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SCIENTIFIC OPINION

Scientific Opinion on the pest categorisation of Elm phloem necrosis mycoplasm[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 Elm phloem necrosis mycoplasma, now renamed *Candidatus* Phytoplasma ulmi (CPu), for the European Union (EU) territory. CPu is a well-defined phytoplasma species of the genus *Candidatus* Phytoplasma, for which molecular detection assays are available. CPu is transmitted by grafting and vegetative propagation material as well as by insect vectors. CPu is reported from North America and is present in at least four EU Member States: the Czech Republic, France, Germany and Italy. CPu distribution in Europe is suspected to be underestimated, with high uncertainty since no systematic surveys are carried out. CPu has a host range restricted to *Ulmaceae* species, and especially to the genus *Ulmus*, with some variations in susceptibility to the disease. It is listed in Annex IAI of Directive 2000/29/EC. CPu is not expected to be affected by EU ecoclimatic conditions wherever its hosts are present and has the potential to establish largely within the EU territory. Two insect vectors, *Macropsis glandacea* and *Philaenus spumarius*, are widely distributed in Europe. The uncertainty about other potential vector species, in which the phytoplasma has been detected, is considered as high. There is a lack of data to fully assess the potential consequences of the disease, with regards to the susceptibility of European elm species and virulence of European CPu strains. Data are not sufficient to reach a conclusion on pest categorisation of CPu and a full risk assessment can be conducted but is unlikely to bring any additional value unless the key additional data gaps on distribution, insect vectors, elm species susceptibility and potential consequences of the pest are filled.

KEY WORDS

Elm phloem necrosis mycoplasm, *Ulmus* sp., pest categorisation, Elm yellows, *Candidatus* Phytoplasma ulmi, CPu, insect vectors

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[1] On request from the European Commission, Question No EFSA-Q-2014 -00251, adopted on 02 July 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 Elm phloem necrosis mycoplasm in response to a request from the European Commission (EC).

1.2. Scope

This pest categorisation is for *Candidatus* Phytoplasma ulmi, which is also called Elm phloem necrosis mycoplasma or Elm yellows. We will use the term *Candidatus* Phytoplasma ulmi or the abbreviation CPu in this opinion.

The pest risk assessment (PRA) area is the territory of the European Union (hereinafter referred to as the EU) with 28 Member States (hereinafter referred to as EU MSs), 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 *Candidatus* Phytoplasma ulmi following guiding principles and steps presented in the EFSA Guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010) and as defined in the International Standard for Phytosanitary Measures (ISPM) No 11 (FAO, 2013) and ISPM No 21 (FAO, 2004).

In accordance with the 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.

The table 1 below 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 agreement with EFSA guidance on a harmonised framework for pest risk assessment (EFSA PLH Panel, 2010).

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.

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 **absent from all or a defined part of the PRA area**	The pest is **present** 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), alternate 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
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 the pest risk assessment process should be continued, as it is clearly stated in the terms of reference that, at the end of the pest categorisation, the European Commission will indicate EFSA if further risk assessment work is required for the pest under scrutiny following its analysis of the Panel's scientific opinion.

2.2. Data

2.2.1. Literature search

A literature search on Elm phloem necrosis mycoplasma 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 on the ISI Web of Knowledge database. Further references and information were obtained from experts, from citations within the references as well as from 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 MSs. A summary table on the pest status based on EPPO PQR and MS replies is presented in Table 2.

Information on distribution of the main host plants were obtained from the JRC forestry host maps and literature.

3. Pest categorisation

3.1. Identity and biology of the pest

3.1.1. Taxonomy

Candidatus Phytoplasma ulmi (CPu) is a member of the genus *Phytoplasma*, a group of pleiomorphic bacteria lacking cell walls and known as phloem obligate parasites and transmitted by insect vectors. CPu is responsible for elm diseases known as Elm yellows or Elm phloem necrosis (in French "Nécrose du liber de l'Orme" and in German "Phloemnekrose der Ulme").

It is commonly accepted that *Phytoplasma* species can be classified based on their 16S rDNA, with *Ca* Phytoplasma ulmi being affiliated to 16SrV. Other phytoplasmas are found in other woody perennial hosts and cause diseases known as Alder yellows, flavescence dorée, rubus stunt, cherry lethal yellows or jujube witches' broom (Jović et al., 2011).

Cpu is a well-delineated and clearly defined species within the 16SrV subgroup A (Lee et al., 2004), based on the requirements defined by the Subcommittee for the Taxonomy of Mollicutes: a specific nucleotide signature lies within its 16S rDNA sequence. Its identification has also been confirmed by multilocus sequence analysis (Arnaud et al., 2007; Jović et al., 2011).

Kingdom: Bacteria
    Phylum: Tenericutes
        Class: Mollicutes

Order: Acholeplasmatales
Family: Acholeplasmataceae
Genus: *Candidatus* Phytoplasma
Species: *Candidatus* Phytoplasma ulmi

3.1.2. Biology of *Candidatus* Phytoplasma ulmi

Elm phloem necrosis was first described by Swingle (1938) in the USA. Symptoms of the disease develop often in mid- to late summer (Sinclair et al., 1987), with leaf yellowing, epinasty and witches' brooms followed by a death of the affected branches (Figure 1). Symptoms are often present on some branches only. They vary according to the host species. Symptoms are often confused with leaf senescence at the end of the growing season.

In the infected plants, CPu is limited to phloem sieve tubes. It survives during winter into the roots, from where it moves to the upper parts of the plants during spring. According to Sinclair (1981), in the USA, the disease's range extends to areas where the average annual temperature is below –26 °C.

CPu is transmitted by sap-feeding insects. The confirmed vector in the USA is the white-banded elm leafhopper (*Scaphoideus luteolus*) (Baker, 1949), but transmission by other vectors has been also proved experimentally, albeit on a small number of cases: the leafhopper *Allygidius atomarius* (Lanier and Manion, 1988), the cercopid *Philaenus spumarius*, a *Latalus* sp. cicadellid and the cercopid *Lepyronia quadrangularis* (Rosa et al., 2014). The presence in this list of *Philaenus spumarius* and *Lepyronia quadrangularis* is surprising because they are xylem sap feeder insects. Three other species, *Cixius* sp., *Iassus scutellaris* and *Allygidius furcatus*, were found infected in the field in France with an EY-group phytoplasma (Boudon-Padieu et al., 2004), although these species have not so far be proven to transmit the disease. The leafhopper *Macropsis mendax* was identified as a vector in Italy (Carraro et al., 2004).

Briefly, phytoplasmas are acquired by insects whilst feeding on phloem sap, pass into the alimentary canal and cross the midgut epithelium, thus reaching the haemocoel. They actively multiply in the haemolymph before reaching the salivary glands. Finally, they are injected into another host plant via the saliva. The transmission mode is defined as persistent and propagative, since after the acquisition the vector is persistently and systemically infected (even through moulting) and, after the completion of a latent period, it is infectious for life. Even though phytoplasmas actively multiply in the insect vectors, transovarial transmission has been reported for few phytoplasma-vector associations (Kawakita et al., 2000; Tedeschi et al., 2006). There is a temperature-dependent latency period between the phytoplasmas acquisition by the insect and its transmission to another host plant, between 12 days and well over a month (Weintraub and Beanland, 2006).

Transmission is also possible through vegetative propagation techniques including bark patch grafts and root grafts (Sinclair et al., 2000; Braun and Sinclair, 1979; Carter and Carter, 1974). CPu is not transmissible by mechanical inoculation.

Transmission by detached bark or wood is considered as not possible (Webber, 2014)

3.1.3. Intraspecific diversity

There is no detailed information on the intraspecific diversity, despite indications on variations between CPu sources. Boudon-Padieu et al. (2004) showed the occurrence of three different 'types' of CPu group in Europe. One type is close to the American type EY1, another is the European type ULW and a third one different from these two (EY-S) (Jović et al., 2011). Jović et al. also reported genetic differences among strains of CPu in Serbia, suggesting some overlap between strains from Europe and North America. It remains unclear whether such reported variations affect the virulence of the isolates.

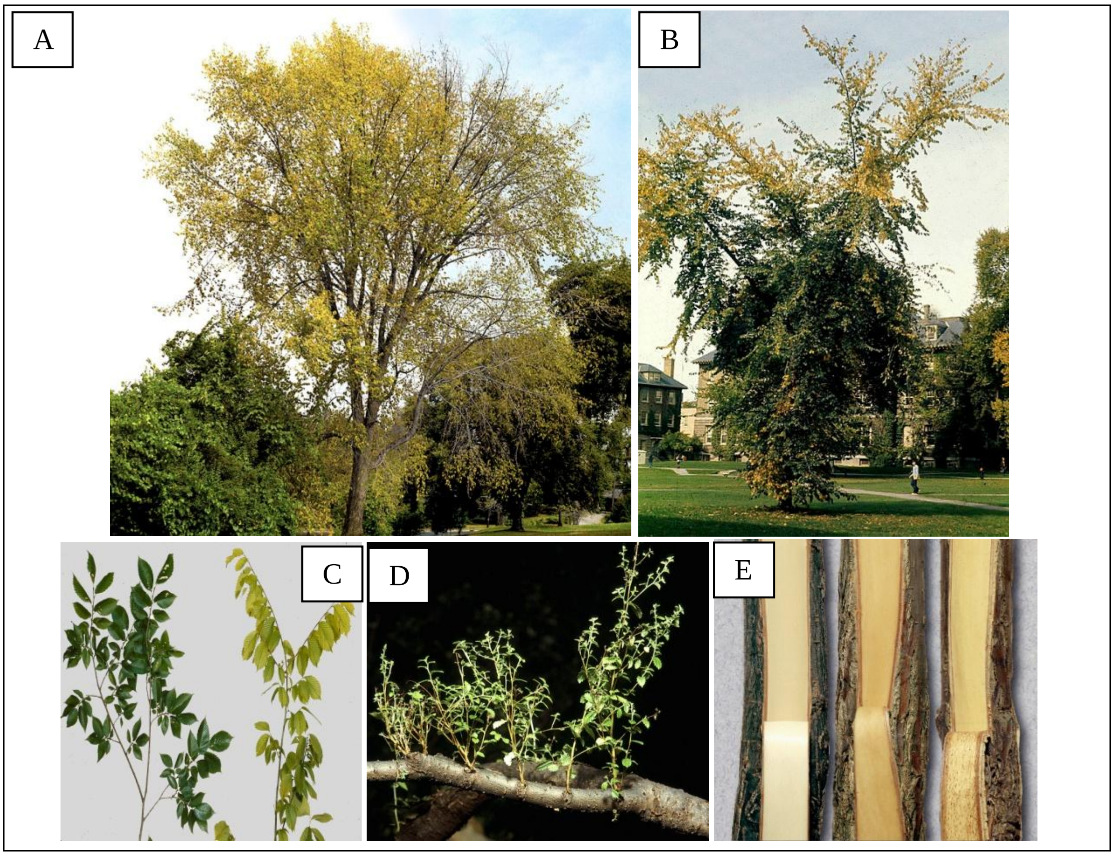

Figure 1: Examples of Elm yellows disease caused by *Candidatus* Phytoplasma ulmi symptoms on dying trees (A and B). Chlorosis and epinasty on the branch at right as compared to a healthy branch (C). Example of witches broom's symptoms (D). Normal (right) and brown discoloration of the innermost of phloem as revealed after peeling bark of small stems, often associated with wintergreen odour detected after peeling (E). (By courtesy of Prof. Wayne Sinclair, Cornell University, NY, USA).

3.1.4. Detection and identification of *Candidatus* Phytoplasma ulmi

Detection of phytoplasmas is not easy, because they are restricted to phloem. Although symptoms might be used as an indication of the presence of CPu (see section 3.1.2), they might not always be expressed or might be confused with leaf senescence, or symptoms produced by other diseases, such as Dutch elm disease. The presence of phloem of butterscotch colour is also indicative, as is the emission of a methylsalicylate odour (wintergreen) while stripping the inner bark (Sinclair, 2000).

The presence of phytoplasmas has been traditionally evidenced by using 4′,6- diamidino-2-phenylindole (DAPI) which produces a diffuse fluorescence within the phloem sieve (Deeley et al., 1979; Lederer and Seemüller, 1992). This method, which, however, is not phytoplasma specific, was further improved by epifluorescence microscopy with the use of different dyes, such as SYTO13 and 3,3′-diheptyloxacarbocyamine iodide (DiOC7(3)) (Molecular Probes, Leiden, The Netherlands) (Christensen et al., 2004). Transmission electron microscopy has also been used to look for the presence of phytoplasmas in the phloem sieve (Pisi et al., 1981).

Current detection methods have been facilitated by the systematic use of polymerase chain reaction (PCR): both real-time PCR (Christensen et al., 2004) for broad-range phytoplasma detection and nested PCR detection using phytoplasma-universal primers targeting 16S rDNA (Lee et al., 1994, 1995, Daire et al., 1997; Boudon-Padieu et al., 2004) combined with a targeted sequencing to verify the presence of the CPu signature sequence. Identification can also be achieved by the use of restriction fragment length polymorphism (RFLP) or through multilocus sequence analysis (Arnaud et al., 2007; Jović et al., 2011), targeting other genes such as secY, rpV or FD9.

It is important to note that most routine laboratories are not yet currently operating detection or identification methods for CPu, mainly for technical reasons (difficulties with nested PCR protocols, need of targeted sequencing combined to PCR, need of specific training with regards of the characteristics of the phloem-inhabiting pathogen). Specific diagnostic capacities are to be settled in most EU MSs.

It is also useful to stress that there are reports of phytoplasmas other than *Ca* Phytoplasma ulmi on elm trees (Carraro et al., 2004; Gao et al., 2011). These might cause some confusion in a preliminary diagnostic step.

3.2. Current distribution of *Candidatus* Phytoplasma ulmi

3.2.1. Global distribution of *Candidatus* Phytoplasma ulmi

Elm yellows is a widespread and serious phytoplasma disease of elm trees, in particular in the eastern half of the USA (see Figure 2). It was described in detail by Swingle (1938), but there are some earlier reports. Since then, several outbreaks have been recorded, in Ohio, Illinois, Pennsylvania and New York (Lanier and Manion, 1988).

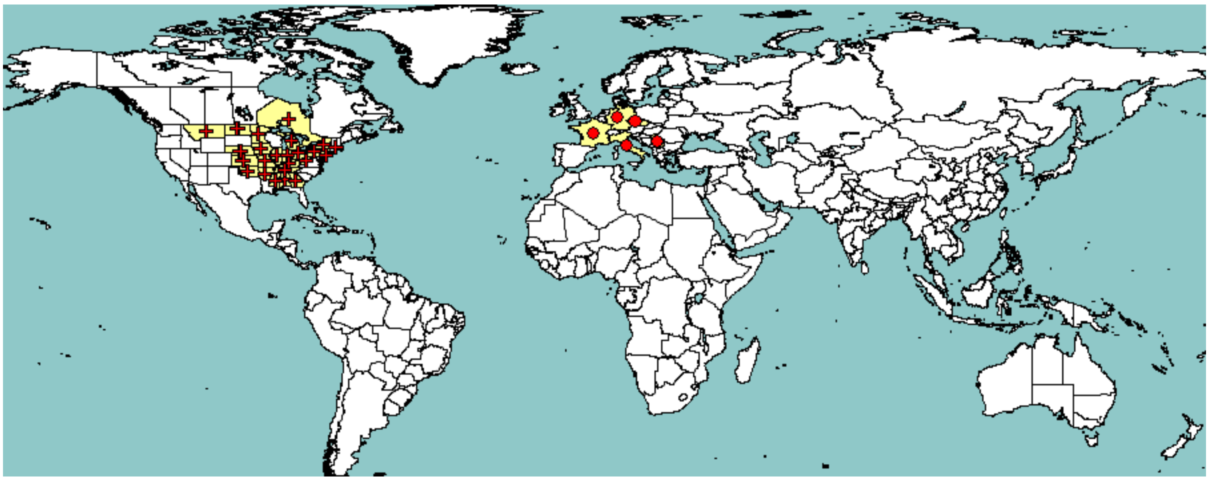

Figure 2: Global distribution of *Candidatus* Phytoplasma ulmi (extracted from EPPO PQR, version 5.3.1, accessed June 2014). Red circles represent pest presence as national records and red crosses represent pest presence as sub-national records (note that this figure combines information from different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

North America: Canada (Ontario) and USA (Alabama, Arkansas, Georgia, Iowa, Illinois, Indiana, Kansas, Kentucky, Massachusetts, Minnesota, Michigan, Mississippi, Missouri, Montana, Nebraska, New Jersey, New York, North Dakota, Ohio, Oklahoma, Pennsylvania, Tennessee, West Virginia);

Europe (outside of the risk assessment area): According to the EPPO PQR the pest status in Serbia is present, with few occurrences (Jović et al., 2008).

3.2.2. *Candidatus* Phytoplasma ulmi distribution in the EU

Typical symptoms have been reported in Italy since 1951 (Goidanich, 1951), with recurrent publications on the topic (Ciferri, 1961; Gualaccini, 1963), and in the Czech Republic (Bojnansky, 1969), but detection of the presence of phytoplasmas in the symptomatic plants has been achieved only by Pisi et al. (1981). CPu was later identified in France (Maürer et al., 1993) and Germany (Seemüller, 1992).

There are no interception records for *Candidatus* Phytoplasma ulmi in the Europhyt database.

Table 2: The current distribution of Elm phloem necrosis mycoplasma in the risk assessment area, based on answers received from the 28 EU MSs, Iceland and Norway, EPPO PQR and other sources

Member State	***Candidatus* Phytoplasma ulmi**		
	NPPO answers	**EPPO PQR**	**Other sources**
Austria	Absent, no pest record	–	
Belgium	Absent, no pest record	–	
Bulgaria	Absent	–	
Croatia	Absent, no pest record	–	Pleše and Juretić, 1999
Cyprus	–	–	
Czech Republic	Present, few occurrences	Present, few occurrences	Bojnansky, 1969
Denmark	Not known to occur	–	
Estonia	Absent, no pest record	–	
Finland	Absent, no pest record	–	
France	–	Present, restricted distribution	Boudon-Padieu et al, 2004, Maürer et al., 1993 ;
Germany	Present, few occurrences (records derive from the 1990s)	Present, few occurrences (records derive from the 1990s)	Seemüller, 1992
Greece	–	–	
Hungary	Absent, no pest record	–	
Ireland	–	–	
Italy	Present, restricted distribution	Present restricted distribution	Carraro et al., 2004; Conti 1987; Marcone et al., 1997; Mittempergher et al., 1990; Pisi et al., 1981
Latvia	–	–	–
Lithuania	–	–	–
Luxembourg	–	–	–
Malta	Absent, no pest record	–	–
Poland	Absent, no pest record	–	–
Portugal	No records	–	–
Romania	–	–	–
Slovak Republic	Absent, no pest record	–	–
Slovenia	Absent, no pest record	–	–
Spain	Absent	–	–
Sweden	Absent, not known to occur	–	–
The Netherlands	Absent, no pest record	–	–
United Kingdom	–	–	–
Iceland	–	–	–
Norway	–	–	–

There is a relative discrepancy between the occurrences reported by the NPPOs and scientific reports. For example, CPu is reported in Italy, in Emilia-Romagna (Pisi et al., 1981), Tuscany (Conti et al., 1987), Basilicate, Campania and Calabria (Marcone et al., 1997), the Po Valley (Mittempergher et al., 1990) and in the Friuli-Venezia Giulia region (Carraro et al., 2004). The disease has also been associated with a decline of *Ulmus chenmoui*, an Oriental elm species, in central Italy (Sfalanga et al., 2002). There are also unverified reports in Croatia (Pleše and Juretić, 1999). In France, observations made in elm conservatories suggest that about 30 % of trees have symptomatic elm yellows (Boudon-Padieu et al., 2004). These authors verified the presence in the regions of Brittany, Languedoc and Franche-Comté as well as in samples from four different clones in nurseries.

The current known distribution of CPu in Europe is therefore thought to be underestimated (Boudon-Padieu et al., 2004). No dedicated surveys are organised in EU MSs to check the presence or absence of CPu. For those reasons, the global distribution of CPu within the EU remains uncertain.

3.2.3. Vectors and their distribution in the EU

The leafhopper *Macropsis glandacea (=mendax)* has been identified as a vector in Italy (Carraro et al., 2004); other species (*Allygidius furcatus*, *Cixius* sp., *Iassus scutellaris*) have been trapped in the field in France and found to be PCR positive to an EY-group phytoplasma, although not proven to transmit it (Boudon-Padieu et al., 2004).

According to the *Fauna Europaea* (de Jong, 2013), the species shown in Table 3 are widely present in Europe. Among the vector species listed in the table, two (*Philaenus spumarius* and *Lepyronia quadrangularis*) are xylem-feeder spittlebugs. Phytoplasmas are phloem-limited pathogens but, according to Wayadande (1994), phloem and xylem feeding guilds are not strict categories for vascular-feeder hoppers. Furthermore, Crew et al. (1998) and Sinclair (2000) remarked that, while searching with its stylet for xylem bundles, *P. spumarius* often damages phloem tissues as well, which might allow it to transmit CPu. Furthermore, *P. spumarius* has already been shown to transmit a *Rubus* stunt phytoplasma in Europe (Jenser et al., 1981).

Table 3: Status of the exotic and European vectors and potential vectors of *Candidatus* Phytoplasma ulmi

Species	Vector status (a)	Location	Comments	Reference	Fauna Europaea
Allygus atomarius (Cicadellidae - "leafhopper")	Vector	USA	Transmission tests	Matteoni and Sinclair, 1988	Absent in Europe
Latalus sp. (Cicadellidae - "leafhopper")	Vector	USA	Transmission tests	Rosa et al., 2014	Absent in Europe
Lepyronia quadrangularis (Cercopidae - "spittlebug")	Vector	USA	Transmission tests	Rosa et al., 2014	Absent in Europe
Macropsis glandacea (=mendax) (Cicadellidae - "leafhopper")	Vector	Italy	Transmission tests	Carraro et al., 2004	Austria; Belgium; Britain I.; Bulgaria; Czech Republic; French mainland; Germany; Hungary; Italian mainland; Norwegian mainland; Poland; Sardinia; Slovakia; Spanish mainland; The Netherlands; Ukraine; Yugoslavia

Philaenus spumarius (Cercopidae - "spittlebug")	Vector	USA	Transmission tests; PCR verified	Matteoni and Sinclair, 1988; Rosa et al., 2014	Albania; Austria; Azores; Balearic Is.; Belgium; Bosnia and Herzegovina; Britain I.; Bulgaria; Canary Is.; Channel Is.; Corsica; Crete; Croatia; Cyclades Is.; Cyprus; Czech Republic; Danish mainland; Dodecanese Is.; Estonia; European Turkey; Finland; French mainland; Germany; Gibraltar; Greek mainland; Hungary; Ireland; Italian mainland; Latvia; Lithuania; Macedonia; Malta; Moldova, Republic of; North Aegean Is.; Norwegian mainland; Poland; Portuguese mainland; Romania; Russia Central; Russia North; Russia South; Sardinia; Sicily; Slovakia; Slovenia; Spanish mainland; Sweden; Switzerland; The Netherlands; Ukraine; Yugoslavia
Allygidius furcatus (Cicadellidae - "leafhopper")	PCR positive	France	Field collected	Boudon-Padieu et al., 2004	Austria; Czech Republic; French mainland; Hungary; Italian mainland; Moldova, Republic of; Poland; Romania; Slovakia; Slovenia; Switzerland; Ukraine; Yugoslavia
Allygidius spp. (Cicadellidae - "leafhopper")	PCR positive	USA	Field collected	Herath et al., 2010	18 species. The genus is present over the whole of Europe
Cixius sp. (Cixiidae - "planthopper")	PCR positive	France	Field collected	Boudon-Padieu et al., 2004	54 species records. The genus present over the whole of Europe
Colladonus spp. (Cicadellidae - "leafhopper")	PCR positive	USA	Field collected	Herath et al., 2010	One species. The genus present over the whole of Europe
Empoasca spp. (Cicadellidae - "leafhopper")	PCR positive	USA	Field collected	Herath et al., 2010	13 species. The genus present over the whole of Europe
Erythroneura spp. (Cicadellidae - "leafhopper")	PCR positive	USA	Field collected	Herath et al., 2010	Absent in Europe
Graphocephala spp. (Cicadellidae - "sharpshooter")	PCR positive	USA	Field collected	Herath et al., 2010	One species, present in Italy (mainland), Germany and Great Britain
Homalodisca spp. (Cicadellidae - "sharpshooter")	PCR positive	USA	Field collected	Herath et al., 2010	Absent in Europe
Iassus scutellaris (Cicadellidae - "leafhopper")	PCR positive	France	Field collected	Boudon Padieu et al., 2004	Austria; Bulgaria; Czech Republic; French mainland; Germany; Greek mainland; Hungary; Italian mainland; Moldova, Republic of; Poland; Romania; Russia South; Sardinia; Sicily; Slovakia; Slovenia; Spanish mainland; The Netherlands; Ukraine; Yugoslavia

Orientus spp. (Cicadellidae - "leafhopper")	PCR positive	USA	Field collected	Herath et al., 2010	One species, present in Switzerland
Typhlocyba spp. (Cicadellidae - "leafhopper")	PCR positive	USA	Field collected	Herath et al., 2010	Two species, present in most European countries

(a): Vector = transmission evidence provided. PCR positive = phytoplasma detected in the insect body, but transmission evidence not provided.

Among the vector species three are only present in North America, one in Europe and one species is known in both locations. The uncertainty on the role of potential insect vectors is considered as high.

3.3. Regulatory status

3.3.1. Legislation addressing *Candidatus* Phytoplasma ulmi (Directive 2000/29/EC)

CPu is regulated as a harmful organism in the EU. It is listed in Council Directive 2000/29/EC in the following section:

Table 4: *Candidatus* Phytoplasma ulmi in Council Directive 2000/29/EC.

Annex I, Part A	Harmful organisms whose introduction into, and spread within, all Member States shall be banned
Section I	Harmful organisms not known to occur in any part of the Community and relevant for the entire Community
(d)	Viruses and virus-like organisms
1	Elm phloem necrosis mycoplasm

3.3.2. Legislation addressing vectors of *Candidatus* Phytoplasma ulmi (Directive 2000/29/EC)

Scaphoideus luteolus (Van Duzee) is regulated as a harmful organism in the EU.

Table 5: *Scaphoideus luteolus* (Van Duzee) in Council Directive 2000/29/EC.

Annex I, Part A	Harmful organisms whose introduction into, and spread within, all Member States shall be banned
Section I	Harmful organisms not known to occur in any part of the Community and relevant for the entire Community
(a)	Insects, mites and nematodes, at all stages of their development
20	*Scaphoideus luteolus* (Van Duzee)

3.3.3. Legislation addressing hosts of *Candidatus* Phytoplasma ulmi (Directive 2000/29/EC)

EU Directive 2000/29/CE addresses in its Annexes IV and V various plants and plant parts related to hosts of CPu. As shown above (section 3.1.2), bark and wood are nevertheless not a pathway for the disease, so here are not considered parts of EU regulation dealing with wood or bark only.

Table 6: *Candidatus* Phytoplasma ulmi host plants in Council Directive 2000/29/EC

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 of the Community,	
	Plants, plant products and other objects	**Special requirements**
14.	Plants of *Ulmus* L., intended for planting, other than seeds, originating in North American countries	Without prejudice to the provisions applicable to the plants in Annex IV (A)(I) (11.4), official statement that no symptoms of Elm phloem necrosis mycoplasm have been observed at the place of production or in its immediate vicinity since the beginning of the last complete cycle of vegetation.

3.3.4. Marketing directives

The Council Directive 99/105/EC deals with the marketing of forest tree reproductive material intended for plantation in forests only. Forest trees not intended to be used for forestry purposes are not covered. That Directive includes in particular a list of forest tree species and hybrids that are important for forestry purposes. That list does not include *Ulmus spp*. Ornamental plant species are not covered by a marketing directive.

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

3.4.1. Host range

The hosts of *Candidatus* Phytoplasma ulmi all belong to the *Ulmaceae* family (Sinclair, 2000) and mostly to the *Ulmus* genus (Table 4). Additionally, there is a recent report by Romanazzi and Murolo (2008) of naturally infected *Zelkova serrata* in Italy. For experimental purposes, it is possible to transmit artificially CPu in *Catharanthus roseus* (*Vinca rosea*) via dodder (*Cuscuta* sp.) (Braun, 1977).

Table 7: Host plants of *Candidatus* Phytoplasma ulmi

	Common name	Symptom	Reference
Ulmus alata	Winged elm	Susceptible—phloem necrosis, foliar epinasty, yellowing, leaf fall and mortality	Sinclair, 2000
Ulmus americana	American or white elm	Susceptible—phloem necrosis, foliar epinasty, yellowing, leaf fall and mortality	Braun and Sinclair, 1979; Sinclair, 1972; Sinclair, 2000
Ulmus chenmoui	Chenmou elm	Generalised decline, paler or red leaves	Sfalanga et al., 2002
Ulmus crassifolia	Texas Cedar elm	Phloem necrosis, foliar epinasty, yellowing, leaf fall and mortality	Sinclair, 2000
Ulmus glabra	Wych elm		Arnaud et al., 2007
Ulmus japonica	Japanese elm	Yellowing, stunting, epicormics	Mittempergher, 2000
Ulmus laevis	European white Elm	Epinasty, chlorosis	Braun and Sinclair, 1979; Jović et al., 2008

	Common name	Symptom	Reference
Ulmus minor (*U. campestris, U. carpinifolia*)	Field elm	Witches' brooms, stunting	Boudon-Padieu et al., 2004; Braun and Sinclair, 1979; Carraro et al., 2004; Conti et al., 1987; Mittempergher, 2000; Piese and Juretić, 1999; Pisi et al., 1981;
Ulmus parvifolia	Lacebark elm	Witches' brooms, stunting, foliage with distinctively yellow or red leaves at the end of the season	Braun and Sinclair, 1979; Mittempergher, 2000; Sinclair, 2000
Ulmus pumila	Siberian elm	Witches' brooms	Carraro et al., 2004; Mittempergher, 2000;
Ulmus rubra	Red or slippery elm	Phloem necrosis, yellow-green leaves, witches' brooms, mortality	Sinclair, 2000
Ulmus serotina	September elm	Phloem necrosis, foliar epinasty, yellowing, leaf fall and mortality	Sinclair, 2000
Ulmus villosa	Cherry-bark elm	Decline, severe symptoms in young trees	Mittempergher, 2000
Zelkova serrata	Japanese zelkova	Leaf yellowing	Romanazzi and Murolo, 2008

If the information available clearly states that the only reported hosts so far belong to the *Ulmaceae* family, and mostly to the genus *Ulmus*, it is clear that there are some major differences with regards to the susceptibility of the host to CPu. While the disease is often associated with leaf yellowing and leaf fall followed by the death of the plant in susceptible hosts, more tolerant host show often reduced growth (stunting) and witches' brooms. Following the devastating effects of Dutch elm disease, breeding programmes have been set up to provide a response to the demand for elm trees, although it is not clear whether they have integrated a screening procedure for CPu. Several cultivars resistant to Dutch elm disease are susceptible to elm yellows, like Independence, New Harmony and Valley forge (Sinclair et al., 2001).

At present, despite efforts, there is still a lack of clear knowledge on the resistance of commonly used elm cultivars (Santamour and Bentz, 1995; Sinclair et al., 2000, 2001) or on their ability to carry the pest without showing symptoms. In addition, only some information is available on the resistance level of the numerous hybrids on the market, such as *Ulmus glabra* × *minor*, *Ulmus minor* × *parvifolia* or *Ulmus rubra* × *pumila*, which have been found to be infected by the disease (Braun and Sinclair, 1979; Sinclair et al., 2000).

3.4.2. EU distribution of main host plants

To assess the distribution of the main host plants, an aggregated map (Figure 3) including data on all elm species was provided by JRC from the European Forest Data Centre (EFDAC, McInerney et al., 2012; Rodriguez-Aseretto et al., 2013) in the Forest Information System for Europe (FISE, European Commission, 2013). In addition to the methods and datasets described in de Rigo et al. (2014), data from EUFGIS have been included after harmonisation processing. Frequency-accuracy maps have also been provided as additional data (see appendix A), based on the geospatial application (de Rigo et al., 2013b) of the Semantic Array Programming paradigm (de Rigo, 2012a,b). In the frequency-accuracy maps, the EFDAC - FISE data are aggregated by also considering the spatial density of the arrays of harmonised data, to qualitatively estimate the level of accuracy of the aggregated frequency.

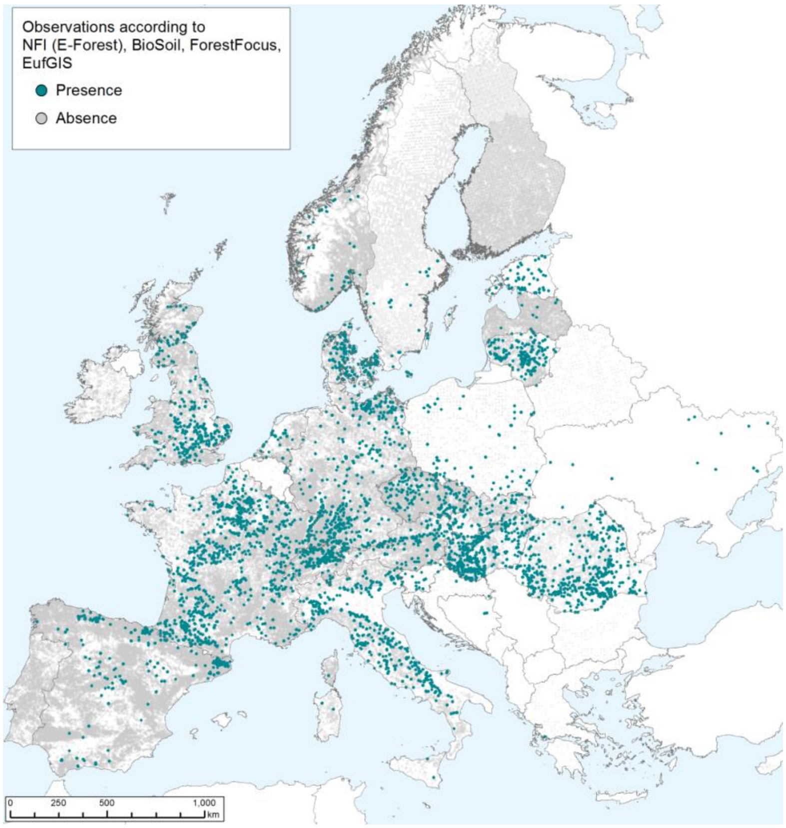

Figure 3: The plain spatial distribution of recorded presences of *Ulmus sp.* In Europe plotted (LAEA EPSG CODE 3035) against the corresponding distribution of all the available field observations (including the ones in which *Ulmus* taxa are not reported) (JRC, 2014)[5].

Elm species are widely distributed in Europe. In Europe and in the Mediterranean area four main species of *Ulmus* are observed "ranging from Scotland and Scandinavia to Algeria and Near East" (Buchel, 2000). In the harmonised datasets of the EFDAC-FISE, a non-negligible share of observations summarised in the *Ulmus sp*. aggregated taxon refers to observations in the *Ulmus* genus whose species was not recorded. *Ulmus laevis* is also not infrequent.

Given the hybridisation between some species and other classification problems, some species may result as ambiguously classified. For example, it is known that *Ulmus procera* has not rarely been referred as a variety of *Ulmus minor*. Jeffers (1999) reports an extensive analysis showing that "the elm population is extremely variable, and that very few discontinuities occur within that variation. The great difficulty that taxonomists have encountered with the genus *Ulmus* results from the complexity of the botanical variation. Many of the variants are also quite narrowly localized, but the elm population consists mainly of four principal taxa: *U. glabra*, *U. procera*, *U. minor*, and the *U. minor* x *U. glabra* hybrids. *Ulmus laevis* (white elm) "does not hybridise with the other European elm species which belong to a different section of the genus" (Collin, 2003).

[5] For this map, potential biases and modelling uncertainty – generated due to assumptions and hypotheses required by intensive data-processing – are reduced to a minimum degree. On the other hand, the heterogeneity of the available datasets at the European scale is remarkable. Despite all efforts for generating harmonised datasets, systematic biases may affect national inventories so that differences may be perceived in the local reported frequency of presences from country to country. In particular, human eyes may be misled by the visual saturation of presences in areas with a higher density of observations while in other areas, with a coarser amount of available observations, a relatively sparser occurrence of presences may be perceived as a lower frequency – which might not be the case.

3.4.3. Analysis of the potential distribution of *Candidatus* Phytoplasma ulmi in the EU

The distribution of CPu within the EU is not well documented, and, therefore, it is not possible to establish a reliable pest distribution (see section 3.2.2).

3.4.4. Spread capacity

According to a recent UK PRA (Webber, 2014), the intra-Community movement of elm cultivars is a way of spreading the disease. On the other hand, the survey carried out in France by Boudon-Padieu et al. (2004) suggests that the disease is already quite widespread in some parts of the EU. Adding to this the ubiquitous distribution of *Philaenus spumarius* and *Macropsis glandacea (=mendax)* already identified as vectors (Table 3), it is concluded that (i) CPu has already spread into the EU to a substantial although still mostly unknown extent, (ii) it could easily spread further owing to the wide geographic distribution of the vectors identified so far and of potential hosts and (iii) new vectors species might still be found.

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

3.5.1. Pest effects of *Candidatus* Phytoplasma ulmi

CPu affects elm trees by limiting phloem translocation, producing visible leaf yellowing and epinasty symptoms. In some cases, witches' brooms appear. The disease is linked to phloem degeneration in the roots and base of the tree, followed by root mortality, then tree mortality. Death of the tree might occur rapidly (within three successive years).

In the USA, several epidemics have been reported, in Ohio, Illinois, Pennsylvania (Merryl and Nichols, 1972) and New York (Lanier and Manion, 1988). In New York, approximately 58 % of elms were lost between 1981 and 1984 (Lanier and Manion, 1988). Similarly, Carter and Carter (1974) compared the effect of Dutch elm disease and phloem necrosis in Illinois (USA) between 1944 and 1972. They found that 21 % of the elm trees in the area disappeared as a result of CPu.

Elm trees were amongst the most widely planted shade and ornamental trees, in parks and along streets, in the 19th century. Elms are appreciated for the rapidity of their growth and their ability to be grown in a wide range of different climates, as well as their varieties of forms and foliage. The progressive disappearance of elm trees triggered by the Dutch elm disease has not only an economic impact (cost of tree replacement and reintroduction programmes), but also an environmental cost. The many elm-dependent or -related species are affected by loss of these trees. This effect on the white-letter hairstreak butterfly (*Satyrium w-album*) was particularly severe and triggered elm reintroduction programmes (Butterfly Conservation Elm Trials, 2013).

3.5.2. Observed impact of *Candidatus* Phytoplasma ulmi in the EU

The disease has been reported from several regions in Italy and France, from Germany and the Czech Republic (see section 3.2.2), but usually from areas considered as restricted. Since no extensive surveys are reported, it is not possible to assess the overall presence of CPu in Europe. Elm species in Europe (*Ulmus minor*, *Ulmus campestris*, *Ulmus laevis*, *Ulmus chenmoui* and others) are usually considered as less susceptible to *Candidatus* Phytoplasma ulmi. The type of symptoms reported (witches' brooms, yellowing) is associated with decline but less often with plant mortality, despite some epidemic foci reports. This is why it was hypothesised that the disease originated from Europe (Boudon-Padieu et al., 2004). The disease is present in at least four countries in the PRA area, but reports usually mention a limited distribution (Pisi et al., 1981; Carraro et al., 2004). There is a lack of extensive surveys that would allow us to assess precisely the distribution and impact of the pest in Europe.

3.6. Currently applied control methods

It is not practicably possible to cure a plant that is infected by *Candidatus* Phytoplasma ulmi. In the USA, high-value trees have been treated with antibiotics, and this led to remission of symptoms

(Webber, 2014), but this is not an option for a large number of trees. In addition, antibiotics are not authorised for that purpose in the EU. The most efficient risk reduction option is to destroy infected trees before the disease spreads to healthy trees (UK Forestry Commission, 2014). Some elm clones and species are known to be moderately or highly susceptible to the strains of the disease where they were tested. Such clones or species should not be used for plantation.

Controlling the vectors of CPu is quite impracticable (EPPO, 1997) in natural environments.

The present EU regulation considers that CPu (referred to in the regulations as Elm phloem necrosis mycoplasm) is not known to occur in the EU. In most MSs, no surveys or inspections are arranged and elm plantlets for planting are not required to have a plant passport. This makes difficult to assess the volume of plants for planting that are traded between MSs and to guarantee that plant material is free from CPu.

The United Kingdom recently implemented a measure (Webber, 2014) requiring those introducing elms into England to declare this in advance to the Plant Health Service, so that inspections can be arranged.

3.7. Uncertainty

The taxonomy of CPu is well defined, but as symptoms may be difficult to recognise, early detection of diseased plants in the field (surveys, first alert, etc.) remains uncertain. Detailed identification requires specific laboratory techniques and reagents that are not available everywhere; this may jeopardise the early detection of outbreaks. No dedicated surveys are organised in EU MSs to check for the presence or absence of CPu. For those reasons, the global distribution of CPu within the EU remains uncertain.

Although this does not affect the conclusions of this pest categorisation, the status of some potential insect vectors still needs to be confirmed.

The host range is apparently limited to the genus *Ulmus*, but uncertainties remain regarding the level of susceptibility of the different species and cultivars.

Limited information is available on the potential impact of CPu on European species and cultivars, strains occurring in the USA as well as cultivars may be different from those in the EU, that makes uncertain the potential impact of CPu in the EU context.

CONCLUSIONS

The Panel summarises in the tables below its conclusions on the key elements addressed in this scientific opinion in consideration of the pest categorisation criteria defined in ISPM 11 and of the additional questions formulated in the terms of reference.

Table 8: 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**	**List of main uncertainties**
Identity of the pest	*Is the identity of the pest clearly defined?* **Yes**, *Candidatus* Phytoplasma ulmi satisfies this criterion. The identity of the pest, *Candidatus* Phytoplasma ulmi, is clearly defined. *Do clearly discriminative detection methods exist for the pest?* Reliable detection and identification methods are available.		-
Absence/presence of the pest in the PRA area	*Is the pest absent from all or a defined part of the PRA area?* CPu is reported in a limited part of the PRA area (four countries), but no systematic surveys have been conducted. CPu has also been reported in other countries either through detection or based on limited scientific evidence. The data available are not considered complete enough for a detailed absence/presence statement in the PRA area.	*Is the pest present in the PRA area?* **Yes**, CPu is present in the PRA area (see Table 2)	There is uncertainty on the way and the extent to which CPu is distributed within the risk assessment area
Regulatory status	*Considering that the pest under scrutiny is already regulated, just mention in which annexes of 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)* CPu satisfies this criterion. It is listed in Directive 2000/29/CE, in Annex I, Part A, Section I		-

Criterion of pest categorisation	Panel's conclusions against ISPM 11 criterion Yes /No	Panel's conclusions against ISPM 21 criterion Yes /No	List of main 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?* **Yes**, CPu satisfies this criterion. Elm trees and other *Ulmaceae* species are widely distributed in Europe and CPu is unlikely to be affected by EU ecoclimatic conditions. Although some reported vectors are absent from the PRA area, vectors are widely present in Europe. CPu is efficiently spread by the movement of plant for planting.	*Are plants for planting a pathway for introduction and spread of the pest?* **Yes,** CPu is graft transmissible and is efficiently transmitted through plant propagation material, which is widely used by nurseries	**Uncertainties** with regards to the spread capacity, since CPu is already well established in the PRA area
Potential for consequences in the PRA area	*What are the potential for consequences in the PRA area?* *Provide a summary of impact in terms of yield and quality losses and environmental consequences* CPu is causing mortality of elm trees, with reduction of biodiversity. The impact of the disease was documented in USA, but probably underestimated because of the concomitant occurrence of Dutch elm disease. Elm trees may suffer more or less of the disease depending on species and cultivar susceptibilities, which are still largely unknown	*If applicable is there indication of impact(s) of the pest as a result of the intended use of the plants for planting?* CPu has been reported in nurseries, but there is a lack of data on the level of impacts of the pest as a result of intended use of the plants for planting.	**There is uncertainty** owing to lack of data on elm species' and cultivars' susceptibility, on the impact of the intended use of plant for planting as well as on the current distribution of the disease in the PRA area.
Conclusion on pest categorisation	Data are not sufficient to reach a conclusion on pest categorisation of CPu and a full risk assessment cannot be conducted unless the key data gaps on CPu distribution, insect vector, elm species' susceptibility and potential consequences are filled.	Data are not sufficient to reach a conclusion on pest categorisation of CPu and a full risk assessment cannot be conducted unless the key data gaps on distribution, elm species' susceptibility and potential consequences of CPu are filled.	Uncertainties on the lack of data on CPu distribution, insect vectors, elm species susceptibility, potential consequences.

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,*	
	CPu is present in at least four Member States: the Czech Republic, France, Germany and Italy. The distribution in Europe is suspected to be underestimated.	No systematic surveys are carried out.
	– *the analysis of the observed impacts of the organism in the risk assessment area* There is a lack of extensive surveys that would allow us to assess precisely the distribution and impact of the pest in Europe.	There is also uncertainty with regards to the insect vectors and elm species susceptibility.

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Appendix A.

The mapping methodology

The maps referring to *Ulmus sp.* provide two different methodologies for visualizing the information associated to the spatial distribution of *Ulmus sp*. The concept of "model-free" distribution, meaning an ideally "undisturbed" spatial representation of field observations which would not be biased by modelling processing steps, is unfortunately not realistic in a complex and highly heterogeneous spatial extent as the European one.

For example, the influence of sudden changes in the spatial density and distribution of observations is often evident along the boundaries between different countries or even smaller administrative units with autonomous responsibility for the local data collection. This kind of artifacts may be present even in the spatial zoning of other aspects related to forest resources (e.g. de Rigo *et al*., 2013a) and the cumulated impact of these phenomena may be mitigated with the help of integrated statistical modelling (de Rigo *et al*., 2014).

Here, a lightweight approach has been followed, trying to reduce the modelling steps to the required ones in order for interesting information to emerge and be easily visualised.

The first method has already been tested in de Rigo *et. al.* (2014) with the objective of reducing as much as possible the number of data-transformation steps. The plain spatial distribution of recorded presences of *Ulmus sp.* has been plotted (LAEA EPSG CODE 3035) against the corresponding distribution of all the available field observations (including the ones in which *Ulmus* taxa are not reported). This way, potential biases and modelling uncertainty – generated due to assumptions and hypotheses required by intensive data-processing – are reduced to a minimum degree. On the other hand, as already highlighted, the heterogeneity of the available datasets at the European scale is remarkable. Despite all efforts for generating harmonised datasets, systematic biases may affect national inventories so that differences may be perceived in the local reported frequency of presences from country to country. In particular, human eyes may be misled by the visual saturation of presences in areas with a higher density of observations while in other areas, with a coarser amount of available observations, a relatively sparser occurrence of presences may be perceived as a lower frequency – which might not be the case.

The second visualization method aims at complementing the information conveyed by the first map, by aggregating the field observations at different spatial scales (in spatial blocks of size 25km x 25km, 75km x 75km and 125km x 125km, LAEA EPSG CODE 3035) (see figure 4).

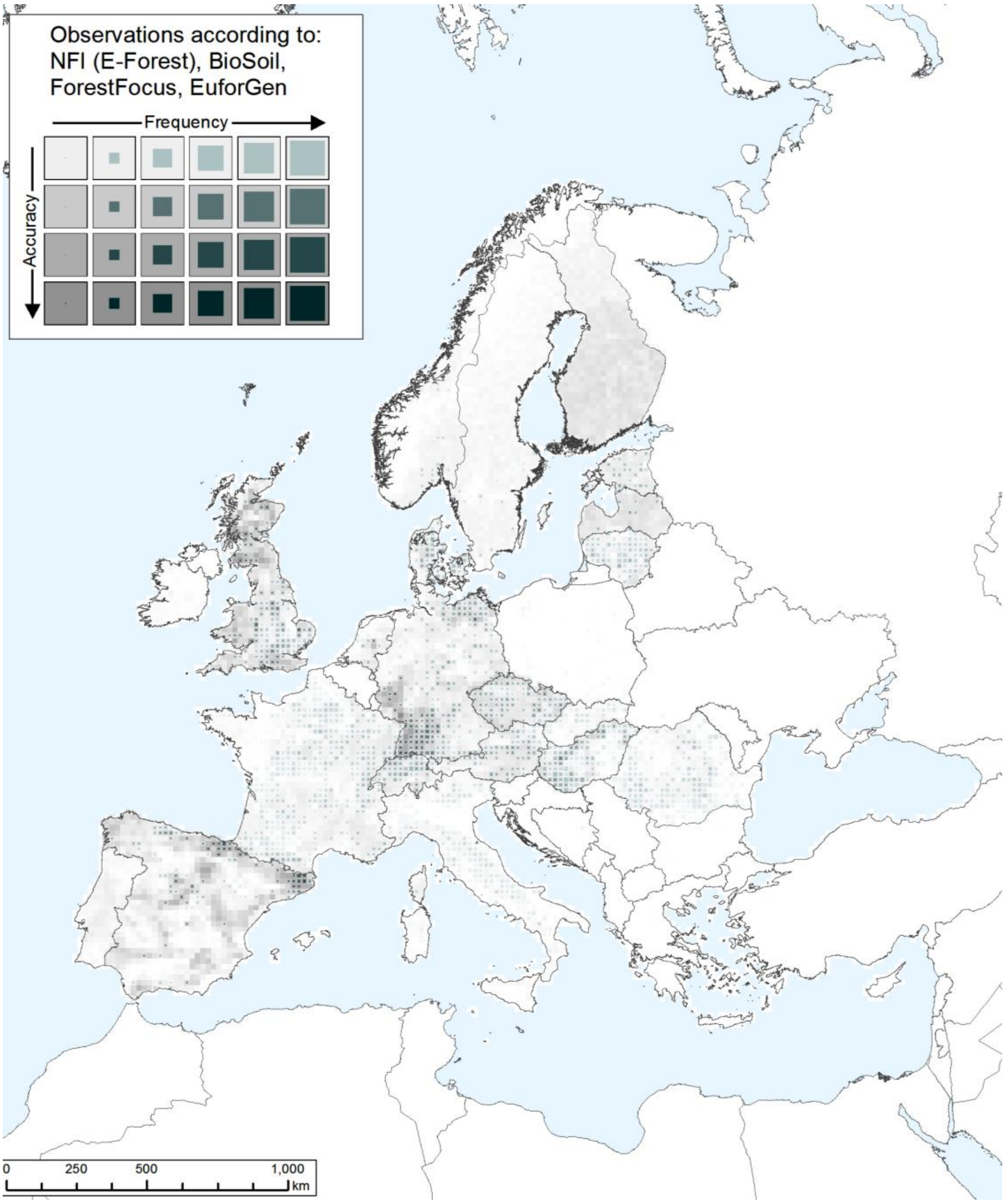

Figure 4: Observed presence of *Ulmus sp.* in Europe (spatial blocks of size 25km x 25km)

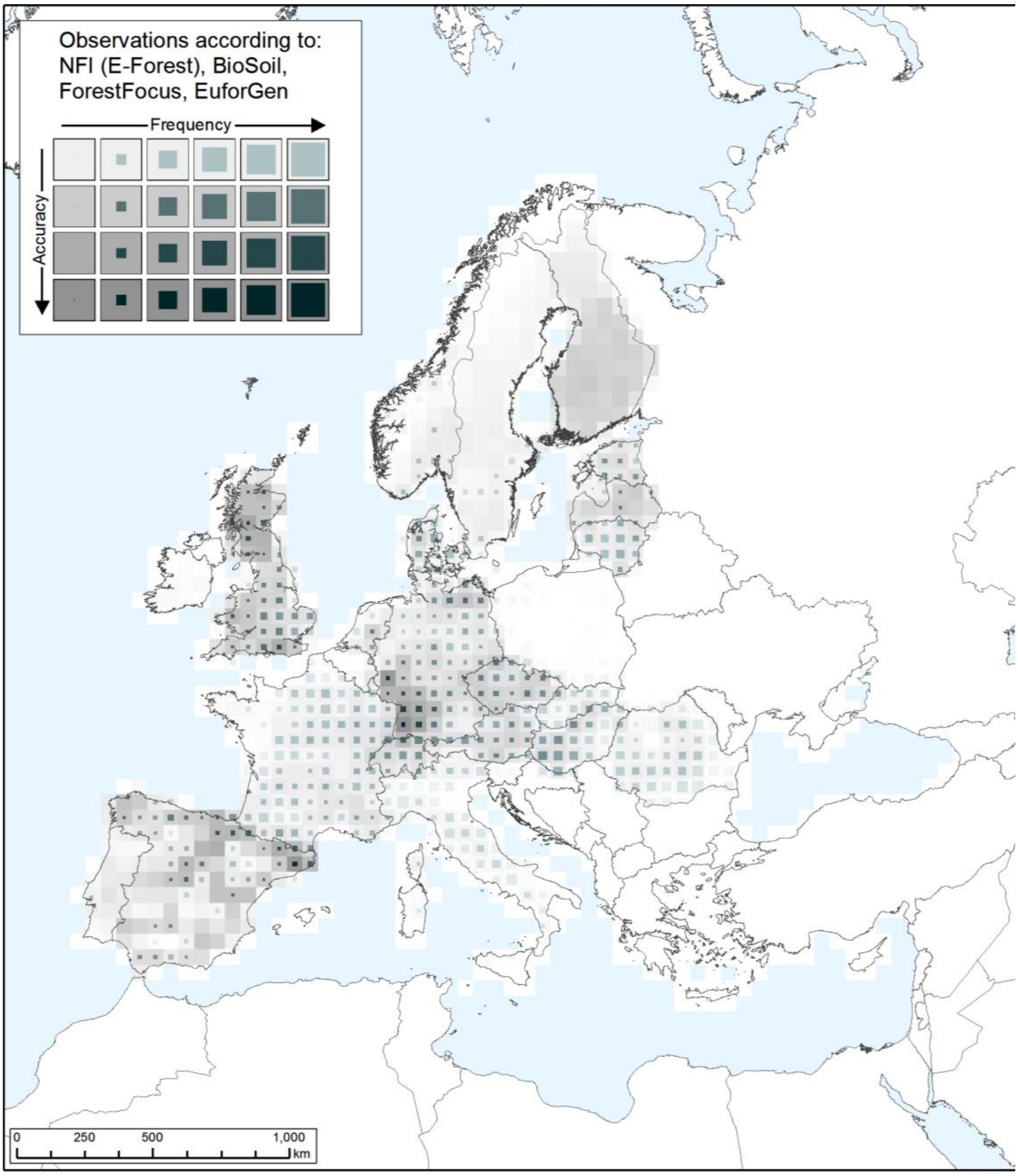

Figure 5: Observed presence of *Ulmus sp.* in Europe (spatial blocks of size 75km x 75km)

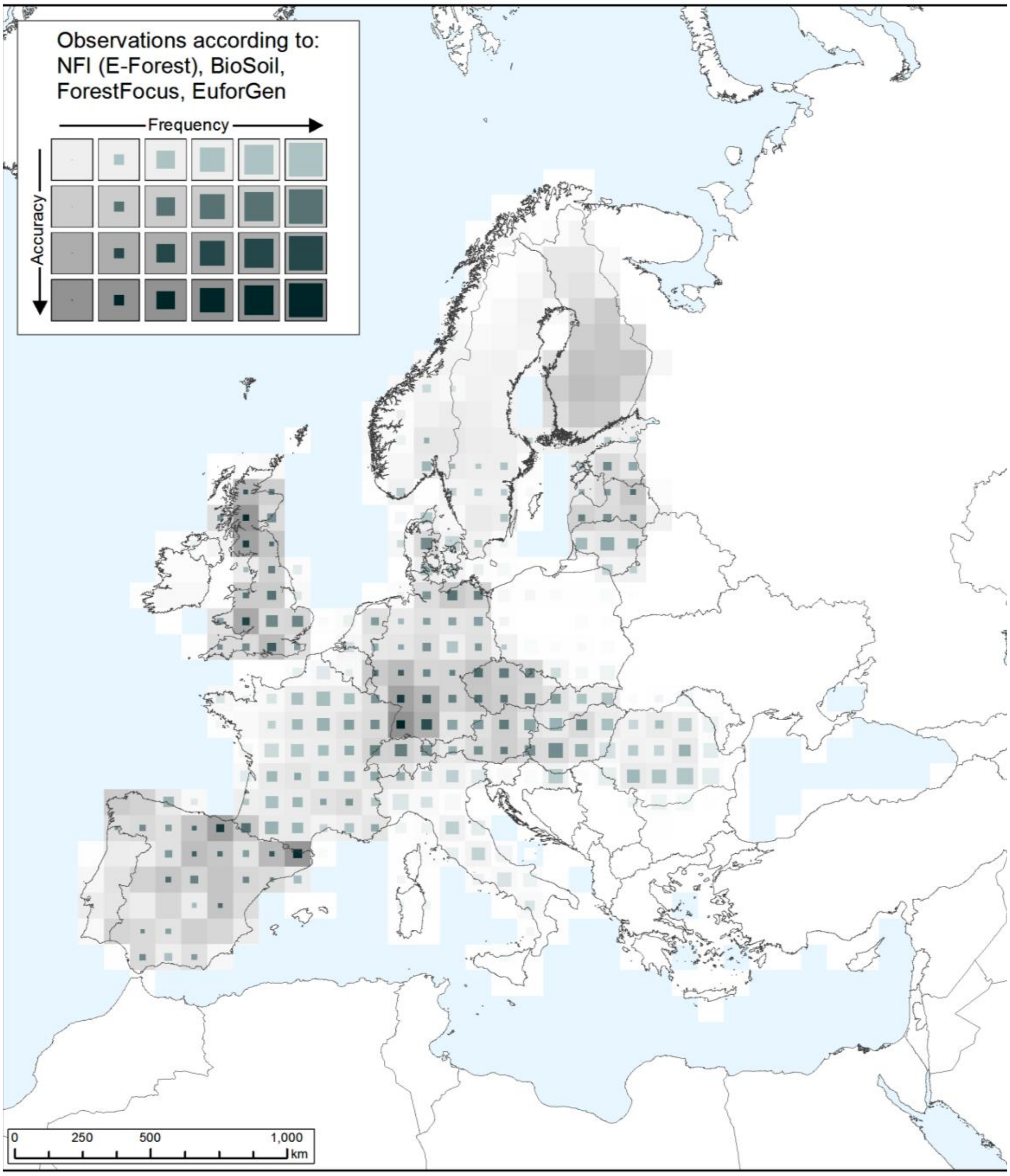

Figure 6: Observed presence of *Ulmus sp.* in Europe (spatial blocks of size 125km x 125km)

These modelling-derived family of visualizations is based on the Geospatial application (de Rigo *et al.*, 2013b) of the Semantic Array Programming paradigm (de Rigo, 2012a,b). In particular, dynamic aggregation tools[6] have been required in order for the arrays of field observations to be processed. The observations refer to four harmonised datasets in the EDFAC, FISE. The observations are aggregated by considering both the frequency of observed *Ulmus* taxa and the spatial density of available observations (including the ones in which *Ulmus* taxa are not reported). This second aspect of the distribution of field observations is here considered to qualitatively estimate the level of accuracy of the aggregated frequency.

[6] For a brief overview of the methods, see http://mastrave.org/doc/mtv_m/mblk_fun and http://mastrave.org/doc/mtv_m/mloop

In the frequency-accuracy maps, the frequency represents the proportion[7] of field-observations in a given spatial block where at least one of the *Ulmus* taxa has been reported. The accuracy represents a nonnegative[8] spatially-explicit index summarising how many field observations are available in each block.

The frequency of *Ulmus sp.* in a given block is represented by a smaller coloured box within the corresponding grey block. The higher the size of the inner coloured box, the higher the observed frequency (irrespective of the colour intensity).

However, when the overall amount of field observations in a certain block is very small, the qualitative robustness (in the maps denoted as *accuracy*) of the reported frequency is correspondingly weak and the stochastic variability associated with the frequency is higher. The extreme of this behaviour would happen when the amount of field observations in a block is zero. In this case, the frequency would not be computable at all. Therefore, when the density of field observations in a given block is zero, the block is rendered as white. It is worth noticing that even in this particular case, where the information on the frequency is missing, still the information on the local robustness is available (i.e. the block is not reliable).

The density of field observations is represented with proportional levels of grey, from white (no observations) to the darker grey (where the maximum number of field observations has been recorded).

The information has been masked by computing the amount of 1km x 1km pixels for each block belonging to territory for which data are available. Blocks with less than 1% of valid territory have been escluded.

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[7] Matematically defined in the Semantic Array Programming paradigm as the array-based constraint **::proportion::** , http://mastrave.org/doc/mtv_m/check_is#SAP_proportion

[8] In the Semantic Array Programming paradigm, it corresponds to the array-based constraint **::nonnegative::** , http://mastrave.org/doc/mtv_m/check_is#SAP_nonnegative

ABBREVIATIONS

EFSA:	European Food Safety Authority
EPPO:	European and Mediterranean Plant Protection Organization
EPPO-PQR:	European and Mediterranean Plant Protection Organization Plant Quarantine Retrieval System
EU:	European Union
EUFGIS:	European Information System on Forest Genetic Resources
ISPM:	International Standard for Phytosanitary Measures
JRC:	Joint Research Centre
MS(s):	Member State(s)
NPPO:	National Plant Protection Organisation
PLH Panel:	Plant Health Panel
RNQP:	Regulated Non Quarantine Pest