

CONTRIBUTIONS TOWARDS A MONOGRAPH OF PHOMA
(COELOMYCETES) – IX
Section *Macrospora*

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Nine species of *Phoma*, characterised by always producing relatively large conidia, usually between $7\text{--}25 \times 2.5\text{--}8 \mu\text{m}$, aseptate or partly septate, are documented and described in vitro. Three of these fungi could not be described in the usual way, because living cultures were no longer available. The following new taxa are proposed: *Phoma andropogonivora* (R. Sprague & Rogerson) comb. nov., *Phoma boeremae* nom. nov., *Phoma commelinicola* (E. Young) comb. nov. and *Phoma gossypicola* nom. nov. The combination *Phoma rabiei* proposed by Khune is validated along with its teleomorph *Mycosphaerella rabiei* Kovatsch. Keys and indices on host-fungus and fungus-host relationships are provided and short comments on the ecology and distribution are given.

The *Phoma*-sections treated so far in this series of Contributions include species usually producing relatively small conidia, i.e. between $(2\text{--})3\text{--}11\text{--}(13) \times (0.5\text{--})1.5\text{--}4\text{--}(5) \mu\text{m}$ ('normal size', compare Boerema, 1997). This applies particularly to sections *Phoma* (De Gruyter & Noordeloos, 1992 and De Gruyter et al., 1993, 1998), *Peyronellaea* (Boerema, 1993) and *Paraphoma* (De Gruyter & Boerema, 2002). Other sections, however, include species that sometimes also produce significantly larger conidia. This is also characteristic of section *Heterospora*: "Taxa with large sized conidial dimorphs" (Boerema et al., 1997, 1999)¹. Some quite large conidia also occur occasionally in species of the sections *Sclerophomella* (Boerema & de Gruyter, 1998), *Phyllostictoides* (Van der Aa et al., 2000 and De Gruyter et al., 2002) and *Plenodomus* (Boerema et al., 1994, 1996 and Boerema & de Gruyter, 1999).

The section *Macrospora* Boerema, de Gruyter & Noordel. (Boerema, 1997), treated in this paper, is characterised by always producing relatively large conidia both in vivo and in vitro, $(7\text{--})8\text{--}19\text{--}(25) \times (2.5\text{--})3\text{--}7\text{--}(9) \mu\text{m}$. The conidia are initially aseptate, but they may become 1-septate by secondary septation.

So far, nine species studied in vitro have been included in this section. Of three of these species, discussed in an Addendum here, only some characteristics of growth in vitro could be noted since living cultures are no longer available.

The type species, *Phoma zae-maydis* Punith. and some other species of the section were originally interpreted as large spored species of *Phyllosticta* ('Macrostiteae').

1) To be added to the species of sect. *Heterospora* discussed in those two papers are two South American pathogens, viz. *Phoma andigena* Turkenst. and *Phoma crystalliniformis* (Loer., R. Navarro, Lôbo & Turkenst.) Noordel. & de Gruyter, see Noordeloos et al., 1993 and Boerema et al., 1995.

- 5a. Colonies on OA greenish olivaceous to citrine green, NaOH spot test positive, bluish/green to red (not an E⁺ reaction), conidia mainly aseptate, hyaline to pale yellowish, (7.5–)8.5–17.5 × 3.5–5.5(–7) μm, ellipsoidal to allantoid, sometimes curved, chlamydospores absent; specific pathogen of *Delphinium* spp. in Europe
4. *P. xanthina*
- b. Colonies on OA colourless/rosy buff to grey olivaceous, with olivaceous grey/olivaceous black sectors, or dark herbage green/dull green to olivaceous, chlamydospores or chlamydospore-like cells present, NaOH spot test negative or pale reddish/brown, not specific 6
- 6a. Growth-rate on OA 40–41 mm; colonies colourless to grey olivaceous, with olivaceous grey to olivaceous black sectors, conidia mainly aseptate, (12–)15–17(–25) × 3.5–5(–6.5) μm, chlamydospores may be present, up to 15 μm diameter; pathogen of *Zea mays*, also on *Sorghum* and *Setaria* spp., in North and South America, and southern Africa
5. *P. zae-maydis* teleomorph *Mycosphaerella zae-maydis*
- b. Growth-rate on OA 45–60 mm; colonies dark herbage green/dull green to olivaceous or colourless/rosy buff to olivaceous 7
- 7a. Growth-rate on OA 45–55 mm; colonies dark herbage green/dull green to olivaceous, conidia aseptate, 10–12.5 × 2.5–3.5 μm, chlamydospores 8–12 μm diameter; pathogen of *Gossypium* spp., widespread in cotton-growing areas
6. *P. gossypicola*
- b. Growth-rate on OA 47–59 mm (slower growing strains with growth-rate of 43–44 mm occur); colonies colourless to rosy buff, sometimes slightly olivaceous at centre, conidia mainly aseptate, 14–19 × 3.5–4.5 μm, chlamydospore-like cells present, 12–19 μm diameter; pathogen of perennial bunch grasses, *Andropogon gerardii* and *Schizachyrium scoparium* (= *Andropogon scoparium*), in United States 7. *P. andropogonivora* [Addendum]
- 8a. Growth-rate on OA slow, 10–15 mm; colonies olivaceous grey to red/bluish purple due to a pigment, conidia mainly aseptate, 8.5–12.5(–16) × 3–4.5(–5) μm; necrophyte on *Chenopodium album* and some other Chenopodiaceae (*Atriplex crassifolia*, *Beta vulgaris*), in Eurasia 8. *P. chenopodii* [Addendum]
- b. Growth-rate on OA fast; colonies grey olivaceous/olivaceous to red-violet due to a pigment, conidia mainly aseptate, 9.5–13.5 × 5.5–9 μm; pathogen of *Oryza sativa* in southern Europe and southeastern United States
9. *P. necator* [Addendum]

HOST-FUNGUS INDEX

Chenopodiaceae

*Atriplex crassifolia*no. 8: *P. chenopodii* (Addendum)*Beta vulgaris*

[Eurasia]

Chenopodium album (main host)

(Necrophyte)

Commelinaceae

*Commelina nudiflora**Tradescantia* spp. e.g. *T. subaspera*
(Disease: Leaf Necrosis)no. 3: *P. commelinicola*
[North and Central America,
New Zealand]

Gramineae

*Andropogon gerardii**Schizachyrium scoparium*
(Disease: Leaf Spot)*Oryza sativa*

(Disease: Wilt symptoms)

Setaria and *Sorghum* spp.*Zea mays* (main host)

(Disease: Yellow Leaf Blight)

no. 7: *P. andropogonivora* (Addendum)
[North America]no. 9: *P. necator* (Addendum)
[southern Europe, south-eastern USA]
no. 5: *P. zae-maydis*
(teleomorph *Mycosphaerella zae-*
maydis)
[North and South America, southern
Africa]

Leguminosae

Cicer arietinum(Disease: Anthracnose, Chickpea
Blight)*Medicago* spp. e.g. *M. falcata* and*M. littoralis*

(Necrophyte)

no. 1: *P. rabiei*
(teleomorph *Mycosphaerella rabiei*)
[widespread on the host]no. 2: *P. boeremae*
[Europe, Australia]

Malvaceae

Gossypium spp.

(Disease: Wet Weather Blight)

no. 6: *P. gossypiicola*
[widespread on the host]

Ranunculaceae

Delphinium spp.

(Disease: Leaf and Stem Necroses)

no. 4: *P. xanthina*
[Europe]

FUNGUS-HOST INDEX

P. andropogonivora (7)*Andropogon gerardii*, *Schizachyrium*
scoparium
(Gramineae)*P. boeremae* (2)*Medicago* spp., e.g. *M. falcata* and
M. littoralis
(Leguminosae)*P. chenopodii* (8)*Chenopodium album* (main host),
Atriplex crassifolia, *Beta vulgaris*
(Chenopodiaceae)*P. commelinicola* (3)*Commelina nudiflora*, *Tradescantia*
spp. e.g. *T. subaspera*
(Comelinaceae)

<i>P. gossypiicola</i> (6)	<i>Gossypium</i> spp. (Malvaceae)
<i>P. necator</i> (9)	<i>Oryza sativa</i> (Gramineae)
<i>P. rabiei</i> (1) (teleomorph <i>Mycosphaerella rabiei</i>)	<i>Cicer arietinum</i> (Leguminosae)
<i>P. xanthina</i> (4)	<i>Delphinium</i> spp. (Ranunculaceae)
<i>P. zaeae-maydis</i> (5) (teleomorph <i>Mycosphaerella zaeae-maydis</i>)	<i>Zea maydis</i> (main host), <i>Setaria</i> and <i>Sorghum</i> spp. (Gramineae)

DESCRIPTIVE PART

Characteristics based on studies *in vitro*. Species with a teleomorph are also described *in vivo*.

1. *Phoma rabiei* (Pass.) Khune³ — Fig. 1

Zythia rabiei Pass., Comment. Soc. crittogam. ital. 2 (3) (1867) 437 [basionym]. — *Phoma rabiei* (Pass.) Khune in S. B. Mathur, Coelom. India (1979) 182 [without direct reference to basionym: not validly published; Art. 33.2]. — *Phoma rabiei* (Pass.) Khune & J. N. Kapoor, Indian Phytopath. 33 (1980) 120 [with citation of basionym, but without reference of page of publication: also not validly published; Art. 33.2]. — *Phyllosticta rabiei* (Pass.) Trotter, Revue Path. vég. Ent. agric. Fr. 9 (1918) 7. — *Ascochyta rabiei* (Pass.) Labr., Revue Path. vég. Ent. agric. Fr. 18 (1931) 228.

Phyllosticta cicerina Prill. & Delacr., Bull. Soc. mycol. Fr. 9 (1893) 273.

Selected literature. Punithalingam & Holliday (1972), Singh et al. (1997), Kaiser (1997).

Teleomorph: *Mycosphaerella rabiei* Kovatsch.

This teleomorph has been described in detail and illustrated by Kovatschevski (1936) but without a Latin diagnosis as needed after 1 January 1935. Therefore, the essentials of the description are here provided in Latin.

Pseudothecia globosa vel sursum depressa, ostioliis inconspicuis, eximie papillatis, plerumque 163–176 μm diameter et 120 μm alta. Asci cylindrico-clavati, plerumque 60 \times 11 μm , octospori, plerumque uniseriati, raro biseriati in ascis. Ascosporae ovoideae, 1-septatae, cellula superior inferiore multo longior, ad septum valde constrictae, plerumque 15 \times 7.5 μm .

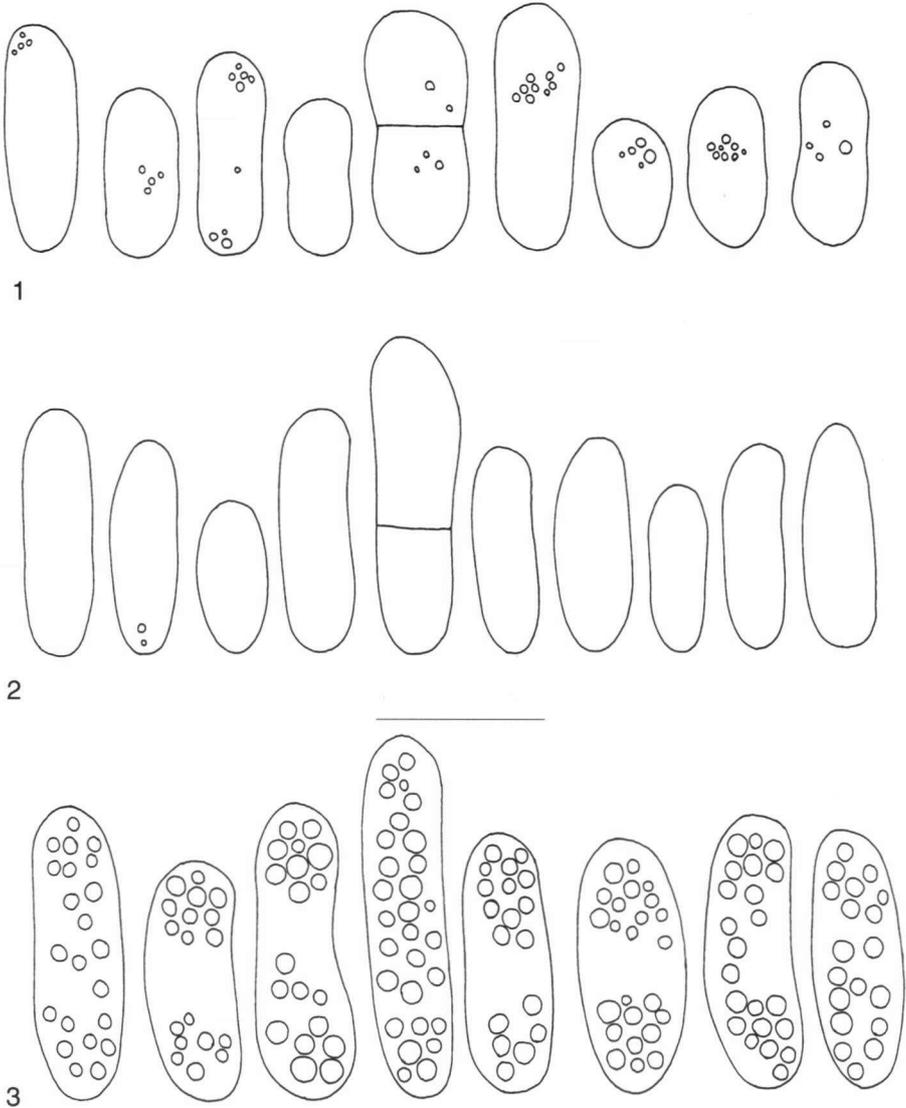
Typus: Pl. IV figs. 4–9 in Kovatschevski, 1936 (in the absence of the specimen from which it was figured, ICBN Art. 8.3).

Description in vitro

OA: growth-rate 18–26 mm after 7 days (after 14 days: 43–52 mm), regular to slightly irregular, aerial mycelium sparse to absent; colony colourless to pale olivaceous grey, sometimes with a rosy buff tinge; reverse similar.

MA: growth-rate 16–29 mm after 7 days (14 days: 30–46 mm), regular to irregular, with finely woolly to floccose, white to pale olivaceous grey aerial mycelium; colony greenish olivaceous dull green and somewhat iron grey in centre, buff to rosy buff near margin; reverse similar.

3) The invalid original combination is here validated by full and direct reference to the basionym.



Figs. 1–3. Conidia. 1. *Phoma rabiei*; 2. *Phoma boeremae*; 3. *Phoma commelinicola*. — Bar = 10 μm .

CA: growth-rate 15–28 mm after 7 days (after 14 days: 25–48 mm), regular to irregular, with felty to finely woolly, white to pale olivaceous grey aerial mycelium; colony colourless to buff or salmon, sometimes olivaceous grey; reverse similar.

Pycnidia 50–160 μm diameter, globose to subglobose, solitary or confluent, glabrous or with some short mycelial outgrowths, with usually one non-papillate or papillate ostiole, citrine/honey, later olivaceous to olivaceous black; walls made up of 2–5 layers of cells, outer layer(s) pigmented; with buff exuded conidial masses; in concentric

zones or scattered, both on and in the agar as well as in the aerial mycelium. Conidio-genous cells $4 \times 10 \mu\text{m}$, globose to bottle shaped. Conidia mainly aseptate, $7\text{--}15.5 \times 3\text{--}5.5 \mu\text{m}$, on average $9.6 \times 3.8 \mu\text{m}$, $Q = 1.7\text{--}3.4$, av. $Q = 2.5$, ellipsoidal to allantoid, with several small guttules; 1-septate conidia up to $18 \times 5.5 \mu\text{m}$.

Chlamydospores absent.

NaOH spot test: negative.

Crystals absent.

Description in vivo (Cicer arietinum)

Pycnidia in concentric rings on lesions on stems, leaves and pods, immersed, becoming erumpent, globose, $(90\text{--})140\text{--}160\text{--}200 \mu\text{m}$ diameter, with non-papillate ostioles. Conidia similar to those in vitro, usually with some small polar guttules, mainly aseptate, some 1-septate; usually $6\text{--}16 \times 3\text{--}7 \mu\text{m}$.

Pseudothecia (observed on overwintered chickpea debris, especially on pods, and on artificially inoculated stem pieces and leaves) globose or depressed globose, $(110\text{--})160\text{--}175\text{--}(250) \mu\text{m}$ diameter (height $75\text{--}150 \mu\text{m}$), with inconspicuous papillate ostioles. Asci cylindrical-clavate, $20\text{--}70 \times 9\text{--}13.5 \mu\text{m}$, 8-spored, usually uniseriate, rarely biseriate. Ascospores ovoid, 1-septate, upper cells much larger than the lower cells, strongly constricted at the septum, $12.5\text{--}19 \times 6.5\text{--}7.5 \mu\text{m}$ (for detailed description and illustrations see Kovatschevski, 1936; see also the Latin description in this article).

Ecology and distribution. A noxious pathogen of chickpea, *Cicer arietinum*. The disease, Anthracnose, Chickpea Blight (or '*Ascochyta*' Blight), is the major disease in most chickpea-growing areas. Being seed-borne, the mycelium may be present in the seed coat and cotyledons, and conidia often contaminate the seed surface (Mathur, 1981). Despite the usually unicellular conidia in vivo, the anamorph has been confused with *Ascochyta pisi* Lib., type species of *Ascochyta* (conidia mainly septate in vivo and in vitro, 'wall-thickening septation'; see Khune & Kapoor, 1980). In phytopathological literature the anamorph is commonly called *Ascochyta rabiei* and 'the ascochyta pathogen of chickpea'.

The fungus shows great variation in virulence. It appears to be heterothallic, because compatible mating types are required for development of fertile pseudothecia. Both pycnidia and pseudothecia may develop on overwintered chickpea debris, but compared with pycnidia very few pseudothecia develop. For detailed information on the life cycle of this pathogen see Kaiser (1997).

Representative culture. CBS 581.83 ex *Cicer arietinum* (Leguminosae), Syria.

2. *Phoma boeremae* De Gruyter, *nom. nov.* — Figs. 2, 10

Macrophoma medicaginis Hollós, Math. Termész Közlém. Magy, Tudom-Akad. 35 (1) (1926) 37 [replaced synonym]; non *Phoma medicaginis* Malbr. & Roum. in Roum., Fungi gall. exs. Cent. 37 (1886) No. 3675 and Revue mycol. 8 (1886) 91 (sect. *Phyllostictoides*, De Gruyter et al., 2002).

Neotype: L 996.294.536, dried culture on MA, dated 7.XI.2001, made by J. de Gruyter, Plant Protection Service (PD), Wageningen, the Netherlands from living culture CBS 109942, isol. seed (VPRI 12312) of *Medicago littoralis* cv. Harbinger, Burnley Gardens, Victoria, Australia, Martin Mebalds, 22 Febr. 1982 [the type material of *Macrophoma medicaginis* was destroyed in World War II].

Description in vitro

OA: growth-rate 60 mm after 7 days, regular, with floccose, olivaceous grey to dull green aerial mycelium; colony dark herbage green to dull green, yellow green near margin; reverse similar.

MA: growth-rate 67–69 mm after 7 days, regular, with coarsely floccose, grey olivaceous to dull green aerial mycelium; colony dull green, citrine green near margin; reverse dull green and leaden black.

CA: growth-rate 66–67 mm after 7 days, regular, with floccose, grey olivaceous to olivaceous grey aerial mycelium; colony grey olivaceous to olivaceous; reverse similar, partly leaden black.

Pycnidia 40–320 µm diameter, globose/subglobose to irregular, solitary or confluent, glabrous or with mycelial outgrowths, with 1(–3) non-papillate or papillate ostiole(s), later often developing into an elongated neck, citrine/honey, later olivaceous to olivaceous black; walls made up of 4–9 layers of cells, outer layer(s) pigmented; with rosy buff to vinaceous exuding conidial masses; scattered, both on and in the agar. Conidiogenous cells 5–8 × 5–11 µm, globose to bottle shaped. Conidia mainly aseptate, 8–15 × 3.5–5.5 µm, on average 12.3 × 4.2 µm, Q = 1.7–3.8, av. Q = 2.9, oblong to ellipsoidal, eguttulate or with some small guttules.

Chlamydospores unicellular or multicellular-dictyo/phragmosporous, botryoid, intercalary or terminal, pale olivaceous, 6–22 µm diameter.

NaOH spot test: negative.

Crystals absent.

Ecology and distribution. The two records examined so far refer to dried stems and seed of cultivated species of *Medicago* in Europe and Australia. Under such dry conditions the conidia may look granular due to the presence of numerous guttules (compare Boerema et al., 1997: 352, 353).

Note. The description above is based on an isolate (neotype) obtained by the Australian Seed Testing Station at Burnley, Victoria, in 1984 and sent for identification to my friend Gerhard(us Hendrik) Boerema, then head of the Mycological Department of the Dutch Plant Protection Service. In an annotation dated June 1985 he had suggested that it might belong to *Macrophoma medicaginis* Hollós, described from dried stems of *Medicago falcata* in Hungary in 1926. It should be noted that the species of *Medicago* cultivated in Australia are all of Mediterranean origin and as expected the various other *Phoma* species found on seeds of *Medicago* in Australia are common in Europe. As the epithet *medicaginis* is no longer available for *Phoma*, I am very pleased to name this typically large spored *Phoma* species after Gerhard Boerema. Our present knowledge of *Phoma* taxonomy is based on his work, in co-operation with several colleagues over recent decades. Retired for 15 years already, he is still working on *Phoma*, and continues to stimulate me with his enthusiasm, experience and knowledge to do this taxonomic work.

Representative culture. CBS 109942 (PD 84/402) ex *Medicago littoralis* (Leguminosae), Australia.

3. *Phoma commelinicola* (E. Young) De Gruyter, *comb. nov.* — Fig. 3

Phyllosticta commelinicola E. Young, *Mycologia* 7 (1915) 144 [basonym; holotype on leaves of *Commelina nudiflora*, coll. F.L. Stevens, Hormigueros, Puerto Rico, 14.I.1913; herb. Stevens No. 214, ILL 11604].

Description in vitro

OA: growth-rate 62–63 mm after 7 days, regular, with woolly, white to pale olivaceous grey aerial mycelium; colony colourless/buff to pale olivaceous grey; reverse similar.

MA: growth-rate 79–80 mm after 7 days, regular, with woolly, white to pale olivaceous grey aerial mycelium; colony buff, with white to pale olivaceous grey overlay due to aerial mycelium; reverse buff to honey, partly olivaceous black.

CA: growth-rate 72–73 mm after 7 days, regular, with woolly, white to pale olivaceous grey aerial mycelium; colony buff, with white to pale olivaceous grey due to aerial mycelium; reverse buff/honey to ochraceous/apricot.

Pycnidia 70–320 μm diameter, globose to subglobose, solitary or confluent, glabrous, with 1 or 2 papillate or non-papillate ostiole(s), honey/sienna, later olivaceous to olivaceous black; walls made up of 2–7 layers of cells, outer layer(s) pigmented; with rosy buff exuding conidial masses; scattered, both on and in the agar as well as in the aerial mycelium. Micropycnidia present, 40–70 μm diameter. Conidiogenous cells 4–11 \times 4–11 μm , globose to bottle shaped. Conidia mainly aseptate, (10.5–)13–17(–21) \times (4–)5–6.5 μm , on average 15.3 \times 5.3 μm , Q = 1.9–5.3, av. Q = 3.0, ellipsoidal, with several small, scattered guttules; 1-septate conidia of similar size, sparse.

Chlamydospores absent.

NaOH spot test: negative.

Crystals absent.

Ecology and distribution. This species, described from *Commelina nudiflora* in Porto Rico, was associated with dead or dying leaves (“pycnidia subepidermal, conidia 9.6–14.4 \times 4.8–7.2 μm ”). It also occurs on other Commelinaceae; the above in vitro description refers to an isolate from leaf spots on a *Tradescantia* sp. in New Zealand. The genus *Tradescantia* is indigenous to America. A specimen on *T. subaspera* was collected in Madison, Wisconsin, United States in 1959 (Greene, 1960: 88; specimen preserved in WIS: “Conidia (10–)12–15(–20) \times 3.5–5 μm , no septa were noted, nevertheless, the aspect of the specimen suggests *Ascochyta*”).

Representative culture. CBS 100409 (LYN 15707) ex *Tradescantia* sp. (Commelinaceae), New Zealand.

4. *Phoma xanthina* Sacc. — Fig. 4

Phoma xanthina Sacc., *Michelia* 1 (4) (1878) 359. — *Macrophoma xanthina* (Sacc.) Berl. & Voglino, *Atti Soc. Veneto-Trent. Sci. nat.* 10 (‘1886’ 1887) 181. — *Ascochyta xanthina* (Sacc.) Petr. & Syd., *Annls mycol.* 22 (1924) 347.

Description in vitro

OA: growth-rate 34–37 mm after 7 days (after 14 days: 54–66 mm), regular, with velvety to woolly, white to pale olivaceous grey/grey olivaceous aerial mycelium; colony greenish olivaceous/citrine green to grey olivaceous; reverse similar.

MA: growth-rate 34–42 mm after 7 days (after 14 days: 80–83 mm), regular, with compact woolly, white to grey olivaceous aerial mycelium; colony citrine green to herbage green/greenish olivaceous, olivaceous grey/iron grey in centre; reverse leaden grey/leaden black, herbage green near margin.

CA: growth-rate 32–37 mm after 7 days (after 14 days: 33–43 mm), regular, compact felty to woolly, pale olivaceous grey/grey olivaceous aerial mycelium; colony (pale) olivaceous grey/grey olivaceous to dull green; reverse leaden grey/leaden black, umber near margin.

Pycnidia 100–320 µm diameter, globose to subglobose, mostly solitary, glabrous or with mycelial outgrowths, with usually one non-papillate, often indistinct ostiole, citrine/honey, later olivaceous black; walls made up of 3–10 layers of cells, outer layer(s) pigmented; exuding conidial masses not observed; scattered, both on and in the agar as well as in aerial mycelium. Conidiogenous cells 6–13 × 14 µm, globose to bottle shaped. Conidia mainly aseptate, hyaline to pale yellowish, (7.5–)8.5–17.5 × 3.5–5.5(–7) µm, on average 12.5 × 4.5 µm, Q = 1.8–4.0, av. Q = 2.9, ellipsoidal to allantoid, eguttulate or with several scattered guttules; occasionally also 1-septate conidia of similar size or larger, up to 24 × 7 µm, ellipsoidal to allantoid, sometimes curved.

Chlamydo-spores absent.

NaOH spot test: positive, a bluish/green to red colour appears on OA, a reddish brown colour appears on MA (not an E⁺ reaction).

Crystals absent, but small yellowish to brownish pigmented grains are produced in the media.

Ecology and distribution. So far only recorded from Europe. It is apparently a specific pathogen of *Delphinium* spp., causing stem- and leaf necroses. The latter often start as small leaf spots, which later coalesce. Conidia usually remain unicellular in vivo (Petrač & Sydow, 1924: “eine *Ascochyta*, bei welcher die Konidien ausnahmsweise 1-zellig geblieben sind”); common dimensions 9–17 × 5–7 µm. It should be noted that a *Phoma* sp. of the section *Heterospora* also frequently occurs on *Delphinium* spp. in Europe, viz. *Phoma delphinii* (Rabenh.) Cooke (see Boerema et al., 1997).

Representative culture. CBS 383.68 ex *Delphinium* sp. (Ranunculaceae), the Netherlands.

5. *Phoma zae-maydis* Punith. — Figs. 5, 11

Teleomorph: *Mycosphaerella zae-maydis* Mukunya & Boothr.

Phoma zae-maydis Punith., Mycopathologia 112 (1990) 50. — *Phyllosticta maydis* Army & R.R. Nelson, Phytopathology 61 (1971) 1171; non *Phoma maydis* Fautrey, Revue mycol. 16 (1894) 161 [agrees with *Phoma nebulosa* (Pers.: Fr.) Berk., see De Gruyter et al., 1993], nor *Phoma maydis* Ellis & Everh., A. Rep. Del. Agric. Exp. Stn 6 ('1893' 1895) 33 [nomen nudum].

Selected literature. Army & Nelson (1971), Punithalingam (1990).

Description in vitro

OA: growth-rate 40–41 mm after 7 days, regular, with felty to finely floccose, white to pale olivaceous grey aerial mycelium; colony colourless to grey olivaceous, and olivaceous grey to olivaceous black sectors; reverse similar.

MA: growth-rate 36–37 mm after 7 days, irregular, with compact, finely floccose to woolly, white to olivaceous buff aerial mycelium; colony partly dull green to olivaceous, herbage green near margin; reverse similar, leaden grey/olivaceous black in centre.

CA: growth-rate 52–55 mm after 7 days, regular, with finely floccose, white to pale olivaceous grey aerial mycelium; colony greenish olivaceous/olivaceous to olivaceous grey sectors; reverse similar.

Pycnidia 120–160(–230) μm diameter, globose to subglobose, solitary or confluent, glabrous, with usually one papillate ostiole, citrine/honey, later olivaceous to olivaceous black; walls made up of 2 or 3 layers of cells, outer layer(s) pigmented; exuded conidial masses not observed; scattered, both on and in the agar.

Conidigenous cells 4–10 \times 3–8 μm , globose to bottle shaped. Conidia mainly aseptate, (12–)15–17(–25) \times 3.5–5(–6.5) μm , on average 15.5 \times 4.5 μm , Q = 3.2–4.9, av. Q = 3.8, ellipsoidal, with several small, scattered guttules; 1-septate conidia of similar size, sparse.

Chlamydospores may be formed, globose to subglobose, intercalary or terminal, in short chains or clustered, 8–20 μm diameter.

NaOH spot test: a reddish/brown, non-specific colour may develop.

Crystals absent.

Description in vivo (Zea mays)

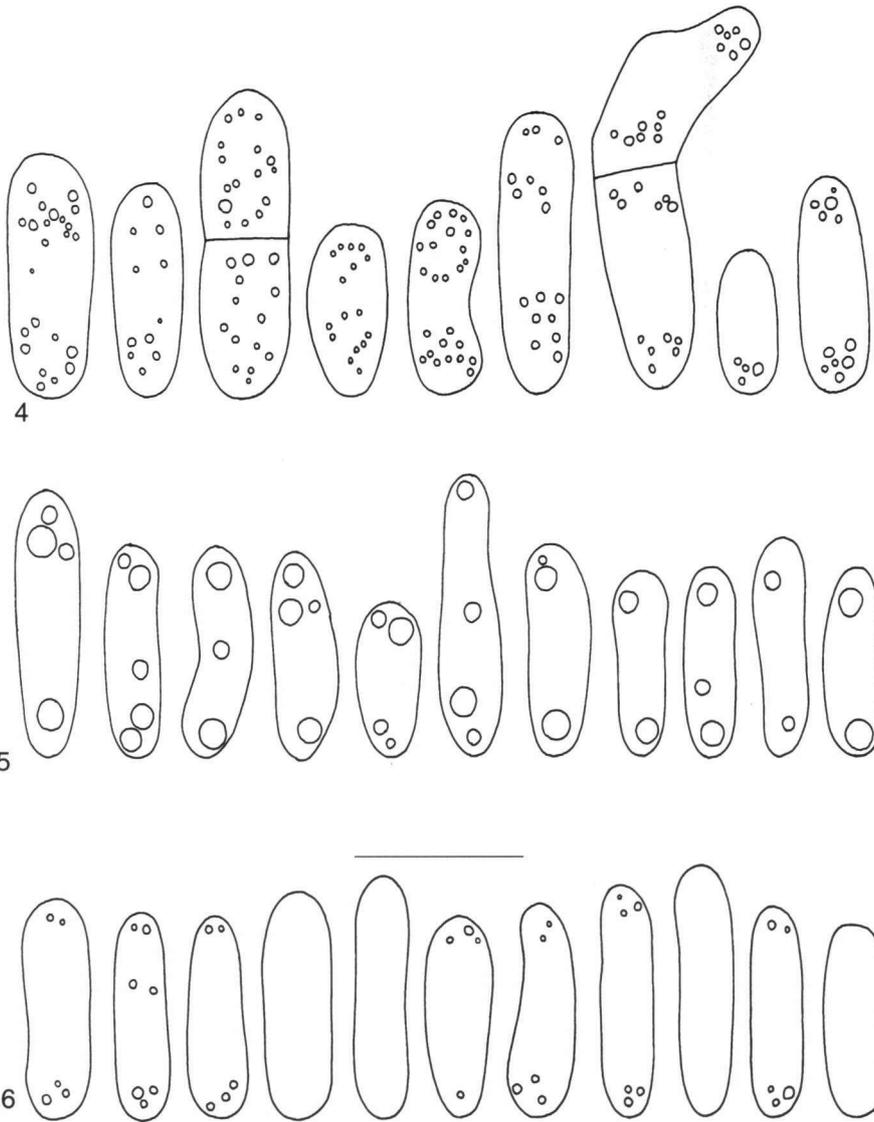
Pycnidia as tiny pinpoints in necrotic lesions on the leaves, chiefly epiphyllous, subglobose to globose, 120–160 μm diameter, with slightly papillate ostioles. Conidia similar to those in vitro, usually conspicuously biguttulate, aseptate, but germinating conidia often develop septa.

Pseudothecia observed naturally in spring on maize leaf debris, and obtained artificially in sterilised leaf tissue, subglobose to globose (86–)90–192(–200) μm diameter, initially closed, later with papillate ostioles. Asci cylindrical to subclavate, 40–65 \times 9.5–12 μm , 8-spored, biseriate to irregularly biseriate. Ascospores ellipsoidal, 1-septate, upper cells usually larger than the lower cells, constricted at the septum, (14–)16–17(–19) \times 4–5(–6) μm (for detailed descriptions and illustrations see Mukunya & Boothroyd, 1973 and Punithalingam, 1990).

Ecology and distribution. The main host of this fungus is *Zea mays* (Yellow Leaf Blight of maize), but it is also recorded on *Sorghum* and *Setaria* spp. Its distribution includes North America (Canada, United States), South America (Bolivia, Equador) and southern Africa. The fungus is probably homothallic, pseudothecia are only known from maize leaves overwintered in the field.

Ascospores may be the cause of early infection in the spring, whilst conidia cause infections in the growing season. The conidia are usually aseptate in vivo and mostly 10–15 \times 3–4 μm .

Representative culture. CBS 588.69 (PD 69/1151) ex *Zea mays* (Gramineae), United States.



Figs. 4–6. Conidia. 4. *Phoma xanthina*; 5. *Phoma zae-maydis*; 6. *Phoma gossypicola*. — Bar = 10 μ m.

6. *Phoma gossypicola* De Gruyter, *nom. nov.* — Figs. 6, 12

Ascochyta gossypii Woron., Vést. tiflis. bot. Sada 35 (1914) 25 [replaced synonym; holotype coll. *N. Woronichin* on a leaf of *Gossypium* sp. cult., near Abazinka, distr. Soci, Caucasus, 19 August 1913]; non *Phoma gossypii* Sacc., Michelia 2 (1) (1880) 144.

Ascochyta gossypii Syd., Anns mycol. 14 (1916) 194 [later homonym].

Selected literature. Holliday & Punithalingam (1970).

Description in vitro

OA: growth-rate 47–55 mm after 7 days, regular, with sparse velvety, olivaceous grey aerial mycelium; colony dark herbage green/dull green to olivaceous; reverse grey olivaceous/olivaceous to violaceous grey/leadene grey.

MA: growth-rate 29–35 mm after 7 days (14 days: 61–68 mm), regular, with sparse velvety, olivaceous grey aerial mycelium; colony olivaceous black, grey olivaceous to dull green near margin; reverse leadene grey to olivaceous black, grey olivaceous to dull green near margin.

CA: growth-rate 38–42 mm after 7 days, regular, with sparse velvety, grey olivaceous aerial mycelium; colony olivaceous to olivaceous black, grey olivaceous to dull green near margin; reverse leadene grey to olivaceous/olivaceous black.

Pycnidia 100–250 µm diameter, globose to subglobose, solitary or confluent, glabrous, with or without one usually non-papillate ostiole, honey, later olivaceous to olivaceous black; walls made up of 3–10 layers of cells, outer layer(s) pigmented; with off-white exuded conidial masses; scattered, both on and in the agar and in aerial mycelium. Conidiogenous cells 5–8 × 5–8 µm, globose to bottle shaped. Conidia aseptate, 10–12.5 × 2.5–3.5 µm, on average 11.5 × 3.1 µm, Q = 3.2–4.6, av. Q = 3.7, ellipsoidal, with several small, scattered guttules.

Chlamydospores present, globose to elongate, usually in chains, olivaceous, with greenish guttules, 8–12 µm diameter.

NaOH spot test: negative.

Crystals absent.

Ecology and distribution. This species is a well-known cause of leaf spots and stem cankers on cotton, *Gossypium* spp. (Wet Weather Blight). As noted above, the relatively large conidia always remain one-celled in vitro, but in vivo most conidia may become two- or even more-celled and longer, up to 14 µm. The fungus appears to be seed- and soil-borne and probably occurs everywhere cotton is grown. Isolates studied were from North America (United States), India and Africa (Sudan). The fungus may also attack other cultivated crops (Holliday & Punithalingam, 1970). However, the literature on its host range must be read with much reserve, because the fungus has been confused with other species such as *Phoma pomorum* Thüm. (sect. *Peyronellaea*) and *Phoma exigua* Desm. (sect. *Phyllostictoides*; see Boerema et al., 1973: 133 and Boerema & Dorenbosch, 1980: 27).

Representative culture. CBS 377.67 (PD 63/942) ex *Gossypium* sp. (Malvaceae), USA (Texas).

ADDENDUM

The classification in sect. *Macrospora* of the three species discussed below, is also based on an in vitro study, but living cultures are no longer available for detailed descriptions on OA, MA and CA.

7. *Phoma andropogonivora* (R. Sprague & Rogerson) De Gruyter, *comb. nov.* — Figs. 7, 13

Phyllosticta andropogonivora R. Sprague & Rogerson, Mycologia 50 (1958) 639 [basionym; holotype on leaf of *Andropogon gerardii*, Miami Co., Kansas, United States, coll. C. T. Rogerson,

WSP]. — *Ascochyta andropogonivora* (R. Sprague & Rogerson) Morgan-Jones in Morgan-Jones et al., Mycotaxon 42 (1991) 56.

Selected literature. Morgan-Jones et al., 1991.

Some characteristics in vitro (adopted from Morgan-Jones et al., 1991).

Growth-rate mostly moderate on PDA (comparable with OA), 47–59 mm after 7 days, at first whitish but becoming pale salmon (rosy buff), sometimes with a slightly olivaceous tinge at centre, with an even and densely woolly to felty mycelial mat; slower growing strains with growth-rate of 43–44 mm after 7 days are less salmon coloured, but with cream patches intermixed with orange-greyish areas and an olive-grey centre. Darker sectors appear, due to the formation of chlamydospore-like cells of 12–19 µm diameter, subglobose to globose, in long intercalary chains or in botryose clusters.

Pycnidia up to 240 µm diameter, (sub)globose to irregular, solitary or confluent, glabrous, with usually 1–3, non-papillate or very slightly papillate ostiole(s), pale to mid brown; walls made up of 3 or 4 layers of cells, outer layers pigmented, mostly superficial on the agar. Conidiogenous cells 6.5–9 × 4.5–7 µm, globose to bottle shaped. Conidia unicellular, rarely 1-septate, 14–19 × 3.5–4.5 µm, cylindrical, often slightly curved, usually with distinct polar guttules.

Ecology and distribution. This fungus causes a leaf spot on varieties of *Andropogon gerardii* and also on plants of *Schizachyrium scoparium* (= *Andropogon scoparius*), both perennial bunch grasses widely distributed in the Great Plains of the United States (big- or sand bluestem and little bluestem). In vivo, the conidia are generally aseptate (Morgan-Jones et al., 1991: “reclassified in *Ascochyta* mainly on the basis of the shape and size of its conidia”), and somewhat shorter and slightly broader than those in vitro, 13.5–15 × 4–4.5 µm.

Representative culture. Not obtained.

8. *Phoma chenopodii* S. Ahmad — Fig. 8

Phoma chenopodii S. Ahmad, Sydowia 2 (1948) 79.

Phoma chenopodii Pavgi & U.P. Singh, Mycopath. Mycol. appl. 30 (1966) 265 [later homonym].

Phyllosticta bacilliformis Padwick & Merh, Mycol. Pap. 7 (1943) 4; not *Phoma bacilliformis* Wehm., Mycologia 38 (1946) 316 [= *Asteromella* sp.].

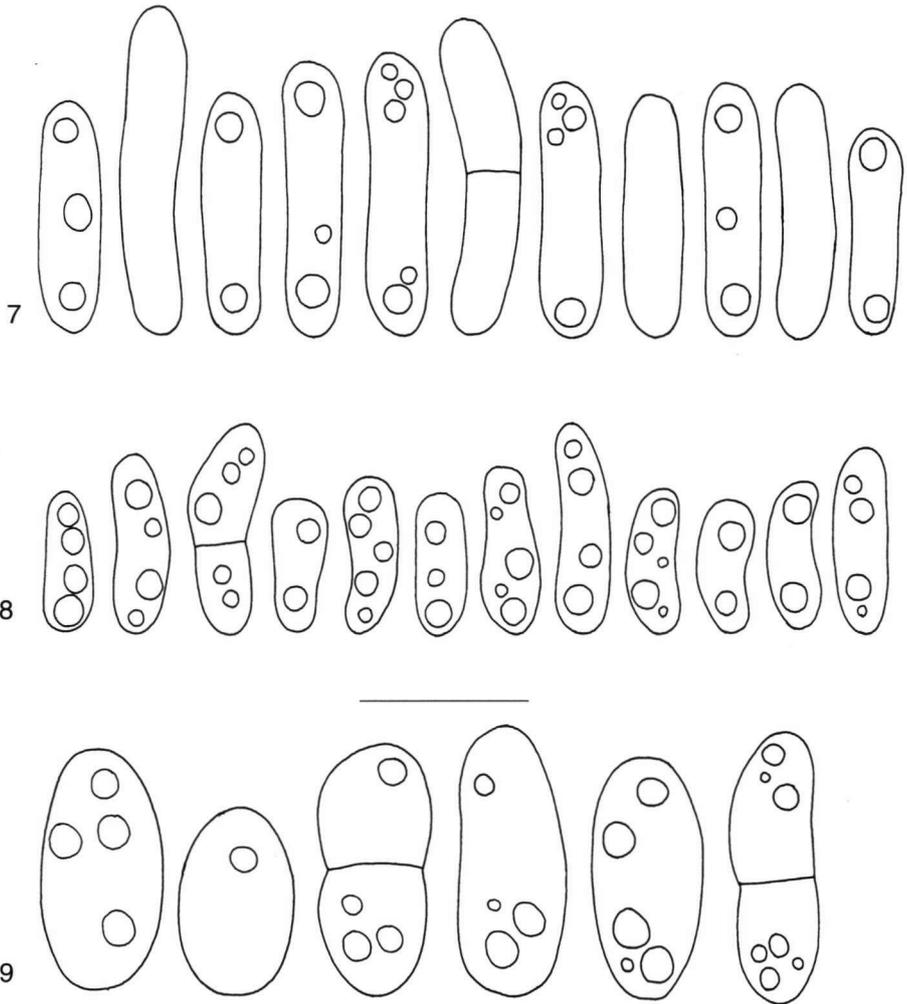
Some characteristics in vitro (documentation concerning lost Dutch cultures, see Boerema, 1984: 33, note).

Colonies on OA, MA and CA slow growing, 10–15 mm diameter after 7 days, regular or irregular (MA), olivaceous grey, with a red/bluish purple discolouration due to a pigment, especially on OA; aerial mycelium sparse, (pale) olivaceous grey.

Pycnidia subglobose, 100–200 µm diameter, slightly papillate, with inconspicuous ostiole. Conidia irregular subcylindrical to ellipsoidal, with several large guttules, 8.5–12.5(–16) × 3–4.5(–5) µm, mostly aseptate within the pycnidium, but often becoming 1-septate and occasionally 2-septate in the exuding mass (secondary septation preceding germination).

NaOH spot test: negative.

Representative cultures have been lost.



Figs. 7–9. Conidia. 7. *Phoma andropogonivora*; 8. *Phoma chenopodii*; 9. *Phoma necator*. — Bar = 10 μm . Drawing 7 after Morgan-Jones et al. (1991).

Note. The main host of this soil- and seed-borne necrophyte is *Chenopodium album*, but it has also been found on some other *Chenopodiaceae*, e.g., *Atriplex crassifolia* and *Beta vulgaris*. The above synonyms refer to specimens collected in Pakistan and India (herb. HCIO, IMI), but the fungus is also recorded in Russia and the Netherlands (Boerema, 1984). The relatively large conidia ($7.5\text{--}16 \times 3\text{--}5 \mu\text{m}$ in vivo) with septation usually occurring immediately before germination, explain why the fungus has sometimes been confused with a true *Ascochyta* occurring on *Chenopodiaceae*, viz. *Ascochyta caulina* (P. Karst.) Aa & Kesteren, the anamorph of *Pleospora calvescens* (Fr. ex Desm.) Tul. (see Boerema et al., 1987).

9. *Phoma necator* Thüm. — Fig. 9

Phoma necator Thüm., Labor. Versuchs-Station Wein-Obstbau Klosterneuburg 12 [Pilze Reispl.] (1889) 12 [not '*necatrix*' as erroneously listed in compiling works].

Selected literature. Padwick, 1950; Bessi & De Carolis, 1974.

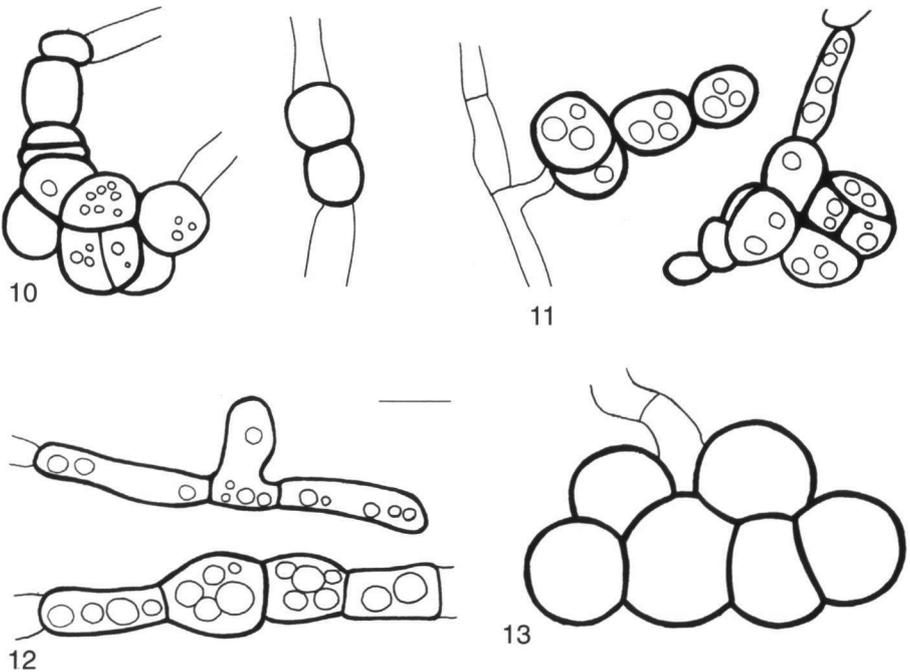
Some characteristics (from a dried Italian culture, see below).

Colonies on OA fast growing, irregular, grey olivaceous to olivaceous, with a red-violet discolouration of the medium due to a pigment, aerial mycelium abundant, grey olivaceous.

Pycnidia 110–325 µm diameter, globose to subglobose, solitary or confluent, glabrous, often covered by aerial mycelium, with usually one non-papillate or papillate ostiole, exuding conidial mass not observed, scattered, both on and in the agar. Conidia aseptate, 9.5–13.5 × 5.5–9 µm, on average 11.5 × 7 µm, Q = 1.3–2.0, av. Q = 1.6, guttulate, subglobose to ellipsoidal; 1-septate conidia up to 16 × 6 µm, constricted at septum.

Ecology and distribution. Associated with a rapid wilt of rice, *Oryza sativa*, in Austria, Italy and southeastern United States. The conidial dimensions in vivo should vary between 10–12 × 6–8 µm.

Representative dried culture. CBS 3509 ex *Oryza sativa* (Gramineae), Italy (leg. Bessi & De Carolis l.c.).



Figs. 10–13. Chlamydospores. 10. *Phoma boeremae*; 11. *Phoma zeaе-maydis*; 12. *Phoma gossypicola*; 13. *Phoma andropogonivora*. — Bar = 10 µm. Drawing 13 after Morgan-Jones et al. (1991).

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