

CONTRIBUTIONS TOWARDS A MONOGRAPH OF PHOMA
(COELOMYCETES) VIII

Section *Paraphoma*: Taxa with setose pycnidia

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In this paper eleven species of *Phoma* with obvious setose pycnidia, grouped in the section *Paraphoma*, are documented and described. Most of these species were formerly classified in *Pyrenochaeta*. The following new taxa have been proposed: *Phoma briardii* nom. nov., *Phoma carteri* nom. nov., *Phoma glycinicola* nom. nov., *Phoma indica* (T.S. Viswan.) comb. nov., *Phoma setariae* (H.C. Greene) comb. nov. and *Phoma leveillei* var. *microspora* var. nov. Indices on host/substratum-fungus and fungus-host relations are included and short comments on the ecology and distribution of the taxa are given.

The following sections have already been treated in this series of 'Contributions towards a Monograph of *Phoma*': sect. *Phoma* sensu stricto (De Gruyter & Noordeloos, 1992; De Gruyter et al., 1993, 1998), sect. *Peyronellaea* (Boerema, 1993), sect. *Plenodomus* (Boerema et al., 1994, 1996; Boerema & de Gruyter, 1999), sect. *Heterospora* (Boerema et al., 1997, 1999), sect. *Sclerophomella* (Boerema & de Gruyter, 1998) and sect. *Phyllostictoides* (Van der Aa et al., 2001). For the collective and differentiating characters of these sections see Van der Aa et al. (1990) and Boerema (1997).

The present paper deals with the section *Paraphoma*, originally described as a separate genus.

***Phoma* sect. *Paraphoma* (Morgan-Jones & J.F. White) Boerema**

Phoma sect. *Paraphoma* (Morgan-Jones & J.F. White) Boerema in Van der Aa et al., Stud. Mycol. 32 (1990) 7.

Paraphoma Morgan-Jones & J.F. White, Mycotaxon (1983) 59–60.

Type: *Paraphoma radicina* (McAlpine) Morgan-Jones & J.F. White. — *Phoma radicina* (McAlpine) Boerema (this paper no. 3).

The species of this section are characterized by a copious production of mainly septate setae on the surface of the relatively thick-walled, pseudoparenchymatous and distinctly ostiolate pycnidia. The conidia are always one-celled both in vivo and in vitro. The setae may be stiff or rather hyphal-like and either short or relatively long. They may be scattered over the entire surface of the pycnidium as shown in the type species of the section, *Phoma radicina* (Fig. 1A), but often they are most abundant around the ostiole (Fig. 1B and Table I). Pycnidia with mainly setae around the ostiole superficially closely resemble those of the genus *Pyrenochaeta* De Not. emend. Schneider (1979). That genus, however, is charac-

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terized by elongated, branched conidiophores instead of simple doliiform or ampulliform conidiogenous cells³.

Some species of this section produce single chlamydospores, solitary or in series and complexes. So far none of the species has been associated with a teleomorph.

It is curious that most species of *Phoma* sect. *Paraphoma* are typical soil fungi, often associated with monocotyledonous plants (Gramineae, Amaryllidaceae, Iridaceae, Liliaceae, Orchidaceae and Zingiberaceae).

MATERIAL AND METHODS

The isolates used in this study were obtained by the Plant Protection Service (PD) and deposited at the CBS (Utrecht, formerly Baarn). The methodology used conforms with that described in Contributions I–1 & 2 of this series (De Gruyter & Noordeloos, 1992 and De Gruyter et al., 1993). See also Contribution VII (Boerema & de Gruyter, 1998). Growth-rate of colonies on oatmeal agar (OA), malt agar (MA) and cherry-decoction agar (CA) are diameters after 7 days, unless otherwise stated.

KEY TO THE SPECIES AND VARIETIES OF PHOMA SECT. PARAPHOMA

Based on characteristics in vitro; see also the Appendix

- 1a. Chlamydospores absent 2
- b. Chlamydospores present 9
- 2a. Characteristic fragmentation of hyphae occurs (Fig. 13), colony greenish to rosy vinaceous/orange on OA, conidia 3.5–6.0 × 1.5–3.0 µm, soil- and air-borne saprophyte, probably cosmopolitan 1. *P. septicialis*
- b. Fragmentation of hyphae absent 3
- 3a. Conidia very small, subglobose, not exceeding 3.5 µm, colony greenish, often with coral pigmentation, on bark and wood *Quercus* spp. in North America and Europe 2. *P. carteri*
- b. Conidia exceeding 3.5 µm 4
- 4a. Colony distinct pale luteous on OA, due to a diffusible pigment production, conidia 3.0–6.0 × 1.0–3.0 µm, cosmopolitan soil-borne fungus, saprophytic, particularly on root surfaces; also isolated from cysts of nematodes 3. *P. radicina*
- b. Colony on OA greenish, greyish, brownish or vinaceous 5

3) It should be noted that at present also included in *Pyrenochaeta* are species producing both undifferentiated discrete conidiogenous cells and conidiogenous cells integrated on branched conidiophores in a single pycnidium, e.g. *Pyrenochaeta corni* (Bat. & A.F. Vital) Boerema et al. (1996) and *Pyrenochaeta dolichi* Mohanty (1958). With reference to the discussion of the taxonomic position of the latter by Grondona et al. (1997) we now think that these species can be better treated as 'setose species' of *Pleurophoma* Höhn. Our recent isolates of the type species of that genus, *Pleurophoma pleurospora* (Sacc.) Höhn., and the related *Pleurophoma cava* (Schulzer) Boerema et al. (1996) also showed the presence of both undifferentiated and integrated conidiogenous cells. All these species have probably more affinity with *Phoma* than with true species of *Pyrenochaeta* (teleomorph, where known, belonging to *Herpotrichia* Fuckel, see Schneider, 1979). Concerning *Pyrenochaeta dolichi*, Grondona et al. (1997) also produce evidence which supports this idea.

- 5a. Colony vinaceous on OA, due to production of pigmented grains of exudate, conidia $4.0-6.0 \times 2.0-2.5 \mu\text{m}$, cosmopolitan soil-borne root pathogen of *Allium* spp., esp. *A. cepa*, also in rhizosphere of other crops 4. *P. terrestris*
- b. Colony on OA greenish, greyish or brownish 6
- 6a. Conidia not exceeding $5.5 \mu\text{m}$ 7
- b. Conidia exceeding $5.5 \mu\text{m}$ 8
- 7a. Colony greenish to greyish on OA, conidia $4.0-5.5 \times 2.0-2.5 \mu\text{m}$, cosmopolitan soil fungus, saprophytic, or opportunistic root pathogen 5a. *P. leveillei* var. *leveillei*
- b. Colony greenish on OA, conidia $3.5-4.5 \times 1.5-2.0 \mu\text{m}$, probably also a cosmopolitan soil fungus 5b. *P. leveillei* var. *microspora*
- 8a. Average length-width ratio (Q) conidia < 3 , colony white to greyish/greenish/brownish on OA, conidia $5.0-7.5 \times 2.0-2.5 \mu\text{m}$, sclerotial bodies covered by short setae present, a pathogen of *Glycine* spp. in Africa 6. *P. glycinicola*
- b. Average length-width ratio (Q) conidia > 3 , colony colourless to greenish/brownish on OA, conidia cylindrical to allantoid, $4.5-7.0 \times 1.0-2.0 \mu\text{m}$, sclerotial bodies absent, soil-borne fungus in Europe, also recorded from roots 7. *P. briardii*
- 9a. Growth-rate fast, 50–70 mm on OA, conidia highly variable and relatively large, $3.5-10.5 \times 1.5-4.5 \mu\text{m}$, colony greenish on OA, common soil-borne fungus in India, opportunistic pathogen 8. *P. gardeniae*
- b. Growth-rate slow to moderate, 10–45 mm on OA 10
- 10a. Growth-rate slow, 10–15 mm on OA, conidia $4.0-5.5 \times 1.5-2.5 \mu\text{m}$, colony brownish on OA and MA, NaOH reaction greenish (not an E⁺ reaction), on leaf spots of *Saccharum officinarum* in India 9. *P. indica*
- b. Growth-rate slow to moderate, ≥ 25 mm on OA 11
- 11a. Growth-rate slow to moderate, 25–30 mm on OA, conidia $3.0-5.0 \times 1.5-2.0 \mu\text{m}$, colony greyish to greenish on OA, NaOH reaction negative, soil-borne fungus in western Europe, especially in agricultural fields, isolated from cysts of nematodes 10. *P. terricola*
- 11b. Growth-rate moderate, 35–45 mm on OA, conidia $4.0-6.0 \times 2.0-2.5 \mu\text{m}$, colony vinaceous on OA, NaOH reaction vinaceous/violet on OA (not an E⁺ reaction), common soil fungus in North and South America; world-widely associated with root rot of *Allium* spp., esp. *A. cepa*; roots of other plants also may be affected 4. *P. terrestris*

HOST/SUBSTRATUM-FUNGUS INDEX

(Including the Appendix)

Plurivorous (but often with preference for monocotyledonous plants, see below): *P. briardii* (no. 7) (common in Europe), *P. gardeniae* (8) (common in India), *P. leveillei* var. *leveillei* and var. *microspora* (5a, 5b) (worldwide), *P. radicina* (3) (recorded from Australia, Eurasia and North America), *P. septicalis* (1) (recorded from Europe and Africa), *P. terrestris* (4) (common in America, but also elsewhere), *P. terricola* (10) (common in Europe).

Isolated from soil: *P. briardii* (7), *P. leveillei* var. *leveillei* (5a), *P. radicina* (3), *P. septicalis* (1), *P. terrestris* (4), *P. terricola* (10).

Isolated from cysts of phytonematodes: *P. radicina* (3), *P. terricola* (10).

Isolated from air: *P. gardeniae* (8), *P. septicalis* (1).

Isolated from water: *P. leveillei* var. *microspora* (5b).

HOSTS NOTED IN THIS PAPER

Fagaceae

- Quercus* spp. no. 2: *P. carteri*
 (Disease: 'Pyrenochaeta-Dieback', [Europe and North America]
 but the *Phoma* is probably not the
 primary cause)

Leguminosae

- Glycine* spp. no. 6: *P. glycinicola*
 (Disease: Leaf Spot) [widespread in Africa]
Glycine max (roots) no. 1: *P. septacidalis*
 [Africa]

Monocotyledonae:

Amaryllidaceae

- Narcissus* sp. (roots) no. 5a: *P. leveillei* var. *leveillei*
 [Europe]

Gramineae

- Oryza sativa* (roots) no. 5a: *P. leveillei* var. *leveillei*
 no. 4: *P. terrestris*
 [records from Asia and North America]

- Pennisetum typhoides* no. 11: *P. setariae* (Appendix)
 (Disease: Leaf Spot) [record from Africa]

- Saccharum officinarum* no. 9: *P. indica*
 (Disease: Leaf Spot) [recorded in India]

- no. 11: *P. setariae* (Appendix)
 [record from South America]

- Secale cereale* (roots) no. 3: *P. radicina*

- no. 5a: *P. leveillei* var. *leveillei*
 [both worldwide distributed]

- no. 7: *P. briardii*
 [so far only known from Europe]

- Setaria lutescens* (roots) no. 4: *P. terrestris*
 (Disease: Leaf Spot) no. 11: *P. setariae* (Appendix)
 [both records from North America]

- Zea mays* (roots) no. 4: *P. terrestris*
 [record from North America]

Iridaceae

- Iris* spp. (roots) no. 3: *P. radicina*
 [record from Europe]

Liliaceae

- Allium* spp., esp. *A. cepa* no. 4: *P. terrestris*
 (Disease: Pink Root) [worldwide]

Orchidaceae

- Phalaenopsis* sp. no. 7: *P. briardii*
 [record from Europe]

Zingiberaceae

- Elettaria cardamomum* no. 5b: *P. leveillei* var. *microspora*
 [record from Central America]

FUNGUS-HOST RECORDS IN THIS PAPER

- P. briardii* (7) e.g. *Secale cereale*, *Milium effusum*
(Gramineae)
Phalaenopsis sp.
(Orchidaceae)
- P. carteri* (2) *Quercus* spp.
(Fagaceae)
- P. gardeniae* (8) e.g. *Gardenia jasminoides*
(Rubiaceae)
Arachis hypogaea
(Leguminosae)
- P. glycinicola* (6) *Glycine* spp.
(Leguminosae)
- P. indica* (9) *Saccharum officinarum*
(Gramineae)
- P. leveillei* var. *leveillei* (5a) e.g. *Oryza sativa*, *Secale cereale*
(Gramineae)
Narcissus sp.
(Amaryllidaceae)
Fragaria × *ananassa*
(Rosaceae)
- P. leveillei* var. *microspora* (5b) e.g. *Elettaria cardamomum*
(Zingiberaceae)
- P. radicina* (3) e.g. *Secale cereale*
(Gramineae)
Iris spp.
(Iridaceae)
Lycopersicon esculentum
(Solanaceae)
Malus sylvestris
(Rosaceae)
- P. septicialis* (1) e.g. *Glycine max*
(Leguminosae)
- P. setariae* (11) (Appendix) e.g. *Pennisetum typhoides*, *Saccharum officinarum*, *Setaria lutescens*
(Gramineae)
- P. terrestris* (4) e.g. *Allium* spp., esp. *A. cepa*
(Liliaceae)
Oryza sativa, *Setaria lutescens*, *Zea mays*
(Gramineae)
Calathea crocata
(Maranthaceae)

Table I. Characteristics of setae in species of *Phoma* sect. *Paraphoma*.

<i>Phoma</i> sect. <i>Paraphoma</i>	setae short, up to 100 μm	setae of moderate length	setae long, exceeding 200 μm	setae mainly around ostiole	setae scattered over pycnidium
<i>P. indica</i> (9)	+			+	
<i>P. gardeniae</i> (8)	+			+	
<i>P. terricola</i> (10)	+			+	
<i>P. leveillei</i> var. <i>microspora</i> (5b)	+			+	+
<i>P. setariae</i> (11)	+			+	
<i>P. carteri</i> (2)		+			+
<i>P. glycinicola</i> (6)		+		+	+
<i>P. briardii</i> (7)			+	+	+
<i>P. leveillei</i> var. <i>leveillei</i> (5a)			+		+
<i>P. radicina</i> (3)			+		+
<i>P. septicidalis</i> (1)			+		+
<i>P. terrestris</i> (4)			+	+	

DESCRIPTIVE PART

Section *Paraphoma*

1. *Phoma septicidalis* Boerema — Figs. 2, 13

Phoma septicidalis Boerema in Boerema & Dorenbosch, Versl. Meded. plziektenk. Dienst Wageningen 153 (Jaarb. 1978) (1979) 20. — *Pyrenochaeta telephii* Allesch., Ber. bayer. bot. Ges. 4 (1896) 33; not *Phoma telephii* (Vestergr.) Kesteren, Neth. J. Pl. Path. 78 (1972) 117.

Selected literature. Boerema & Dorenbosch (1979).

Description in vitro

OA: growth-rate 22–40 mm, (14 days: 52–77 mm), regular to slightly irregular, with felty, (pale) olivaceous grey/grey olivaceous aerial mycelium; colony citrine/greenish olivaceous to dull green, rosy vinaceous to orange towards margin; reverse similar.

MA: growth-rate 21–39 mm, (14 days: 41–72 mm), regular to slightly irregular, with compact finely floccose to felty aerial mycelium; colony grey olivaceous/dull green, or honey/amber, with buff to rosy buff near margin; reverse similar.

CA: growth-rate 21–31 mm (14 days: 40–63 mm), regular to slightly irregular, with felty, white to grey olivaceous aerial mycelium; colony honey or dull green; reverse greenish olivaceous/honey or dull green, with olivaceous/olivaceous black or leaden grey/leaden black near centre.

Pycnidia setose, 70–170 μm diam., globose to subglobose, solitary or confluent, with 1 (or 2) non-papillate ostioles, honey to olivaceous, later olivaceous black; setae relatively long, exceeding 200 μm , spread over the upper surface; walls made up of 2–8 layers of cells, sometimes partly thicker due to protruding of cells into the pycnidial cavity, outer

layers pigmented; with white coloured conidial exudate; abundant, mainly on the agar; micropycnidia present, 25–50 µm diam. Conidiogenous cells 3–6 × 3–6 µm, bottle-shaped. Conidia aseptate, 3.5–5(–6) × 1.5–3 µm, av. 4.0–4.5 × 1.8–2.3 µm, Q = 1.5–3.0, av. Q = 2.0–2.3, subglobose to ellipsoidal, with several small or large guttules.

Chlamydospores absent.

NaOH spot test: rosy vinaceous margin may discolour to livid violet /purple on OA.

Crystals absent.

Note: a characteristic fragmentation of the hyphae occurs (Fig. 13).

Ecology and distribution. In Europe a widespread soil- and air-borne saprophyte ('pioneer flora'). The fungus is also found in Africa and may be equally common in others parts of the world. The epithet '*septicidalis*' refers to the easy fragmentation of the hyphae in vitro.

Representative cultures. CBS 112.79 (PD 74/1018) ex air, Finland; CBS 101636 (PD 86/1186) ex root *Glycine max* (Leguminosae), Zimbabwe.

2. *Phoma carteri* De Gruyter & Boerema, *nom. nov.* — Fig. 3

Pyrenochaeta minuta J.C. Carter, Bull. Ill. nat. Hist. Surv. 21 (1941) 214 [replaced synonym; type specimen pure culture isolated from bark of *Quercus palustris*, coll. J.C. Carter, Xenia, Clay County, Illinois, USA, Oct. 8, 1937]; not *Phoma minuta* Wehm., Mycologia 38 (1946) 318, nor *Phoma minuta* Alcalde, An. Jard. bot. Madr. 10 (1952) 233.

Selected literature. Carter (1941).

Description in vitro

OA: growth-rate 23–25 mm (14 days: 47–57 mm), regular to somewhat irregular, with finely floccose/finely woolly, (pale) olivaceous grey aerial mycelium; colony olivaceous buff/greenish olivaceous to grey olivaceous, often with a coral pigmentation; reverse similar.

MA: growth-rate 19–20 mm (14 days: 49–51 mm), regular to somewhat irregular, with compact woolly to floccose, pale olivaceous grey aerial mycelium; colony buff to citrine/greenish olivaceous, with olivaceous grey at centre, also with salmon to flesh coloured patches, with amber margin; reverse similar.

CA: growth-rate 23–24 mm, (14 days: 48–61 mm), regular, with finely floccose to finely woolly, (pale) olivaceous grey aerial mycelium; colony greenish olivaceous to pale luteous, often with a coral pigmentation; reverse similar, with olivaceous/olivaceous black at centre.

Pycnidia setose, 80–230 µm diam., globose, solitary or confluent, with 1 (or 2) non-papillate ostioles, greenish olivaceous/olivaceous, later olivaceous black; setae of moderate length, up to 200 µm, spread over the upper surface; walls made up of 2–6 layers of cells, sometimes partly thicker due to protruding of cells into the pycnidia cavity, outer layers pigmented; with buff/rosy buff coloured conidial exudate; on the agar and in aerial mycelium. Conidiogenous cells 3–5 × 3–6 µm, globose to bottle-shaped. Conidia aseptate, 2.5–3.5 × 2–2.5 µm, av. 3.1 × 2.3 µm, Q = 1.0–1.6, av. Q = 1.3, subglobose, with 1(–2) minor guttules.

Chlamydospores absent.

NaOH spot test: coral pigmentation discolours to violet on OA, amber pigmentation discolours to orange on MA.

Crystals absent.

Ecology and distribution. Isolated from discoloured bark and wood of different species of oaks (*Quercus alba*, *Q. palustris* and *Q. suber*) in North America (USA, Illinois) and Europe (the Netherlands, Spain). Although die-back has been attributed to this fungus (USA), it is probably only an opportunistic pathogen.

Representative culture. CBS 101633 (PD 84/74) ex *Quercus* sp. (Fagaceae), the Netherlands.

3. *Phoma radicina* (McAlpine) Boerema — Figs. 1A, 4

Phoma radicina (McAlpine) Boerema in Boerema & Dorenbosch, Versl. Meded. plziektenk. Dienst Wageningen 153 (Jaarb. 1978) (1979) 20. — *Pyrenochaeta radicina* McAlpine, Fung. Dis. Stone-Fruit Austr. (1902) 127. — *Paraphoma radicina* (McAlpine) Morgan-Jones & J.F. White, Mycotaxon 18 (1983) 60.

Selected literature. Morgan-Jones & White (1983), Boerema (1985).

Description in vitro

OA: growth-rate 29–30 mm (14 days: 56–57 mm), regular, with woolly, pale olivaceous grey aerial mycelium; colony pale luteous, due to production of a diffusible pigment, with coral concentric zones; reverse pale luteous to amber.

MA: growth-rate 22–24 mm (14 days 29–44 mm), regular, with compact, finely floccose to woolly, greenish grey aerial mycelium; colony olivaceous grey to greenish grey, with amber due to production of a diffusible pigment; reverse citrine to amber, partly olivaceous to olivaceous black.

CA: growth-rate 25–27 mm (14 days: 52–54 mm), regular, with finely floccose to woolly, (pale) olivaceous grey aerial mycelium; colony buff to pale olivaceous grey/greenish grey; reverse pale luteous to sienna/dark brick.

Pycnidia setose, 180–450 µm diam., globose to subglobose, mostly solitary, with 1 (or 2) non-papillate or papillate ostioles, honey/olivaceous, later olivaceous black; setae relatively long, exceeding 200 µm, spread over the upper surface; walls made up of 3–7 layers of cells, outer layers pigmented; with off-white to buff coloured conidial exudate; abundant, mainly on the agar. Conidiogenous cells 4–7 × 3–7 µm, bottle-shaped. Conidia aseptate, (3–)4–6 × (1–)2–3 µm, av. 5.4 × 2.6 µm, Q = 1.7–2.4, av. Q = 2.1, ellipsoidal to subglobose, usually with several guttules.

Chlamydo-spores absent.

NaOH spot test: a greenish discolouring may occur on OA.

Note: red pigmented grains of exudate, resembling small crystals, are produced in culture media.

Ecology and distribution. Recorded from a wide variety of woody and herbaceous plants in Australia, Eurasia and North America. Very often isolated from root surfaces (e.g. *Iris* spp. and *Secale cereale*). Also from bulbs, cysts of nematodes and various soil samples. The fungus may be regarded as harmless or saprophytic. It represents the type of the section *Paraphoma*.

Representative culture. CBS 111.79 (PD 76/437) ex *Malus sylvestris* (Rosaceae), the Netherlands; CBS 102875 (PD 78/1097) ex *Lycopersicon esculentum* (Solanaceae), Germany.

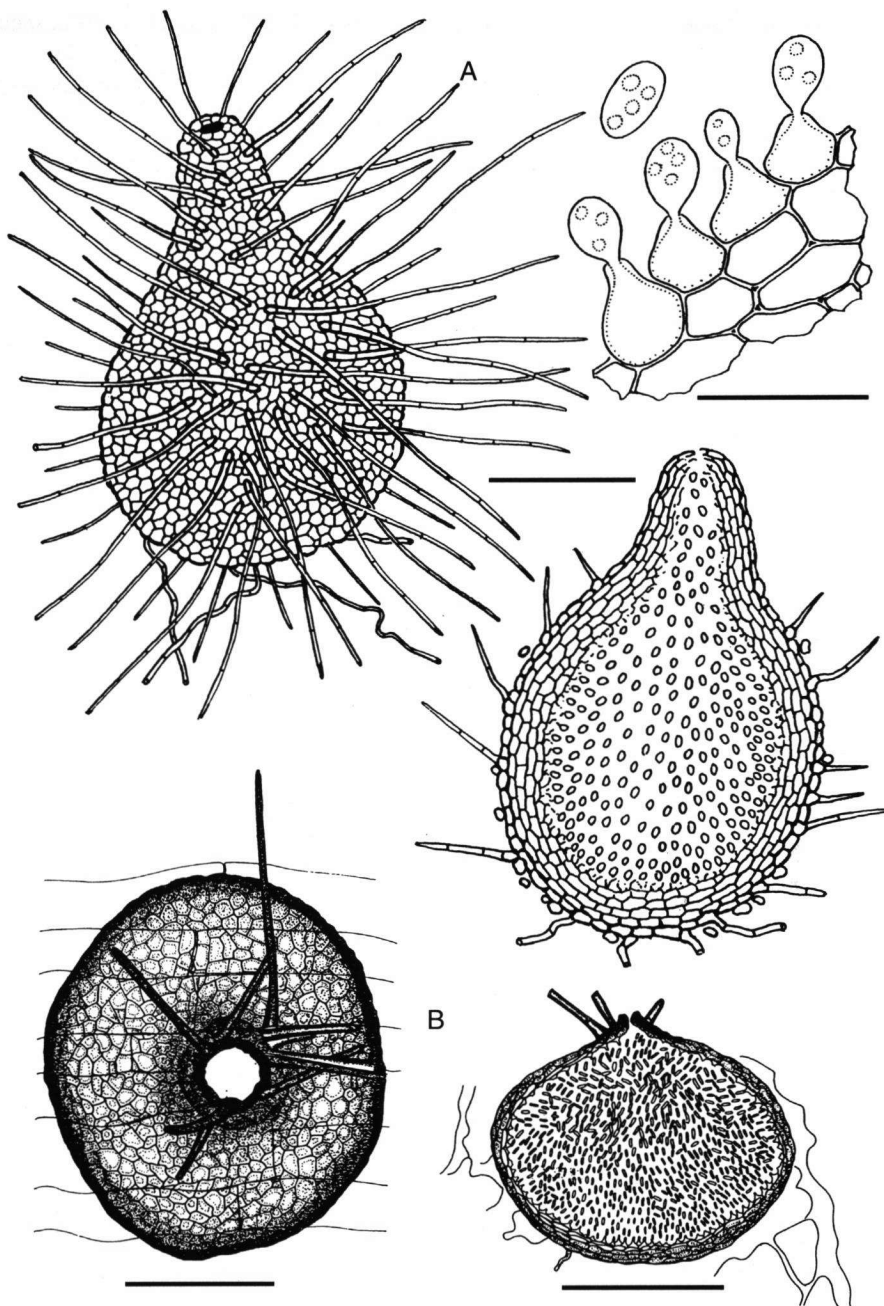
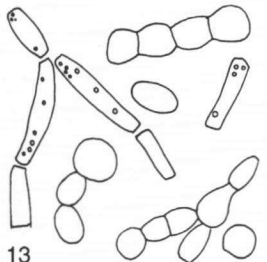
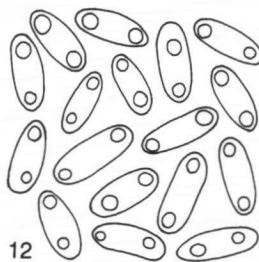
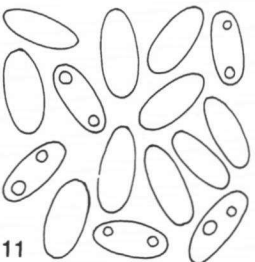
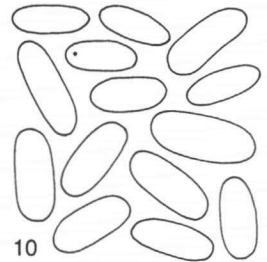
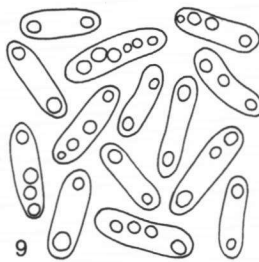
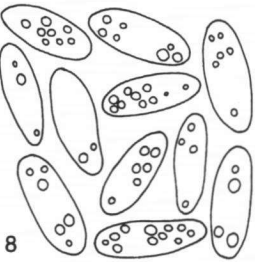
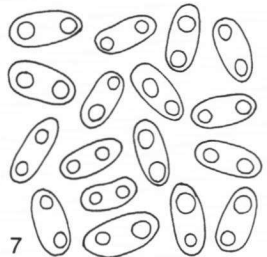
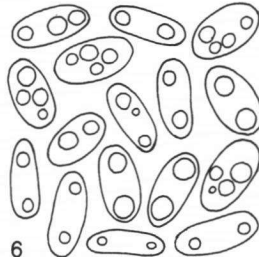
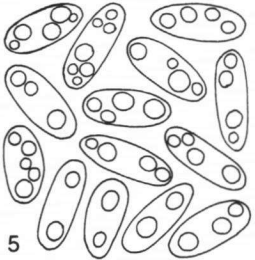
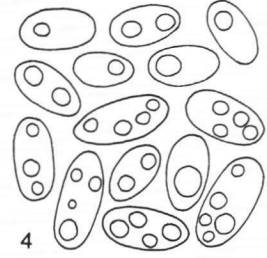
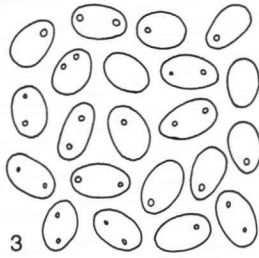
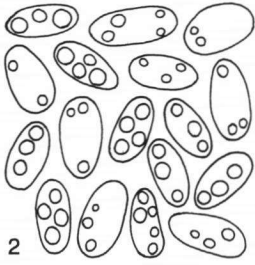


Fig. 1. A. *Phoma radicina*, type species of *Phoma* sect. *Paraphoma*. Surface view and vertical section of pycnidium with setae scattered over the entire pycnidial wall. Inner part of wall with conidiogenous cell; B. *Phoma terrestris*, surface view and vertical section of pycnidium with setae around the ostiole. Drawing A after Morgan-Jones & White (1983; with permission), B after Punithalingam & Holliday (1973; with permission). — Bar = 100 μ m for pycnidia and 10 μ m for conidiogenous cells and conidia.



Figs. 2–12. Conidia. 2. *Phoma septicaldis*; 3. *Phoma carteri*; 4. *Phoma radicina*; 5. *Phoma terrestris*; 6. *Phoma leveillei* var. *leveillei*; 7. *Phoma leveillei* var. *microspora*; 8. *Phoma glycinicola*; 9. *Phoma briardii*; 10. *Phoma gardeniae*; 11. *Phoma indica*; 12. *Phoma terricola*; Fig. 13. *Phoma septicaldis*, fragmentation of the hyphae. — Bar = 10 μ m.

4. *Phoma terrestris* H.N. Hansen — Figs. 1B, 5, 14

Phoma terrestris H.N. Hansen, *Phytopathology* 19 (1929) 699. — *Pyrenochaeta terrestris* (H.N. Hansen) Gorenz, J. Walker & Larson, *Phytopathology* 38 (1948) 838; not *Phoma terrestris* Saksena, Nand & A.K. Sarbhoy, *Mycopath. Mycol. appl.* 29 (1966) 86 [= *Phoma multirostrata* var. *macrospora* Boerema; de Gruyter et al., 1998].

Selected literature. Hansen (1929), Punithalingam & Holliday (1973), Boerema (1985).

Description in vitro

OA: growth-rate 35–45 mm after 7 days, regular, with felty to finely woolly, pale olivaceous grey aerial mycelium; colony brick to vinaceous, or partly primrose, often with dull green patches; reverse similar, often with fulvous to rust patches.

MA: growth-rate 15–40 mm after 7 days, regular or slightly irregular, with felty to finely woolly, pale olivaceous grey to smoke grey aerial mycelium; colony rosy vinaceous to vinaceous/brick, with buff near margin and hazel at centre; reverse similar, brown vinaceous at centre.

CA: growth-rate 28–35 mm after 7 days, regular, with felty to finely woolly, pale olivaceous grey aerial mycelium; colony rosy vinaceous to vinaceous or vinaceous buff to hazel; reverse similar, partly grey olivaceous/olivaceous grey, and hazel to olivaceous/olivaceous black at centre.

Pycnidia setose, 120–370 µm diam., globose to subglobose, solitary or confluent, with 1(–3) usually papillate ostioles, honey, later olivaceous to olivaceous black; setae relatively long, exceeding 200 µm, mainly concentrated around the ostiole; walls made up of 4–11 layers of cells, outer layer(s) pigmented; with white coloured conidial exudate; scattered or in concentric rings, mostly on the agar. Conidiogenous cells 4–8 × 4–7.5 µm, globose to bottle shaped. Conidia aseptate, 4–6 × 2–2.5 µm, av. 5.0 × 2.3 µm, Q = 1.8–2.9, av. Q = 2.2, ellipsoidal, with several distinct guttules.

Chlamydospores may be present, globose to subglobose, solitary or aggregated, ochraceous to olivaceous, with greenish guttules, intercalary or terminal, 6–12 µm diam.

NaOH spot test: brick to vinaceous pigments becoming vinaceous/violet on OA.

Note: vinaceous or amber pigmented grains of exudate, resembling small crystals, may be produced in culture media.

Ecology and distribution. This well-known causal organism of Pink Root of onion (*Allium cepa*) is apparently a widely distributed soil fungus in North America (USA and Canada) and probably also a common soil inhabitant in some regions of South America (Argentina, Brazil, Venezuela). Records from Europe, Africa and Australia are generally associated with the cultivation of onions or other crops of *Allium* (leek, shallot, garlic and chive). The fungus is frequently isolated from the roots of grasses (e.g. *Setaria lutescens*) and other herbaceous plants, but usually without any disease symptoms. However, the roots of maize plants (*Zea mays*) and rice (*Oryza sativa*) may also be affected. The fungus is characterized by a red pigment in the mycelium and this easily distinguishes it from the morphologically very similar *Phoma leveillei* Boerema & Bollen var. *leveillei* (no. 5a) and from *Phoma terricola* Boerema (no. 10).

Representative cultures. CBS 377.52 ex *Allium cepa* (Liliaceae), CBS 732.97 (PD 94/379) ex *Calathea crocata* (Maranthaceae), the Netherlands; CBS 335.87 (PD 2000/8963) ex *Allium cepa* (Liliaceae), Senegal.

5a. *Phoma leveillei* Boerema & G.J. Bollen var. *leveillei* — Fig. 6

Phoma leveillei Boerema & G.J. Bollen, *Persoonia* 8 (2) (1975) 115, var. *leveillei* [autonym created by the separation of the variety *microspora*, see below]. — *Vermicularia acicola* Moug. & Lév. apud Léveillé, *Annls Sci. nat. (Bot.)* III, 9 (1848) 259–260 [as 'Moug. Lév.']; not *Phoma acicola* (Moug. & Lév.) Sacc., *Sylloge Fung.* 3 (1884) 100 [as '(Lév.) Sacc.']; = *Sclerophoma pythiophila* (Corda) Höhn.]. — *Pyrenochaeta acicola* (Moug. & Lév.) Sacc., *Sylloge Fung.* 3 (1884) 220 [as '(Lév.) Sacc.'].

Pyrenochaeta phlogis Masee, *Bull. misc. Inf. R. bot. Gdns Kew* (1907) 241; not *Phoma phlogis* Roum., *Revue mycol.* 6 (1884) 160 [= *Phoma acuta* (Hoffm.: Fr.) Fuckel subsp. *acuta* f. sp. *phlogis*, see Boerema et al., 1994: 465].

Pyrenochaeta oryzae Shirai ex I. Miyake, *J. Coll. Agric. imp. Univ. Tokyo* 2 (4) (1910) 255–256; not *Phoma oryzae* Catt., *Arch. Bot. crittog. Pavia* 2–3 (1877) 118; not *Phoma oryzae* Cooke & Masee, *Grevillea* 16 (1887) 15 [= *Phoma minutispora* P.N. Mathur, see de Gruyter & Noordeloos, 1992: 75]; not *Phoma oryzae* Hori, 'Nosakubutsu-Biyogatu' (1903) 111–113 [in Japanese].

Pyrenochaeta lupini Sibilina, *Annali Bot.* 18 (1930) 284; not *Phoma lupini* Ellis & Everh., *Bull. Washburn [Coll.] Lab. nat. Hist.* 1 (1884) 6 [see de Gruyter et al., 1992: 375]; not *Phoma lupini* Buchw. in Möller, *Fungi Faeröes* 2 (1958) 153.

Pyrenochaeta calligoni Kratzev apud Schwarzman & Kratzev, *Trudy Inst. Bot., Alma Ata* 9 (1961) 45; not *Phoma calligoni* Murashk., *Trans. Agric. Forest. Omsk* 9 (1928) 6.

Pyrenochaeta spinaciae Verona & Negru in Negru & Verona, *Mycopath. Mycol. appl.* 30 (1966) 309–310; not *Phoma spinaciae* Bubák & K. Krieg. in Bubák, *Annls mycol.* 10 (1912) 47 [= *Phoma betae* Frank, see Boerema et al., 1987].

Pyrenochaeta anthyllidis Manoliu & Mítitfuc, *Reprrium nov. Spec. Regni veg. [Feddes Reprrium]* 87 (1976) 142.

Selected literature. Dorenbosch (1970), Boerema & Hamers (1989).

Description in vitro

OA: growth-rate 21–24 mm (14 days: 40–48 mm), regular to somewhat irregular, with woolly, (pale) olivaceous grey aerial mycelium; colony grey olivaceous/olivaceous grey to dull green; reverse similar.

MA: growth-rate 16–20 mm (14 days: 30–40 mm), regular to somewhat irregular, with compact, finely floccose to woolly, (pale) olivaceous grey aerial mycelium; colony olivaceous grey, becoming grey olivaceous at margin; reverse olivaceous black, with olivaceous buff/grey olivaceous to leaden grey at margin.

CA: growth-rate 19–24 mm (14 days: 40–45 mm), regular to somewhat irregular, with compact, felty to woolly, (pale) olivaceous grey aerial mycelium; colony buff to grey olivaceous/olivaceous grey; reverse olivaceous grey to purplish grey, buff/saffron at margin.

Pycnidia setose, 180–270 µm diam., globose to subglobose, with usually 1, non-papillate or slightly papillate ostiole, olivaceous to olivaceous black; setae relatively long, exceeding 200 µm, spread over the upper surface; walls made up of 2–7 layers of cells, outer layers pigmented; with white to buff coloured conidial exudate; abundant, scattered or in concentric rings, on the agar as well as in aerial mycelium. Conidiogenous cells 3–7 × 3–7 µm, subglobose to bottle-shaped. Conidia aseptate, 4–5.5 × 2–2.5 µm, av. 4.4 × 2.4 µm, Q = 1.6–2.3, av. Q = 1.8, subglobose to ellipsoidal, with 2 or more, distinct guttules.

Chlamydospores absent, but hyphal swollen cells may occur.

NaOH spot test: negative.

Note: luteous to ochraceous pigmented grains of exudate, resembling small crystals, may be produced in culture media.

Ecology and distribution. A worldwide soil fungus (Eurasia, North America, Africa, Australia), regarded as a collective species with much variability in morphological and physiological characters. Generally it behaves like a saprophyte; all listed synonyms being associated with necrotic plant tissue. However, the basal and underground parts of monocotyledonous plants may be affected by it (reported from e.g. *Oryza sativa*, *Secale cereale* and *Narcissus* spp.). The fungus has been confused with morphologically very similar soil fungi: *Phoma terrestris* Hansen (no. 4; characterized by the production of a red pigment) and *Phoma terricola* Boerema (no. 10; distinguished by abundant production of chlamydospores).

Representative cultures. CBS 260.65 ex wheat field soil, Germany; CBS 101634 (PD 76/416) ex *Fragaria* (\times) *ananassa* (Rosaceae), the Netherlands.

5b. *Phoma leveillei* var. *microspora* De Gruyter & Boerema, var. nov. — Fig. 7

A varietate *leveillei* conidiis minoribus ($3.5-4.5 \times 1.5-2 \mu\text{m}$) et setis vulgo brevioribus quam $100 \mu\text{m}$ differens.

Holotypus: HLB 999-242399, cultura exsiccata, viva CBS 102876, isolatus ex aqua in Yugoslavia.

Description in vitro

OA: growth-rate 26–28 mm (14 days: 52 mm), regular, with finely woolly, pale olivaceous grey aerial mycelium; colony grey olivaceous to dull green/dark herbage green; reverse similar to olivaceous.

MA: growth-rate 24–26 mm (14 days 47–49 mm), regular, with compact woolly/finely floccose, pale olivaceous grey aerial mycelium; colony buff, (pale) olivaceous grey at centre; reverse pale luteous to olivaceous grey, with leaden grey/leaden black at centre.

CA: growth-rate 15–17 mm (14 days: 27–29 mm), irregular, with compact, finely woolly to finely floccose, grey olivaceous aerial mycelium; colony grey olivaceous to dull green; reverse similar with fulvous patches, and an olivaceous black centre.

Pycnidia setose, (20–)80–270 μm diam., globose to subglobose, solitary or confluent, with 1 (or 2) non-papillate ostioles, greenish olivaceous/olivaceous, later olivaceous black; setae relatively short, up to 100 μm , spread over the upper surface, more densely around the ostiole; walls made up of 2–7 layers of cells, outer layers pigmented; conidial exudate off-white; scattered or in concentric rings, mainly on the agar. Conidiogenous cells 3–6 \times 3–6 μm , bottle-shaped. Conidia aseptate, $3.5-4.5 \times 1.5-2 \mu\text{m}$, av. $4.0 \times 1.7 \mu\text{m}$, $Q = 1.7-2.8$, av. $Q = 2.3$, ellipsoidal to oblong, with 2 distinct guttules.

Chlamydospores absent.

NaOH spot test: a pale greenish discolouring may occur, but this is not specific.

Crystals absent.

Ecology and distribution. In saprophytic behaviour and apparently worldwide distribution (SE Europe and Central America (fruits of *Elettaria cordamamum*, Zingiberaceae)) this newly recognized variety resembles the very variable and ubiquitous *Phoma leveillei*. Morphologically, however, it is distinguished by significantly smaller conidia and shorter setae.

Representative culture. CBS 102876 (PD 75/911) ex water, Lake of Skadar, Yugoslavia (Montenegro).

6. *Phoma glycinicola* De Gruyter & Boerema, *nom. nov.* — Fig. 8

Pyrenochaeta glycinis R. B. Stewart, Mycologia 49 (1957) 115 [replaced synonym; holotype on leaf spot of *Glycine max*, coll. R. B. Stewart, Jimma, Ethiopia, Sept. 15, 1955, BPI, compare Schneider, 1979]; not *Phoma glycinis* Sawada, Spec. Publ., Coll. Agric., Nat. Taiwan Univ. 8 (1959) 129.

Selected literature. Stewart (1957).

Description in vitro

OA: growth-rate 18–25 mm (14 days: 35–48 mm), regular, with scarce, finely felty, white aerial mycelium; colony white to pale olivaceous grey/pale dull green to brick; reverse similar.

MA: growth-rate 15–25 mm (14 days: 30–49 mm), regular to irregular due to outgrowths of sectors, with floccose to coarsely floccose, white to salmon aerial mycelium; colony white to salmon due to aerial mycelium, with pale olivaceous grey to grey olivaceous/greenish olivaceous patches; reverse salmon to saffron, with pale luteous or greenish olivaceous patches, olivaceous at centre.

CA: growth-rate 15–25 mm (14 days: 30–37 mm), regular to irregular due to outgrowths of sectors, with felty to floccose, white to pale greenish grey aerial mycelium; colony colourless, to white due to aerial mycelium, with pale greenish grey/glaucous grey to greenish olivaceous patches; reverse similar or with salmon/saffron, and a dull green to olivaceous/olivaceous black centre.

Pycnidia setose, 70–240 µm diam., globose to irregular, solitary or confluent with 1(–3) non-papillate or papillate ostioles, honey/olivaceous, later olivaceous black; setae of moderate length, up to 200 µm, spread over the upper surface, more densely around the ostiole; walls made up of 4–11 layers of cells, outer layers pigmented; with rosy buff to salmon/saffron coloured conidial exudate; abundant, mainly in concentric rings, both on and in the agar, and in aerial mycelium as well. Conidiogenous cells 4.5–9.5 × 4–6.5 µm, bottle-shaped. Conidia aseptate, 5–7.5 × 2–2.5 µm, av. 6.0 × 2.3 µm, Q = 2.2–3.3, av. Q = 2.6, ellipsoidal to subglobose, with several small guttules.

Sclerotia present, up to 600 µm, covered with very short, setae (up to 10 µm), globose to subglobose, solitary or confluent. The cell-structure of these sclerotial bodies resembles those of the pseudoparenchymatous ‘pyncosclerotia’ found in some species of *Phoma* sect. *Sclerophomella* (Höhn.) Boerema et al. (Boerema & de Gruyter, 1998); after addition of iodine only the contents of the cells become red, not the walls of the cells.

Chlamydospores absent, but dark red mycelial fragments occur due to crystallization of the pigments.

NaOH spot test: brick pigments which may turn to greenish blue.

Note: reddish pigmented grains of exudate, resembling small crystals, may be produced in culture media.

Ecology and distribution. Recorded as serious pathogen of *Glycine* spp.: Leaf Spot in Africa (Ethiopia, Zambia, Zimbabwe). The primary indigenous host is probably *Glycine javanica*. Varieties of soybean, *Glycine max* (originally native of eastern Asia), appear to be very susceptible. The leaf spots, at first small, reddish brown, soon become necrotic and may fall out, giving the plants a very ragged appearance. In susceptible varieties of soybean leaf abscission is the most damaging aspect of the disease.

Representative culture. IMI 294986 ex *Glycine max* (Leguminosae), Zambia.

7. *Phoma briardii* De Gruyter & Boerema, *nom. nov.* — Fig. 9

Pyrenochaeta leptospora Sacc. & Briard, *Revue mycol.* 11 (1889) 16 [replaced synonym; holotype on stem pieces of *Milium effusum*, coll. P.A. Briard 'no. 6', near Troyes, France, PAD]. — *Pyrenochaeta spegazziniana* Trotter, *Sylloge Fung.* 25 (1931) 190 [illegitimate: nomenclaturally superfluous name⁴]; not *Phoma leptospora* Speg., *Fungi Chilens.* (1910) 145, nor *Phoma leptospora* Sacc., *Annl. mycol.* 11 (1913) 553; not *Pyrenochaeta leptospora* Speg., *Ann. Mus. Buenos Aires* 20 (1910) 354.

Description in vitro

OA: growth-rate 20–22 mm, (14 days: 44–46 mm), regular, with finely velvety, pale olivaceous grey aerial mycelium; colony colourless to grey olivaceous/olivaceous; reverse similar.

MA: growth-rate 16–21 mm, (14 days: 32–41 mm), regular to somewhat irregular, with velvety to compact felty, (pale) olivaceous grey aerial mycelium; colony buff/honey to hazel/olivaceous; reverse similar to pale luteous, (pale) mouse grey at centre.

CA: growth-rate 23–26 mm (14 days: 44–48 mm), regular, with (finely) felty, pale olivaceous grey to greenish glaucous aerial mycelium; colony vinaceous buff/fawn to pale grey olivaceous, colourless near margin; reverse vinaceous buff to fawn/hazel.

Pycnidia 70–265 µm diam., setose, globose to subglobose, solitary to confluent, with usually 1 papillate or non-papillate ostiole, honey/citrine, later olivaceous to olivaceous black; setae relatively long, exceeding 200 µm, spread over the upper surface, more densely around the ostiole; walls made up of 2–6(–10) layers of cells, outer layers pigmented, with white coloured conidial exudate; scattered, both on and in the agar; micropycnidia present, mainly 20–50 µm diam. Conidiogenous cells 3–7 × 3–6 µm, sometimes with a slightly elongated neck at a later state, bottle-shaped. Conidia aseptate, 4.5–7 × (1–)1.5–2 µm, av. 5.6 × 1.6 µm, Q = 2.8–5.2, av. Q = 3.6, cylindrical to allantoid, with two or more distinct guttules.

Chlamydospores absent.

NaOH spot test: negative.

Crystals absent.

Ecology and distribution. This fungus has been repeatedly isolated from soil in agricultural fields in Europe (especially Germany and the Netherlands). The French type collection on stem debris of millet had already indicated a soil-inhabiting fungus. Other records refer specifically to roots of Monocotyledonae, Gramineae (e.g. *Secale cereale*) and Orchidaceae (*Phalaenopsis* sp.). So far there are no data on pathogenicity.

Representative culture. CBS 101635 (PD 71/1027) ex *Secale cereale* (Gramineae), the Netherlands.

8. *Phoma gardeniae* (S. Chandra & Tandon) Boerema — Figs. 10, 15

Phoma gardeniae (S. Chandra & Tandon) Boerema in Boerema & Dorenb., *Versl. Meded. plziektenk. Dienst Wageningen* 156 (Jaarb. 1979) (1980) 27.

Pyrenochaeta gardeniae S. Chandra & Tandon, *Mycopath. Mycol. appl.* 29 (1966) 274–275.

Selected literature. Chandra & Tandon (1966), Boerema & Dorenbosch (1980).

4) Trotter probably intended to replace the later homonym *Pyrenochaeta leptospora* Speg. with *Pyrenochaeta spegazziniana*, but listed the latter as a substitute for *P. leptospora* Sacc. & Briard.

Description in vitro

OA: growth-rate 50–68 mm, regular, with finely floccose, grey olivaceous to olivaceous grey aerial mycelium; colony grey olivaceous to greenish olivaceous towards margin, or colourless with grey olivaceous to dull green sectors; reverse olivaceous grey to leaden grey/leaden black, or with grey olivaceous to olivaceous grey sectors.

MA: growth-rate 55–73 mm, regular to somewhat irregular, with abundant, floccose to woolly, grey olivaceous aerial mycelium; colony grey olivaceous to olivaceous grey towards margin, or colourless with greenish olivaceous/olivaceous grey to dull green sectors; reverse grey olivaceous to leaden grey/leaden black, or with greenish olivaceous to olivaceous grey sectors.

CA: growth-rate 59–78 mm, regular, with floccose to woolly, (pale) olivaceous grey aerial mycelium; colony greenish olivaceous to olivaceous, or colourless with greenish olivaceous to olivaceous sectors; reverse olivaceous to leaden grey at centre, or buff to rosy buff with olivaceous sectors.

Pycnidia setose, 50–180 µm diam., globose to irregular, solitary or confluent, with usually 1 slightly papillate or non-papillate ostiole, olivaceous to olivaceous black; setae relatively short, up to 100 µm, concentrated around ostiole; walls made up of 3–8 layers of cells, or filling nearly the entire cavity, outer layers pigmented; with white to flesh-coloured conidial exudate; scattered, both on and in the agar as well as in aerial mycelium. Conidiogenous cells 4–8 × 4–7 µm, bottle-shaped. Conidia aseptate, (3.5–)5–8.5(–10.5) × (1.5–)2–3.5(–4.5) µm, av. 5.6–7.0 × 2.7–3.0 µm, Q = 1.4–3.4, av. Q = 2.1–2.4, ellipsoidal to ovoid, with or without several small guttules.

Chlamydospores present, 6–15 µm, globose to subglobose, solitary or aggregated, ochraceous to olivaceous, with greenish guttules, usually intercalary.

NaOH spot test: a weak reddish/brownish discoloring may occur, but this is not specific. Crystals absent.

Ecology and distribution. The original Indian isolate of this species was made from leaf spots of the cape jasmine, *Gardenia jasminoides*. In India it seems to be a common soil-borne fungus, which may act as an opportunistic pathogen of woody as well as herbaceous plants (once isolated from *Arachis hypogaea*). The fungus is also reported from Curaçao. It has been confused with *Phoma leveillei* Boerema & G.J. Bollen var. *leveillei* (no. 5a), but can be easily distinguished from the latter by its highly variable, relatively large conidia and the production of chains of chlamydospores.

Representative cultures. CBS 626.68 (IMI 108771) ex *Gardenia jasminoides* (Rubiaceae), India; CBS 302.79 (PD 79/1156) ex air, Netherlands Antilles (Curaçao).

9. *Phoma indica* (T.S. Viswan.) De Gruyter & Boerema, *comb. nov.* — Fig. 11

Pyrenochaeta indica T.S. Viswan., Curr. Sci. 26 (1957) 118 [basionym; holotype on leaf spot of *Saccharum officinarum*, Poona, India, AMH-11; dried culture of type in Herb. IMI-062569(b)].

Description in vitro

OA: growth-rate 12 mm after 7 days (14 days: 28–30 mm), regular, with sparse, felty, pale olivaceous grey aerial mycelium; colony olivaceous, reverse similar.

MA: growth-rate 16–17 mm after 7 days (14 days: 40–41 mm), regular, with felty, white to smoke grey/pale olivaceous grey aerial mycelium; colony greyish due to aerial mycelium, grey olivaceous to olivaceous near margin; reverse similar.

CA: growth-rate 14–15 mm after 7 days (14 days: 23–25 mm), regular, with felty, white to smoke grey/pale olivaceous grey aerial mycelium; colony greyish due to aerial mycelium, hazel near margin; reverse hazel, with mouse grey at centre.

Pycnidia (on type herbarium material) setose, 55–240 µm diam., globose to subglobose, solitary or confluent, with 1 or 2 papillate ostioles, citrine/honey, later sienna to olivaceous/olivaceous black; setae relatively short, up to 100 µm, mainly concentrated around the ostiole; walls made up of 3–12 layers of cells, outer layer(s) pigmented; with (pale) luteous coloured conidial exudate; scattered, both on and in the agar. Conidiogenous cells 4–6 × 3–6 µm, globose to bottle shaped. Conidia aseptate, 4–5.5 × 1.5–2.5 µm, av. 4.8 × 2.0 µm, Q = 2.0–3.4, av. Q = 2.4, ellipsoidal, usually with 2 guttules.

Chlamydospores present, 5–11 µm diam., globose to subglobose, solitary or in short chains, occasionally clustered, olivaceous with greenish guttules, mostly terminal.

NaOH spot test: positive on OA and MA, herbage green (not E reaction).

Crystals absent.

Ecology and distribution. Found on the whitish centre of fusiform dirty brownish leaf spots of sugar-cane, *Saccharum officinarum* in India. There are no data on pathogenicity. On the spots a species of *Melanospora* was also found. *Phoma indica* produces significantly smaller conidia than *P. setariae* (no. 11), recorded in Brazil from leaf spots of sugar-cane.

Representative culture. IMI 062569 ex *Saccharum officinarum* (Gramineae), India.

10. *Phoma terricola* Boerema — Figs. 12, 16

Phoma terricola Boerema, Versl. Meded. plziektenk. Dienst Wageningen 163 (Jaarb. 1984) (1985) 38–39; not *Phoma terricola* 'Agnihotr.', Soil Sci. 91 (1961) 135 [a nomen nudum erroneously adopted in Mathur, Coelom. India (1979) 185].

Pyrenochaeta decipiens Marchal, Champ. copr. 6 (1891) 8; not *Phoma decipiens* Mont., Fl. chil. cell. 7 (1852) 488.

Selected literature. Boerema (1985).

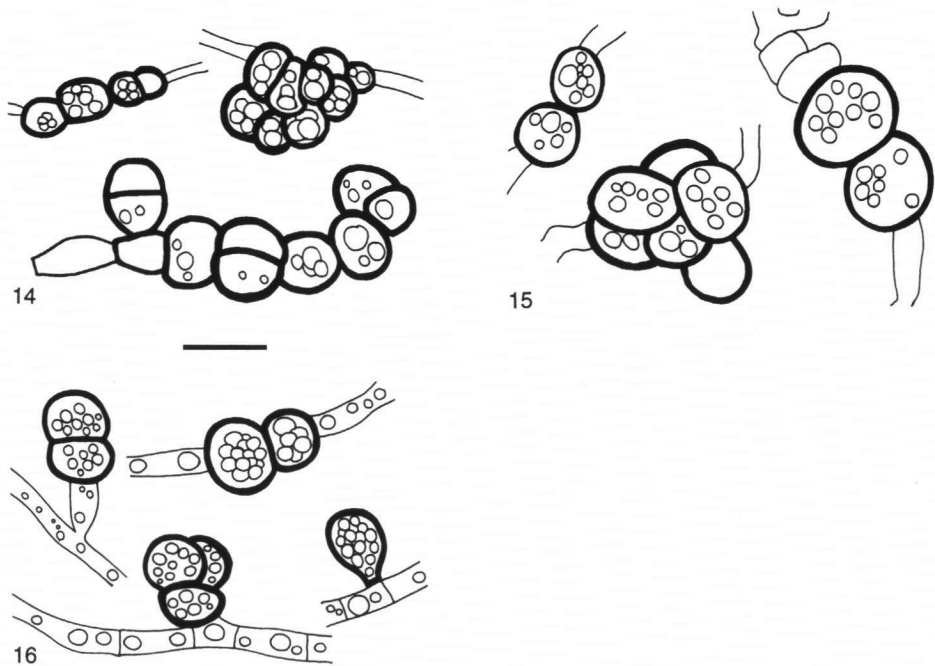
Description in vitro

OA: growth-rate 25–29 mm (14 days: 46–51 mm), regular to somewhat irregular, with finely floccose, pale olivaceous grey to pale greenish grey aerial mycelium; colony pale olivaceous grey/grey olivaceous to dark herbage green/dull green; reverse dull green/olivaceous to leaden grey/leaden black.

MA: growth-rate 20–22 mm (14 days: 39–40 mm), regular to somewhat irregular, with finely felty, pale olivaceous grey aerial mycelium; colony olivaceous grey/grey olivaceous to dull green; reverse similar, olivaceous to leaden grey/leaden black.

CA: growth-rate 22–24 mm (14 days: 42–46 mm), regular to somewhat irregular, with floccose, white to pale olivaceous grey aerial mycelium; colony grey olivaceous to olivaceous grey; similar, with fawn to hazel and leaden grey patches.

Pycnidia setose, 130–250 µm diam., globose, usually solitary, with usually 1, non-papillate or slightly papillate ostiole, honey to citrine, later olivaceous black; setae relatively short, up to 100 µm, mainly concentrated around the ostiole; walls made up of 2–5 layers of cells, outer layer(s) pigmented; with white coloured conidial exudate; scattered or in concentric rings, both on and in the agar. Conidiogenous cells 3–6 × 3–7 µm, globose to bottle-shaped. Conidia aseptate, 3–5(–5.5) × 1.5–2 µm, av. 3.6–4.4 × 1.5–1.6 µm, Q = 1.8–3.3, av. Q = 2.5–2.8, ellipsoidal to subcylindrical, with usually 2 guttules.



Figs 14–16. Chlamydospores. 14. *Phoma terrestris*; 15. *Phoma gardeniae*; 16. *Phoma terricola*. — Bar = 10 μ m.

Chlamydospores present, globose to subglobose, solitary or aggregated, ochraceous to olivaceous, with greenish guttules, intercalate or terminal, 6–10 μ m diam.

NaOH spot test: negative.

Crystals absent.

Ecology and distribution. A soil fungus recorded in western Europe (Belgium, the Netherlands). Probably widespread occurring in agricultural fields. For example, it has been found in the rhizosphere of wheat (*Triticum aestivum*) and beet (*Beta vulgaris*), and isolated from cysts of the golden nematode of potatoes (*Globodera pallida*). The pycnidia of this fungus are very similar to those of *Phoma leveillei* Boerema & G.J. Bollen var. *leveillei* (no. 5a), but can be easily distinguished by an abundant production of chlamydospores. It also morphologically resembles *Phoma terrestris* H.N. Hansen (no. 4), but does not produce red pigment.

Representative culture. CBS 343.85 (PD 85/1044) ex cyst of *Globodera pallida*, the Netherlands.

APPENDIX

Insufficiently known species

Apart from the seventeen *Pyrenochaeta* synonyms of the *Phoma* species treated in this paper in section *Paraphoma*, Schneider (1979) listed 23 other *Pyrenochaeta* spp. which, on account of their original descriptions or type material, should also belong to *Phoma*.

Most of these taxa are only known from a single collection. However, Schneider (1979) noted that three differently named African/American collections from leaf spots on *Pennisetum*, *Saccharum* and *Setaria* spp. refer to one and the same species. An old isolate of this pathogen appears to be available (CBS 333.39 from *Saccharum officinarum* in Brazil), but has remained sterile. Without doubt a *Phoma* species of sect. *Paraphoma* is involved. Below it is transferred from *Pyrenochaeta* to *Phoma* with a resumé of its characteristics on the hosts.

11. *Phoma setariae* (H.C. Greene) De Gruyter & Boerema, *comb. nov.*

Pyrenochaeta setariae H.C. Greene, Trans. Wis. Acad. Sci. Arts Lett. 53 (1964) 211[–212] [basionym; holotype on leaf of *Setaria lutescens*, coll. T.F. Hubb, near Pine Bluff, Dane County, Wisconsin, USA, Sept. 1964, WIS].

Pyrenochaeta sacchari Bitanc., Arquivos Inst. Biol., São Paulo 9 (1938) 301; not *Phoma sacchari* (Cooke) Sacc., Sylloge Fung. 3 (1884) 166; not *Phoma sacchari* Gutner apud Bond.-Mont., Gutner & Novos., Acta Inst. Bot. Acad. Sci. URSS, Ser. II, Fasc. 3 (1936) 789 [= *Phoma gutneri* Pons, Fitopat. Venezolana 3 (2) (1990) 40[–42].

Pyrenochaeta penniseti Kranz, Sydowia 22 (1968) 360–361.

Selected literature. Schneider (1979).

Description in vivo

Pycnidia (initially epiphyllous, later also amphigenous, in oval-fusiform, often confluent, first pale buff, later brownish or vinaceous spots with narrow darker border) in majority setose, 100–150 µm diam., subglobose with usually 1 papillate ostiole, brownish, lighter at the base and darker toward the ostiole; setae short, continuous, 15–75 µm, uniform, mostly around the ostiole; wall made up of 2–5 layers of cells, outer layer(s) pigmented; conidial exudate whitish. Conidia aseptate, 6–10(–12) × 2.5–4 µm, broadly ellipsoidal, subcylindrical to subfusoid or irregular, with usually 2 distinct guttules.

Ecology and distribution. Possibly a widely distributed weak pathogen of Gramineae, which only becomes noticeable in conditions favourable for spread. The records refer to *Pennisetum typhoides* in Africa (Guinea, Nigeria), *Saccharum officinarum* in Brazil and *Setaria lutescens* in North America: Leaf Spot. As the infection progresses the first infected leaves may die back completely.

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