NAME OF THE ORGANISM: Fusarium (anamorphic genus) (1FUSAG)

GENERAL INFORMATION ON THE PEST

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

Fusarium spp.
Pest category:

Fungi **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?:

No
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?

* Yes: Oil and fibre plants sector, Seed potato sector, Vegetable propagating and planting material (other than seeds) sector
* No: 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?

Not relevant
Conclusion:

* Not candidate: Vegetable propagating and planting material (other than seeds) sector, Ornamental sector
* Candidate: Oil and fibre plants sector, Seed potato sector, Vegetable propagating and planting material (other than seeds) sector

Justification (if necessary):

In the RNQP Questionnaire, for the 'Oil and Fibre plant' Sector, no EU MS justified a listing at a higher level than the Species level. CZ proposed to only list Fusarium oxysporum f. sp. Lini on Linum usitatissimum. The Agricultural species SEWG considered that at least three species could infect Linum usitatissimum: Fusarium oxysporum f. sp. lini, Fusarium equiseti and Fusarium avenaceum.
For the 'Vegetable propagating and planting material (other than seeds)' Sector, FR is the only EU MS requiring, for Asparagus officinalis, to keep such a listing (without any justification). Experts agreed with this proposal for Asparagus officinalis, based on the publication by Gossmann et al. (2001) showing that more than 15 Fusarium species are involved. Nine of them are of phytopathological relevance: F. acuminatum [Gibberella acuminata], F. avenaceum [G. avenacea], F. culmorum, F. oxysporum, F. proliferatum, F. redolens [F. oxysporum var. redolens], F. sambucinum [G. pulicaris], F. solani and F. subglutinans [G. fujikuroi var. subglutinans. The listing at a higher level than the species level is justified on Asparagus officinalis by the difficulty to differentiate them soundly, unless by molecular tools. For cucurbits, there is generally one main Fusarium oxysporum forma specialis for each host species. In aubergine, it is mainly Fusarium oxysporum f. sp. melongenae. For cucurbits and aubergine the listing at a higher level than the species level is not justified.
For the 'Seed potato' Sector, experts agreed that, even F. solani var. coeruleum, F. sulphureum (=F. sambucinum) and F. avenaceum are the main encountered species in potato, there are many other species present in the soil (some are not pathogenic directly). More investigations and efforts to diagnose pest at the species level is needed. This would be necessary for a listing at the species level. Experts concluded that, as long as measures are only based on symptoms for this pest, a listing at the genus level is appropriate.
For the ornamental sector, no EU Member State considered this entry as important in the replies to the RNQP Questionnaire and gave justification(s) for a listing at a higher level than the species level. This entry will be covered by the 'substantially free from' requirement that will remain in the Ornamental EU Marketing Directives. **2 – Status in the EU:**

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

No
Presence in the EU:

Yes
Conclusion:

candidate

HOST PLANT N°1: Asparagus officinalis (ASPOF) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

2 - Vegetable seedling sector: Commission Directive 93/61/EC
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:

Asparagus officinalis L. is an important crop in many European countries, likely infected by a number of Fusarium species. Most of them produce mycotoxins in plant tissues, thus affecting the physiology of the host plant (Stępień et al, 2016). Asparagus can suffer from a crown and root rot caused by Fusarium oxysporum f. sp. asparagi and F. proliferatum. The disease is exacerbated when allelopathic toxins from old, rotting asparagus crowns are present in the soil (Elmer, 2016).
Asparagus crowns can be infected by the fungus and hence are a pathway. If other inoculum sources are controlled and the plants grown in clean soil under enclosed conditions, plants for planting can be a significant pathway. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

In Germany, this pest is of medium economic importance, mainly with respect to vigor and life span of the crop (pers. information of consultants of grower associations).
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 SEWG considered that installation of crowns is a critical point. Impact is therefore considered to be major. **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:

Most plants for planting (about 90-95 % are "crowns") are produced in the field. An effective way to prevent infections is to select "clean" fields for crown production. Infections of module raised transplants (about 5-10%, usually in peat pots) grown from healthy seeds are very unlikely and not a main pathway.
There are no effective fungicides available or registered in Germany [EU?]. **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. Many Fusarium may affect this crop. Asparagus is a long term crop with propagating material grown in field. Installation of crowns is a critical point. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

Yes
Proposed Tolerance levels:

Zero tolerance approach, based on visual examination and/or testing (see following risk management measures). **9 - Risk management measures:**
Is there a need to change the Risk management measure:

Yes
Proposed Risk management measure:

(A) (a) The crop has been inspected at an appropriate time during the growing season, a representative sample of the plants have been uprooted and no symptoms of Fusarium have been observed;
or
(b) The crop has been inspected at least twice at appropriate times during the growing season and plants showing symptoms of Fusarium have been rogued out immediately with no symptoms seen at a final inspection of the growing crop;
AND
(B) The crowns have been inspected before marketing and no symptoms of Fusarium have been seen.
Justification (if necessary):

Measures should be based on a visual examination of the crop (If the plant reproductive material is tested, Fusarium may always be found. Moreover visual symptoms can be differentiated from Rhizoctonia). Crowns are sold after one year. First symptoms are only visible on the crown. At the end of the season, the whole plant is wilting. **REFERENCES:**

* Elmer W H (2016) Effect of Leaf Mold Mulch, Biochar, and Earthworms on Mycorrhizal Colonization and Yield of Asparagus Affected by Fusarium Crown and Root Rot. Plant disease 100, 2507-2512;
* Stępień Ł, Waśkiewicz A and Urbaniak M (2016) Wildly Growing Asparagus (Asparagus officinalis L.) Hosts Pathogenic Fusarium Species and Accumulates Their Mycotoxins. Microbial Ecology 71, 927-37;

HOST PLANT N°2: Cucumis melo (CUMME) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

2 - Vegetable seedling sector: Commission Directive 93/61/EC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: listing at a higher level than the species level is not justified (one main Fusarium oxysporum forma specialis for each host species in cucurbits). Plants are not considered to be a significant pathway provided seeds are healthy. Pathway from seed to economic impact on young seedlings is less direct than for bacterial diseases, and dependent on growing conditions. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

* EPPO (2004) Good plant protection practice PP 2/32 (1) Outdoor cucurbits. OEPP/EPPO Bulletin 34, 101-108;

HOST PLANT N°3: Cucumis sativus (CUMSA) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

2 - Vegetable seedling sector: Commission Directive 93/61/EC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: listing at a higher level than the species level is not justified (one main Fusarium oxysporum forma specialis for each host species in cucurbits). Plants are not considered to be a significant pathway provided seeds are healthy. Pathway from seed to economic impact on young seedlings is less direct than for bacterial diseases, and dependent on growing conditions. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

* EPPO (2004) Good plant protection practice PP 2/32 (1) Outdoor cucurbits. OEPP/EPPO Bulletin 34, 101-108;

HOST PLANT N°4: Cucurbita pepo (CUUPE) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

2 - Vegetable seedling sector: Commission Directive 93/61/EC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: listing at a higher level than the species level is not justified (one main Fusarium oxysporum forma specialis for each host species in cucurbits). Plants are not considered to be a significant pathway provided seeds are healthy. Pathway from seed to economic impact on young seedlings is less direct than for bacterial diseases, and dependent on growing conditions. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

* EPPO (2004) Good plant protection practice PP 2/32 (1) Outdoor cucurbits. OEPP/EPPO Bulletin 34, 101-108;

HOST PLANT N°5: Dianthus caryophyllus (DINCA) for the Ornamental sector.

Origin of the listing:

Commission Directive 93/49/EEC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: No EU Member State considered this entry as important in the answers to the RNQP Questionnaire and gave justification(s) for a listing at a higher level than the species level. This entry will be covered by the 'Substantially free from' requirement that will remain in the Ornamental EU Marketing Directives. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

HOST PLANT N°6: Euphorbia pulcherrima (EPHPU) for the Ornamental sector.

Origin of the listing:

Commission Directive 93/49/EEC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: No EU Member State considered this entry as important in the answers to the RNQP Questionnaire and gave justification(s) for a listing at a higher level than the species level. This entry will be covered by the 'Substantially free from' requirement that will remain in the Ornamental EU Marketing Directives. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

HOST PLANT N°7: Gerbera (1GEBG) for the Ornamental sector.

Origin of the listing:

Commission Directive 93/49/EEC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: No EU Member State considered this entry as important in the answers to the RNQP Questionnaire and gave justification(s) for a listing at a higher level than the species level. This entry will be covered by the 'Substantially free from' requirement that will remain in the Ornamental EU Marketing Directives. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

HOST PLANT N°8: Linum usitatissimum (LIUUT) for the Oil and fibre plants sector.

Origin of the listing:

3 - Oil and fibre plants sector: Council Directive 2002/57/EC
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:

Fusarium oxysporum f. sp. lini is a specific biotrophic pathotype. It infests soil for long term and survives saprophytically on the remaining plants. Seed transmission is rare and not considered to be significant. However the seed transmission of non-specific Fusarium [F. equiseti and F. avenaceum] is frequent. Experts considered that presence of the Fusarium complex on seeds is a significant pathway for the impact on seedlings. **5 - Economic impact:**
Are there documented reports of any economic impact on the host?

Yes
Justification:

Fusarium wilt of flax, caused by Fusarium oxysporum f. sp. lini (Fol), can infect flax at any growth stage and may result in 100% disease incidence in certain cultivars. Mycelial growth in the xylem interferes with water conduction, thus resulting in wilting of the plant. Depending on the plant growth stage, death of seedlings or premature death of plants can occur randomly or as distinct patches throughout the field. Plants grown from cracked or split seeds are more susceptible to wilting than intact seeds, whereas temperature and moisture level are considered to be the main factors affecting disease development (Edirisinghe, 2016). Fusarium spp, other than F. oxysporum f. sp. Lini, can cause non-specific symptoms on roots, leaf yellowing, and growth depression. They have a negative impact on seed emergence. These necrotrophic species are also slowly decaying the root bark, leading first to dry root rots before that roots are progressively decomposing. Destructive effects of these Fusarium spp. are observed later (in contrast with the biotrophic species F. oxysporum f. sp. Lini): infested plants do not bloom and stalks brown and dry prematurely.
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:

Impact is major on seedlings. **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:

 **7- Is the quality of the data sufficient to recommend the pest to be listed as a RNQP?**

No

Conclusion:

Candidate by default
Justification:

 **CONCLUSION ON THE STATUS:**

Recommended for listing as an RNQP, by default. This analysis was complicated by the judgment that F. oxysporum f. sp. Lini, is the most damaging Fusarium on Linum, but also that this particular pathotype is not primarily spread on seed. Conclusion was that there is insufficient evidence to recommend changes from the current regulation and measures of Fusarium spp. on seed of L. usitatissimum. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

Yes
Proposed Tolerance levels:

Basic and certified material:
(a) Seed treatment authorised for use against Fusarium spp. has been applied;
or
(b) Not more than 5% of seed affected with Alternaria linicola, Boeremia exigua var. linicola, Colletotrichum lini, Fusarium spp based on laboratory test of a representative sample. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Justification (if necessary):

The SEWG noted that some member states currently have additional requirements for thresholds for this pathogen in field inspection of Linum, and that effective seed treatments may be available [one reference suggests seed treatment reducing damage from Fusarium oxysporum f. sp. lini]. **REFERENCES:**

* Edirisinghe P V (2016) Characterization of Flax Germplasm for Resistance to Fusarium Wilt Caused by Fusarium oxysporum f. sp. Lini. Department of Plant Science. University of Saskatchewan. Saskatoon. Available from: <https://ecommons.usask.ca/bitstream/handle/10388/7844/EDIRISINGHE-THESIS-2017.pdf?sequence=1>;

HOST PLANT N°9: Solanum melongena (SOLME) for the Vegetable propagating and planting material (other than seeds) sector.

Origin of the listing:

2 - Vegetable seedling sector: Commission Directive 93/61/EC
Plants for planting:

Plants intended for planting **CONCLUSION ON THE STATUS:**

Disqualified: listing at a higher level than the species level is not justified (main formae specialis on aubergine: Fusarium oxysporum f.sp. melongenae). Less information on impact and pathway is available than for cucurbits. Impact is likely to depend on the cropping system (glasshouse or outdoor, substrate). The ‘substantial freedom’ will already offer some protection. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

Delisting. **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

Delisting. **REFERENCES:**

* EPPO (2004) Good plant protection practice PP 2/30 (1) Outdoor solanaceous crops. OEPP/EPPO Bulletin 34, 79-90;

HOST PLANT N°10: Solanum tuberosum (SOLTU) for the Seed potato sector.

Origin of the listing:

5 - Seed potato sector: Council Directive 2002/56/EC
Plants for planting:

Plants intended for planting, other than [true] seeds **3 - Is the pest already listed in a PM4 standard on the concerned host plant?**

Yes
Conclusion:

Qualified

Justification (if necessary):

Pest already listed in the EPPO PM 4 Standard under the dry/wet rot symptoms. **CONCLUSION ON THE STATUS:**

Recommended for listing as an RNQP, based on EPPO PM 4 Standard. **8 - Tolerance level:**
Is there a need to change the Tolerance level:

No
Proposed Tolerance levels:

 **9 - Risk management measures:**
Is there a need to change the Risk management measure:

No
Proposed Risk management measure:

 **REFERENCES:**

* UNECE (2014) UNECE Standard S-1 concerning the marketing and commercial quality control of Seed Potatoes. UNECE Guide to Seed Potato Diseases, Pests and Defects. Available at <http://www.unece.org/tradewelcome/steering-committee-on-trade-capacity-and-standards/tradeagr/brochures-and-publications/potato-diseases-and-pests.html>;