Express – PRA[1)] for *Diplocarpon mali Y. HARADA & SAWAMURA*

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Initiation: Occurrence in Baden-Württemberg and Hesse

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Phytosanitary Risk for Germany	**high** ☐	**medium** ☒	**low** ☐
Phytosanitary Risk for EU-MS	**high** ☐	**medium** ☒	**low** ☐
Certainty of Assessment	**high** ☐	**medium** ☒	**low** ☐
Conclusion	The fungus *Diplocarpon mali* (anamorph: *Marssonina coronaria*) occurs in Italy since 2003, since 2010 in Germany (Hesse and Baden-Württemberg) and since 2011 in Austria and Switzerland. It is assumed that the fungus has established in different parts of Baden-Württemberg, the actual spread in Germany is not known. Possibly the fungus had already established before and only got conspicuous because of the very humid weather conditions during the last three summer periods. The main host plant is *Malus* spp., but also *Chaenomeles* is described as a host plant in the literature. The fungus may cause severe early defoliation. Thereby the trees are weakened and thus the sprouting and fruit development are reduced in the subsequent year. Up to now mainly organic apple plantations and scrab resistant varieties are concerned, presumably because for those rarely/no fungicides are used. Severe damage is reported from Korea. In nurseries, damage can be limited by usual fungicides against apple scrab (*Venturia inaequalis*) and by means of hygienic measures and removal of infested foliage. The fungus is naturally spread via conidiospores and ascospores via wind and water. An introduction with nursery stock is possible when leaves remain on the plant. Based on this risk assessment it has to be assumed that the fungus *Diplocarpon mali* will establish further, spread and cause severe damage in Germany and other EU Member States. In general, measures to control and prevent the further spread of *Diplocarpon mali* should meet § 4a of the PBVO, however it is questionable whether such measures against a further spread were effective and practicable. Measures against the natural spread are only effective and useful in case that the infestation would only occur in very few locations to a very limited extent. Presumably this is not the case. Thus the infestation would have to be surveyed specifically.		
Taxonomy[2)]	Fungi, Ascomycota, Leotiomycetes, Helotiales, Dermateaceae Anamorph (conidial stage): *Marssonina coronaria* Ellis & J. J. Davis [EPPO Plant Protection Thesaurus]		

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Common names	Marssonina Blattfleckenkrankheit, Marssonina Blotch, Marssonina Leafspot, sooty blotch of apple
Synonyms	*Marssonina mali*
Does a relevant earlier PRA exist?	No, though commodity related risk assessments from Australia exist in which the fungus was considered and classified as a quarantine pest (Australian Government 2008, Australian Government 2009, Australian Quarantine & Inspection Service 1998).
Biology	In summer, the fruit-bodies of the asexual propagation form (Acervuli) with bicellular conidiospores (anamorph: *Marssonina coronaria*) are produced. They are distributed via rain and wind, in case of prolonged damp weather spread could be epidemic. In autumn, fruit-bodies of the teleomorph *Diplocarpon mali* (Apothecium) may be formed. The fungus overwinters in fallen leaves (Lindner, 2012). The fungus needs a prolonged moisture period for its development and moderate temperatures from 20 – 22 °C (Lee *et al*. 2011, Sharma *et al*. 2009), though in tests germination of the overwintering fungus was already possible at temperatures from 5°C (Gao *et al*. 2011).
Is the pest a vector?[3)]	No.
Is a vector needed?[4)]	No, the fungus spreads via various spore forms in combination with wind and water.
Host plants	*Malus* spp. (apple), *Chaenomeles* spp. is sporadically mentioned as a host plant (Farr *et al*. 2008).
Symptoms[5)]	The infestation occurs in summer after longer rainy periods. It starts with greyish-black diffuse leaf spots on the upper surface of fully developed leaves which – by and by - run into one another. Also a necrotic stippling of the leaves is possible, which is more distinct on the upper leaf surface than on the under leaf surface. On the leaf surface small, round to oval black fruit-bodies break through, so-called acervuli. Within short time half of the leaves may get brown and early defoliation is possible (Hinrichs-Berger 2011; Hinrichs-Berger 2012).
Presence of host plants in Germany[6)]	Main host plant: *Malus* spp. Apple trees are widespread in Germany, in cultivation and also as roadside trees or in gardens. In Germany, the commercial cultivation of apples is an important economic factor and takes up a big part of apple cultivation areas (see fig. 5, German Statistical Federal Office, 2012). In 2011, apples were cultivated in an area of app. 31,600 ha, with a crop load of app. 900,000 t (Destatis 2011). Baden-Württemberg ranks first for cultivation areas just less than 10,000 ha, followed by Lower Saxony (just less than 8,999 ha) and Saxony with app. 2,500 ha (see Table 1). In 2011, app. 41,750 t apples were organically produced in Germany. Thus Germany ranks second of the Bio apple producers in Europe, following Italy (BOLW, 2012). *Chaenomeles* is a popular ornamental that is often used in

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	amenity plantings and private gardens. Nevertheless there is no detailed information on the distribution available.
Presence of host plants in the MS[7)]	In relation to the area apples are the most important fruit in the EU-27: f. e. in 2007, on 35.5 % of the fruit cultivation areas apples for consumption were cultivated. In 2007, important producers of apples were mainly Poland with more than 160,000 ha, Romania with app. 60,000 ha, Italy with more than 55,000 ha and France with more than 40,000 ha (see Table 2). (German Statistical Federal Office, 2009). For organic production, Italy ranks first in relation to the harvest of apples (app. 42,500 t). In other countries minor quantities were produced in organic production, in Austria f. e. 12,000 t, in the Netherlands 6,000 t, in France app. 3,000 t and in Belgium just under 2,500 t (BOLW 2012).
Known infested areas[8)]	The Invasive Species Compendium of CABI lists the fungus *Diplocarpon mali* (teleomorph) as present in parts of Asia (China, Japan, Korea, India) as well as in the USA and Canada (CABI 2012). In 2001, the fungus was found in Italy for the first time (Tamietti & Matta, 2003). In 2010, it was detected in an enterprise with organic production in Baden-Württemberg, then in 2011, in several parts of Baden-Württemberg (Hinrichs-Berger 2011). In 2010, the fungus was found in Switzerland for the first time (Anonym, 2012). In August 2011, the fungus was detected in Southern Tyrol (Lindner, 2012) and in September 2011, it was detected in Austria in 4 different locations for the first time (*Persen* et al. 2012). Possibly the fungus is already present in Europe since a long time, but up to now it did not occur to a great extent (Anonym 2012). Extremely damp summers in the last years might be responsible for the more frequent occurrence.
Pathways[9)]	Up to now no concrete indication. In case of deciduous trees or leaf remains an introduction via nursery goods seems probable. The introduction via infested fruits seems unlikely (Australian Government 2009), as infested fruits attract attention. Furthermore they are usually imported for consumption purposes so that even in case of an infestation the transmission of the fungus from fruit to a host plant seems unlikely.
Natural spread[10)]	Via conidiospores or ascospores that are dispersed via rain and wind. No investigations on the radius of conidiospores and ascospores of *Diplocarpon mali* are available. It is presumed that the natural spread mainly happens in a small radius. Nevertheless it might be possible that conidiospores were transported to higher air layers by wind and spread over longer distances, also spread via insects or device-adherent conidiospores cannot be excluded.
Expected establishment and spread in Germany[11)]	The fungus occurred already in several parts of Baden-Württemberg in organically producing apple plantations within the last two years (Hinrichs-Berger 2012) and in 2012, it was detected in Hesse. It is expected that the fungus already established there and will spread when no control measures are

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	taken.
Expected establishment and spread in the MS[12)]	In 2003, the fungus occurred for the first time in Italy. Last year it was detected in Austria, South Tyrol and in Switzerland. Without control measures further spread and establishment is probable.
Known damage in infested areas[13)]	The fungus occurs mainly in organic production on varieties that are resistant against apple scab (*Venturia inaequalis*) (Hinrichs-Berger 2011). These varieties are never or only rarely treated with fungicides. Due to the severe untimely defoliation, fruits and resting buds are only insufficiently supplied in the following year so that the subsequent flowering and harvest are threatened (Hinrichs-Berger 2011). In Korea the fungus is considered as the severest infestation in apple cultivation at present. Lee *et al.* (2006) describe a defoliation of almost 88 % of the trees in a research area. In India the building of round spots directly on the fruits was observed (Sharma *et al.* 2004), up to now this has not been observed in Europe. Sagong *et al.* (2009) stated a reduction of the fruit quality with increasing defoliation, reduced starch storage, reduced fruit colouring as well as a negative influence on new shoots and flowering in the subsequent year.
Limitation of the endangered area in Germany	A limitation is not possible (See distribution of the main host plant).
Expected damage in the endangered area in Germany[14)]	Currently, the damage that is caused by an infection with *Diplocarpon mali* (or the anamorph *Marssonina coronaria*) is limited to the severe untimely defoliation, an increased weakening of the trees and a reduced fructification in the subsequent years. A direct damage on the fruits has not yet been described. Nevertheless a quality loss caused by reduced starch storage and fruit weight is possible.
Expected damage in the endangered area in MS[15)]	See above
Control feasibility and measures[16)]	The fungus occurs mainly in organic production and on scab resistant varieties. It is assumed that the fungicides that are used against scab have a side-effect on the fungus (Hinrichs-Berger, 2011). Nevertheless, in Japan strains were detected that were resistant against the active ingredient Thiophanate-methyl (Tanaka *et al.* 2000). In general, a stringent hygiene in the enterprise is a condition to hinder further spread. Also the thorough disposal of fallen leaves contributes to the reduction of a new infestation risk (Hinrichs-Berger, 2012). Resistant apple varieties are not yet known here. Nevertheless, in China there are first tests on resistant varieties and stocks (Li *et al.* 2012). It is questionable to which extent measures against a further spread are effective and feasible.

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Detection and diagnosis[17)]	Diagnosis of the conidiospores by optical microscope: the conidiospores that are produced in the acervuli are bicellular with a medium size of 20 x 8 µm. The outer cell wall is tied up at the location of the mutual cell wall. For the diagnoses also platings on pepton-dextrose-potato-agar and PCR-methods can be used (Lee *et al*. 2011). As the symptoms are similar to those of the leaf spot disease that is caused by the genus *Phyllosticta*, it can easily be mistaken.
Remarks	Up to now there is only little information on the current pathways and the current distribution of the fungus. Thus a targeted assessment of the infestation would be necessary in the following year to allow a realistic assessment of the infestation situation in Germany. Only on this basis the feasibility and alignment of measures against further spread could be estimated.
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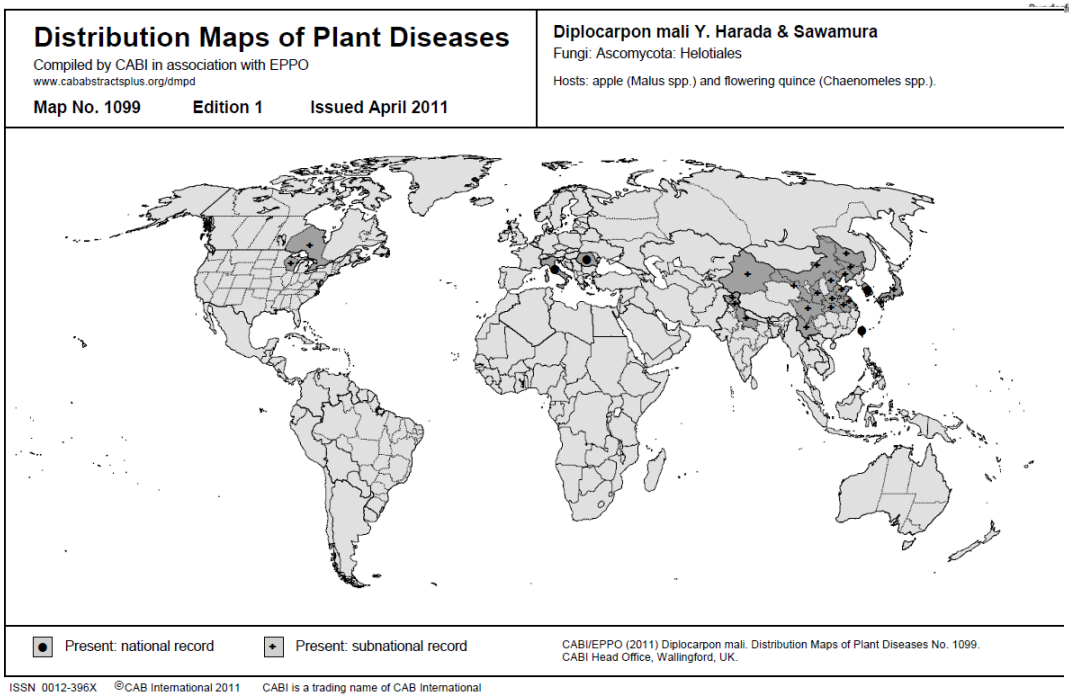

Fig. 1: Distribution map of *Diplocarpon mali* (CABI 2012)

Fig. 2: Infested apple tree (Photo: Lindner, 2012)

Fig. 3: Infested apple leaves (Photo: Lindner, 2012)

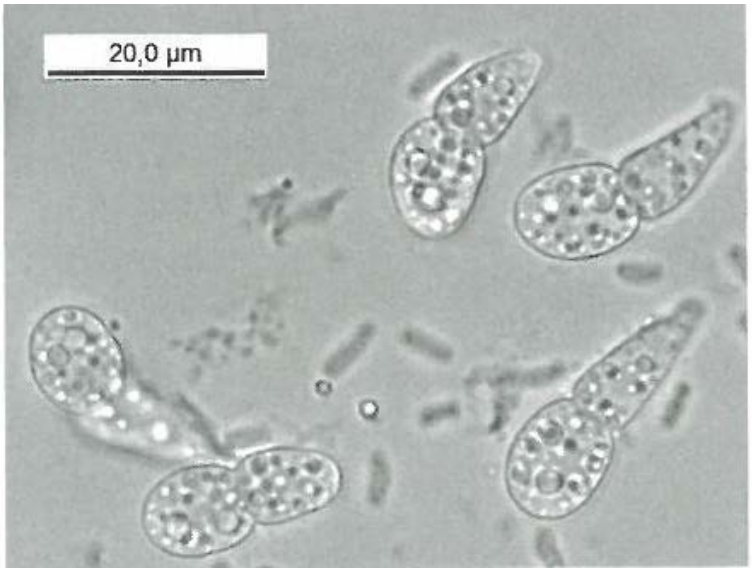

Fig. 4: Conidiospores of *Marssonina coronaria* (Photo: Hinrichs-Berger, 2012)

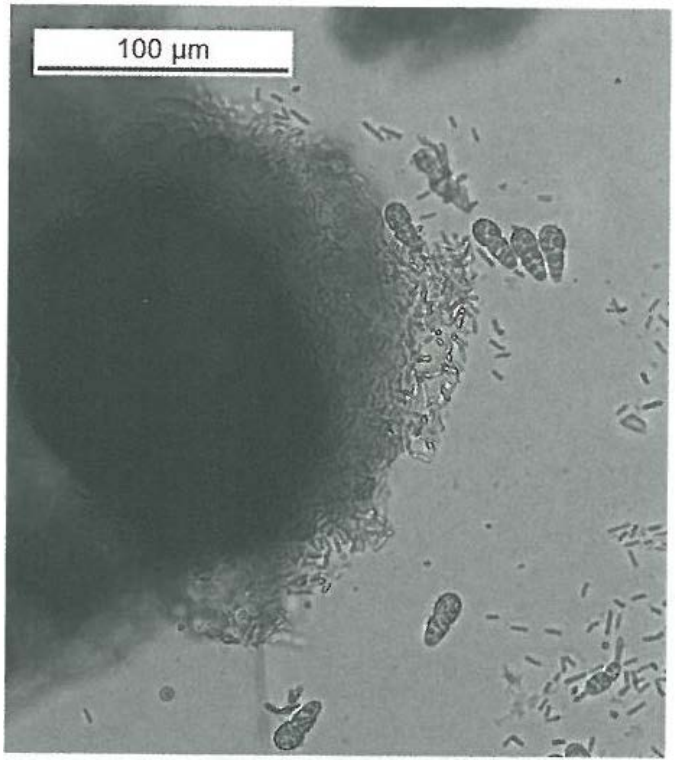

Fig. 5: Conidiospores and spermatia emerging from Acervulus (Photo: Hinrichs-Berger, 2011)

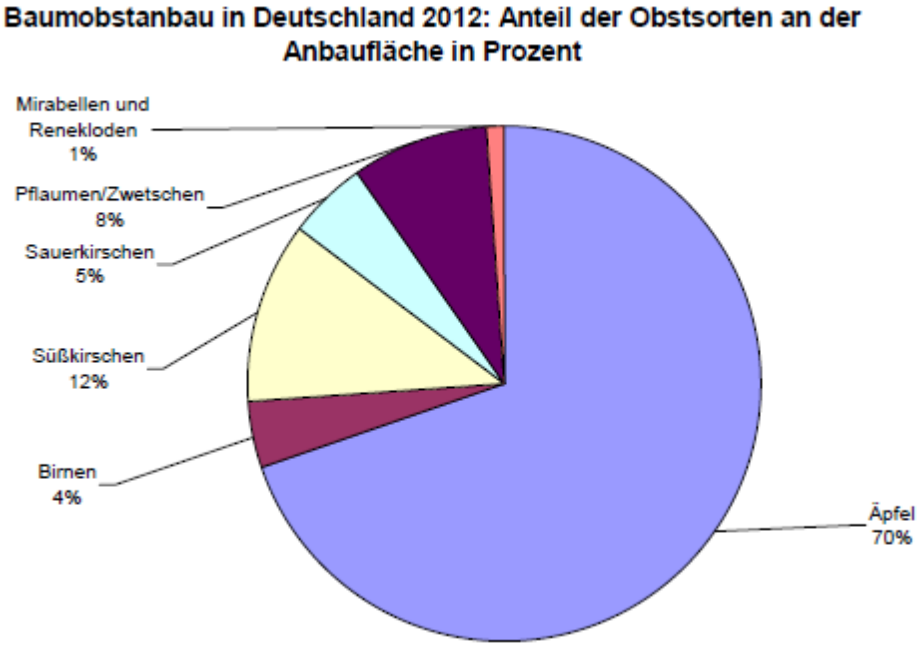

Fig. 6: Statistic presentation of the portions of different fruit tree species in cultivation areas in Germany in 2012 (German Statistical Federal Office, 2012)

Table 1: Apple cultivation in Germany in 2011, broken down to the single Federal States (Source: German Statistical Federal Office, 2012)

Apfelanbau 2011						
	Erntemenge		Anbaufläche		Ertrag	
	Rang	Tonnen	*Rang*	ha	*Rang*	dt/ha
Deutschland insgesamt		898 448		31 608		284,2
darunter:						
Baden-Württemberg	*1*	293 412	*1*	9 953	*8*	294,8
Niedersachsen	*2*	238 226	*2*	7 760	*6*	307,0
Sachsen	*3*	94 774	*3*	2 577	*1*	367,7
Nordrhein-Westfalen	*4*	58 938	*4*	1 758	*3*	335,3
Bayern	*5*	38 330	*7*	1 221	*5*	313,9
Hamburg	*6*	35 668	*11*	1 006	*2*	354,4
Sachsen-Anhalt	*7*	33 744	*10*	1 007	*4*	335,0
Rheinland-Pfalz	*8*	29 686	*5*	1 608	*11*	184,6
Thüringen	*9*	29 569	*9*	1 157	*9*	255,6
Mecklenburg-Vorpommern	*10*	15 379	*6*	1 383	*12*	111,2
Schleswig-Holstein	*11*	12 411	*12*	551	*10*	225,3
Hessen	*12*	10 625	*13*	352	*7*	302,1
Brandenburg	*13*	6 248	*8*	1 197	*13*	52,2
Saarland	*14*	.	*14*	78	*14*	.
Berlin/Bremen	-	-	-	-	-	-

- = nichts vorhanden

Quelle: Statistisches Bundesamt, BLE

Table 2: Cultivation area of tree fruits in the European Union in 2007 (Source: German Statistical Federal Office, 2009)

	Anbau-flächen von Baumobst insgesamt in ha	Davon:						
		Tafel-äpfel	Tafelbir-nen	Pfir-siche	Apri-kosen	Orangen	Kleinfrüchtige Zitrusgewäch-se (Mandari-nen, Clemen-tinen etc.)	Zitronen
EU-27	1 365 096	485 100	112 258	206 957	67 369	279 048	151 509	62 855
darunter:								
Spanien	459 524	24 822	25 976	75 118	18 700	158 824	116 225	39 859
Italien	279 120	55 225	32 075	63 754	15 649	73 786	21 998	16 634
Polen	176 730	165 715	7 048	2 907	1 060	0	0	0
Griechenland	94 771	9 337	3 127	34 127	3 929	32 440	6 632	5 180
Frankreich	76 638	40 113	6 707	14 308	13 804	29	1 654	23
Rumänien	70 659	60 494	4 834	1 897	3 434	0	0	0
Portugal	39 792	11 711	9 228	2 424	283	12 416	3 235	494
Deutschland	**29 469**	**27 888**	**1 581**	. [1]	. [1]	**0**	**0**	**0**

Explanations

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 into and spread in Germany and the Member States as well as possible damage are taken into account.

2) Taxonomic classification – also subspecies; in 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 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

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Where, in which regions are the host plants present and to which extent?
How important are the host plants (economical, ecological,..)? Possible origin

8) F. e. acc. to CABI, EPPO, PQR, EPPO Datasheets

9) Which pathways are known for the pest and how important are they for the possibility of introduction? Primarily the transport of the pest 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 possibility of 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 relevant 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 the economic, ecological/environmental relevant 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)?