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Xylella fastidiosa
Pest Report to support ranking of EU candidate priority pests

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Table of Contents

1. Introduction to the report

This document is one of the 28 Pest Reports produced by the EFSA Working Group on EU Priority Pests under task 3 of the mandate M-2017-0136. supports the corresponding Pest Datasheet published together on Zenodo[1] and applies the methodology described in the Methodology Report published on the EFSA Journal (EFSA, 2019a).

This Pest Report has five sections. In addition to this introduction, a conclusion and references, there are two key sections, sections 2 and 3.

Section 2 first summarises the relevant information on the pest related to its biology and taxonomy. The second part of Section 2 provides a review of the host range and the hosts present in the EU in order to select the hosts that will be evaluated in the expert elicitations on yield and quality losses. The third part of Section 2 identifies the area of potential distribution in the EU based on the pest's current distribution and assessments of the area where hosts are present, the climate is suitable for establishment and transient populations may be present. The fourth part of Section 2 assesses the extent to which the presence of the pest in the EU is likely to result in increased treatments of plant protection products. The fifth part of section 2 reviews additional potential effects due to increases in mycotoxin contamination or the transmission of pathogens.

In Section 3, the expert elicitations that assess potential yield losses, quality losses, the spread rate and the time to detection are described in detail. For each elicitation, the general and specific assumptions are outlined, the parameters to be estimated are selected, the question is defined, the evidence is reviewed and uncertainties are identified. The elicited values for the five quantiles are then given and compared to a fitted distribution both in a table and with graphs to show more clearly, for example, the magnitude and distribution of uncertainty. A short conclusion is then provided.

It should be noted that this report is based on information available up to the last day of the meeting[2] that the Priority Pests WG dedicated to the assessment of this specific pest. Therefore, more recent information has not been taken into account.

Xylella fastidiosa was assessed between 2018 and 2019 by five EFSA working groups each with different mandates: i) *Xylella* host plant database (EFSA, 2018a), ii) Xylella pest categorisation (EFSA PLH Panel, 2018), iii) EFSA pest risk assessment (EFSA PLH Panel, 2019a) and Effectiveness of *in planta* control measures for *Xylella fastidiosa* (EFSA PLH Panel, 2019b), iv) survey cards (EFSA, 2018b) and v) EU candidate priority pests (current output). Due to this reason, part of the activity relevant to this project was conducted in collaboration with the EFSA Working Group on *Xylella* pest risk assessment (from now on, PRA) in order to obtain outputs consistent and suitable for multiple purposes. The content of this Pest Report is therefore mainly a cross reference with the other outputs and detailed results are provided only when they are specific to this mandate.

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[1] Open-access repository developed under the European OpenAIRE program and operated by CERN, https://about.zenodo.org/

[2] The minutes of the Working Group on EU Priority Pests are available at http://www.efsa.europa.eu/sites/default/files/wgs/plant-health/wg-plh-EU_Priority_pests.pdf

2. The biology, ecology and distribution of the pest

2.1. Summary of the biology and taxonomy

For the biology and taxonomic identity of *X. fastidiosa* relevant to this assessment, see section 3.1 “Identity and biology of the pest” in EFSA PLH Panel (2018).

2.2. Host plants

2.2.1. List of hosts

Xylella fastidiosa affects a wide range of host plants, including agricultural and horticultural crops, forest and ornamental species. In this document, the EFSA *Xylella* spp. host plant database (EFSA, 2018a) is referred to as the full list of hosts.

2.2.2. Selection of hosts for the evaluation

The main hosts in the assessment area include several species of economic and environmental importance. The EFSA PRA (EFSA PLH Panel, 2019a) focused its assessment on: *Citrus* spp., *Olea europaea*, *Prunus avium*, *Prunus domestica*, *Prunus dulcis*, *Prunus salicina*, *Vitis vinifera*, forest species and nurseries. Quantitative risk assessment in the EFSA PRA was conducted by Expert Knowledge Elicitation (EKE) on the following hosts:

- *Citrus* spp., as a unique class, i.e. all species and varieties
- *Olea europaea*, for two age classes: trees older than 30 years of age assumed to be mainly cultivated in traditional olive orchards, and trees younger than 30 years of age, assumed to be cultivated mainly in more modern olive orchards
- *Prunus dulcis*, as a unique class, i.e. all varieties
- *Vitis vinifera*, as two categories, wine grapes and table grapes

2.2.3. Conclusions on the hosts selected for the evaluation

The EFSA PRA (EFSA PLH Panel, 2019a), as referred to here, selected the following hosts for evaluation through the EKE process: *Citrus* spp., *Olea europaea*, *Prunus dulcis* and *Vitis vinifera*.

2.3. Area of potential distribution

2.3.1. Area of current distribution

See section 1.4 “Current distribution of *X. fastidiosa* outbreaks in Europe and known vectors” of EFSA PLH Panel (2019a).

2.3.2. Area of potential establishment

See section 3.1.3 “Establishment” of EFSA PLH Panel (2019a).

2.3.3. Transient populations

Xylella fastidiosa is not expected to form transient populations in the EU.

2.3.4. Conclusions on the area of potential distribution

For this assessment, the area of potential distribution of the pest is equivalent to the area of potential establishment as summarise in section 3.1.3 of the EFSA PLH Panel (2019a). The assessment of potential distribution does not consider the role of the vectors in limiting the area of potential establishment.

2.4. Expected change in the use of plant protection products

Based on the conclusion that no plant protection products (PPP) are currently available to eliminate *X. fastidiosa* from a diseased plant in open field conditions (EFSA PLH Panel, 2019b) and that the control of this pest requires an integrated strategy of control acting both on the host and on the vector, the most suitable PPP indicator is Case "D" and category "2" based on Table 3.

Table 1: Expected changes in the use of Plant Protection Products (PPPs) following *Xylella fastidiosa* establishment in the EU in relation to four cases (A-D) and three level score (0-2) for the expected change in the use of PPPs

Expected change in the use of PPPs	**Case**	**PPPs indicator**
PPPs effective against the pest are not available/feasible in the EU	A	0
PPPs applied against other pests in the risk assessment area are also effective against the pest, without increasing the amount/number of treatments	B	0
PPPs applied against other pests in the risk assessment area are also effective against the pest but only if the amount/number of treatments is increased	C	1
A significant increase in the use of PPPs is not sufficient to control the pest: only new integrated strategies combining different tactics are likely to be effective	**D**	**2**

2.5. Additional potential effects

2.5.1. Mycotoxins

The species is not known to be related to problems caused by mycotoxins.

2.5.2. Capacity to transmit pathogens

The species is not known to vector any plant pathogens.

3. Expert Knowledge Elicitation report

3.1. Yield and quality losses

3.1.1. Structured expert judgement

3.1.1.1. Generic scenario assumptions

All the generic scenario assumptions common to the assessments of all the priority pests are listed in the section 2.4.1.1 of the Methodology Report (EFSA, 2019a).

3.1.1.2. Specific scenario assumptions

- Olive: section E.2.1 of EFSA PLH Panel (2019a)
- Almond section E.2.2 of EFSA PLH Panel (2019a)
- Grapevine section E.2.3 of EFSA PLH Panel (2019a)
- Citrus spp.: section E.2.4 of EFSA PLH Panel (2019a)

3.1.1.3. Selection of the parameter(s) estimated

- Olive: section E.2.1 of EFSA PLH Panel (2019a); impact in olive was assessed for the two age classes: trees older than 30 years of age assumed to be mainly cultivated in traditional olive orchards, and trees younger than 30 years of age, assumed to be cultivated mainly in more modern olive orchards
- Almond section E.2.2 of EFSA PLH Panel (2019a)
- Grapevine section E.2.3 of EFSA PLH Panel (2019a); impact in grapevine was assessed for two categories, wine grapes and table grapes. For the specific scope of the Priority Pest project, the impact has been assessed at the geographical extremes (southernmost and northernmost) of the distribution of grapevine production. The calculation of intermediate values was obtained by interpolation as described in EFSA (2019a, section 2.4.1.1.). In case of table grapes, a single distribution was considered.
- Citrus spp.: section E.2.4 of EFSA PLH Panel (2019a)

3.1.1.4. Defined question(s)

The following questions were formulated during the quantitative assessment of the EFSA PRA WG:

What is the annual % of loss (in weight) in olive production in EU averaging the different countries, production systems, olive varieties in the long-term situation under the condition of the general scenario for olive orchards younger than 30 years?

What is the annual % of loss in olive production in EU averaging the different countries, production systems, olive varieties in the long-term situation under the condition of the general scenario for olive orchards older than 30 years?

What is the annual % of loss in almond production in EU averaging the different countries, production systems, varieties in the long-term situation under the condition of the general scenario?

What is the annual % of loss in grapevine production devoted to wine production in southern EU countries, averaging the different production systems, varieties in the long-term situation under the condition of the general scenario?

What is the annual % of loss in grapevine production devoted to table grape production in southern EU countries, averaging the different production systems, varieties in the long-term situation under the condition of the general scenario?

What is the annual % of loss in grapevine production devoted to wine production in Central EU countries, averaging the different production systems, varieties in the long-term situation under the condition of the general scenario?

What is the annual % of reduction in citrus production weight including lower number of fruits, size of fruit below the marketable threshold (e.g. 5 cm for sweet oranges), lower productivity of plants, in the long-term situation under the condition of the general scenario?

3.1.1.5. Evidence selected

- Olive: section E.2.1.1 of EFSA PLH Panel (2019a)
- Almond section E.2.2.1 of EFSA PLH Panel (2019a)
- Grapevine section E.2.3.1 of EFSA PLH Panel (2019a)
- Citrus spp.: section E.2.4.1 of EFSA PLH Panel (2019a)

3.1.1.6. Uncertainties identified

- Olive: section E.2.1.1 of EFSA PLH Panel (2019a)
- Almond section E.2.2.1 of EFSA PLH Panel (2019a)
- Grapevine section E.2.3.1 of EFSA PLH Panel (2019a)
- Citrus spp.: section E.2.4.1 of EFSA PLH Panel (2019a)

3.1.2. Elicited values for yield losses for olive trees younger than 30 years

What is the annual % of loss (in weight) in olive production in EU averaging the different countries, production systems, olive varieties in the long-term situation under the condition of the general scenario for olive orchards younger than 30 years?

The five elicited values on yield loss on olive trees younger than 30 years on which the group agreed are reported in the table below.

Table 2: Summary of the 5 elicited values on yield loss (%) on olive trees younger than 30 years

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	10%	25%	35%	45%	60%

3.1.2.1. *Justification for the elicited values for yield loss on olive trees younger than 30 years*

Section E.2.1.2 of EFSA PLH Panel (2019a).

3.1.2.2. *Estimation of the uncertainty distribution for yield loss on olive trees younger than 30 years*

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 3: Fitted values of the uncertainty distribution on the yield loss (%) on olive trees younger than 30 years

Percentile	**1%**	**2.5%**	**5%**	**10%**	**17%**	**25%**	**33%**	**50%**	**67%**	**75%**	**83%**	**90%**	**95%**	**97.5%**	**99%**
Expert elicitation	10%					25%		35%		45%					60%
Fitted distribution	9.4%	12.1%	14.9%	18.5%	22.0%	25.6%	28.7%	34.6%	40.9%	44.5%	48.9%	53.6%	59.0%	63.5%	68.5%

Fitted distribution: BetaGeneral(4.1534,7.5543,0,1), @RISK7.5

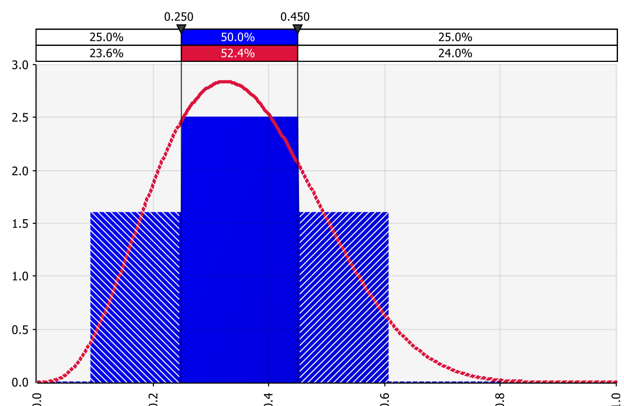

Figure 1 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on olive trees younger than 30 years.

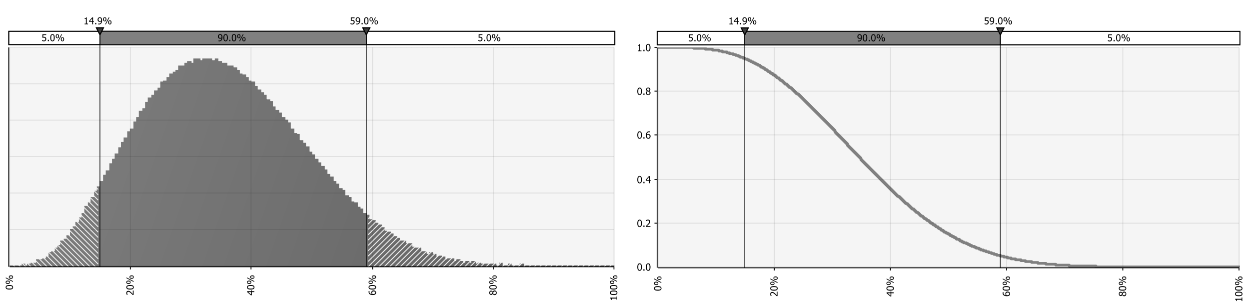

Figure 2 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on olive trees younger than 30 years.

3.1.3. Elicited values for yield losses for olive trees older than 30 years

What is the annual % of loss (in weight) in olive production in EU averaging the different countries, production systems, olive varieties in the long-term situation under the condition of the general scenario for olive orchards older than 30 years?

The five elicited values on yield loss on olive trees older than 30 years on which the group agreed are reported in the table below.

Table 4: Summary of the 5 elicited values on yield loss (%) on olive trees older than 30 years

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	25%	55%	70%	80%	95%

3.1.3.1. Justification for the elicited values for yield loss on olive trees older than 30 years

Section E.2.1.3 of EFSA PLH Panel (2019).

3.1.3.2. Estimation of the uncertainty distribution for yield loss on olive trees older than 30 years

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 5: Fitted values of the uncertainty distribution on the yield loss (%) on olive trees older than 30 years

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	25%					55%		70%		80%					95%
Fitted distributio n	24.4%	30.6%	36.3%	43.4%	49.8%	55.8%	60.7%	69.1%	76.7%	80.5%	84.6%	88.4%	91.9%	94.3%	96.3%

Fitted distribution: BetaGeneral(4.438,2.1598,0,1), @RISK7.5

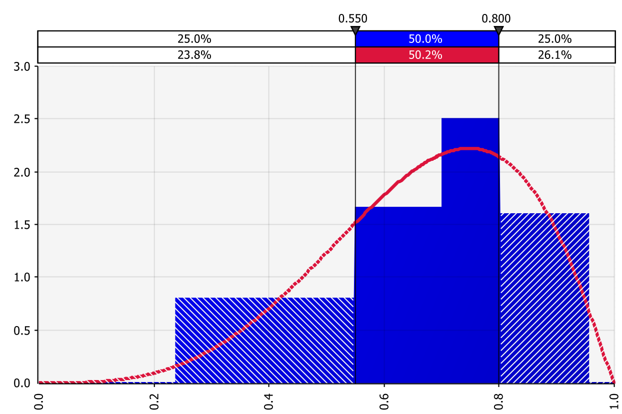

Figure 3 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on olive trees older than 30 years.

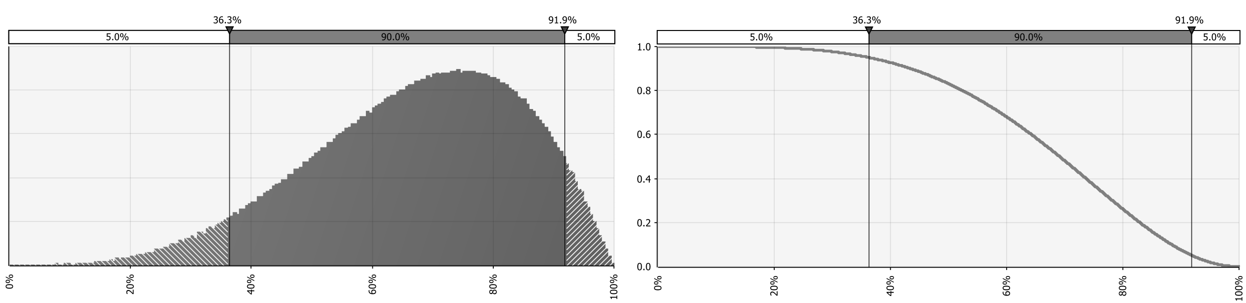

Figure 4 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on olive trees older than 30 years.

3.1.4. Elicited values for yield losses for almond

What is the annual % of loss in almond production in EU averaging the different countries, production systems, varieties in the long-term situation under the condition of the general scenario?

The five elicited values on yield loss on almond on which the group agreed are reported in the table below.

Table 6: Summary of the 5 elicited values on yield loss (%) on almond

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	3%	9%	13%	19%	25%

3.1.4.1. Justification for the elicited values for yield loss on almond

Section E.2.1.3 of EFSA PLH Panel (2019a).

3.1.4.2. *Estimation of the uncertainty distribution for yield loss on almond*

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 7: Fitted values of the uncertainty distribution on the yield loss (%) on almond

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	3%					9%		13%		19%					25%
Fitted distributio n	1.8%	2.8%	3.9%	5.5%	7.2%	8.9%	10.4%	13.3%	16.2%	17.7%	19.5%	21.2%	22.8%	24.0%	25.0%

Fitted distribution: BetaGeneral(2.2137,2.2703,0,0.27), @RISK7.5

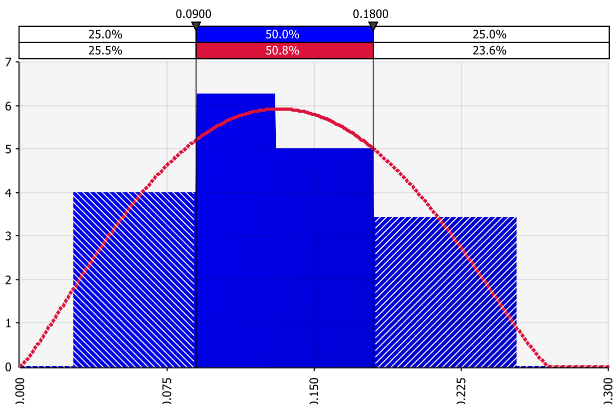

Figure 5 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on almond.

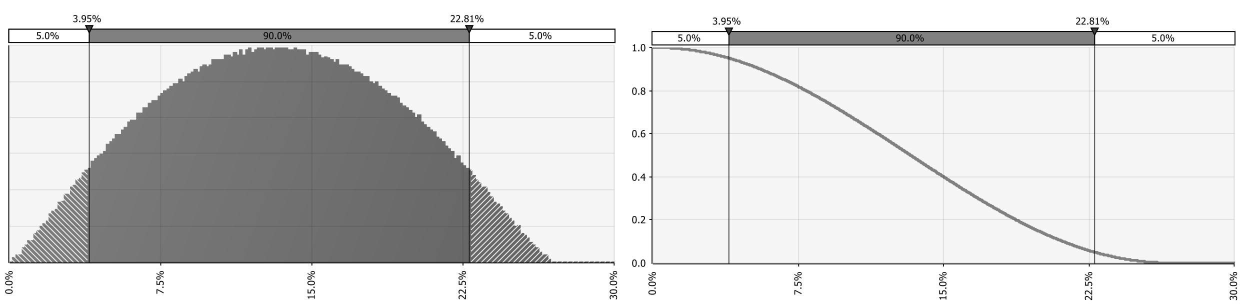

Figure 6 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on almond.

3.1.5. Elicited values for yield losses for wine grapes in southern EU

What is the annual % of loss in grapevine production devoted to wine production in southern EU countries, averaging the different production systems, varieties in the long-term situation under the condition of the general scenario?

The five elicited values on yield loss on wine grapes in southern EU on which the group agreed are reported in the table below.

Table 8: Summary of the 5 elicited values on yield loss (%) on wine grapes in southern EU

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	0.3%	1.2%	2%	3.5%	6%

3.1.5.1. Justification for the elicited values for yield loss on wine grapes in southern EU

Section E.2.3.2 of EFSA PLH Panel (2019a).

3.1.5.2. Estimation of the uncertainty distribution for yield loss on wine grapes in southern EU

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 9: Fitted values of the uncertainty distribution on the yield loss (%) on wine grapes in southern EU

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	0.3%					1.2%		2%		3.5%					6%
Fitted distribution	0.2%	0.3%	0.5%	0.7%	0.9%	1.2%	1.5%	2.1%	2.8%	3.3%	3.9%	4.7%	5.6%	6.8%	8.1%

Fitted distribution: Gamma(2.0511,0.011956), @RISK7.5

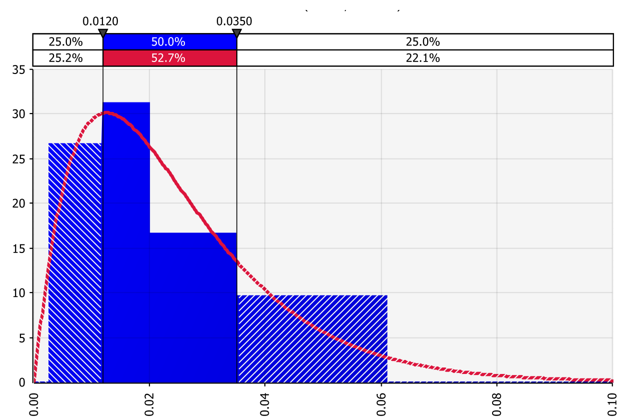

Figure 7 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on wine grapes in southern EU.

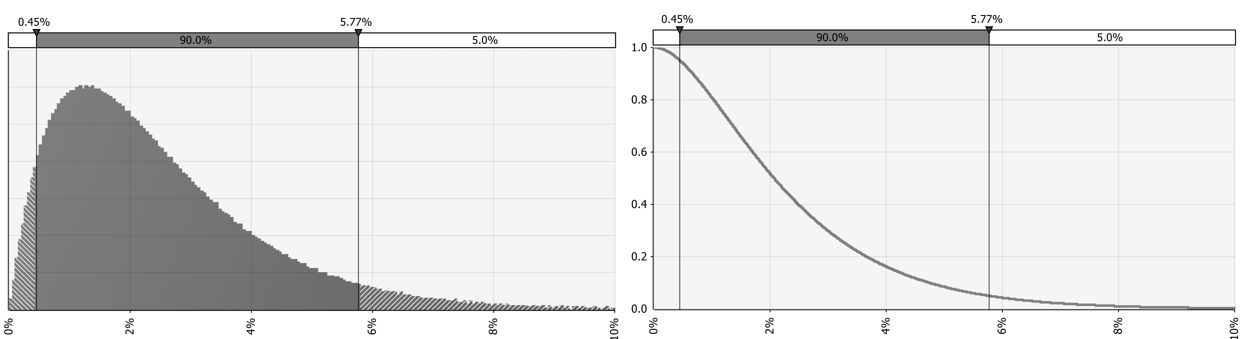

Figure 8 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on wine grapes in southern EU.

3.1.6. Elicited values for yield losses for table grapes

What is the annual % of loss in grapevine production devoted to table grape production in southern EU countries, averaging the different production systems, varieties in the long-term situation under the condition of the general scenario?

The five elicited values on yield loss on table grapes on which the group agreed are reported in the table below.

Table 10: Summary of the 5 elicited values on yield loss (%) on table grapes

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	0.1%	0.5%	1%	2%	4%

3.1.6.1. Justification for the elicited values for yield loss on table grapes

Section E.2.3.3 of EFSA PLH Panel (2019a).

3.1.6.2. *Estimation of the uncertainty distribution for yield loss on table grapes*

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 11: Fitted values of the uncertainty distribution on the yield loss (%) on table grapes

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	0.1%					0.5%		1%		2%					4%
Fitted distribution	0.0%	0.1%	0.1%	0.2%	0.4%	0.5%	0.7%	1.0%	1.5%	1.9%	2.3%	2.9%	3.7%	4.4%	5.4%

Fitted distribution: Gamma(1.3469,0.010083),@RISK7.5

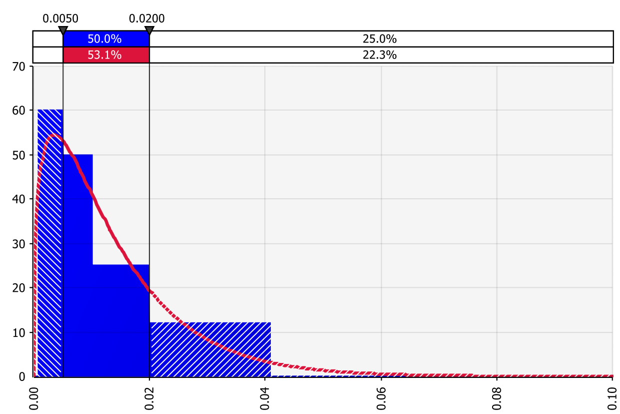

Figure 9 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on table grapes.

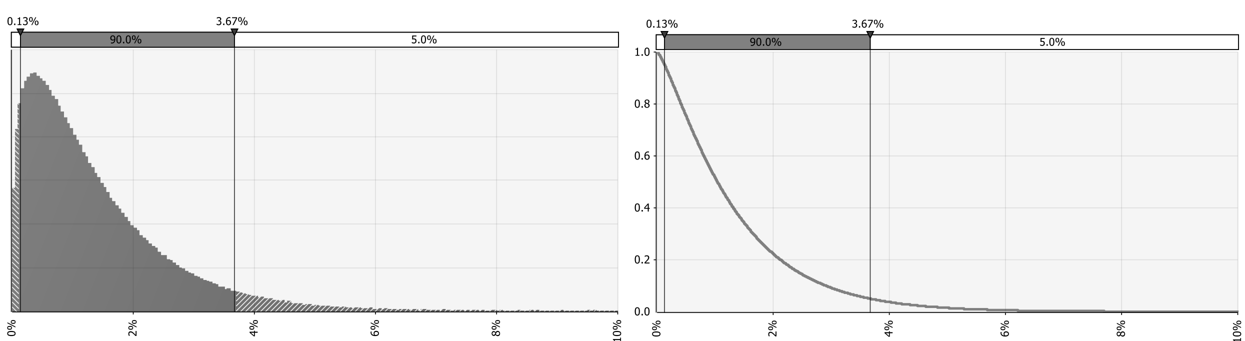

Figure 10 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on table grapes.

3.1.7. Elicited values for yield losses for wine grapes in central EU

What is the annual % of loss in grapevine production devoted to wine production in central EU countries, averaging the different production systems, varieties in the long-term situation under the condition of the general scenario?

The five elicited values on yield loss on wine grapes in central EU on which the group agreed are reported in the table below.

Table 12: Summary of the 5 elicited values on yield loss (%) on wine grapes in central EU

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	0.05%	0.3%	0.5%	0.8%	2%

3.1.7.1. Justification for the elicited values for yield loss on wine grapes in central EU

Section E.2.3.4 of EFSA PLH Panel (2019).

3.1.7.2. *Estimation of the uncertainty distribution for yield loss on wine grapes in central EU*

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 13: Fitted values of the uncertainty distribution on the yield loss (%) on wine grapes in central EU

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	0.05 %					0.3%		0.5%		0.8%					2%
Fitted distribution	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.4%	0.5%	0.7%	0.8%	0.9%	1.1%	1.4%	1.6%	1.9%

Fitted distribution: Gamma(2.1598,0.0027498),@RISK7.5

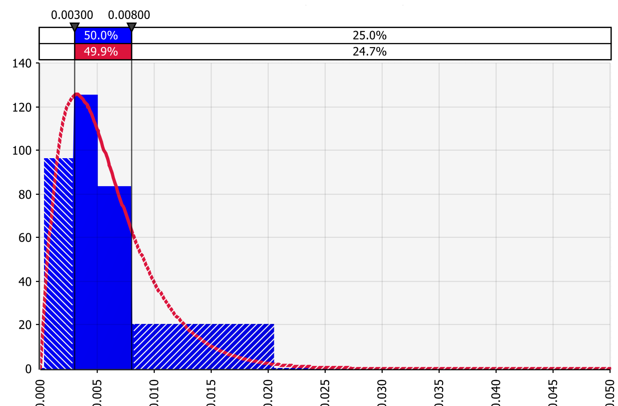

Figure 11 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on wine grapes in central EU.

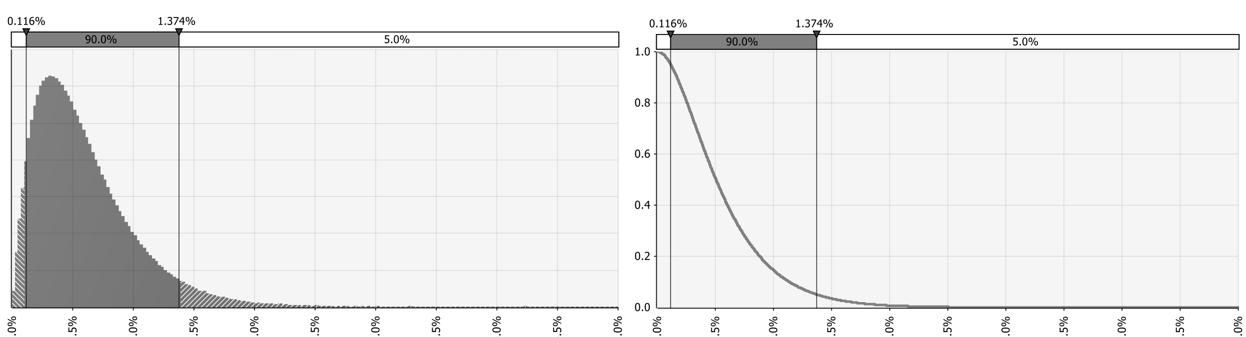

Figure 12 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on wine grapes in central EU.

3.1.8. Elicited values for yield losses for *Citrus* spp.

What is the annual % of reduction in citrus production weight including lower number of fruits, size of fruit below the marketable threshold (e.g. 5 cm for sweet oranges), lower productivity of plants, in the long-term situation under the condition of the general scenario?

The five elicited values on yield loss on *Citrus* spp. on which the group agreed are reported in the table below.

Table 14: Summary of the 5 elicited values on yield loss (%) on *Citrus* spp.

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	0%	5%	10%	20%	35%

3.1.8.1. Justification for the elicited values for yield loss on Citrus spp.

Section E.2.4.2 of EFSA PLH Panel (2019a).

3.1.8.2. Estimation of the uncertainty distribution for yield loss on Citrus spp.

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 15: Fitted values of the uncertainty distribution on the yield loss (%) on *Citrus* spp.

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	0%					5%		10%		20%					35%
Fitted distribution	0.1%	0.3%	0.7%	1.5%	2.8%	4.5%	6.4%	10.9%	16.2%	19.4%	23.1%	26.7%	30.2%	32.5%	34.4%

Fitted distribution: BetaGeneral(0.85391,1.6537,0,0.37), @RISK7.

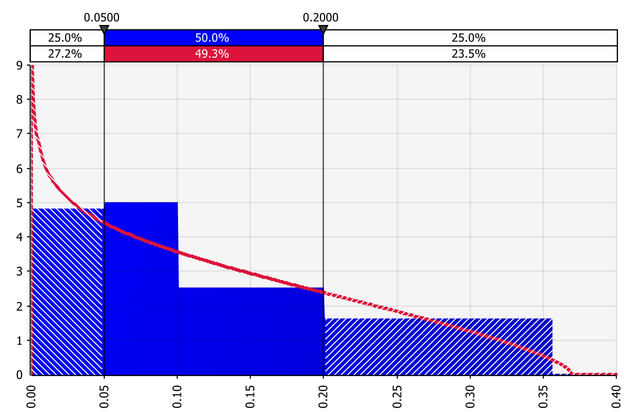

Figure 13 Comparison of judged values (histogram in blue) and fitted distribution (red line) for yield loss on *Citrus* spp.

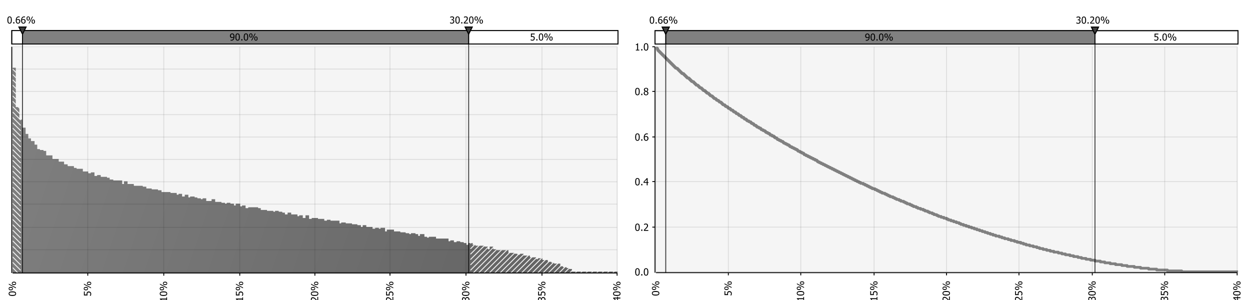

Figure 14 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for yield loss on *Citrus* spp.

3.1.9. Conclusions on the yield loss

Based on the general and specific scenario considered in this assessment, the percentage yield losses caused by *Xylella fastidiosa* are estimated to be:

- 34.6 % (with a 95% uncertainty range of 12.1 -63.5%) on olive trees younger than 30 years
- 69.1 % (with a 95% uncertainty range of 30.6 -94.3%) on olive trees older than 30 years
- 13.3 % (with a 95% uncertainty range of 2.8 -20.4%) on almond
- 2.1 % (with a 95% uncertainty range of 0.3 -6.8%) on wine grapes in southern EU
- 1 % (with a 95% uncertainty range of 0.1 -4.4%) on table grapes
- 0.5 % (with a 95% uncertainty range of 0.1 -1.6%) on wine grapes in central EU
- 10.9 % (with a 95% uncertainty range of 0.3 -32.5%) on *Citrus* spp.

Quality losses are not relevant to this assessment.

3.2. Spread rate

3.2.1. Structured expert judgement

3.2.1.1. Generic scenario assumptions

All the generic scenario assumptions common to the assessments of all the priority pests are listed in the section 2.4.2.1 of the Methodology Report (EFSA, 2019a).

3.2.1.2. Specific scenario assumptions

Section F.2.2 of EFSA PLH Panel (2019a)

3.2.1.3. Selection of the parameter(s) estimated

The spread rate has been assessed as the number of kilometres per year.

3.2.1.4. Defined question(s)

What is mean distance (km) which will comprise 90% of the area containing the newly infected plants around an infected area within 1 year (in absence of the application of any eradication or containment phytosanitary measure, section 3.2.1.2)?

3.2.1.5. Evidence selected

Section F.2.2.1 of EFSA PLH Panel (2019a)

3.2.1.6. Uncertainties identified

Section F.2.2.1 of EFSA PLH Panel (2019a)

3.2.2. Elicited values for the spread rate

What is mean distance (km) which will comprise 90% of the area containing the newly infected plants around an infected area within 1 year (in absence of the application of any eradication or containment phytosanitary measure, section 3.2.1.2)? (units: km/year)

The five elicited values on spread rate on which the group agreed are reported in the table below.

Table 16: Summary of the 5 elicited values on spread rate (km/y)

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	1	3	5	8.5	12

3.2.2.1. Justification for the elicited values of the spread rate

Section F.2.2.1 of EFSA PLH Panel (2019a).

3.2.2.2. Estimation of the uncertainty distribution for the spread rate

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 17: Fitted values of the uncertainty distribution on the spread rate (km/y)

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	1					3		5		8.5					12
Fitted distributio n	0.42	0.73	1.10	1.69	2.37	3.07	3.74	5.18	6.85	7.82	9.05	10.57	12.35	13.98	15.10

Fitted distribution: Weibull (1.6840,6.4398), @RISK7.5

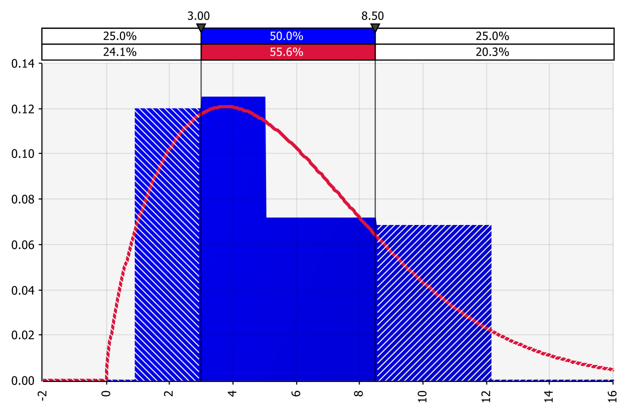

Figure 15 Comparison of judged values (histogram in blue) and fitted distribution (red line) for spread rate.

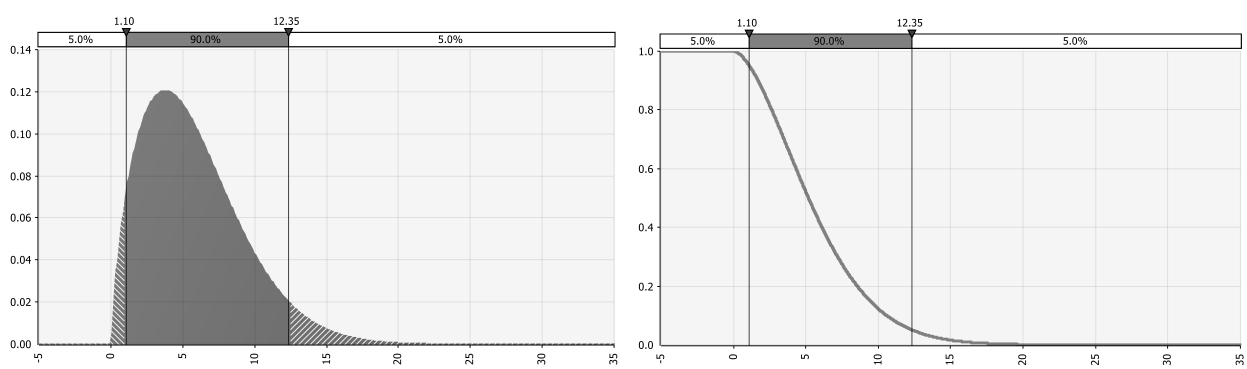

Figure 16 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for spread rate.

3.2.3. Conclusions on the spread rate

Based on the general and specific scenarios considered in this assessment, the mean distance (km) which will comprise 90% of the area containing the newly infected plants around an infected area within 1 year is 5.18 km (with a 95% uncertainty range of 0.73 – 13.98 km).

3.3. Time to detection

3.3.1. Structured expert judgement

3.3.1.1. Generic scenario assumptions

All the generic scenario assumptions common to the assessments of all the priority pests are listed in the section 2.4.2.1 of the Methodology Report (EFSA, 2019a).

3.3.1.2. Specific scenario assumptions

- the evaluation takes into account the emergency measures currently in place for *Xylella*
- It is sufficient that a part of the plant is infected and is not removed by current agricultural practices (e.g. pruning)
- the vector's presence and its efficiency in transmitting the disease are not limiting factors
- the moment "zero" is the transmission of the disease into a new area, either by infectious vectors reaching the new area or by introduction of an infected plant into the new area where vectors are already present
- the parameter is assessed by considering Xylella at the species level and not at the subspecies/strain level
- the conditions of detection take into account the intensification of surveillance activity and the stronger awareness related to this pest, which are in place in EU since the first *Xylella* outbreak
- due to the widespread and intensive surveys required by the emergency measures for *Xylella*, which include molecular analysis of samples, symptom expression is not critical for detection
- the time to detection does not include what happens in the demarcated areas where the pathogen is already present
- outbreaks in nurseries are not included in the scenario

3.3.1.3. Selection of the parameter(s) estimated

The time for detection has been assessed as the number of days between the first event of pest transfer to a suitable host and its detection.

3.3.1.4. Defined question(s)

What is the time between the event of pest transfer to a suitable host and its first detection within this scenario based on average European conditions? (unit: months)

3.3.1.5. Evidence selected

- Information concerning asymptomatic period, symptoms expression and identification can be found in section 3.2.1 of EFSA PLH Panel (2019a)
- How many years are needed to expect 1, 5, 10% of infected plants to be still asymptomatic?
- In particular Table 12 section 3.2.1 of EFSA PLH Panel (2019a): percentile estimates of the time until symptoms appearance from the parametric (maximum likelihood) and non-parametric (Kaplan-Meier) models, e.g.:
  - *X. fastidiosa* subsp. *fastidiosa* on almond: 1 years and 10 months
  - *X. fastidiosa* subsp. *fastidiosa* on grapevine: 6.5 months
  - *X. fastidiosa* subsp. *pauca* on orange: 3 years
  - *X. fastidiosa* subsp. *pauca* on olive: 3 years and 9 months
- Methods of detection are not exactly the same for all MSs or different regions in the same country (both in terms of techniques and sampling efforts)
- Methods of detection are still evolving in each MS
- Monitoring programs vary from region to region
- Outbreak in a citrus orchard: characteristic chlorosis can be observed on some branches of infected trees. This has not been observed in the EU
- Outbreak in almond: in one case, the infection was spotted due to the yield reduction on one tree. The symptoms observed on leaves are not so specific
- Outbreak in grapevine: infected plants are recognisable in September, while in other periods symptoms are not so specific
- Outbreak in olive: symptoms in the Apulian outbreak started appearing 3-5 years before October 2013. When the epidemic started spreading fast the authorities needed several months before identifying the pathogen. The symptoms were not specific to *Xylella*. In addition, at that time, olives were not among the known hosts of *Xylella*
- Outbreak in wild environments: e.g. Corsica, symptoms very similar to the effect of drought stress
- The attention given to the different plant species depends a lot on the first plant found infected and varies according to whether it is a wild plant, an olive tree or an ornamental
- In many cases the outbreaks are detected by growers
- A new outbreak is more likely to occur in a managed environment (orchard, nursery, urban area) than in a natural environment

3.3.1.6. Uncertainties identified

- Full host list
- Symptom expression depending on the *Xylella* subspecies and strain, and the species and variety of host
- Aspects affecting the latency period
- Effect of climate
- The role of vectors

- Intensity of survey
- Efficacy of the different methods of survey

3.3.2. Elicited values for the time to detection

What is the time between the event of pest transfer to a suitable host and its first detection within this scenario based on average European conditions? (unit: months)

The five elicited values on time to detection on which the group agreed are reported in the table below.

Table 18: Summary of the 5 elicited values on time to detection (months)

Percentile	**1%**	**25%**	**50%**	**75%**	**99%**
Expert elicitation	10	24	33	50	84

3.3.2.1. Justification for the elicited values of the time to detection

Reasoning for a scenario which would lead to a long time for detection (99th percentile / upper limit)

The upper value represents an outbreak in a wild environment, where also it is difficult to attract the attention of people dedicated to surveillance. Symptoms might not be so severe and distinctive.

However, even in natural environments, due to the application of EU emergency measures, it is likely that nowadays the pest will be recognised: the increased awareness on *Xylella* limits the highest extreme to 7 years. In addition, an outbreak starting in a natural environment could still move to cultivated areas with a reduction in time to detection.

Abundance of the vectors: low population density on *Xylella* hosts with low infection capacity.

Susceptibility and age of the host: species with low susceptibility and young plants.

Long time required for symptom expression (e.g. depending on climatic factors)

Reasoning for a scenario which would lead to a short time for detection (1st percentile / lower limit)

The lower value is due to the rapid symptom expression in combination with high efforts in sampling activity and effective laboratory testing.

The estimated value takes into account factors keeping the bacterial load below the threshold of molecular detectability (e.g. winter period).

This scenario reflects a condition ofrapid detection in a cultivated environment.

Abundance of the vectors on the *Xylella* hosts is high.

The susceptibility and age of the host is conducive to Xylella attack and symptom expression.

Reasoning for a central scenario, equally likely to over- or underestimate the time for detection (50th percentile / median)

The median value is related to the fact that most of the outbreaks are expected to happen in cultivated areas, where awareness and surveillance capacity is high as required by the EU emergency measures. However, the exclusion of nurseries makes the time increasing.

Reasoning for the precision of the judgement describing the remaining uncertainties (1st and 3rd quartile / interquartile range)

The precision is mainly driven by the fact that experts consider the low value very unlikely.

3.3.2.2. Estimation of the uncertainty distribution for the time to detection

The comparison between the fitted values of the uncertainty distribution and the values agreed by the group of experts is reported in the table below.

Table 19: Fitted values of the uncertainty distribution on the time to detection (months)

Percentile	1%	2.5%	5%	10%	17%	25%	33%	50%	67%	75%	83%	90%	95%	97.5%	99%
Expert elicitation	10					24		33		50					84
Fitted distribution	9.9	11.3	13.1	16.0	19.3	23.1	26.8	34.4	43.4	48.8	55.6	63.0	71.5	78.6	86.3

Fitted distribution: BetaGeneral(1.6778,4.7291,8,120), @RISK7.5

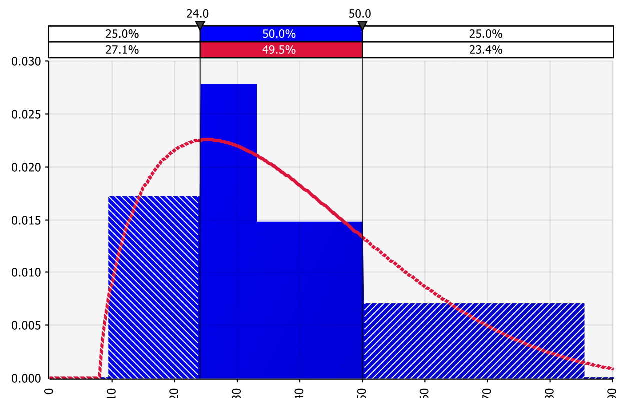

Figure 17 Comparison of judged values (histogram in blue) and fitted distribution (red line) for time to detection.

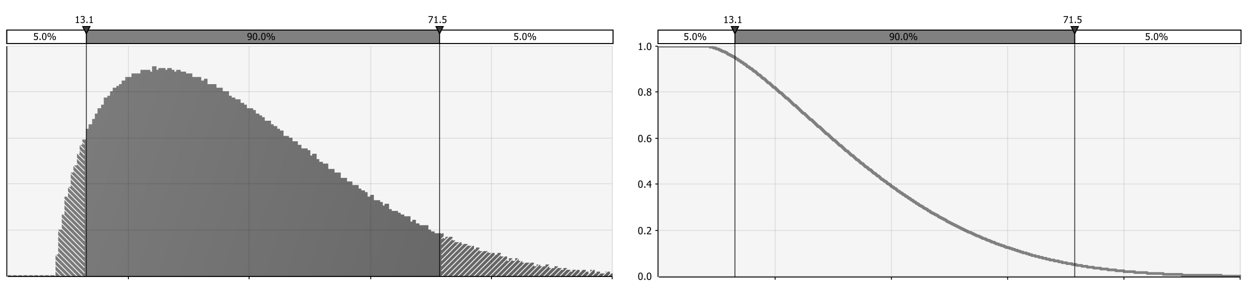

Figure 18 Fitted density function to describe the uncertainties with 90% uncertainty interval (left) and fitted descending distribution function showing the likelihood (y-axis) that a given proportion (x-axis) maybe exceeded (right) for time to detection.

3.3.3. Conclusions on the time to detection

Based on the general and specific scenarios considered in this assessment, the time between the event of pest transfer to a suitable host and its detection is estimated to be approximately 3 years (with a 95% uncertainty range of 1 – 6.5 years).

4. Conclusions

Hosts selection

The EFSA PRA (EFSA PLH Panel, 2019a) selected the following hosts for evaluation through the EKE process: *Citrus* spp., *Olea europaea*, *Prunus dulcis* and *Vitis vinifera*.

Area of potential distribution

For this assessment, the area of potential distribution of the pest is equivalent to the area of potential establishment as summarise in section 3.1.3 of the EFSA PLH Panel (2019a). The assessment of potential distribution does not consider the role of the vectors in limiting the area of potential establishment.

Increased number of treatments

Based on the conclusion that no plant protection products are currently available to eliminate *X. fastidiosa* from a diseased plant in open field conditions (EFSA PLH Panel, 2019b) and that the control of this pest requires an integrated strategy of control acting both on the host and on the vector, the most suitable PPP indicator is Case “D” and category “2”.

Yield and quality losses

Based on the general and specific scenario considered in this assessment, the percentage yield losses caused by *Xylella fastidiosa* are estimated to be:

- 34.6 % (with a 95% uncertainty range of 12.1 -63.5%) on olive trees younger than 30 years
- 69.1 % (with a 95% uncertainty range of 30.6 -94.3%) on olive trees older than 30 years
- 13.3 % (with a 95% uncertainty range of 2.8 -20.4%) on almond
- 2.1 % (with a 95% uncertainty range of 0.3 -6.8%) on wine grapes in southern EU
- 1 % (with a 95% uncertainty range of 0.1 -4.4%) on table grapes
- 0.5 % (with a 95% uncertainty range of 0.1 -1.6%) on wine grapes in central EU
- 10.9 % (with a 95% uncertainty range of 0.3 -32.5%) on *Citrus* spp.

Quality losses are not relevant to this assessment.

Spread rate

Based on the general and specific scenarios considered in this assessment, the mean distance (km) which will comprise 90% of the area containing the newly infected plants around an infected area within 1 year is 5.18 km (with a 95% uncertainty range of 0.73 – 13.98 km).

Time for detection after entry

Based on the general and specific scenarios considered in this assessment, the time between the event of pest transfer to a suitable host and its detection is estimated to be approximately 3 years (with a 95% uncertainty range of 1 – 6.5 years).

5. References

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