THE IDENTITY OF PHYLLOSTICTA DESTRUCTIVA DESM. AND SIMILAR PHOMA-LIKE FUNGI DESCRIBED FROM MALVACEAE AND LYCIUM HALIMIFOLIUM

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SUMMARY

By comparative examination of type specimens and freshly collected material, and pure cultures and by inoculation experiments, it was shown that *Phyllosticta destructiva* and numerous other *Phoma*-like fungi described on *Malvaceae* and *Lycium halimifolium* are identical with the ubiquitous weak and wound parasite *Phoma exigua* Desm.

1. INTRODUCTION

In 1847 DESMAZIÈRES described *Phyllosticta destructiva* as a member of the *Sphaeropsidales* with "sporidiis minutis ovoideo-oblongis, subhyalinis, 1–2 septatis". This fungus was found on *Malva* species (*Phyllosticta destructiva* var. *malvarum*) and on *Lycium* species (var. *lycii*) and was therefore considered to be a polyphagous species. According to the type specimen (Herb. PC) and the distributed exsiccata in Pl. cryptog. N. France [ed. 1] Fasc. 33, No. 1627. 1847 of *Phyllosticta destructiva* on *Malva sylvestris* and *Lycium halimifolium* (sub syn. *L. europaeum*) the spores now can be characterized as 1-, 2-, or occasionally 3-celled, (2.5)5–10(13) × (1.5)2–4 μ in size. This species concept does not fit in SACCARDO's *Sphaerioideae-hyalosporae*. In his system (1884) the most important characters for separating genera and species were septation of the spores, identity of the host and the part of the plant on which the fungus occurred. This was the reason why subsequent authors described different species of *Ascochyta*, *Diplodina*, *Phoma*, and *Phyllosticta* on *Malvaceae* and on *Lycium halimifolium* similar to *Phyllosticta destructiva* and ignored the existence and priority of this name. BUBÁK & KABÁT (1904) and VON HÖHNEL (1919) at last tried to place Desmazières' *Phyllosticta destructiva* in the Saccardoan system by splitting it up into two different species, one growing on *Malva* and the other on *Lycium* spec. The synonyms proposed by von Höhnel were discussed again by KEISSLER (1922).

In our investigation of numerous isolates from various *Malvaceae* it became evident that Desmazières' view of a polyphagous species, characterized by variable septation, was correct. In modern taxonomy the primary character for the separation of genera in *Sphaeropsidales* is considered to be the mode of spore formation. Because the spores originate from undifferentiated sporogenous cells, by a monopolar repetitive budding process (BREWER & BOEREMA 1965; BOERE-

MA 1965), the fungus in question is a characteristic *Phoma* species. Septation of spores in *Phoma* species is a secondary process (euseptation) and occurs independently of the sporogenesis (BOEREMA 1970). Furthermore the fungus proved to be identical with *Phoma exigua* Desm., a very common weak and wound parasite on herbaceous plants, the diagnostic characters of which were described by BOEREMA & HÖWELER (1967).

Phyllosticta destructiva Desm. (1847) antedates *Phoma exigua* Desm. (1849) but a recombination using the epithet *destructiva* in the genus *Phoma* is not possible, because this would result in a later homonym of *Phoma destructiva* Plowr. (1881), a quite different species causing fruit rot of tomatoes (JAMIESON 1915).

2. PATHOGENICITY AND VARIABILITY OF THE FUNGUS ON MALVACEAE AND LYCIUM HALIMIFOLIUM

In natural infections on leaves and stems of various *Malvaceae* and *Lycium halimifolium* irregular local necroses occur in which the fungus soon starts to sporulate. Artificial infections were carried out by placing drops of a spore-suspension of *Phoma exigua* on the leaves of *Malva sylvestris* and *Lycium halimifolium*. An arbitrarily chosen strain of *Phoma exigua* isolated from potato tubers showing gangrene symptoms (BOEREMA 1967) and other isolates of the fungus obtained from *Malva sylvestris* and *Lycium halimifolium* were used. The results were uniformly positive and there was no difference in pathogenicity between the fungi of different origins to both plants tested. However, the intensity of attack was influenced by the vigour of the inoculated plants and the concentration of the spore suspension. Weak plants withered completely and died quickly. In all cases the identity of the fungus was confirmed by re-isolation and study of pure cultures.

A Russian investigation recently published by ZERBELE (1962) has to be mentioned in connection with the variability in spore size and septation. He inoculated 14 different species of *Malvaceae* with one isolate from *Althaea rosea* identified as *Ascochyta althaeina* Sacc. & Bizz. (*table 1*). All inoculations except two were successful. He noted clear differences in susceptibility between various plants, but finally pycnidia were formed on all. There was considerable variation in spore sizes and the percentage of septate spores, ranging from an average of 5.8 × 2.7 μ, with 4% septate spores on *Hibiscus cannabinus* up to 8.5 × 3 μ with 85% septate spores on *Althaea rosea*. It is worth mentioning that Zerbele found a comparable variation in spore sizes and septation after inoculating different *Solanaceae* with *Ascochyta solani-tuberosi* Naumov. This name can also be regarded as a synonym of *Phoma exigua*.

Table 2 illustrates the variation in spore sizes and septation found by us in natural infections of the fungus on different *Malvaceae*. Comparison of table 1 and 2 reveals marked differences between percentages of septation on the same host. One reason may be that Zerbele worked with a strain of the fungus from *Althaea rosea*. Other factors can play a role, e.g. light, variation in humidity, etc.

Table 1. Variability of pycnidiospores in *Phoma exigua* after inoculation of an isolate from *Althaea rosea* ('*Ascochyta althaeina*') on various *Malvaceae*. From ZERBELE (1962).

Trial plants	Incubation period in days	level of attack	Dimensions of pycnidiospores in μ		Percentage of 2-celled pycnidio-spores
			Variation	Average	
Althaea rosea	5	+++	6.0–12.0 × 3.0	8.5 × 3.0	85
Abutilon theophrasti (*A. avicennae*)	6	+	4.5–10.5 × 1.5–3.0	6.9 × 2.9	27
Anoda cristata	6	+	4.5–10.5 × 1.5–3.0	7.1 × 2.9	32
Hibiscus cannabinus	5	+	4.5– 7.5 × 1.5–3.0	5.8 × 2.7	4
Lavatera thuringiaca	6	+	4.5–12.0 × 1.5–3.0	7.2 × 2.9	40
L. olbia	–	–	–	–	–
Malope trifida	6	+	4.5– 9.0 × 1.5–3.0	6.6 × 2.9	22
Malva cretica	6	+	4.5– 9.0 × 1.5–3.0	6.3 × 2.8	10
M. brasiliensis	6	+	4.5– 9.0 × 1.5–3.0	6.7 × 2.9	11
M. crispa	6	+	4.5– 9.0 × 1.5–3.0	6.1 × 2.9	4
M. moschata	7	+	4.5– 9.0 × 1.5–3.0	6.8 × 2.9	25
M. nicaeensis	–	–	–	–	–
M. verticillata	6	+	4.5– 9.0 × 1.5–3.0	6.4 × 2.9	5
Sida hermaphrodita (*S. napaea*)	7	+	4.5– 9.0 × 1.5–3.0	6.9 × 2.9	27

– No attack
+ Some necrotic spots without pycnidia. Sporulation takes place in a moist chamber.
+++ Moderate attack. Spots with abundant sporulation.

Table 2. Natural variability of pycnidiospores in *Phoma exigua* on various *Malvaceae* and *Lycium halimifolium*.

Host	Variation	Percentage of septate spores
Althaea cannabina	8–11 × 3–4.5	63
A. rosea	6–9 × 3–4.5	41
Anoda cristata	6–12 × 2–3.5	23
Hibiscus moscheutos	6–12 × 2.5–4	43
Kitaibelia vitifolia	5–10 × 2.5–3.5	46
Lavatera thuringiaca	3–11 × 2–2.5	51
Lycium halimifolium	5–10 × 2–3.5	8.3
Malva alcea	8–12 × 3–4	66
M. pusilla	6–11 × 3–4	67
M. sylvestris	8–13 × 3–4.5	50
Sida hermaphrodita	7–13 × 2.5–4	37
Sidalcea candida	7–11 × 3–4	16
S. oregana	8–11 × 3–5	11.3

On one host we found a great variation in the percentage of septate spores in different pycnidia, at different seasons, and from different origin. Especially in *Malva sylvestris* and *Althaea rosea* the percentages of septation varied from one collection to another. It seems that the percentage of septate spores is not so much characteristic for a certain hostplant but rather depends on other factors. In general a great variation in both size and septation of the spores is a typical character of *Phoma exigua.*

3. TAXONOMIC CONSIDERATIONS

BOEREMA & HÖWELER (1967) listed 14 synonyms of *Phoma exigua* and pointed out that this list was only provisional and numerous other synonyms were still to be found. More synonyms were given by BOEREMA (1970). Various names of fungi described from species of *Malvaceae* and *Lycium halimifolium* can now be added. All the species of *Ascochyta, Diplodina, Phoma* and *Phyllosticta,* of which the original descriptions suggest similarity with *Phoma exigua,* are discussed here in alphabetical order. As far as they appeared to be *Phoma exigua,* the observed spore characters give additional information on the variability of the fungus *in vivo.*

Ascochyta

Ascochyta abutilonis Hollós in Annls hist.-nat. Mus. natn. hung. 7: 53. 1909. On *Abutilon theophrasti* (sub syn. *A. avicennae*). Type probably destroyed during the second world war (information from Museum of Natural History at Budapest); = *Phoma exigua* Desm. in Annls Sci. nat. (Bot.) III, 11: 282. 1849.

The description of the leaf spots and the characters of the spores clearly point to *P. exigua.*

Ascochyta alceina Lambotte & Fautr. apud Fautr. in Bull. Soc. mycol. Fr. 15: 153. 1899 ≡ *Diplodina alceina* (Lambotte & Fautr.) Allesch. in Rabenh. Kryptog Flora ed. 2, Pilze 7 (Lief. 88): 881. 1903. On *Althaea rosea.* Type in herbarium Maublanc (PC); = *Phoma exigua* Desm. l.c.

According to the type specimen undoubtedly identical with *P. exigua.* Continuous spores measure 5.8–8 × 2.5–3 μ; two-celled spores 9.8–10 × 2.5–3.5 μ.

Ascochyta althaeina Sacc. & Bizz. apud Sacc. in Atti Ist. veneto Sci. VI, 2: 444. 1884; in Sylloge Fung. 3: 399. 1884. On *Althaea officinalis.* Type in herbarium Saccardo (PAD); = *Phoma exigua* Desm. l.c.

As shown by the type specimen certainly identical with *P. exigua.* Continuous spores measure 6–9 × 2–3 μ, but a high percentage are septate. The two-celled spores are 6–10 × 2–3 μ; three-celled spores are 9–12 × 2.5–3.5 μ in size. The binomial *Ascochyta althaeina* was used by ZERBELE (1962) in his study of the variability of *P. exigua* on *Malvaceae.*

Ascochyta althaeina var. *brunneo-cincta* Pass. apud Brun. in Revue mycol. 8:

141. 1886. On *Althaea officinalis*. Type not known to be in existence; = *Phoma exigua* Desm. l.c.

The epithet *brunneo-cincta* refers to the leaf spots: "Taches marginées de brun". The published spore characters agree with *P. exigua* .The deviating type of leaf spot mentioned is apparently only the effect of a somewhat different reaction of the plant. ZERBELE (1962) already suggested that the differences in colour of the leaf spots did not justify the distinction of the var. *brunneo-cincta*.

Ascochyta althaeina var. *major* Brun. in Annls Soc. Sci. nat. Charente-Infér. 1889: 62. 1889. On *Althaea officinalis*. Type not known to be in existence; = *Phoma exigua* Desm. l.c.

The spore dimensions given by Brunaud fall entirely within the normal range of spore sizes of *P. exigua*. Therefore we agree with ZERBELE (1962) in considering that this variety cannot be distinghuised.

Ascochyta destructiva Kab. & Bubák in Sber. K. böhm. Ges. Wiss. 1903, 11: 4. 1904. On *Lycium halimifolium* (sub syn. *L. barbarum*). Type in herbarium Bubák (formerly BKL, presently BPI); = *Phoma exigua* Desm. l.c.

On the type specimen a characteristic *Phoma* spec. is present, with spores 7–10 × 2.5–3.3 μ. Kabát and Bubák stated that if their fungus would appear to be identical with *Phyllosticta destructiva* Desm. it should not be considered as a new species but as a recombination: *A. destructiva* (Desm.) Kab. & Bubák. Although both fungi are indeed conspecific, the proposed recombination is not validly published in accordance with Art. 34 of the "Edinburgh Code" ("Provisional name"). Later on VON HÖHNEL (1919) again proposed the recombination of *Phyllosticta destructiva* in the genus *Ascochyta*, but this also was not valid, being at that time a later homonym of *A. destructiva* Kab. & Bubák. See further under *Phyllosticta destructiva* Desm.

Ascochyta destructiva (Desm.) Höhn. in Hedwigia 60: 165. 1919; = *Phoma exigua* Desm. l.c.
See above and under *Phyllosticta destructiva* Desm.

Ascochyta hibisci-cannabini Khokhryakow apud Tranz., Gutner & Khokhryakow in Trudy Inst. nov. Bast Raw Material Vaskhnil, Leningrad 1: 131. 1933. On *Hibiscus cannabinus*. Type not known to be in existence; = *Phoma exigua* Desm. l.c.

The spores are described as hyaline, cylindrical, rounded at both ends, at first continuous, later on with a septum, 5–10 × 2.5–4.5 μ. The description of other characters of this species also clearly points to *P. exigua*.

Ascochyta lycii Sacc., Bomm. & Rouss. in Bull. Soc. r. Bot. Belg. 26: 220. 1887. On *Lycium halimifolium* (sub syn. *L. barbarum*). Type in herbarium Saccardo (PAD); = *Phoma exigua* Desm. l.c.

The characters of the type specimen clearly point to *P. exigua*. The spores are 10–12.5 × 3.3–5 μ in size.

Ascochyta lycii Rostr. in Bot. Tidsskr. 26: 311–312. 1905 (illegitimate as later homonym of *A. lycii* Sacc. & al.). On *Lycium halimifolium* (sub syn. *L. babarum*). Type in herbarium Rostrup (C); = *Phoma exigua* Desm. l.c.

The size of spores on the type specimen is the same as usually found in *P. exigua:* 4–8.5 × 2.5–3.5 μ. VON HÖHNEL (1919) already considered *A. lycii* Rostr. as a synonym of *Phyllosticta destructiva* var. *lycii* Desm. = *Phoma exigua.* See under *Phyllosticta destructiva* Desm.

Ascochyta lycii Died. in KryptogFlora Brandenburg 9, Pilze 7: 391. 1915 (illegitimate as later homonym of *A. lycii* Sacc. & al.). On *Lycium halimifolium* (sub *L. barbarum*). Type probably destroyed during the second world war (according to information from the Botanical Institute Wroclaw (BRSL); = *Phoma exigua* Desm. l.c.

According to the description this fungus is identical with *P. exigua.*

Ascochyta lycii (Desm.) ex Höhn. in Hedwigia 60: 165–166. 1919 (illegitimate as later homonym of *A. lycii* Sacc. & al.); = *Phoma exigua* Desm. l.c.

Based upon *Phyllosticta destructiva* var. *lycii* Desm. (nomen nudum). See under *Phyllosticta destructiva* Desm.

Ascochyta malvacearum Kab. & Bubák (unpublished herbarium name). On *Malva neglecta* (sub syn. *M. rotundifolia*). Type in herbarium Bubák (formerly BKL, presently BPI); = *Phoma exigua* Desm. l.c.

The original collection of this fungus is identical with *P. exigua.* In an accompanying note Kabát described the spores as cylindrical, rounded at the ends, septate, 8–13 × 3 μ in size.

Ascochyta malvae H. Zimm. in Verh. naturf. Ver. Brünn 47: 94–95. 1908. On *Malva neglecta.* Type not known to be in existence; = *Phoma exigua* Desm. l.c. Zimmerman noted a resemblance with *Phyllosticta destructiva* Desm. (see there), but on account of the usually septate spores in the mature pycnidia of his collection he concluded that his fungus must be a separate species. Conscious of the variability of *Phyllosticta destructiva* (= *Phoma exigua*), VON HÖHNEL (1919) already listed *A. malvae* H. Zimm. as a synonym of *Ascochyta destructiva* (Desm.) Höhn. (= *P. exigua*).

Ascochyta malvae Died. in KryptogFlora Brandenburg 9, Pilze 7: 391. 1915 (illegitimate as later homonym of *A. malvae* H. Zimm.) ≡ *Ascochyta malvarum* Mig. in Thomé KryptogFlora Pilze 4 (1): 281. 1921 (nomen novum, misprinted as *A. malvacum*). On *Malva alcea.* Type probably destroyed during the second world war (according to information from Botanical Institute Wroclaw (BRSL); = *Phoma exigua* Desm. l.c.

From the description of both leaf spots and spores this species can also be placed in the synonymy of *P. exigua. A. malvae* Died. was already listed by VON HÖHNEL (1919) as a synonym of *Ascochyta destructiva* (Desm.) Höhn. = *P. exigua* Desm. See also under *Phyllosticta destructiva* Desm.

Ascochyta malvarum Mig. in Thomé KryptogFlora Pilze 4 (1): 281. 1921 (misprinted as *A. malvacum*); = *Phoma exigua* Desm. l.c.

This binomial was introduced as a nomen novum for the illegitimate name *Ascochyta malvae* Died., see there.

Ascochyta malvicola Sacc. in Michelia 1 (2): 161. 1878; in Sylloge Fung. 3: 399–400. 1884. On *Malva sylvestris*. Type in herbarium Saccardo (PAD); = *Phoma exigua* Desm. l.c.

In his description Saccardo mentioned that the spores are 20–4 μ in size, but on the type specimen we found the spores to be much smaller: 4.5–12 × 2–2.5 μ, some of them septate. In all other characters this species agrees with *P. exigua*. VON HÖHNEL (1919) already considered *A. malvicola* as identical with *Ascochyta destructiva* (Desm.) Höhn. = *P. exigua*. See also under *Phyllosticta destructiva* Desm.

Ascochyta montenegrina Bubák in Sber. K. böhm. Ges. Wiss. 1903, 12: 13. 1904. On *Malva sylvestris*. Type in herbarium Bubák (formerly BKL, presently BPI); = *Phoma exigua* Desm. l.c.

The spores on the type specimen are 8.8–12.5 × 2.5–3 μ in size. Bubák notes that the fungus is closely related to *Ascochyta malvicola* Sacc. (= *P. exigua*) but differs by smaller spores. However, examination of the type specimen of *Ascochyta malvicola* (see above) has proved that the length of the spores published by Saccardo for this species was somewhat exaggerated: 20–4 μ. VON HÖHNEL (1919) already listed *A. montenegrina* as a synonym of *Ascochyta destructiva* (Desm.) Höhn. = *P. exigua*. See under *Phyllosticta destructiva* Desm.

Ascochyta parasita Fautr. in Revue mycol. 13: 79. 1891. On *Althaea rosea*. Type in herbarium Fautrey (UPS); = *Phoma exigua* Desm. l.c.

On the type specimen and on the syntype specimen in Roumeguère, Fungi gall. exs. [Ed. Roum.], Cent. 57, No. 5660. 1891, *P. exigua* grows in association with the rust *Puccinia malvacearum* Bertero ex Mont. Pycnidia of the fungus with continuous spores were classified by Fautrey in *Phyllosticta destructiva* Desm., those containing septate spores in *Ascochyta parasita*. The spore measurements in both are 5–10 × 2–3 μ. It is reported to parasitize *Puccinia malvacearum*, but was also associated with leaf spots. We have also often observed plants of *Althaea rosea* attacked by both the rust and *P. exigua*.

Ascochyta sidae Sawada in Spec. Publs Coll. Agric. natn. Taiwan Univ. 8: 152; 1959. On *Sida acuta*. Type in herbarium Sawada (TNS); = *Phoma exigua* Desm. l.c.

On account of the spore sizes and other characters this fungus must be placed in the synonymy of *P. exigua*. Continuous spores measure 5.8–6.8 × 2.8–3 μ, the two-celled spores are 6.5–7.5 × 2.5–3 μ in size.

Ascochyta urenae Sawada in Spec. Publs Coll. Agric. natn. Taiwan Univ. 8o 152. 1959. On *Urena lobata* var. *tomentosa*. Type in herbarium Sawada (TNS). = *Phoma exigua* Desm. l.c.

As shown by the spore sizes and the other characters this fungus appeared t:

be identical with *P. exigua*. The continuous spores are 5–7.5 × 2.8 μ, the two-celled ones 7.5–9.5 × 2.5–3.3 μ.

Diplodina

Diplodina abutilonis Ahmad in Biologia, Lahore 13: 34. 1967. On *Abuliton indicum*. Type could not be obtained; = *Phoma exigua* Desm. l.c.

Spore dimensions (6.5–10.5 × 3–3.5 μ) and other characters, given by the author, agree with those of *P. exigua*.

Diplodina alceina (Lambotte & Fautr.) Allesch. in Rabenh. KryptogFlora ed. 2, Pilze 7 (Lief. 88): 881. 1903; = *Phoma exigua* Desm. l.c.
See under *Ascochyta alceina* Lambotte & Fautr.

Diplodina althaeae Hollós in Annls hist.-nat. Mus. natn. hung. 4: 342. 1906. On *Althaea officinalis*. Type probably destroyed during the second world war (information from Museum of Natural History at Budapest); = *Phoma exigua* Desm. l.c.

The published spore dimensions, 8–10 × 3 μ, fully agree with those of *P. exigua*.

Diplodina hibisci Hollós in Annls hist.-nat. Mus. natn. hung. 4: 344. 1906. On *Hibiscus syriacus*. Type probably destroyed during the second world war (information from Museum of Natural History at Budapest); = *Phoma exigua* Desm. l.c.

The description of the spores, which are 10–14 × 3.5–4 μ in size, points to *P. exigua*.

Diplodina malvae f. *lavaterae* Grove, Br. Coelomyc. 1: 335. 1935. On *Lavatera arborea*. Type in herbarium Grove (K); = *Phoma exigua* Desm. l.c.

The type specimen contains one piece of stem on which some pycnidia with the characters of *P. exigua* could be found. One-celled spores were 7.5 × 2.8, two-celled spores 8.5 × 3.5 μ.

Phoma

Phoma alcearum Cooke in Grevillea 13: 94. 1885. On *Althaea rosea*. Type in herbarium Cooke (K); = *Phoma exigua* Desm.

The characters of the type specimen agree fairly well with those of *P. exigua*. The continuous spores were found to be 6–9 × 2.5–3 μ, the two-celled spores 6.8–10 × 2.5–3.3 μ.

Phoma barbari Cooke in Grevillea 14: 3. 1885. On *Lycium halimifolium* (sub syn. L. *barbarum*). Type in herbarium Cooke (K); = apparently a separate *Phoma* species.

The type specimen bears large, thick-walled pycnidia with uniformly ellipsoid, continuous spores, 7.5–10 × 3.5–4.5 μ in size. Although the description suggested similarity to *Phoma exigua* it proved to be a species quite different from *P. exigua*.

Phoma dilleniana Rabenh. in Fungi europ. exs./Klotzschii Herb. mycol. Cont.,

Cent. 10, No. 960. 1866; in Hedwigia 5: 192. 1866. On *Anoda dilleniana*. Isotypes e.g. at B, BR and L; = *Phoma exigua* Desm. l.c.

The distributed exsiccata of Fungi europ. exs. No. 960 contain different *Phoma*-like fungi (cf. ALLESCHER, 1898: 266, 267); the fungus with spore characters agreeing with the original description, however, is *P. exigua*. Rabenhorst (l.c.) already noticed that *Phoma dilleniana* was closely related to *P. exigua*.

Phoma hibisci Hollós in Mat. természettud. Közl. 35: 8, 41. 1926. On capsules of *Hibiscus syriacus*. Type probably destroyed during the second world war (information from Museum of Natural History at Budapest); = *Phoma exigua* Desm. l.c.

From the study of ZERBELE (1962) it can be concluded that *P. exigua* on *Hibiscus* may produce relatively small continuous spores: 4.5–7.5 × 1.5–3.0 μ, with only 4% septate spores (see table 1). Therefore it appears justified to consider *Phoma hibisci*, with the spores described as continuous, 7–8 × 2.5–3 μ, to be conspecific with *P. exigua*.

Phoma hibisci-esculenti Sawada in Trans. nat. Hist. Soc. Taiwan 33: 33. 1943; in Rep. Govt Res. Inst. Dep. Agric. Formosa 85: 68. 1943. On *Hibiscus esculentus*. Type in herbarium Sawada (TNS); = *Phomopsis* spec.
According to the isotype (TNS) this fungus appears to be a *Phomopsis* species with α-spores only, probably the *Hibiscus*-host form of *Diaporthe eres* Nitschke (WEHMEYER, 1933: 81). See also under *Phoma maculare* Desm.

Phoma lavaterae Westend. in Bull. Acad. r. Belg. Cl. Sci. II, 7: 92. 1859. On *Lavatera triloba*. Type in herbarium Westendorp (BR); = *Phomopsis malvacearum* (Westend.) Grove in Bull. misc. Inf. 2: 58. 1917.

According to the original description it could be *Phoma exigua*, but the type at the herbarium of Westendorp (BR) confirmed Grove's interpretation. See also GROVE (1935).

Phoma lyndonvillensis Fairm. in Proc. Rochester Acad. Sci. 1: 51. 1891. On *Malva neglecta* (sub syn. *M. rotundifolia*). Type in herbarium Fairman (CUP); = *Phoma exigua* Desm. l.c.

The type specimen contains two pieces of stem on which the characteristic fructifications of *P. exigua* could be found. The spore dimensions are 5.5–8 × 2.5–3 μ.

Phoma maculare Desm. in Annls Sci. nat. (Bot.) III, 20: 219. 1853 ≡ *Phyllosticta macularis* (Desm.) Allesch. in Rabenh. KryptogFlora ed. 2, Pilze 6 (Lief. 59): 47. 1898. On *Hibiscus syriacus*. Type in herbarium Desmazières (PC); = *Phomopsis* spec.

The original description suggested *Phoma exigua*, but the holotype specimen proved to be a *Phomopsis*, probably the *Hibiscus*-host form of *Diaporthe eres* Nitschke (WEHMEYER 1933: 81). See also under *Phoma hibisci-esculenti*.

Phoma protuberans Lév. in Annls Sci. nat. (Bot.) III, 5: 281. 1846. On *Lycium halimifolium* (sub syn. *L. europaeum*). Type not known to be in existence; = apparently a distinct *Phoma* species.

The description: "petits tubercules épars, noirs, globuleux, saillants, s'ouvrant par un ostiole conique; leur intérieur est d'un gris cendré, et composé de spores ovales-allongées, simples et transparentes", points to a pycnidial fungus which may be confused with *Phoma exigua* but that in vivo can be differentiated by its distinct conical ostiole. This fungus, incidentally found in association with leaf spot on *Lycium halimifolium*, is characterized *in vitro* by very irregular pycnidia with a conical or cylindrical ostiolar beak of interwoven hyphae. The spores are in vitro highly variable in size and shape, mostly oval or elongate, 1–2 celled, (3.8) 5.9–10.2(20.4) × 2.1–4.2(5.1) μ.

Phyllosticta

Phyllosticta althaeicola Pass. in J. Hist.-nat. Bordeaux 1885: 54. 1885; in Act. Soc. linn. Bordeaux 40: 66. 1886. On *Althaea officinalis*. Type not known to be in existence; = *Phoma exigua* Desm. l.c.

The description of the leaf spots and the pycnidiospores, which are 7–10 × 3 μ in size, clearly points to *P. exigua*.

Phyllosticta althaeina Sacc. in Michelia 1 (2): 143. 1878; in Sylloge Fung. 3: 40. 1884. On *Althaea rosea*. Type in herbarium Saccardo (PAD); = *Phoma exigua* Desm. l.c.

The characteristics of the type specimen clearly point to *P. exigua*. The spores are 5–10 × 3–3.5 μ in size and many are septate.

Phyllosticta destructiva Desm. in Annls Sci. nat. (Bot.) III, 8: 29. 1847.

a. var. *malvarum* (to be considered as var. *destructiva*) ≡ *Ascochyta destructiva* (Desm.) Höhn. in Hedwigia 60: 165. 1919 (illegitimate as a later homonym of *Ascochyta destructiva* Kab. & Bubák, see there) = *Peyronellaea destructiva* (Desm.) Goid. in Rc. Accad. Lincei 1: 455. 1946 (misapplied and not validly published, see BOEREMA et al. 1965: 57). On *Malva sylvestris*. Holotype in Herbarium Desmazières (PC); = *Phoma exigua* Desm. l.c.

b. var. *lycii* Desm. (without separate description) ≡ *Ascochyta lycii* (Desm.) ex Höhn. in Hedwigia 60: 165–166. 1919 (illegitimate as a later homonym of *Ascochyta lycii* Sacc. & al.). On *Lycium halimifolium* (sub syn. *L. europaeum*). Holotype in herbarium Desmazières (PC); = *Phoma exigua* Desm. l.c.

The type specimens of both varieties represent the ubiquitous *P. exigua*. Although *Phyllosticta destructiva* antedates the name *Phoma exigua*, the epithet *destructiva* is not available for replacing *exigua* since its transfer to *Phoma* would result in a homonym of *Phoma destructiva* Plowr. in Gard. Chron. II, 16: 620. 1881 (see JAMIESON, 1915).

Phyllosticta destructiva f. *althaeae-roseae* Thüm. (unpublished herbarium-name). On *Althaea rosea*. Syntype in Thüm., Herb. mycol. oecon. No. 369 and in Mycoth. univ. No. 1299 (both in L); = *Phoma exigua* Desm. l.c.

According to the specimens mentioned above and distributed by von Thümen in two different series of exsiccata, this form agrees with *P. exigua* in all its characters. The spores are 1- or 2-celled, 6–11 × 2–3.5 μ.

Phyllosticta gossypii Sawada in Spec. Publs Coll. Agric. natn. Taiwan Univ. 8: 137. 1959. On *Gossypium herbaceum*. Type in herbarium Sawada (TNS).

On the isotype no fructifications could be found. Different *Phoma*-like fungi have been described on *Gossypium* spp. and have to be compared before the identity of *Phyllosticta gossypii* can be decided.

Phyllosticta lycii Ell. & Kell. in Am. Nat. 17: 1166. 1883. On *Lycium halimifolium* (sub syn. *L. vulgare*). Type in N. Am. Fungi no. 1157 (FH); = *Phoma protuberans* Lév. in Annls Sci. nat. (Bot.) III, 5: 281. 1846.

According to the description it might be *Phoma exigua* but examination of the specimen in N. Am. Fungi 1157 (FH) revealed that the characters of this fungus resembled those of *P. protuberans* Lév. (see there).

Phyllosticta malkoffii Bubák in Annls mycol. 6: 24. 1908. On *Gossypium herbaceum*. Type not known to be in existence; = *Phoma exigua* Desm. l.c.

The description of this fungus agrees with *P. exigua*. The spores are given as 5–9 × 2–4 μ in size.

Phyllosticta pucciniophila Massal. in Atti Ist. veneto Sci. 59 (2): 687. 1900. On *Althaea rosea*. Type not known to be in existence; = *Phoma exigua* Desm. l.c.

Like *Ascochyta parasita* Fautr. this species is described as occurring on *Althaea rosea* in association with the rust *Puccinia malvacearum*. The indicated spore dimensions, although rather small, fall within the range of *P. exigua*. We have also often found this species on plants affected by rust.

Phyllosticta syriaca Sacc. in Michelia 1 (2): 136. 1878; in Sylloge Fung. 3: 27. 1884. On *Hibiscus syriacus*. Type in herbarium Saccardo (PAD); = *Cytospora* spec.?

The description suggested some similarity with *Phoma exigua* but the type specimen contains only a *Cytospora*-like fungus.

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REFERENCES

ALLESCHER, A. (1898–1901): Fungi imperfecti: Hyalin-sporige Sphaerioideen. Rabenh. *KryptogFlora*, Pilze **6** (for dates of publication, see Rabenh. *KryptogFlora*, Pilze **8**: 852. 1907).

BOEREMA, G. H. (1965): Spore development in the form-genus Phoma. *Persoonia* **3**: 413–417.

— (1967): The Phoma organisms causing gangrene of potatoes. *Neth. J. Pl. Path.* **73**: 190–192.

— (1970): Additional notes on Phoma herbarum. *Persoonia* **6**: 15–48.

—, M. M. J. DORENBOSCH & H. A. VAN KESTEREN (1965): Remarks on species of Phoma referred to Peyronellaea. *Persoonia* **4**: 47–68.

— & L. H. HÖWELER (1967): Phoma exigua Desm. and its varieties. *Persoonia* **5**: 15–28.

BREWER, J. G. & G. H. BOEREMA (1965): Electron microscope observations on the development of pycnidiospores in Phoma and Ascochyta spp. *Proc. K. Ned. Akad. Wet.* (*Sect. C*) **68**: 86–97.

BUBÁK, F. & J. E. KABÁT (1904): Ascochyta destructiva Kabát et Bubák – Phyllosticta destructiva Desm.?; Mykologische Beiträge I. Nr. 6. *Sber. K. böhm. Ges. Wiss.* **1903** (11): 4.

DESMAZIÈRES, J. B. H. J. (1847): Phyllosticta destructiva Desmaz. a. Malvarum. b. Lycii. Quatorzième notice sur les plantes cryptogames récemment découvertes en France no. 40. *Annls Sci. nat.* (*Bot.*) III, **8**: 29.

— (1849): Phoma exigua Desmaz.; Dix-septième notice sur les plantes cryptogames récemment découvertes en France no. 16. *Annls Sci. nat.* (*Bot.*) III, **11**: 282–283.

GROVE, W. B. (1935): *British stem-* and *leaf-fungi* (*Coelomycetes*) *Vol. I. Sphaeropsidales.* University Press, Cambridge.

HÖHNEL, F. VON (1919): Über Phyllosticta destructiva Desmaz.; Fungi imperfecti, Beiträge zur Kenntnis derselben Nr. 68. *Hedwigia* **60**: 165–167.

JAMIESON, C. O. (1915): Phoma destructiva, the cause of a fruit rot of the tomato. *J. agric. Res.* **4**: 1–20.

KEISSLER, K. (1922): Über Phyllosticta destructiva Desm. und einige verwandte Formen; Mykologische Mitteilungen I, Nr. 16. *Annln naturh. Mus. Wien* **35**: 15–19.

SACCARDO, P. A. (1884): Sylloge Sphaeropsidearum et Melanconiearum omnium hucusque cognitarum. *Sylloge Fung.* **3.**

WEHMEYER, L. E. (1933): The genus Diaporthe Nitschke and its segregates. *Univ. Mich. Stud. scient.* **9.**

ZERBELE, I. (1962): O specializacii gribov roda Ascochyta. *Bot. Issledov.* (*Scr. bot.*) **2**: 108–120.