abundance of wild plants that dried and forced leafhoppers to invade beet fields (Severin, 1933). However, although it can be postulated that a very high population of a phloem feeder insect may impact the growth and yield of the crop, no information on the direct damage caused by these leafhoppers is available, and the economic importance of Ch and Ct is always associated with their role in spreading plant-pathogenic organisms.

3.5.1.2. Pest effects of phloem-limited bacterial diseases transmitted by *C. tenellus* and *C. haematoceps*

Stubborn disease of citrus caused by *S. citri* was so named because infected bud-grafted trees grew slowly (Calavan and Bové, 1989). The disease affects both the quality and the yield of fruit (Mello et al., 2010). It is correlated with the occurrence of warm and dry periods of weather. The disease was at first believed to spread only by budding. However, the detection of several thousand stubborn-diseased trees in southern California provided evidence of wider natural spread. Calavan (1969) estimated that about 1 000 000 trees were affected by stubborn disease. Visual surveys indicated that the proportion of trees infected with stubborn disease in affected orchards in California and Morocco ranged from less than 1 % to over 50 % (Calavan and Carpenter, 1965).

The disease is characterised by stunted trees, with short internodes and small, abnormally upright leaves that are sometimes mottled or chlorotic (Shi et al., 2014). Shoots may be abnormally bunched and like a witches' broom; premature leaf drop and twig dieback are also found. Flowering sometimes occurs off-season. Fruits are misshapen or abnormally coloured. Fruit production may be reduced in affected trees (Bové et al., 1988; Gumpf, 1988). Yield losses are variable. In California, USA, losses of Valencia oranges of 44 to 74 % and of navel oranges of up to 100 % have been reported (Calavan, 1979). Mello et al. (2010) studied the impact of citrus stubborn disease on navel orange. They showed that a significant reduction in fruit number occurred only in severely symptomatic trees in which *S. citri* was widely distributed within the tree. *S. citri* also causes horseradish brittle root in USA (Fletcher et al., 1981) and carrot purple leaf (Lee et al., 2006). The latter disease was recently reported in Spain and Israel (Cebrian et al., 2010; Gera et al., 2011).

BLTVA, a strain of '*Ca.* Phytoplasma trifolii' transmitted by Ct in USA, causes potato purple top disease. It has recently been shown that BLTVA can cause reductions in yield and tuber quality that can reach 20 % in the presence of infectious vector populations (Murphy et al., 2014). In the Zarghan region of Iran, a Ch-transmitted strain of '*Ca.* P. asteris' produces stem proliferation and phyllody in rapeseed fields (*B. rapa*) (Salehi et al., 2010).

3.5.1.3. Pest effects of viral diseases transmitted by *C. tenellus* and *C. haematoceps*

BCTV (and the related BSCTV and BMCTV) causes important diseases in sugarbeet and in a range of other crops, including other beet types, Swiss chard, tomato, pepper, bean, cucurbits and spinach (Thomas and Mink 1979; Wisler and Duffus, 2000; Soto and Gilbertson, 2003). In the initial absence of control measures and, given the high local Ct populations, beet curly top disease virtually destroyed the nascent California sugarbeet industry (Wissler and Duffus, 2000). The potential impact is still very significant today, resulting in extensive insecticide treatment programmes on thousands of hectares of non-crop areas to limit the migrating Ct populations responsible for the infestation of sugarbeet and other crops (Wissler and Duffus, 2000; Chen et al., 2010).

Symptoms of curly top disease consist of severe leaf dwarfing, crinkling and rolling. The severity of symptoms generally varies with a range of parameters, including species/variety susceptibility, viral species/isolate aggressiveness, earliness of infection and temperature (Wintermantel and Kaffka, 2006). Plants of susceptible species/cultivars may die if infected early as seedlings or young plants (Wintermantel and Kaffka, 2006; Strausbaugh et al., 2007). Even the most resistant sugarbeet varieties can be negatively impacted by infection, with yield losses of as much as 13 % reported and early infection of susceptible varieties essentially destroying all the production (Duffus and Skoyen, 1977). Although less well documented, impacts in other crop species can also be very high (Chen et al., 2010).

Information about the pest effect of the other *Geminiviridae* species transmitted by Ct and Ch is much more limited, but the severity of the symptoms reported (Klute et al., 1996; Hernandez and Brown, 2010; Soleimani et al., 2009; Briddon et al., 2010; Razavinejad et al., 2013), which are very similar to those caused by BCTV, BMCTV and BSCTV, indicate that the potential effects can be very significant.

3.5.2. Observed pest impact of *C. haematoceps* and *C. tenellus* in the EU

3.5.2.1. Observed direct impact of *C. haematoceps* and *C. tenellus* in the EU

No reports of direct damage due to the feeding activity of Ch and Ct in the EU, either on cultivated or on wild plants, were found. Although very high populations of Ct have been observed in the USA in some years (Severin, 1933), in Europe high densities have never been reported. Frazier (1953), after a survey of the Mediterranean region for the beet leafhopper, concluded that Ct was never abundant in the area while Ch was more common and abundant on Cruciferae, Chenopodiaceae and Amaranthaceae, but no damage was observed on these host plants.

3.5.2.2. Observed impact of phloem-limited bacterial diseases transmitted by *C. tenellus* and *C. haematoceps* in the EU

Although the stubborn disease of citrus caused by *S. citri* has been reported in several Mediterranean countries, including Spain (Hernandez Gimenez, 1975) and other EU territories, such as the islands of Sardinia, Sicily and Corsica (Gumpf, 1988), almost no data on the impact of this disease in the EU are available. In Cyprus, Kyriakou et al. (1996) reported yield reductions of 19 % to 34 %, with a reduction in fruit size, weight and quality for both orange cultivars Frost Washington Navel and Frost Valencia. *S. citri* is commonly thought to be present at low levels in areas where the disease is known to occur (Bové et al., 1988), and damage depends primarily on the abundance of the vector and on the occurrence of warm and dry periods of weather. Although *S. citri* affects several host plants other than citrus, most often it does not cause them any economic damage.

None of the phytoplasma diseases transmitted by Ct or Ch has been reported so far in the EU.

3.5.2.3. Observed impact of the viruses transmitted by *C. tenellus* and *C. haematoceps* in the EU

Of the various viruses transmitted by Ct and Ch, only BCTV is reported to be present in two EU MS, Italy and Cyprus, with a restricted distribution. The Panel was unable to identify any precise data on the impact of BCTV on the various susceptible host crops and, in particular, on sugarbeet in these two countries. Although with high uncertainty, the absence of any precise data on impact or of any research work on European isolates of BCTV suggests that any impacts are likely to be limited.

3.6. Currently applied control methods

Ct and Ch are susceptible to a range of insecticides. Nevertheless, insecticide treatments have limitations as a control measure, in particular when applied solely on the crops to be protected, because the host range is quite large and includes weeds, the principal damage is caused not by the insects themselves but by the viruses and phytoplasmas they can transmit, and the insects can fly long distances, According to the University of California (UC IPM Pest Management Guidelines, 2014), "Foliar insecticides have not proven to be generally effective in controlling beet leafhopper [Ct] or reducing the incidence of *Beet curly top virus* when applied directly to the sugarbeet crop. Occasionally systemic insecticides have proven valuable in reducing the incidence of this virus. The effectiveness of these materials depends on the climatic factors affecting weed hosts of the leafhopper and the virus, timing of planting and application of materials relative to leafhopper migration, and proximity of fields to leafhopper and virus overwintering sites".

However, other results have demonstrated significant effects of neonicotinoid and pyrethroid insecticide foliar applications or seed treatments. Symptoms in field trials were reduced by 26 to 56 %, while root yield increased by 55 to 95 %, sucrose content by 6.5 to 7.2 % and sugar yield by 13 to up to 96 % (Strausbaugh et al., 2012, 2014).

In California, curly top disease in sugarbeet and other crops grown in the Central Valley is managed by a statewide Curly Top Virus Control Program (CTVCP) initiated in 1943 and including the aerial spraying with insecticides (formerly DTT, more recently malathion) of hundreds of hectares of non-crop areas representing the leafhopper overwintering grounds (Wissler and Duffus, 2000; Chen et al., 2010). However, this strategy has a high annual cost, and there are concerns about its environmental impact. Control in sugarbeet also involves the use of resistant or tolerant varieties and adaptions in the time of planting and plantation density (Wissler and Duffus, 2000; Chen et al., 2010). However, severe outbreaks of beet curly top disease are occasionally recorded despites these measures, indicating that their effectiveness is only partial and that the disease is difficult to control (Chen et al., 2010).

3.7. Uncertainty

There are some uncertainties regarding the precise geographical distribution of the two species as inconsistencies exist between EPPO PQR, Fauna Europaea and NPPO answers (see section 3.2.2). Surveys have not been performed on this pest in all EU MS. Only the Netherlands confirmed the absence of the pest through survey.

There is no information about the precise geographic distribution in the EU of the BMCTV and BSCTV species, which were previously considered as strains of BCTV. Similarly, there is no precise data on the impact of the viruses transmitted by Ct and Ch in the EU.

Finally, the control methods developed so far only concern Ct in the USA, and no information exist regarding control methods used against both insect species and the pathogens they transmit in the EU.

CONCLUSIONS

Table 6: The Panel's conclusions on the pest categorisation criteria defined in the International Standards for Phytosanitary Measures No 11 and No 21 and on the additional questions formulated in the terms of reference

Criterion of pest categorisation	**Panel's conclusions against ISPM 11 criterion** Yes/No	**Panel's conclusions against ISPM 21 criterion** Yes /No	**Uncertainties**
Identity of the pest	*Is the identity of the pest clearly defined?* The two species are clearly defined. *Do clearly discriminative detection methods exist for the pest?* Identification based on external morphology and male genitalia is routinely applied for both Ct and Ct. However, owing to the wide range of morph variation and morphological convergence among species, the identification of *Circulifer* spp. at the species level is challenging, particularly for the two closely related species, Ch and *C. opacipennis*. The females, in particular, are difficult to separate.		Uncertainty is low
Absence/presence of the pest in the PRA area	*Is the pest absent from all or a defined part of the PRA area?* According to the NPPOs and the literature, Ch is absent from several MS and its presence is doubtful in Germany, Hungary and Finland. Ct is considered to be absent from most MS.	*Is the pest present in the PRA area?* Ch is reported in several Mediterranean and Central European MS. Ct is reported from Spain (including the Canary Islands), France, Italy (including Sicily) and Greece.	Uncertainty is medium (discrepancies between the different sources of information) and lack of data for several countries.
Regulatory status	*In consideration that the pest under scrutiny is already regulated just mention in which annexes of Council Directive 2000/29/EC and the marketing directives the pest and associated hosts are listed without further analysis. (the risk manager will have to consider the relevance of the regulation against official control)* These species are regulated harmful organisms in the EU and listed on plants of *Citrus* L., *Fortunella* Swingle, *Poncirus* Raf., and their hybrids, other than fruit and seeds in Council Directive 2000/29/EC in Annex IIAII.		

Criterion of pest categorisation	**Panel's conclusions against ISPM 11 criterion** Yes/No	**Panel's conclusions against ISPM 21 criterion** Yes /No	**Uncertainties**
Potential establishment and spread	*Does the PRA area have ecological conditions (including climate and those in protected conditions) suitable for the establishment and spread of the pest?* *And, where relevant, are host species (or near relatives), alternative hosts and vectors present in the PRA area?* The presence of both species in several EU MS shows that the ecological conditions are suitable for their establishment and spread in at least part of the PRA area. A large range of wild host species and of cultivated hosts is widely available in the PRA area. Plants for planting, hitchhiking and natural dispersal constitute three pathways for Ch and Ct spread.	*Are plants for planting a pathway for introduction and spread of the pest?* As the eggs are inserted in the leaf veins and petioles of a large number of plants species, plants for planting constitute a pathway if they are transported with leaves.	The uncertainties are low.
Potential for consequences in the PRA area	*What are the potential consequences in the PRA area? Provide a summary of impact in terms of yield and quality losses and environmental consequences* Ct and Ch cause little, if any, damage by themselves. However, they are able to transmit *S. citri*, two phytoplasmas and several viruses, some of which can cause severe damage. Of the pathogens vectored by Ct and Ch, *S. citri* and *Beet curly top virus* are regulated. Ct and Ch and the organisms they vector have no identified environmental impact.	*If applicable is there indication of impact(s) of the pest as a result of the intended use of the plants for planting*? The various organisms vectored by Ch and Ct are not transmitted transovarially. The association of nymphs and adults with plants for planting is likely to be loose. Overall, plants for planting can spread Ch and Ct to uncontaminated areas but movement of the organisms vectored necessitates infection by these organisms of the plants for planting.	The uncertainties are medium and are mostly related to the impact of the distribution of Ch and Ct on the distribution of the vectored organisms. There are also uncertainties about the damage potential of some of the recently described vectored viruses.

Criterion of pest categorisation	**Panel's conclusions against ISPM 11 criterion** Yes/No	**Panel's conclusions against ISPM 21 criterion** Yes /No	**Uncertainties**
Conclusion on pest categorisation	Ct and Ch are well-defined species present in the EU but absent in several MS. They have a large range of wild and cultivated host plants that are widespread in the EU. They have the potential to establish and spread further in the PRA area. They are not harmful by themselves; however, they can transmit a number of damaging plant pathogens, some of which are already present and/or regulated in the EU.	Ct and Ch are already present in some MS and they are considered to be of Old World origin. They can be associated with the plants for planting pathway. The use of plants for planting can result in the spread of Ch and Ct to uncontaminated areas but movement of the organisms vectored necessitates infection by these organisms of the plants for planting.	Overall, the uncertainties are low to medium. Uncertainties exist on the precise geographical distribution of Ch and Ct, the impact of this distribution on that of the organisms vectored and on the damage potential of some of the recently described viruses vectored.
Conclusion on specific ToR questions	*If the pest is already present in the EU, provide a brief summary of* – *the analysis of the present distribution of the organism in comparison with the distribution of the main hosts, and the distribution of hardiness/climate zones, indicating in particular if, in the PRA area, the pest is absent from areas where host plants are present and where the ecological conditions (including climate and those in protected conditions) are suitable for its establishment,* There is no evidence that the two insect species can cause any quantifiable harm by themselves. Although the stubborn disease of citrus caused by *S. citri* has been reported in several Mediterranean countries, including Spain and the islands of Sardinia, Sicily and Corsica, almost no data on the impact of this disease in the EU are available. None of the phytoplasma diseases transmitted by Ct or Ch has been reported so far in the EU. Of the various viruses transmitted by Ct and Ch, only BCTV is reported to be present in two EU MS, Italy and Cyprus, with a restricted distribution – *the analysis of the observed impacts of the organism in the risk assessment area* Although present or reported in the past in MS around the Mediterranean Sea, poor information is available on the impact of the disease. Data from Cyprus indicate yield reductions from 19 to 34 %, with impact on reduction in fruit size, weight and quality of two cultivars of navel oranges.		

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ABBREVIATIONS

BCTIV	*Beet curly top Iran virus*
BCTV	*Beet curly top virus*
BLTVA	beet leafhopper-transmitted virescence agent
BMCTV	*Beet mild curly top virus*
BSCTV	*Beet severe curly top virus*
Ch	*Circulifer haematoceps*
Ct	*Circulifer tenellus*
EFSA	European Food Safety Authority
EPPO	European and Mediterranean Plant Protection Organization
EPPO-PQR	European and Mediterranean Plant Protection Organization Plant Quarantine Retrieval System
EC	European Commission
EU	European Union
EUFGIS	European Information System on Forest Genetic Resources
ISPM	International Standard for Phytosanitary Measures
JRC	Joint Research Centre
MS	Member State(s)
NPPO	National Plant Protection Organisation
PLH Panel	Plant Health Panel
PRA	pest risk analysis
RNQP	regulated non-quarantine pest
TCTV	*Turnip curly top virus*