

SOME PYCNIDIAL FUNGI OCCURRING ON ATRIPLEX
AND CHENOPODIUM

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Plantenziektenkundige Dienst, Wageningen

(With six Text-figures)

A number of pycnidial fungi described from *Atriplex* and *Chenopodium*, in Europe, North- and South-America are brought into synonymy with *Phoma variospora* nom. nov., *Phoma dimorphospora* (Speg.) comb. nov. and *Ascochyta caulina* (P. Karst.) comb. nov. Descriptions of these species in vivo and in vitro are given and the differentiating characters are discussed. *A. caulina* represents the type species of *Chaetodiplodia* P. Karst., which genus is reduced to the level of a section of *Ascochyta* Lib.

Numerous pycnidial fungi with 1- or more-celled, hyaline or pigmented conidia from leaves and stems of *Atriplex* and *Chenopodium* spp. (Chenopodiaceae), have been described and classified according to the sporological system of Saccardo. Comparative studies of herbarium specimens, fresh collections and pure cultures revealed that most of these species are synonymous. A number of species listed under *Phyllosticta*, *Phoma*, *Ascochyta*, *Stagonospora* and *Septoria* appear to represent two related fungi belonging to the form-genus *Phoma* Sacc. emend. Boerema & Bollen (1975). Several other species formerly described under *Ascochyta*, *Ascochyttula*, *Chaetodiplodia*, *Diplodia*, *Diplodina*, *Macrophoma*, *Microdiplodia*, *Phleospora*, *Phyllosticta*, *Septoria*, *Stagonospora* and *Stagonosporopsis* are recognized as two related fungi belonging to *Ascochyta* Lib. emend. Boerema & Bollen (1975). Both *Ascochyta* species, characterized by occasionally setose pycnidia and subhyaline to yellowish brown conidia represent a separate section of *Ascochyta*, original described as the genus *Chaetodiplodia* P. Karst. (1884). One of these species was recently discussed by Boerema & al. (1977).

P H O M A Sacc. emend. Boerema & Bollen

Phoma Sacc. emend. Boerema & Bollen in *Persoonia* 8: 134–135. 1975.

The form-genus *Phoma*, according to its modern concept, includes pycnidial states with hyaline or slightly coloured conidia which may be 1-celled but also partly 2- or even more-celled.

The conidial septation in species of *Phoma* can be characterized as a secondary process occurring independently of the conidiogenesis; this in contrast with the distoseptation-process of the conidia in *Ascochyta* species, which is an essential part of the completion of the conidial development (Boerema & Bollen, 1975). In culture under normal laboratory conditions the conidia of *Phoma* species usually remain 1-celled. The septate conidia formed on the host plant by the two species treated below are relatively large (macroconidia) in comparison with the 1-celled conidia (microconidia) produced in vivo as well as in vitro.

1. *Phoma variospora* v. d. Aa & v. Kest. *nom. nov.*—Fig. 1

Phyllosticta chenopodii Westend. in Bull. Acad. r. Belg. Cl. Sci. II, 2: 567. 1857. — *Septoria westendorpii* Wint. in Hedwigia 26: 26. 1887. — non *Phyllosticta chenopodii* Sacc. in Syll. Fung. 3: 55. 1884 [= *Phoma exigua* Desm. *vide* von Arx in Bibliotheca mycol. 24 (Revis. Gloeosporium, 2nd Ed.): 140. 1970]; non *Septoria chenopodii* Westend. in Bull. Acad. r. Belg. Cl. Sci. 18: 396–397. 1851 [= *Cercospora dubia* (Riess) Wint.; see under *Ascochyta caulina*, p. 275]; non *Phoma chenopodii* Ahmad in Sydowia 2: 79. 1948 [see discussion]; non *Phoma chenopodii* Pavgi & U. P. Singh in Mycopath. Mycol. appl. 30: 265. 1966 [= *Phoma chenopodii* Ahmad]; non *Phoma westendorpii* Tosquinet *apud* Westendorp in Bull. Acad. r. Belg. Cl. Sci. II, 2: 564. 1857.

Description in vivo.

Leaf spots roundish, pale yellowish brown to almost white, 1–5 cm diam., surrounded by a purplish brown or brownish, rather narrow border. Pycnidia epiphyllous, scattered over the infected spots, sometimes in concentric rings, subglobose or pyriform, 100–550 μm diam., usually distinctly papillate with an apical, 15–60 μm wide porus. Wall 2–5 cells (6–14 μm) thick and composed of rather thin-walled, pale yellowish brown, in the ostiolar region darker, isodiametrical cells, 3–10 μm diam. Conidiogenous cells lining the whole cavity, subglobose to short conical, sometimes hardly differentiated from the inner wall cells, 4–10 μm in size, phialidic. Conidia of two types: macroconidia ellipsoidal or cylindrical or somewhat irregular in shape, rounded at the apex, rounded or somewhat attenuate and truncate at the base, 1- or 2-, seldom 3- or 4-celled, not constricted at the septa, hyaline, irregularly multiguttulate (8–)15–20(–27) \times (3–)3.5–4.5(–7) μm ; microconidia ellipsoidal or short cylindrical, sometimes curved or irregular in shape, rounded at both ends, 1-celled, hyaline, minutely bi-guttulate, 3–6 \times 1.2–1.7 μm .

Cultural characters.

Colonies growing slowly on oatmeal, malt and cherry decoction agars, attaining a diameter of 11–16 mm in 8 days, 35–45 mm in 21 days at room temperature. Growing zone irregularly fimbriate at the margin; aerial mycelium well-developed, whitish or greyish, sometimes with yellowish or greenish sectors; submerged mycelium pale yellowish brown, with local patches in various greenish or yellowish shades on malt agar. Pycnidia formed from about the 10th day; further transfers soon becoming sterile, except when exposed to near-UV light; the addition of sterilized lupine stems also stimulating the development of pycnidia. Conidia of two types: 1-celled conidia (3–)4–5.1(–6.8) \times (1.2–)1.75–2(–2.5) μm and, very scarce, more-celled conidia 12.5–17.5 \times 3.25–5.0 μm in size.

Material examined.

HERBARIUM MATERIAL.—*Phyllosticta chenopodii* Westend., Herb. crypt. (Ed. Beyaert-Feys) no. 959, on leaves of *Chenopodium suecicum* (viride) and *Chenopodium urbicum*, Belgium, Beverloo, no date (holotype ex Herb. G. D. Westendorp, BR; two specimens of isotype, BR).

Phoma variospora v. d. Aa & v. Kest., Herb. mycol. H. A. van der Aa no. 726, on leaf spots on *Chenopodium spec.*, Aarhus, Jutland, Denmark, *J. Gremmen* 2497, 30 July 1968; Herb. mycol. H. A. van der Aa no. 678 and no. 712, both on *Chenopodium album*, leaf spots, Baarn, Netherlands, resp. 3 and 24 July 1968 (all in CBS).

Septoria westendorpii Wint., Kabát & Bubák, Fungi imp. exs. no. 568, on living leaves of *Chenopodium album*, Czechoslovakia, Böhmen, Vazovectale near Turnau, *J. E. Kabát*, 15 June 1903 (M).

LIVING CULTURES.—CBS 448.68, isolated from leaf spots of *Chenopodium album* (H. A. van der Aa no. 678, see above); CBS 513.77 isolated from leaf of *Chenopodium album*; Z. Flevoland, Netherlands, *J. W. Veenbaas-Rijks*, 17 July 1975.

Phoma variospora is a very common parasite on various species of *Chenopodium* in Europe. On account of the septate macroconidia in vivo it is sometimes confused with the leaf form of *Ascochyta caulina* (p. 271). *Phoma variospora* may be considered a European counterpart of the American species *Phoma dimorphospora* (p. 269), from which it is most easily distinguished by the occasionally also in vitro occurring septate macroconidia and the colonial morphology.

A new combination with the epithet '*chenopodii*' could not be made as this would have been homonymous with *Phoma chenopodii* Ahmad, a quite different fungus (cf. type, IMI 85383).

2. *Phoma dimorphospora* (Speg.) v. d. Aa & v. Kest., *comb. nov.*—Fig. 2

Basionym: *Phyllosticta dimorphospora* Speg. in An. Mus. nac. Buenos Aires, III, 20: 334. 1910.

Stagonospora chenopodii Peck in Rep. N.Y. St. Mus. nat. Hist. 40: 60. 1887¹. — non *Phoma chenopodii* Ahmad in Sydowia 2: 79. 1948 [see under *Phoma variospora*]; non *Phoma chenopodii* Pavgi & U. P. Singh in Mycopath. Mycol. appl. 30: 265. 1966 [= *Phoma chenopodii* Ahmad].

Description in vivo.

Pycnidia either epiphyllous on angular or roundish, up to 1 cm wide, very pale brown leaf spots or on eye-shaped lesions on stems, subglobose, 80–200 μm seldom up to about 300 μm wide with a rather flat papilla pierced by a 10–18 μm wide porus. The pycnidial wall 10–25 μm thick and composed of an outer prosenchymatous layer with rather thin-walled, yellowish brown, 2–4.5 μm wide hyphae, a sometimes incomplete pseudoparenchymatous, 1–4 cells (5–15 μm) thick middle layer composed of isodiametrical, rather thick-walled, brownish, 4–12 μm wide cells and a 1–7 cells thick inner layer, composed of thin-walled, hyaline, isodiametrical cells, 3–7 μm diam. Conidiogenous cells subglobose or short coniform, often hardly differentiated from the inner wall cells, 3–8 μm in diameter, phialidic. Conidia of two types: macroconidia ellipsoidal to cylindrical, straight or slightly curved, rounded at both apices or somewhat truncate at the base, 1- or 2-, seldom 3-celled, not constricted at the septa, hyaline, 16.25–22.5(25) \times 3.75–4.5(6.8) μm ; microconidia short cylindrical or ellipsoidal, hyaline, 1-celled, 4.25–5.0 \times 2–2.5 μm .

Cultural characters.

Colonies on oatmeal, malt and cherry decoction agar growing rather slowly, attaining a diameter of 14–23 mm in 8 days, 55–60 mm in 21 days at room temperature in daylight. Growing zone lobate, finely fimbriate at the margin. Aerial mycelium whitish with a shade of yellowish brown to olivaceous brown (on malt agar), reduced under near-UV light. Submerged mycelium subhyaline to yellowish brown, somewhat darker in old cultures; the medium becomes cinnamon

¹ In 'Petraik's List 1' (1930) erroneously cited as '*Stagonospora chenopodii* House 1920. Bull. N.Y. St. Mus 219/220 p. 58', which however refers to a reprint of Peck's Report (1887).

to rusty brown on oatmeal and cherry decoction agar and olivaceous green to dark brown on malt agar. Pycnidia are formed in fresh isolates from about the 8–10th day, arranged in concentric rings or irregularly scattered. After several transfers, near-UV light and the addition of sterile lupine stems stimulated good sporulation. Generally the pycnidia in vitro contain only microconidia.

Material examined.

HERBARIUM MATERIAL.—*Phyllosticta dimorphospora* Speg., Colect. micol. Museo Inst. Spegazzini no. 11.353, on leaves of *Chenopodium hircinum*, La Plata, C. Spegazzini, 13 October 1906 (holotype, LPS).

Stagonospora chenopodii Peck, Fl. New York, on leaves of *Chenopodium album*, Menands, Albany, C. H. Peck, August 1886 (holotype, NYS).

Characteristic specimens of this fungus have also been distributed under names referring to the European *Phoma variospora* [p. 268], viz. '*Phyllosticta chenopodii* Westend.' in Ellis, N. Am. Fungi no. 10.1158, on leaves of *Chenopodium album*, Ohio, W. A. Kellerman, June 1883 (M), and '*Septoria westendorpii* Wint.' in Rabenh.-Wint. Fungi europ. extraeurop. no. 3500, on leaves of *Chenopodium album*, Amand, Ohio, W. A. Kellerman, June 1883 (M).

LIVING CULTURES.—CBS 165.78 and 166.78, isolated from stem of *Chenopodium quinoa*, International Potato Center, Lima, Peru, 1977, by L. J. Turkensteen; CBS 345.78 = PD 76/1015, isolated from lesions on stems of *Ch. quinoa*, Peru, 1976, by V. Otazu; CBS 245.79 = PD 79/139, isolated from *Ch. quinoa*, Yanamuri near Puno, Peru, 3800 m. alt., March 1979, by L. J. Turkensteen.

Phoma dimorphospora is a parasite on species of *Chenopodium* in North- and South-America. In some parts of S. America the fungus causes eye-shaped stem lesions on *Chenopodium quinoa*. The species is closely related to the European *Phoma variospora*, as it shows the same conidial dimorphism. It differs in its cultural characters and in that in vitro usually only microconidia are formed.

The oldest name is *Stagonospora chenopodii* Peck, but the epithet '*chenopodii*' can not be used since this would result in a homonym of *Phoma chenopodii* Ahmad (see discussion under *Phoma variospora*).

ASCOCHYTA Lib. emend. Boerema & Bollen

Ascochyta Lib. sect. *Chaetodiplodia* (P. Karst.) v. d. Aa & v. Kest., *comb. nov.*

Basionym: *Chaetodiplodia* P. Karst. in Hedwigia 23: 62. 1884. — Type: *Ascochyta caulina* (P. Karst.) v. d. Aa & v. Kest.

Ascochyta species with occasionally setose pycnidia and subhyaline to yellowish brown conidia.

The two species of this section which are found on Chenopodiaceae, are characterized by showing two different pycnidial phenotypes, depending on growth conditions and the substrate. Conidia on leaves (often associated with leaf spots) are relatively large, oblong, hyaline to yellowish green and 1-, seldom 2- or 3-distoseptate at maturity; those on the stems and in pure culture are smaller, ellipsoidal, yellowish to pale brown and 1-distoseptate at maturity. In the European representative of the section described below the pycnidia are distinctly setose on the

stems and in pure culture, but not setose in the leaf spots. The American representative only shows a few setae which are restricted to the ostiolar region.

The automatically created section *Ascochyta* contains the bulk of the known species and is distinguished by pycnidia devoid of setae and hyaline or subhyaline conidia.

1. *Ascochyta caulina* (P. Karst.) v. d. Aa & v. Kest., *comb. nov.*—Figs. 3–6

Basionym: *Chaetodiplodia caulina* P. Karst. in *Hedwigia* 23: 62. 1884 [stem form: s.f.].

Sphaeria (*Depazea*) *vagans* forma ('e') *atriplicicola* Fr. in *Syst. mycol.* 2: 532. 1823; Rabenh. KryptogFl (1. Aufl.): 139. 1844 [leaf form: l.f.].

Depazea vagans subsp. ('β') *atriplicis* Kickx in *Fl. crypt. Env. Louv.*: 125. 1835 (with the annotation '*Ascochyta atriplicis* Frank in litt.') nomen nudum. — *Phyllosticta atriplicis* (Kickx) Westend. in *Bull. Acad. r. Belg. Cl. Sci.* 18(2): 397. 1851 (as *P. a.* 'Nob'), nomen nudum, ex Kickx, *Fl. crypt. Fland.* 1: 414. 1867; illegitimate as later homonym of *P. atriplicis* Desm. (see below). — *Stagonospora atriplicis* (Kickx ex Kickx) Lind, *Danish Fungi*: 444. 1913 (as *S. a.* '(West.) Lind'). [l.f.].

Ascochyta atriplicis Lasch in *Klotzschii Herb. mycol.* (Ed. Rabenh.) Cent. 9, no. 861, 1846, nomen nudum [l.f.].

Phyllosticta atriplicis Desm. in *Annls Sci. nat. (Bot.)* III, 16: 298. 1851. — *Septoria atriplicis* (Desm.) Sacc. in *Michelia* 1: 190. 1878; illegitimate as a later homonym of *S. atriplicis* Fuckel, see below [l.f.].

Septoria atriplicis Fuckel in *Fungi rhen.* (suppl. Fasc. 2) no. 1680. 1866; in *Jb. nassau. Ver. Naturk.* 23–24 (= *Symb. mycol.*): 390. 1870 ('1869 und 1870') [l.f.].

Diplodina chenopodii P. Karst. in *Hedwigia* 25: 73. 1885. — *Ascochyta chenopodii* (P. Karst.) Died. in *Annls mycol.* 10: 139. 1912; illegitimate, as later homonym of *A. chenopodii* Rostr. (see below). — *Ascochyta chenopodiicola* Pisareva in *Byzova & al., Flora Sporovykh Rastenii Kazakhstana* 5, 2: 229. 1968 [s.f.].

Ascochyta nebulosa Sacc. & Berl. apud Sacc. in *Bull. Soc. r. Bot. Belg.* 28: 98. 1889; *Syll. Fung.* 10: 305–6. 1892 [s.f.].

Diplodina atriplicis Vestergr. in *Bih. K. svenska VetenskAkad. Handl.* 22, Afd. 3, 6: 19. 1896 [s.f.].

Macrophoma chenopodii Oudem. in *Ned. kruidk. Archf.* Sér. 3, 2: 733. 1902 [l.f.].

Ascochyta atriplicis Died. in *Annls mycol.* 2: 180. 1904 [l.f.].

Ascochyta chenopodii Rostr. in *Bot. Tidsskr.* 26: 311. 1905 [s.f.].

Microdiplodia henningsii Staritz in *Hedwigia* 53: 163. 1913 [s.f.].

Ascochyta atriplicis Died. in *KryptogFl. Mark Brandenb.* 9, Pilze 7: 409. 1915 [s.f.].

Stagonosporopsis atriplicis A. Bond. in *Mat. Mykol. Obsled. Ross.* 2: 5. 1921 [l.f.].

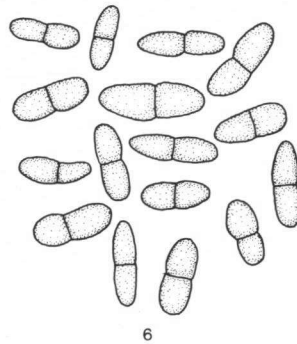
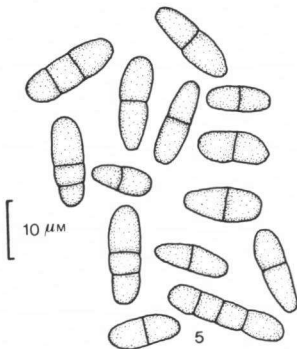
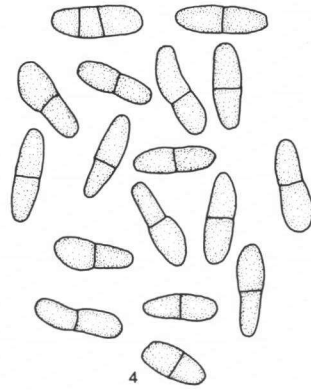
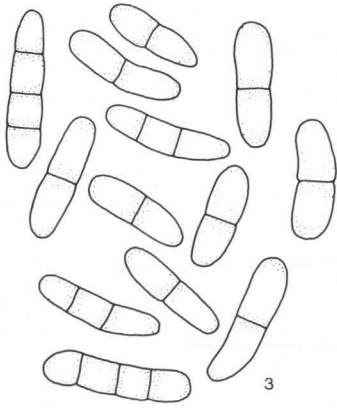
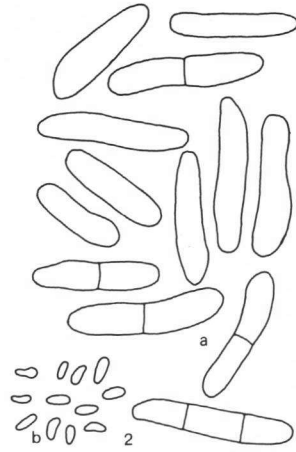
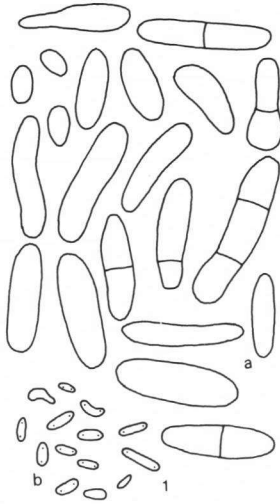
Ascochyta atriplicis Beeli in *Bull. Soc. r. Bot. Belg.* 56: 67. 1924 [l.f.].

Stagonospora chenopodii Baudys & Picbauer in *Práce Moravsk. přírod. Společ.* 3, 2 (Sign. F 22): 32–33. 1926 [as '*Stagonospora*'] [s.f.].

Diplodia chenopodii Cherepanov in *J. Bot. U.S.S.R.* 36: 274. 1951 [s.f.].

Description in vivo.

Pycnidia either irregularly scattered over pale, yellowish brown, roundish or somewhat irregularly shaped leaf spots, 5–15 mm, seldom up to 30 mm diam., surrounded by a small brownish border, or on withering and dead stems, immersed, secondarily erumpent or almost free, especially on old stems; usually single, globose or pyriform with a broad papilla provided with an apical roundish, about 25 μm wide porus, covered with rather stiff, 1–5-septate, 30–110 μm long, 2–7.5 μm broad setae and these tapering to a rounded apex, with a thick-walled and dark brown base, becoming thin-walled and yellowish brown to subhyaline at the apex; setae on the immersed pycnidia only apical, on the erumpent pycnidia and in pure culture all around but most dense in the substiolar zone. Pycnidial wall 15–30 μm thick and differentiated into an outer pseudoparenchymatous layer, 1–4 cells thick and composed of thick-walled, brownish, 5–



17 μm wide cells, darkest in the ostiolar region, and a 2–7 cells thick inner layer with hyaline, thin-walled, isodiametric cells, 3–10 μm diam. The outer cell layers containing a dark to almost blackish, irregularly distributed intercellular pigment giving the wall a characteristic appearance.

Conidiogenous cells regularly lining the cavity, conical, 4–7 μm diam., sometimes hardly differentiated from the inner wall cells, annellidic (cf. Boerema & Bollen, 1975), but the older ones sometimes showing a distinct collar, with the light microscope not to distinguish from the phialidic collarette ('annellated collar' cf. Boerema & Bollen, 1975). Conidia ellipsoidal to fusiform, usually with a rounded apex and a truncate base, with 1, seldom 2–3 septa (distoseptate), not or only slightly constricted at the septum, subhyaline to yellowish-green, olivaceous or rarely brownish, irregularly multiguttulate, 12.0–27 \times 3.5–7.5 μm , (generally distinctly smaller in pure culture), olivaceous-brown 'en masse'.

Cultural characters.

Colonies growing rather fast, attaining a diameter of 35–40 mm on oatmeal and malt agar or up to 30 mm on cherry decoction agar in 8 days at about 20 °C (room temperature). Growing zone pinnate to fimbriate at the margin. Aerial mycelium irregularly tufted, whitish to greyish, later gaining with various local shades of an olivaceous green, yellowish green or rust colour. Submerged mycelium subhyaline to various shades of brown, giving the culture an olivaceous-green and later very dark to almost black reverse, with a bright yellow to olivaceous marginal growing zone. In fresh isolates pycnidia immediately formed in a usually regular concentric arrangement, especially on oatmeal and cornmeal agars; in further transfers the use of near-UV and the addition of sterile lupine stems aided good sporulation.

Material examined.

HERBARIUM MATERIAL.—*Chaetodiplodia caulina* P. Karst., Herb. P. A. Karsten, on stem of *Chenopodium* spec., Finland, Tammela, Mustiala, 15 May 1872, holotype (of the genus *Chaetodiplodia* P. Karst., S).

Ascochyta atriplicis Died., on leaves of *Atriplex* spec., Nieder-Lausitz, Sommerfeld (Lubsko, Poland), *H. Diedicke*, 15 July 1910 (B); Kabát & Bubák, Fungi imp. exs. no. 556, on living and dying leaves of *Atriplex nitens*, Czechoslovakia, Bohemia, Melník, *J. E. Kabát* (as 'A.a. (Desm.) Diedicke'), 24 June and 3 August 1908 (B).

Ascochyta atriplicis Lasch, Klotzschii Herb. mycol. (Ed. Rabenh.) no. 861, on leaves of *Atriplex* spec. (*nitens*?), Driesen (Dresdenko, Poland), no date (holotype, B; isotype B and M).

Ascochyta caulina (P. Karst.) v. d. Aa & v. Kest., on stems of *Atriplex hastata*, Zoutelande, 14 August 1968 (PD); on leaves of *Atriplex* spec., Maurik at Nederrijn, *J. Gremmen*, 16 July 1968 (PD); on stems of *Atriplex hastata*, Bergen op Zoom, 19 Nov. 1976 (PD); Herb. mycol. H. A. van der Aa no. 879, on leaves of *Atriplex hastata*, Texel, De Schorren, 21 Oct. 1968 (CBS); idem no. 5953, on dead stems of *Atriplex hastata*, Texel, dyke of Waddenzee, near Oost, 28 June 1977 (CBS).

Ascochyta chenopodii Rostr., Herb. E. Rostrup, on leaves of *Atriplex littoralis*, Aarhus, *J. Lind*, 11 May 1904 (holotype, C), on leaves of *Atriplex littoralis* and *Chenopodium album*, Aarhus, *J. Lind*, 11 May 1904 (paratype and isotype, C); Herb. E. Rostrup and *J. Lind*, Fl. dan., on leaves of *Chenopodium glaucum*, Aarhus, *J. Lind*, 7 Sept., 1898 (C); Fl. succ. no. 5466, on living stems of *Chenopodium* spec. (*suecicum* ?), Sweden, Ulleråker at river Fyris, *N. Lundqvist*, 11 August 1967 (UPS).

Ascochyta nebulosa Sacc. & Berl., Herb. P. A. Saccardo no. 1443, on stems of *Chenopodium* spec., Siberia, prov. Tomsk, Kultchek, *N. Martinoff*, no date (holotype, PAD).

Diplodina atriplicis Vestergr., Herb. T. Vestergren, on dead leaf-stalks of *Atriplex hastata*, Gotland, Visby,

Fig. 1. *Phoma variospora*, in vivo (*H. A. v. d. Aa* 4787). — a. Macroconidia. — b. Microconidia.

Fig. 2. *Phoma dimorphospora* (holotypus, LPS). — a. Macroconidia. — b. Microconidia.

Fig. 3–4. *Ascochyta caulina*, leaf form (*H. A. v. d. Aa* 879). — 3. In vivo. — 4. In vitro.

Fig. 5–6. *Ascochyta caulina*, stem form (*H. A. v. d. Aa* 5953). — 5. In vivo. — 6. In vitro.

March 1895 (holotype and paratype, S); Vill, Fungi bav. no. 853, on stems of *Atriplex hortensis*, Unterfranken-Donnersdorf, March 1906 (S); Sydow, Mycoth. germ. no. 2957, on dead stems of *Atriplex oblongifolium*, Nordhausen, 7 April 1935 (S); Jaap, Fungi sel. exs. no. 172, on dead stems of *Atriplex hastata*, Sylt, Munkmarsch, 21 July 1904 (S).

Diplodina chenopodii P. Karst., Herb. P. A. Karsten no. 3129, on dead stems of *Chenopodium suecicum* (*viride*), Finland, Tammela, Mustiala, 30 June 1871 (holotype, H); on stems of *Chenopodium vulvaria*, France, F. Fautrey, no date (UPS); Petrak, Fl. Morav. no. 4, no date, and Petrak, Fl. Boh. Morav. exs. Ser. II Abt. I no. 1132, 5 Dec. 1914, both on *Chenopodium glaucum*, Czechoslovakia, Weisskirchen (in both cases as *D. c.* '(Karst.) Died.', BPI).

Microdiplodia henningsii Staritz, in Sydow, Mycotheca germanica no. 142, on dry stems of *Chenopodium album*, Anhalt, Ziebigk near Dessau, R. Staritz, Nov. 1903 (isotype, U 15407).

Phyllosticta atriplicis Desm., Herb. J. B. H. J. Desmazières, on leaves of *Atriplex hastata*, France, Remparts d'Abbeville, 6 Sept. 1850 (holotype, PC).

Phyllosticta atriplicis (Kickx) Westend. ex Kickx, Herb. crypt. (Ed. Beyaert -Feys) no. 960, on leaves of *Atriplex hastata*, Belgium, Ghent, no date (as *P. a.* 'Nob.', BR).

Septoria atriplicis Fuckel, Fungi rhen. no. 1680, on living leaves of *Atriplex patula*, Hattenheim (Rheingau), no date (syntype, M); Krieger, Fungi sax. no. 644, on leaves of *Atriplex nitens*, Königstein (Elbe), July 1890/91 and Fungi sax. no. 1945, on leaves of *Atriplex hastata*, Königstein, August 1905 (both as *S. a.* '(West.) Fckl.', M); Herb. A. Vill, on leaves of *Atriplex hastata*, Unterfranken, August 1898, and Vill, Fungi bav. no. 778, on leaves of *Chenopodium murale*, Unterfranken-Brünnau, Sept. 1903 (both as *S. a.* '(West.) Fuckel', M); Herb. G. Niessl von Mayendorf, on leaves of *Atriplex* spec., Leipzig, G. Winter, June 1874 (M); on leaves of *Atriplex hortensis*, France, Meaux, P. Dumée, June 1900 (as *S. a.* '(West.) Fuck.', M).

Stagonospora atriplicis (Kickx ex Kickx) Lind, Fl. dan., on leaves and petioles of *Chenopodium album*, Aarhus, 11 August 1901 (as *S. a.* '(West.) Lind', C), on leaves of *Atriplex patula*, Sjaelland, Overby, O. Rostrup, 3 Sept. 1917 (as *S. a.* '(West.) Lind', C).

Stagonosporopsis atriplicis A. Bond. on leaves of *Atriplex hortense*, near Korotscha, garden, A. Bondartsev, 26 July 1915 (lectotype, LE); on leaves of *Atriplex lacinata*, near Belgorod, A. Bondartsev, 9 Aug. 1915 (LE). Numerous herbarium specimens of this fungus have been filed under the misapplied name '*Septoria chenopodii* Westend.' (see discussion), viz. Keissler, Kryptog. exs. no. 2228, on living leaves of *Chenopodium murale*, Hungary/Czechoslovakia, Hont, Prencsfalu, A. Kmeť, no date (M); Fuckel, Fungi rhen. no. 1679, on living leaves of *Chenopodium viride*, Bundenheim (Rheingau) no date (M); Fungi Schemnitziensis, on leaves of *Chenopodium murale*, Schemnitz (Banská Stiaavnica, Czechoslovakia), Preňow, A. Kmeť, 14 Sept. 1887 (M); Petrak, Fungi polon. exs. no. 223, on leaves of *Chenopodium hybridum*, Stanislaw (Ivano-Frankovsk, Russia), 12 Oct. 1917 (M); Sydow, Mycoth. germ. no. 2401, on leaves of *Chenopodium bonus-henricus*, no date, no location (M).

LIVING CULTURES.—*CBS 787.68*, isol. fr. leaves of *Atriplex hastata*, Texel, De Schorren, 21 Oct. 1968 (Herb. mycol. H. A. van der Aa no. 879); *CBS 344.78 = PD 68/682*, isol. fr. stems of *Atriplex hastata*, Zoutelande, 14 August 1968 (Herb. PD); *CBS 343.78*, isol. fr. dead stems of *Atriplex hastata*, Texel, dyke Waddenzee, near Oost, 28 June 1977 (Herb. mycol. H. A. van der Aa no. 5953); *CBS 246.79 = PD 77/655*, isol. fr. leafspots of *Atriplex nastata*, Sylt, 20 July 1977, by G. H. Boerema.

Ascochyta caulina is wide spread in Europe and is also found in central Siberia. It is the cause of leaf spots and stem necroses on various species of *Chenopodium* and *Atriplex*. The appearance on stems and leaves is so different that it is hard to believe that these phenotypes belong to only one species. However, in all our isolates, kept under various laboratory circumstances, only the pycnidia of the stem-phenotype were formed. In one occasion pycnidia of the leaf phenotype were formed on some plate cultures which had been kept outside on a balcony in Wageningen during several weeks in the autumn of 1976. Reinoculation experiments have proved that which phenotype appears depends on the substrate. In the list of synonyms those marked with s.f. (stem form) are based on the stem-phenotype, which is characterized by setose pycnidia and dark, 2-

celled conidia; synonyms marked with l.f. (leaf form) are based on the leaf-phenotype, characterized by pycnidia without setae and relatively large, subhyaline, 2–4-celled conidia.

Webster & Lucas (1959) have isolated quite a similar fungus from ascospores of *Pleospora calvescens* (Fr.) Tul. which also occurs on various *Chenopodiaceae*. They identified this fungus as *Microdiploia henningsii* Staritz by comparison with the type collection. Menzies (1966) found the same connection between isolates from *Chenopodium album* in New Zealand (his so-called 'Group III') and a *Pleospora* for which he also adopted the name used by Webster & Lucas. *Microdiploia henningsii* is here included in the synonymy of *Ascochyta caulina* on the basis of a study of an isotype collection. Although the present authors did not find an ascigerous state in the rather extensive pycnidial state material which they studied, it seems to be without doubt that *Pleospora calvescens* ss. Webster & Lucas is the ascigerous state of *Ascochyta caulina*. Von Arx & Müller (1975) only listed *Alternaria*, *Stemphylium*, *Dendryphon* and *Phoma* as conidial connections of *Pleospora* species.

The oldest known name for the conidial state is Fries's forma *atriplicicola* of the collective species *Sphaeria (Depazea) vagans* Fr. (cf. Desmazières, 1851, and Kickx, 1867). However, at the specific level the epithet '*atriplicicola*' bears no priority (Leningrad Code art. 60). At the specific level, under *Ascochyta* the epithet *caulina*, from *Chaetodiploia caulina* P. Karst. (1884) bears priority above *Ascochyta nebulosa* Sacc. & Berl. (Saccardo, 1889 l.c.), *A. atriplicis* Died. (1904 l.c.) and *A. chenopodii* Rostr. (1905 l.c.).

It should be noted that Saccardo (1892) and others (see material examined) also considered *Septoria chenopodii* Westend. (1851) to be a synonym of this species. However, the original material of *Septoria chenopodii* (holotypus in Herb. Westendorp, BR, and iso-types in Herb. Crypt. 643, BR and M) shows that this name refers to *Cercospora dubia* (Riess) Winter.

Macrophoma chenopodii Oudem. is included as a synonym in accordance with Petrak & Sydow (1927). *Ascochyta atriplicis* Beeli, *Stagonospora chenopodii* Baudys & Picbauer and *Diploia chenopodii* Cherepanov are included on the basis of the descriptions. Several further synonyms probably exist but in many cases the original material is unavailable at present and the diagnoses are insufficient.

2. ASCOCHYTA HYALOSPORA (Cooke & Ellis) Boerema & al.

Diploia hyalospora Cooke & Ellis in Grevillea 7: 5. 1878 [s.f.]. — *Ascochyta hyalospora* (Cooke & Ellis) Boerema, S. B. Mathur & Neergaard in Neth. J. Pl. Path. 83: 156. 1977.

Diploina ellisii Sacc. in Syll. fung. 3: 417. 1884 [s.f.].

Phleospora chenopodii Ellis & Kellerm. in J. Mycol. 4: 26. 1888 [l.f.].

For description and illustration see Boerema & al. (loc. cit.)

Ascochyta hyalospora occurs in N. and S. America and causes leaf spots and stem necroses on *Chenopodium album* and *C. quinoa* respectively, and probably also on other *Chenopodiaceae*. Boerema & al. studied the fungus on isolates from infected seeds of *C. quinoa*. It was obvious that the species resemble *Ascochyta caulina* in many respects (personal communication Boerema). However, the ellipsoidal, dark, 2-celled conidia are larger than those of *A. caulina* in vitro.

Further the pycnidia show only a few rather short setae in the ostiolar region. After inoculation of stems from *Chenopodium album* and *C. quinoa*, pycnidia and conidia were formed which could be compared with those obtained in pure culture. After inoculation of the leaves, pycnidia were formed in leaf spots and the conidia were oblong, subhyaline, and 2–3 celled. The phenomenon of two pycnidial types, dependent on the substrate, is the same as in *Ascochyta caulina*. The synonyms *Diplodia hyalospora* and *D. ellisii* are based on the stem-phenotype (stem form: s.f.); the synonym *Phleospora chenopodii* is based on the leaf-phenotype (leaf form: l.f.).

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REFERENCES

- ARX, J. A. VON & MÜLLER, E. (1975). A re-evaluation of the bitunicate Ascomycetes with keys to families and genera. *In* Stud. Mycol. **9**.
- BOEREMA, G. H. & BOLLEN, G. J. (1975). Conidiogenesis and conidial septation as differentiating criteria between *Phoma* and *Ascochyta*. *In* Persoonia **8**: 111–144.
- BOEREMA, G. H., MATHUR, S. B. & NEERGAARD, P. (1977). *Ascochyta hyalospora* (Cooke & Ell.) comb. nov. in seeds of *Chenopodium quinoa*. *In* Neth. J. Pl. Path. **83**: 153–159.
- DESMAZIÈRES, J. B. H. J. (1851). Dix-neuvième notice sur les plantes cryptogames, récemment découvertes en France. *In* Annls Sci. nat. (Bot.) III, **16**: 296–330.
- KARSTEN, P. A. (1884). Fragmenta mycologica XVI. *In* Hedwigia **23**: 61–63.
- KICKX, J. (1867). Flore cryptogamique des Flandres (Oeuvre posthume publiée par J. J. Kickx) I. Gand, Paris.
- MENZIES, S. A. (1966). An investigation of a fungus disease of Fathen (*Chenopodium album*). Thesis Univ. Canterbury, New Zealand.
- PETRAK, F. (1930). X. Verzeichnis der neuen Arten, Varietäten, Formen, Namen und wichtigsten Synonyme. *In* Just's bot. Jber. **48**, 2. Abt.: 184–256. Reprinted by the C.M.I. Univ. Press Oxford, 1953 ('Pettrak's List 1').
- PETRAK, F. & SYDOW, H. (1927). Die Gattungen der Pyrenomyzeten. Sphaeropsideen und Melanconieen. I. Die phaeosporen Sphaeropsideen und die Gattung *Macrophoma*. *In* Beih. Repert. Spec. nov. Regni veg. **12**.
- SACCARDO, P. A. (1892). Supplementum universale Pars II. Discomycetae-Hyphomycetae. *In* Sylloge Fung. **10**.
- WEBSTER, J. & LUCAS, M. T. (1959). Observations on British species of *Pleospora*. I. *In* Trans. Br. mycol. Soc. **42**: 332–342.