Express-PRA[1] for *Diplodia bulgarica* – Occurrence –

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Initiation: Occurrence on apple and pear trees in the Federal State Baden-Württemberg

Express-PRA	***Diplodia bulgarica* Phillips, Lopes & Bobev**		
Phytosanitary risk for Germany **Phytosanitary risk for EU-Member States**	Classification not applicable, since the fungus does not fulfill the criteria according to Article 29 of Regulation (EU) 2016/2031. Nevertheless, there is a significant risk for the cultivation of apple and pear trees.		
Certainty of the assessment	**high** ☐	**medium** ☒	**low** ☐
Conclusion	The fungus *Diplodia bulgarica* was first detected in Bulgaria in 2012. It is already present in Germany. So far, it was found in the Federal States Baden-Württemberg (widespread) and Hesse (one finding). It is not listed in the Annexes of Regulation (EU) 2019/2072 or by EPPO. *Diplodia bulgarica* infects apple and pear trees. Due to suitable climatic conditions, it is assumed that *D. bulgarica* can further establish and spread in Germany in the open field. The establishment in other EU-Member States (Central and South Europe) is possible, too. Due to its high damage potential for apple and pear trees, *D. bulgarica* poses a significant risk for the cultivation of apples and pears in Germany and other EU-Member States. Damage occurs especially in case of severe drought and on stressed trees. There are effective pathways that can be influenced only to a limited extent. Thus, *Diplodia bulgarica* is not classified as a quarantine pest and Article 29 of Regulation (EU) 2016/2031 does not apply. Nevertheless, it is strictly recommended to destroy infected (plant) material, at least where the application of fungicides is not possible or not allowed. For better clarification of the spread in Germany and the EU, a survey on apple and pear trees regarding the infection with *D. bulgarica* is necessary.		
Taxonomy[2], common name, synonyms	Fungi, Ascomycota, Botryosphaeriales, Botryosphaeriaceae, *Diplodia*, *Diplodia bulgarica* Phillips, Lopes & Bobev In 2012, the fungus was described for the first time. The first finding was in Bulgaria (Phillips et al., 2012, photos of the fungus included). It is not known whether the fungus is endemic		

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	there. Phylogenetically it is closely related to the fungus *D. cupressi*, that is present in Cyprus, Greece, Italy, Israel, Morocco, Tunesia, South Africa and the USA (De Wet et al. 2009, Alves et al. 2006, Solel et al. 1987) and to *D. tsugae* (*Botryosphaeria tsugae*) that is only known from British Columbia, Canada, so far (Phillips et al. 2012 und 2013).
EPPO Code	Only for the genus *Diplodia*: 1DIPDG
Does a relevant earlier PRA exist?	No.
Biology	This species differs morphologically from other *Diplodia*-species, that were described on apple trees. The conidia are shorter and broader than those of the species *D. intermedia* (known to be present in Portugal) and *D. malorum* (known to e present in Germany and Portugal). The conidia are characterized by the fact that they get pale brown shortly after their formation (Phillips et al. 2012). Another species from the genus *Diplodia* is *D. mutila*. This fungus is detected in meadow orchards (apple) in Germany since 2003, and in biological cultivation on pears and causes black bark scorch. Like *D. bulgarica* this fungus is favoured by heat, drought and nutrient deficiency (Ragazzi et al.1999). Black bark scorch as caused by *D. bulgarica* is also caused by several other *Diplodia*-species. So far, six species were isolated and identified morphologically and via sequencing in Baden-Württemberg. In the examinations, *Diplodia bulgarica* dominated.
Is the pest a vector?[3]	No.
Is a vector needed?[4]	No.
Host plants	*Malus sylvestris*, *M. domestica* (Phillips et al., 2012, Abdollahzadeh, 2015); for the first time Hinrichs-Berger et al. (2021) describe *Pyrus communis* as a host plant with comparable symptoms and damage as on apple trees.
Symptoms[5]	Deepened brown elliptic lesions with a series of concentric circles (Nabi et al., 2020), symptoms of canker, gummosis (abnormal resinosis), dying-off and twig-decay symptoms (Abdollazadeh, 2015). Often together with bark injuries like cracks, pruning wounds or damage by sun (Hinrichs-Berger et al. 2021).

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Presence of the host plants in Germany[6]	Apple and pear trees are widespread in Germany.
Presence of the host plants in the Member States[7]	Apple and pear trees are widespread in the EU-Member States.
Known infested areas[8]	Bulgaria (Philipps et al. 2012), India (Nabi et al. 2020), Iran (Abdollahzadeh, 2015). The fungus is already widespread in Baden-Württemberg. Furthermore, *D. bulgarica* was detected in an apple tree in a meadow orchard in Hesse. Inspected trees from Rhineland-Palatinate showed no infection with *D. bulgarica*, although only very few samples were checked (Hinrichs-Berger, personal communication).
Pathways[9]	Via infected plants or plant parts. Movement possibly also via (latently infected) nursery material.
Natural spread[10]	Details are only known in respect to other *Diplodia* species: conidia of *D. pinea* e.g. are mainly spread via rain splashes or wind and thus, have a limited potential for a broad natural spread (Legesse, 2011). Conidia spread via water splashes is also supposed for *D. bulgarica*.
Expected establishment and spread in Germany[11]	In general, establishment is expected where apple and pear trees are present, the presence of the fungus in Bulgaria, India, Iran and currently also in Germany indicates that the establishment of the fungus in moderate (presumably rather warmer regions → Baden-Württemberg) to Mediterranean/subtropical climates is possible. Obviously, trees in ecological cultivation and in meadow orchards are more at risk; at least the infection in Germany suggests this. Severe drought and weakening of the trees promote the establishment and spread of the fungus.
Expected establishment and spread in Member States[12]	See above.
Known damage in infested areas[13]	Experimental (Abdollahzadeh, 2015): 2-year-old apple trees were inoculated with the fungus. Disease symptoms on apple trees including necrosis, gummosis, cancer, vascular discolouration of the wood and dieback were observed and all inoculated trees died after 6 weeks under greenhouse conditions resp. 8 weeks under field conditions. Brown necrotic lesions extend up and down from the inoculation points. The fungus is described as highly virulent and according to

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	Abdollahzadeh (2015) and further authors cited there, poses a threat for the apple cultivation in Iran. Germany, Baden-Württemberg: black bark scorch on trunks and branches of ecologically cultivated apple and pear trees. In older infestations, black pycnidia occasionally broke through the bark near the canker. As the infection progressed, the bark separated from the underlying wood and fell off. The wood underneath was blackened and looked like charcoal. Several trees (9 to 12 years after planting) were strangulated by the cancer and died (Hinrichs-Berger et al. 2021, including photos of the infection).
Limitation of the endangered area in Germany	See expected establishment and spread in Germany.
Expected damage in endangered area in Germany[14]	According to Hinrichs-Berger et al. (2021, and personal communication) the fungus poses a threat for the apple and pear trees in meadow orchards, in private and allotment gardens as well as in biological cultivation in Germany.
Expected damage in endangered area in Member States[15]	As already shown for Iran and Germany by Abdollahzeh (2015) and Hinrichs-Berger et al. (2021), significant damage is to be expected in cultivation of apples and pears in the Member States.
Control and measures[16]	It is not known yet whether effective fungicides are available, since the fungus was only recently described, but presumably, fungicides against the apple and pear scab are effective because *Diplodia* is found in conventional and integrated cultivation only very rarely. Alijani et al. (2016) investigated the efficiency of endophytes against the fungus. Since *D. bulgarica* causes massive damage, infected plants should be destroyed quickly (in a waste incineration plant, if possible; during transport, care must be taken to ensure that the packaging is closed, so that the fungus cannot spread) in case of a first occurrence in a location. Infected planting material should not be marketed and not be distributed to prevent spread of the fungus. With sufficient water and nutrient supply, there is no visible infestation. Sunburn-preventing pruning measures and white painting of the trees seem to reduce infections.
Detection and diagnosis[17]	Phillips et al. (2012) provide an illustrated description. Laboratory identification is possible via isolation and subsequent DNA-sequencing (ITS and TEF-1α regions).

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Remarks	Due to the already advanced spread in Baden-Württemberg and possibly also other Federal States and the effective transmission pathways of the fungus, which can only be influenced to a limited extent, no classification is made according to Article 29 of Regulation (EU) 2016/2031. However, with the increase in hot, dry summers due to climate change, it is very likely that damage to apples and pears will increase. The survey of the pest status of *D. bulgarica* in Germany would help to identify infection-free regions and to take appropriate precautionary measures for the prevention of further spread of the fungus. Furthermore, the establishment of the endophytic colonization of the host plants (latent, i.e. no symptoms) is required for the clarification of the actual spread of the fungus in Germany.
Literature	ABDOLLAHZADEH, J. (2015): *Diplodia bulgarica*, as a new pathogen and potential threat to the apple industry in Iran. Phytopathologia Mediterranea, 54(1), 128-132. ALIJANI, N., MANAFI SHABESTARI, M., GHOSTA, Y. (2016): Biocontrol effects of endophytic fungi isolated from apple trees against *Diplodia bulgarica* the causal agent of apple canker disease. In 22th Iranian Plant Protection Congress, 339. ALVES, A., CORREIA, A., PHILLIPS, A. J. (2006): Multi-gene genealogies and morphological data support *Diplodia cupressi* sp. nov., previously recognized as *D. pinea* f. sp. *cupressi*, as a distinct species. Fungal Diversity, 23, 1-15. HINRICHS-BERGER, J., ZEGERMACHER, K., ZGRAJA, G. (2021): First report of *Diplodia bulgarica* causing black canker on apple (*Malus domestica*) and pear (*Pyrus communis*) in Germany. New Disease Reports, 43(1), e12004. LEGESSE, W. B. (2011): Understanding the global population genetics of *Diplodia pinea* and its life cycle in plantation pines (Doctoral dissertation, University of Pretoria). NABI, S. U., RAJA, W. H., MIR, J. I., SHARMA, O. C., SINGH, D. B., SHEIKH, M. A., KAMIL, D. (2020): First report of *Diplodia bulgarica* a new species causing canker disease of apple (*Malus domestica* Borkh) in India. Journal of Plant Pathology, 102(2), 555-556. PHILLIPS, A. J. L., LOPES, J., ABDOLLAHZADEH, J., BOBEV, S., ALVES, A. (2012): Resolving the *Diplodia* complex on apple and other Rosaceae hosts. Persoonia: Molecular Phylogeny and Evolution of Fungi, 29, 29.

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Explanations

Erläuterungen

[1] Compilation of the most important directly available information allowing a first preliminary estimation of the phytosanitary risk. This short assessment is necessary for the decision on a notification to EU and EPPO as well as the preparation of a complete risk analysis, for the information of the countries and as a basis for the possible initiation of eradication measures. Regarding the phytosanitary risk especially the possibility of the introduction to and spread in Germany and the Member States as well as possible damage are taken into account.

[2] Taxonomic classification – also subspecies – in the case that the taxonomical classification is uncertain the JKI-scientist initiates the taxonomic classification as far as possible.

[3] If so, which organism (which organisms) is (are) transmitted and does it (do they) occur in Germany / the MS?

[4] If so, which organism serves as a vector and does it occur in Germany / the MS?

[5] Description of the pattern of damage and the severity of the symptoms/damage on the different host plants

[6] Presence of host plants in protected cultivation, open field, amenity plantings, forest…….; where, in which regions are the host plants present and to which extent?
How important are the host plants (economical, ecological, …)?

[7] Presence of the host plants in protected cultivation, open field, amenity plantings, forest ....; where, in which regions are the host plants present and to which extent?
How important are the host plants (economical, ecological, ...)?, possible origin

[8] E.g. acc. to CABI, EPPO, PQR, EPPO Datasheets.

[9] Which pathways are known for the pest and of which relevance are they in respect to the probability of the spread? Primarily the transport over long distances is meant, normally with infested traded plants, plant products or other contaminated articles. This does not comprise the natural spread resulting from introduction.

[10] Which pathways are known for the pest and of which relevance are they in respect of the probability of the spread? In this case, the natural spread resulting from introduction is meant.

[11] Under the given prevalent environmental conditions

[12] Under the given prevalent environmental conditions (native areas and areas of introduction)

[13] Description of the economic, ecological/environmental and social damage in the area of origin resp. areas of occurrence up to now

[14] Description of the economic, ecological/environmental relevant and social damage to be expected in Germany, as far as possible and required, differentiated between regions

[15] Description of economic, ecological/environmental and social damage to be expected in the EU /other Member States, as far as possible and required, differentiated between regions

[16] Can the pest be controlled? Which possibilities of control are given? Are plant health measures conducted in respect to this pest (in the areas of current distribution resp. by third countries)?

[17] Description of possibilities and methods for detection. Detection by visual inspections? Latency? Uneven distribution in the plant (sampling)?