NAME OF THE ORGANISM: Clavibacter michiganensis subsp. michiganensis (CORBMI)

GENERAL INFORMATION ON THE PEST

Name as submitted in the project specification (if different to the preferred name):

Pest category:

Bacteria **1- Identity of the pest/Level of taxonomic listing:**
Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?

Yes
Is the pest defined at the species level or lower?:

Yes
Can listing of the pest at a taxonomic level higher than species be supported by scientific reasons or can species be identified within the taxonomic rank which are the (main) pests of concern?

* Not relevant: Vegetable seed sector, Vegetable propagating and planting material (other than seeds) sector, Ornamental sector

Is it justified that the pest is listed at a taxonomic rank below species level?

Yes
Conclusion:

* Candidate: Vegetable seed sector, Vegetable propagating and planting material (other than seeds) sector, Ornamental sector

Justification (if necessary):

C. michiganensis is subdivided into height subspecies.
All strains of C. michiganensis pathogenic in natural conditions on tomatoes are grouped in the subspecies michiganensis. This pest is a clear, distinguished taxonomic entity. It is the causal agent of bacterial wilt and canker of tomato (EFSA-PLH, 2014). As a consequence, a listing of this pest below the species level is justified. Remark: in inoculation tests many members of the Solanaceae, including tomato and aubergines, were found to be susceptible to C. michiganensis subsp. sepedonicus (Crop Protection Compendium).
Concerning the Capsicum spp. host, natural infections have only been found on Capsicum annuum and Capsicum frutescens. The listing of the entire Capsicum genus is not justified for the vegetable sector. It should be noted that bacterial strains showing very similar canker disease symptoms to those of a strain originally classified as C. michiganensis subsp. michiganensis have been isolated from pepper. The strains isolated from pepper were grouped in a separate clade from other subspecies of C. michiganensis: A new subspecies is proposed (C. michiganensis subsp. capsici) (Oh et al., 2016). **2 – Status in the EU:**

Is this pest already a quarantine pest for the whole EU?

No
Presence in the EU:

Yes
List of countries (EPPO Global Database):

Bulgaria (1993); Cyprus (2005); Czech Republic (1994); France (2011); Germany (1998); Greece (2001); Greece/Kriti (1996); Hungary (2001); Italy (2013); Italy/Sicilia (1994); Italy/Sardegna (1994); Latvia (2013); Poland (2011); Romania (2011); Slovenia (1995); Spain (2016)
Conclusion:

candidate
Justification (if necessary):

Data of the presence of this pest on the EU territory are available in EPPO Global Database (<https://gd.eppo.int/>).

HOST PLANT N°1: Capsicum (1CPSG) for the Ornamental sector.

Origin of the listing:

IIA2AWG
Plants for planting:

Plants intended for planting **3 - Is the pest already listed in a PM4 standard on the concerned host plant?**

No
Conclusion:

Evaluation continues **4 - Are the listed plants for planting the main\* pathway for the "pest/host/intended use" combination? (\*: significant compared to others):**

?
Conclusion:

Justification:

In general, the pathogen is seed borne and seed is considered to be the major means of long-distance dispersal. The pathogen can survive for years on seed, and a low inoculum dose of a few cells can result in transmission from seed to seedling. A few infection loci can lead to outbreaks. Transplants can also be a primary infection source and can serve as a means of long-distance dispersal. However there is little evidence for the transmission with pepper seeds other than the work of Yim et al., 2012. In comparison with tomato isolates, pepper isolates showed limited pathogenicity on tomato and higher pathogenicity on pepper and therefore it was suggested that the pepper isolates may represent a separate Cmm population that has evolved within the limits of this host. It should also note that according to Oh et al., 2016, based on biochemical, physiological and genetic characteristics of the strain isolated from pepper, it was defined as a different subsp. of C. michiganensis (Clavibacter michiganensis subsp. capsici).
Seedlings grown from contaminated seeds can release high densities of bacteria. At production sites, pepper and tomato volunteer plants and infected soil and crop debris, in which Cmm can survive, are recognised as a source of inoculum and so most producers have through clean-up at the end of each season. Cultivation practices including clipping and pruning contribute considerably to the rapid spread of the pathogen in a crop (EFSA-PLH, 2014).
Plants for planting (including seeds) may be an important pathway of Cmm for a clean and pathogen free place of production, especially for indoor cultivation, even if the pest is present in the area. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

The damage and economic losses in pepper are relatively limited compared to the damage that exists in the tomato.
What is the likely economic impact of the pest irrespective of its infestation source in the absence of phytosanitary measures? (= official measures)

Minor
Is the economic impact due to the presence of the pest on the named host plant for planting, acceptable to the propagation and end user sectors concerned?

Yes
Is there unacceptable economic impact caused to other hosts (or the same host with a different intended use) produced at the same place of production due to the transfer of the pest from the named host plant for planting?

No
Conclusion:

Not candidate
Justification:

It should be mentioned that, in comparison with tomato isolates, pepper isolates showed limited pathogenicity on tomato and higher pathogenicity on pepper (EFSA PLH, 2014). From this it can be assumed that bacterial presence in the pepper will not have much effect and will not cause damage to the tomato. **CONCLUSION ON THE STATUS:**

Disqualified: acceptable economic impact and limited pathogenicity of pepper isolates on tomato. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Not recommended for the RNQP status. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Not recommended for the RNQP status. **REFERENCES:**

* EU COM (2014) Recommendation of the Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms as regards the future listing of Clavibacter michiganensis subsp. michiganensis
* EFSA PLH Panel (EFSA Panel on Plant Health) (2014) Scientific Opinion on the pest categorisation of Clavibacter michiganensis subsp. michiganensis (Smith) Davis et al. EFSA Journal 2014;12(6):3721, 29 pp. doi:10.2903/j.efsa.2014.3721". <http://www.efsa.europa.eu/en/efsajournal/doc/3721.pdf>

HOST PLANT N°2: Capsicum annuum and Capsicum frutescens (Capsicum) (1CPSG) for the Vegetable seed sector.

Origin of the listing:

IIA2AWG
Plants for planting:

Seeds **3 - Is the pest already listed in a PM4 standard on the concerned host plant?**

No
Conclusion:

Evaluation continues **4 - Are the listed plants for planting the main\* pathway for the "pest/host/intended use" combination? (\*: significant compared to others):**

?
Conclusion:

Justification:

In general, the pathogen is seed borne and seed is considered to be the major means of long-distance dispersal. The pathogen can survive for years on seed, and a low inoculum dose of a few cells can result in transmission from seed to seedling. A few infection loci can lead to outbreaks. Transplants can also be a primary infection source and can serve as a means of long-distance dispersal. However there is little evidence for the transmission with pepper seeds other than the work of Yim et al., 2012. In comparison with tomato isolates, pepper isolates showed limited pathogenicity on tomato and higher pathogenicity on pepper and therefore it was suggested that the pepper isolates may represent a separate Cmm population that has evolved within the limits of this host. It should also note that according to Oh et al., 2016, based on biochemical, physiological and genetic characteristics of the strain isolated from pepper, it was defined as a different subsp. of C. michiganensis (Clavibacter michiganensis subsp. capsici).
Seedlings grown from contaminated seeds can release high densities of bacteria. At production sites, pepper and tomato volunteer plants and infected soil and crop debris, in which Cmm can survive, are recognised as a source of inoculum and so most producers have through clean-up at the end of each season. Cultivation practices including clipping and pruning contribute considerably to the rapid spread of the pathogen in a crop (EFSA-PLH, 2014).
Plants for planting (including seeds) may be an important pathway of Cmm for a clean and pathogen free place of production, especially for indoor cultivation, even if the pest is present in the area. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

The damage and economic losses in pepper are relatively limited compared to the damage that exists in the tomato.
What is the likely economic impact of the pest irrespective of its infestation source in the absence of phytosanitary measures? (= official measures)

Minor
Is the economic impact due to the presence of the pest on the named host plant for planting, acceptable to the propagation and end user sectors concerned?

Yes
Is there unacceptable economic impact caused to other hosts (or the same host with a different intended use) produced at the same place of production due to the transfer of the pest from the named host plant for planting?

No
Conclusion:

Not candidate
Justification:

It should be mentioned that, in comparison with tomato isolates, pepper isolates showed limited pathogenicity on tomato and higher pathogenicity on pepper (EFSA PLH, 2014). From this it can be assumed that bacterial presence in the pepper will not have much effect and will not cause damage to the tomato. **CONCLUSION ON THE STATUS:**

Disqualified: little evidence for the transmission with pepper seeds, acceptable economic impact and limited pathogenicity of pepper isolates on tomato. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Not recommended for the RNQP status. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Not recommended for the RNQP status. **REFERENCES:**

* EU COM (2014) Recommendation of the Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms as regards the future listing of Clavibacter michiganensis subsp. Michiganensis;
* EFSA PLH Panel (EFSA Panel on Plant Health) (2014) Scientific Opinion on the pest categorisation of Clavibacter michiganensis subsp. michiganensis (Smith) Davis et al. EFSA Journal 2014;12(6):3721, 29 pp. doi:10.2903/j.efsa.2014.3721". <http://www.efsa.europa.eu/en/efsajournal/doc/3721.pdf>;
* Oh E-J, Bae C, Lee H-B, Hwang I S, Lee H-I, Yea M C, Yim K-O, Heu S, Cha J-S & Oh C-S (2016) Clavibacter michiganensis subsp. capsici subsp. nov., causing bacterial canker disease in pepper. International Journal of Systematic and Evolutionary Microbiology 66, 4065-4070;
* Yim K-O, Lee H-I, Kim J-H, Lee S-D, Cho J-H & Cha J-S (2012) Characterization of phenotypic variants of Clavibacter michiganensis subsp. michiganensis isolated from Capsicum annuum. European Journal of Plant Pathology 133, 559-575;

HOST PLANT N°3: Capsicum annuum and Capsicum frutescens (Capsicum) (1CPSG) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

IIA2AWG
Plants for planting:

Plants intended for planting **3 - Is the pest already listed in a PM4 standard on the concerned host plant?**

No
Conclusion:

Evaluation continues **4 - Are the listed plants for planting the main\* pathway for the "pest/host/intended use" combination? (\*: significant compared to others):**

?
Conclusion:

Justification:

In general, the pathogen is seed borne and seed is considered to be the major means of long-distance dispersal. The pathogen can survive for years on seed, and a low inoculum dose of a few cells can result in transmission from seed to seedling. A few infection loci can lead to outbreaks. Transplants can also be a primary infection source and can serve as a means of long-distance dispersal. However there is little evidence for the transmission with pepper seeds other than the work of Yim et al., 2012. In comparison with tomato isolates, pepper isolates showed limited pathogenicity on tomato and higher pathogenicity on pepper and therefore it was suggested that the pepper isolates may represent a separate Cmm population that has evolved within the limits of this host. It should also note that according to Oh et al., 2016, based on biochemical, physiological and genetic characteristics of the strain isolated from pepper, it was defined as a different subsp. of C. michiganensis (Clavibacter michiganensis subsp. capsici).
Seedlings grown from contaminated seeds can release high densities of bacteria. At production sites, pepper and tomato volunteer plants and infected soil and crop debris, in which Cmm can survive, are recognised as a source of inoculum and so most producers have through clean-up at the end of each season. Cultivation practices including clipping and pruning contribute considerably to the rapid spread of the pathogen in a crop (EFSA-PLH, 2014).
Plants for planting (including seeds) may be an important pathway of Cmm for a clean and pathogen free place of production, especially for indoor cultivation, even if the pest is present in the area. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

The damage and economic losses in pepper are relatively limited compared to the damage that exists in the tomato.
What is the likely economic impact of the pest irrespective of its infestation source in the absence of phytosanitary measures? (= official measures)

Minor
Is the economic impact due to the presence of the pest on the named host plant for planting, acceptable to the propagation and end user sectors concerned?

Yes
Is there unacceptable economic impact caused to other hosts (or the same host with a different intended use) produced at the same place of production due to the transfer of the pest from the named host plant for planting?

No
Conclusion:

Not candidate
Justification:

It should be mentioned that, in comparison with tomato isolates, pepper isolates showed limited pathogenicity on tomato and higher pathogenicity on pepper (EFSA PLH, 2014). From this it can be assumed that bacterial presence in the pepper will not have much effect and will not cause damage to the tomato. **CONCLUSION ON THE STATUS:**

Disqualified: little evidence for the transmission with pepper seeds, acceptable economic impact and limited pathogenicity of pepper isolates on tomato. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Not recommended for the RNQP status. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Not recommended for the RNQP status. **REFERENCES:**

* EU COM (2014) Recommendation of the Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms as regards the future listing of Clavibacter michiganensis subsp. Michiganensis;
* EFSA PLH Panel (EFSA Panel on Plant Health) (2014) Scientific Opinion on the pest categorisation of Clavibacter michiganensis subsp. michiganensis (Smith) Davis et al. EFSA Journal 2014;12(6):3721, 29 pp. doi:10.2903/j.efsa.2014.3721". <http://www.efsa.europa.eu/en/efsajournal/doc/3721.pdf>;
* Oh E-J, Bae C, Lee H-B, Hwang I S, Lee H-I, Yea M C, Yim K-O, Heu S, Cha J-S & Oh C-S (2016) Clavibacter michiganensis subsp. capsici subsp. nov., causing bacterial canker disease in pepper. International Journal of Systematic and Evolutionary Microbiology 66, 4065-4070;
* Yim K-O, Lee H-I, Kim J-H, Lee S-D, Cho J-H & Cha J-S (2012) Characterization of phenotypic variants of Clavibacter michiganensis subsp. michiganensis isolated from Capsicum annuum. European Journal of Plant Pathology 133, 559-575;

HOST PLANT N°4: Solanum lycopersicum (LYPES) for the Vegetable seed sector.

Origin of the listing:

IIA2AWG
Plants for planting:

Seeds **3 - Is the pest already listed in a PM4 standard on the concerned host plant?**

No
Conclusion:

Evaluation continues **4 - Are the listed plants for planting the main\* pathway for the "pest/host/intended use" combination? (\*: significant compared to others):**

Yes
Conclusion:

Candidate

Justification:

The pathogen is seed borne and seed is considered to be the major means of long-distance dispersal. The pathogen can survive for years on seed, and a low inoculum dose of a few cells can result in transmission from seed to seedling. A few infection loci can lead to outbreaks. Transplants can also be a primary infection source and can serve as a means of long-distance dispersal. Seedlings grown from contaminated seeds can release high densities of bacteria. At production sites, pepper and tomato volunteer plants and infected soil and crop debris, in which Cmm can survive, are recognised as a source of inoculum and so most producers have through clean-up at the end of each season. Cultivation practices including clipping and pruning contribute considerably to the rapid spread of the pathogen in a crop (EFSA-PLH, 2014).
Plants for planting (including seeds) is the most important pathway of Cmm for a clean and pathogen free place of production, especially for indoor cultivation, even if the pest is present in the area. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

The pathogen is considered to be one of the most important bacterial pathogens of tomato and can be very destructive. Infections often result in high yield losses; in several cases losses of between 50 % and 100 % have been reported. However, growers and the seed industry are putting considerable efforts into preventing the introduction and dissemination of Cmm. Production systems involving integral testing tomato seed and transplants using validated protocols are used by the tomato seed companies and nurseries. These largely exclude the introduction and spread of Cmm by propagation material. This has resulted in a considerable reduction in crop damage and may be considered an effective way of controlling the disease (EFSA PLH, 2014).
What is the likely economic impact of the pest irrespective of its infestation source in the absence of phytosanitary measures? (= official measures)

Major
Is the economic impact due to the presence of the pest on the named host plant for planting, acceptable to the propagation and end user sectors concerned?

No
Conclusion:

Candidate
Justification:

The pathogen is considered to be one of the most important bacterial pathogens of tomato (EFSA PLH, 2014). **6 - Are there feasible and effective measures available to prevent the presence of the pest on the plants for planting at an incidence above a certain threshold (including zero) to avoid an unacceptable economic impact as regards the relevant host plants?**

Yes

Conclusion:

candidate
Justification:

Control is mainly based on seed treatments and on hygiene and cultivation measures reducing the risk of introductions and disseminations. An effective control of the disease during production of plants for planting requires management of the entire production chain (EFSA, 2014) **7- Is the quality of the data sufficient to recommend the pest to be listed as a RNQP?**

Yes

Conclusion:

Candidate
Justification:

 **CONCLUSION ON THE STATUS:**

Recommended for listing as an RNQP, based on data. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Zero tolerance based on visual examination or testing
Justification (if necessary):

The threshold for a disease outbreak is low, as one infected seed in 10 000 is capable of initiating an epidemic (EFSA PLH, 2014). **9 - Risk management measures:**
Is there a need to change the Risk management measure:

Yes
Proposed Risk management measure:

(A) The seeds have been obtained by means of an appropriate acid extraction method or an equivalent method;
AND
(B) (a) The seeds originate in areas known to be free from Clavibacter michiganensis ssp. michiganensis;
or
(b) No symptoms of disease caused by Clavibacter michiganensis ssp. michiganensis have been observed in inspections at appropriate times during their complete cycle of vegetation of the plants at the site of production;
or
(c) The seeds have been subjected to official testing for Clavibacter michiganensis ssp. michiganensis on a representative sample and using appropriate methods, and have been found, in these tests, to be free from the pest.
Justification (if necessary):

Acid extraction is not available for organic production. **REFERENCES:**

* EU COM (2014) Recommendation of the Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms as regards the future listing of Clavibacter michiganensis subsp. Michiganensis;
* EFSA PLH Panel (EFSA Panel on Plant Health) (2014) Scientific Opinion on the pest categorisation of Clavibacter michiganensis subsp. michiganensis (Smith) Davis et al. EFSA Journal 2014;12(6):3721, 29 pp. doi:10.2903/j.efsa.2014.3721". <http://www.efsa.europa.eu/en/efsajournal/doc/3721.pdf>;
* Oh E-J, Bae C, Lee H-B, Hwang I S, Lee H-I, Yea M C, Yim K-O, Heu S, Cha J-S & Oh C-S (2016) Clavibacter michiganensis subsp. capsici subsp. nov., causing bacterial canker disease in pepper. International Journal of Systematic and Evolutionary Microbiology 66, 4065-4070;

HOST PLANT N°5: Solanum lycopersicum (LYPES) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

IIA2AWG
Plants for planting:

Plants intended for planting **3 - Is the pest already listed in a PM4 standard on the concerned host plant?**

No
Conclusion:

Evaluation continues **4 - Are the listed plants for planting the main\* pathway for the "pest/host/intended use" combination? (\*: significant compared to others):**

Yes
Conclusion:

Candidate

Justification:

The pathogen is seed borne and seed is considered to be the major means of long-distance dispersal. The pathogen can survive for years on seed, and a low inoculum dose of a few cells can result in transmission from seed to seedling. A few infection loci can lead to outbreaks. Transplants can also be a primary infection source and can serve as a means of long-distance dispersal. Seedlings grown from contaminated seeds can release high densities of bacteria. At production sites, pepper and tomato volunteer plants and infected soil and crop debris, in which Cmm can survive, are recognised as a source of inoculum and so most producers have through clean-up at the end of each season. Cultivation practices including clipping and pruning contribute considerably to the rapid spread of the pathogen in a crop (EFSA-PLH, 2014).
Plants for planting (including seeds) are the most important pathway of Cmm for a clean and pathogen free place of production, especially for indoor cultivation, even if the pest is present in the area. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

The pathogen is considered to be one of the most important bacterial pathogens of tomato and can be very destructive. Infections often result in high yield losses; in several cases losses of between 50 % and 100 % have been reported. However, growers and the seed industry are putting considerable efforts into preventing the introduction and dissemination of Cmm. Production systems involving integral testing tomato seed and transplants using validated protocols are used by the tomato seed companies and nurseries. These largely exclude the introduction and spread of Cmm by propagation material. This has resulted in a considerable reduction in crop damage and may be considered an effective way of controlling the disease (EFSA PLH, 2014).
What is the likely economic impact of the pest irrespective of its infestation source in the absence of phytosanitary measures? (= official measures)

Major
Is the economic impact due to the presence of the pest on the named host plant for planting, acceptable to the propagation and end user sectors concerned?

No
Conclusion:

Candidate
Justification:

The pathogen is considered to be one of the most important bacterial pathogens of tomato (EFSA PLH, 2014). **6 - Are there feasible and effective measures available to prevent the presence of the pest on the plants for planting at an incidence above a certain threshold (including zero) to avoid an unacceptable economic impact as regards the relevant host plants?**

Yes

Conclusion:

candidate
Justification:

Control is mainly based on seed treatments and on hygiene and cultivation measures reducing the risk of introductions and disseminations. An effective control of the disease during production of plants for planting requires management of the entire production chain (EFSA, 2014) **7- Is the quality of the data sufficient to recommend the pest to be listed as a RNQP?**

Yes

Conclusion:

Candidate
Justification:

 **CONCLUSION ON THE STATUS:**

Recommended for listing as an RNQP, based on data. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Zero tolerance.
Justification (if necessary):

The threshold for a disease outbreak is low, as one infected seed in 10 000 is capable of initiating an epidemic (EFSA PLH, 2014). **9 - Risk management measures:**
Is there a need to change the Risk management measure:

Yes
Proposed Risk management measure:

The plants have been grown from seeds which comply with the requirements laid down and have been maintained free from infection by appropriate hygiene measures.
Justification (if necessary):

Remark: these measures should also cover home grown seeds for plant production. **REFERENCES:**

* EU COM (2014) Recommendation of the Working Group on the Annexes of the Council Directive 2000/29/EC – Section II – Listing of Harmful Organisms as regards the future listing of Clavibacter michiganensis subsp. Michiganensis;
* EFSA PLH Panel (EFSA Panel on Plant Health) (2014) Scientific Opinion on the pest categorisation of Clavibacter michiganensis subsp. michiganensis (Smith) Davis et al. EFSA Journal 2014;12(6):3721, 29 pp. doi:10.2903/j.efsa.2014.3721". <http://www.efsa.europa.eu/en/efsajournal/doc/3721.pdf>;
* Oh E-J, Bae C, Lee H-B, Hwang I S, Lee H-I, Yea M C, Yim K-O, Heu S, Cha J-S & Oh C-S (2016) Clavibacter michiganensis subsp. capsici subsp. nov., causing bacterial canker disease in pepper. International Journal of Systematic and Evolutionary Microbiology 66, 4065-4070;