PERSOONIA
Published by Rijksherbarium / Hortus Botanicus, Leiden
Volume 15, Part 2, pp. 197–221 (1993)

CONTRIBUTIONS TOWARDS A MONOGRAPH OF PHOMA (COELOMYCETES) – II
Section Peyronellaea

G.H. BOEREMA

Karel Doormanstraat 4-5, 2041 HD Zandvoort, The Netherlands

Seventeen taxa in *Phoma* sect. *Peyronellaea* are keyed out and briefly described by their characteristics in vitro. The following new taxa are described: *Phoma narcissi* (Aderh.) Boerema, de Gruyter & Noordeloos comb. nov., *Phoma pomorum* var. *calorpreferens* Boerema, de Gruyter & Noordeloos var. nov. and *Phoma subglomerata* Boerema, de Gruyter & Noordeloos nom. 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.

A comparative study in vivo and in vitro of the anamorphic genus *Phoma* resulted in its division into a number of sections, see e.g. van der Aa, Noordeloos & de Gruyter (1990). In the first contribution towards a planned monograph of *Phoma* (nr. I–1) some typical species of sect. *Phoma* have already been treated (de Gruyter & Noordeloos, 1992). This second contribution deals with all species so far placed in *Phoma* sect. *Peyronellaea* (Goid. ex Togl.) Boerema (van der Aa et al., l.c.: 6). For the history of the original genus *Peyronellaea* Goid. ex Togl. see Boerema, Dorenbosch & van Kesteren (1965).

The species of sect. *Peyronellaea* are characterized by the production of conspicuous multicellular chlamydospores, a phenomenon which only can be assessed by study in vitro. The morphology of these structures is important for species differentiation and identification in this section. In most cases they show much resemblance with certain types conidia in the dematiaceous hyphomycete genus *Alternaria* Nees: Fr., see Figs. 1–5, 6A: typical alternarioid to irregular botryoid configurations.[1]

The original genus *Peyronellaea* was based on species with this kind of 'dictyochlamydospore' (a term first applied to them by Luedemann, 1959), often occurring in combination with unicellular chlamydospores. In *Phoma* sect. *Peyronellaea* are now also included species in which the chlamydospores are aggregated into large irregular masses, looking like pseudosclerotia (see Fig. 6B, 7A; pseudosclerotioid appearance). To this section has also been added a fungus which, apart from having *Phoma*-pycnidia, produces multicellular chlamydospores indistinguishable from the conidia of *Epicoccum nigrum* Link (Fig. 7B).

1) This example of evolutionary convergence refers especially to the similarity with the conidia in *Alternaria alternata* (Fr.) Keissler (dictyosporous, catenate) *A. chrysanthemi* Simmons & Crosier (phragmo/dictyosporous, solitary), *A. citri* Ellis & Pierce (variable dictyosporous, solitary and in short chains), *A. radicina* Meyer et al. (variable dictyosporous, solitary, rarely in short chains) and *A. raphani* Groves & Skolko (dictyo/phragmosporous to irregular botryoid, solitary, rarely in short chains). Compare the figures in Ellis (1971).

This is supported by the similarity in the genesis of the spores, and the fact that heavily melanized and roughened dictyochlamydospores sometimes look like *Epicoccum* spores (see Fig. 3B; epicoccoid appearance). The above concept of sect. *Peyronellaea* is in line with the opinion of White & Morgan-Jones (1983) about the *Phoma* species belonging to "A group ... characterized by possession of phaeodictyochlamydospores."

The pycnidia and the chlamydospores occur as two different asexual forms (anamorphs) adapted to the conditions of growth. In both the carbon-nitrogen (C/N) ratio of the medium proved to be a determining factor; at low values there is greater production of pycnidia, at higher values the development of chlamydospores usually increases (first shown by Lacoste, 1955). However, genetical differences are also involved. Sometimes the chlamydospores may also develop separately and independently. Most of the species occasionally produce micropycnidia in the mycelium or developing from a single chlamydospore cell (mp in Figs. 1–3).

In vitro the conidia are always mainly one-celled, but some species show secondary septation of long conidia. In vivo the septate condition is often more prominent and sometimes even dominant. Conidia in old pycnidia may become light-brown and occasionally also form extra septa.

Members of the section occurring on leaves have in the past repeatedly been classified in *Phyllosticta* Auct. Species producing in vivo a variable number of septate conidia have formerly often been arranged under *Ascochyta* Lib., *Diplodina* Auct. or *Stagonospora* (Sacc.) Sacc.

None of the species of this section so far has been associated with a teleomorph.

MATERIAL AND METHODS

The isolates studied include most of the strains used in previously published cultural studies of the *Phoma* species now classified in sect. *Peyronellaea*; compare Boerema, (1983), Boerema, Dorenbosch & van Kesteren (1965, 1968, 1971, 1973, 1977), Boerema & Dorenbosch (1973), Brooks (1932), Dorenbosch (1970), Hauptmann & Schickedanz (1986), Jooste & Papendorf (1981), Morgan-Jones & White (1983), Morgan-Jones & Burgh (1987), Punithalingam, Tulloch & Leach (1972) and White & Morgan-Jones (1983, 1986, 1987).

For each species only one representative culture has been listed. The methodology applied conforms with that described in the first part of this series (de Gruyter & Noordeloos, 1992), but the descriptions are mainly restricted to the characteristics on oatmeal agar (OA). On that medium the pycnidia as well as the characteristic multicellular chlamydospores are usually well-developed. The growth-rate on OA and malt agar (MA) refers to the diameter of the colonies after 7 days growth in darkness at 20–22°C.

KEY TO THE SPECIES AND THE VARIETIES

1a. Colonies in addition to pycnidia producing multicellular chlamydospores resembling the conidia in *Alternaria*: typical alternarioid to irregular-botryoid; sometimes looking like pseudosclerotia: pseudosclerotioid; often also unicellular chlamydospores occur (Figs. 1–6, 7A) 2

b. Colonies in addition to pycnidia producing multicellular chlamydospores indistinguishable from the conidia of *Epicoccum nigrum* Link (Fig. 7B); pycnidia subglobose, stromatic, intermixed with pycnosclerotia; conidia variable, mostly 3–7 × 1.5–3 µm ..... 14. *P. epicoccina*

2a. Pseudosclerotioid chlamydospores absent 3

b. Pseudosclerotioid chlamydospores present (Figs. 6B, 7A); pycnidia to varying degrees covered by hyphae (semi-pilose) 17

3a. Colonies conspicuously dark cyan blue; chlamydospores and pycnidia also cyan blue; conidia mostly 5–7 × 2–3 µm ..... 1. *P. cyanea*

b. Colonies not blue pigmented 4

4a. Pycnidia glabrous 5

b. Pycnidia to varying degrees covered by hyphae; conidia occasionally two-celled 12

5a. Multicellular chlamydospores typical alternarioid-dictyosporous or phragmosporous, mostly terminal (catenate or solitary), but sometimes also intercalary (Figs. 1–3) 6

b. Multicellular chlamydospores, more irregular botryoid-alternarioid in shape, intercalary or terminal, mostly solitary (Figs. 4–5) 13

6a. Multicellular chlamydospores frequently catenate and explicitly dictyosporous (solitary dictyosporous chlamydospores also occur) 7

b. Multicellular chlamydospores mostly solitary, dictyosporous or phragmosporous (some catenation may occur) 8

7a. Abundant production of chains of alternarioid chlamydospores; no unicellular chlamydospores; pycnidia variable; conidia variable one-celled, mostly 4–8.5 × 1.5–3 µm ..... 2. *P. glomerata*

b. Apart from short chains of alternarioid chlamydospores also chains of unicellular chlamydospores; pycnidia usually subglobose; conidia relatively large, 7–12 × 2–3.5 µm, occasionally two-celled, 12–17 × 3–4 µm ..... 3. *P. subglomerata*

8a. Apart from alternarioid chlamydospores (mainly solitary) always many unicellular chlamydospores, relatively large with conspicuous guttules 9

b. Solitary alternarioid chlamydospores in sympodial arrangement; unicellular chlamydospores – if present – relatively small; pycnidia usually ampulliform 10

9a. Pycnidia variable, often globose-divided; conidia variable, mostly 5–7 × 1.5–2.5 µm; no growth at 30°C ..... 4a. *P. pomorum* var. *pomorum*

b. Variety adapted to relatively high temperatures: good growth at 30°C; pycnidia not divided; conidia relatively large, mostly 5–8.5 × 2–3 µm
4b. *P. pomorum* var. *calorpreferens*

10a. Pycnidia abundantly produced at 22°C; conidia variable in shape and dimensions 11

b. Pycnidia occur only at temperature ranges of 28–30°C; at room temperature only alternarioid chlamydospores, often with a kind of halo; conidia consistent in shape, ellipsoid-obovoid, eguttulate, mostly 4–5.5 × 2.5–3 µm
5c. *P. jolyana* var. *sahariensis*

11a. Conidia biguttulate and eguttulate, mostly 4–7 × 2–4 µm; predominantly tropical or subtropical in distribution ..... 5a. *P. jolyana* var. *jolyana*

b. Variety adapted to cold climate: at room temperature abundant sympodial clusters of alternarioid chlamydospores; conidia often with several polar guttules, relatively long, mostly 5–9 × 2–3.5 µm ..... 5b. *P. jolyana* var. *circinata*

12a. Multicellular chlamydospores alternarioid, terminal and intercalary (Fig. 3B), solitary; unicellular chlamydospores usually single and with conspicuous guttules; pycnidia globose, often 'hairy' and confluent; conidia mostly 5–8 × 2–3 µm, occasionally two-celled, 8–12 × 3–3.5 µm; so far only known from North America
6. *P. americana*

b. Multicellular chlamydospores irregular botryoid-alternarioid, generally intercalary, solitary or in complexes with series of unicellular chlamydospores (Figs. 5A, 6A) 16

13a. Colonies extremely variable, reverse usually with reddish-lilac or pinkish discolouration; botryoid-alternarioid chlamydospores intercalary or terminal, often with discrete individual cellular elements (Fig. 4); mainly in subtropical regions 14

b. Colonies rather uniform, felted, reverse greyish to black; extremely irregular botryoid-alternarioid chlamydosporal configurations 15

14a. Abundant production of intercalary botryoid-alternarioid chlamydospores and series of unicellular chlamydospores; pycnidia papillate-rostrate; conidia variable, mostly 4.5–7 × 2–3 µm; often a reddish or yellowish discolouration below the colony
7. *P. sorghina*

b. Production of botryoid-alternarioid chlamydospores usually scarce, intercalary and terminal; pycnidia papillate-rostrate; conidia relatively broad, mostly 6–7 × 3.5–4 µm ..... 8. *P. pimprina*

15a. Apart from botryoid-alternarioid chlamydosporal configurations also pseudosclerotioid structures present 17

b. No pseudosclerotioid structures present; botryoid-alternarioid chlamydospores mostly intercalary and solitary; pycnidia subglobose; conidia eguttulate, variable in dimensions, mostly 4–7 × 2.5–3.5 µm; pathogenic to *Zantedeschia aethiopica*
9. *P. zantedeschiae*

16a. Botryoid-alternarioid chlamydospores usually intercalary and solitary; also short chains of unicellular chlamydospores; pycnidia subglobose and often hairy; conidia finely guttulate, mostly 5–7.5 × 2.5–3.5 µm, occasionally larger and two-celled, 8–15 × 3–5.5 µm; pathogenic to Amaryllidaceae, esp. *Narcissus* and *Hippeastrum* spp. ..... 10. *P. narcissi*

b. Complexes of botryoid-alternarioid chlamydospores and series of unicellular chlamydospores, usually intercalary; pycnidia papillate, often hairy around the ostiole; conidia usually 4–8.5 × 2–3 µm, frequently also two-celled, 9–13 × 3–4 µm; pathogenic to *Clematis* spp. ..... 11. *P. clematidina*

17a. Production of irregular botryoid-alternarioid chlamydospores, unicellular chlamydospores and pseudosclerotioid masses; pycnidia subglobose, papillate or rostrate, often hairy; conidia relatively large, biguttulate, mostly 9–10 × 2–3 µm; pathogenic to *Viola* spp. ..... 12. *P. violicola*

b. Usually abundant production of irregular pseudosclerotioid masses of chlamydospores; often a reddish or yellowish discolouration below the colony; pycnidia subglobose, sometimes confluent, often hairy; conidia mostly 4–5.5 × 1.5–2 µm; saprophytic soil fungus; a specific pathogenic form commonly occurs on cultivated chrysanthemums ..... 13. *P. chrysanthemicola*

HOST/SUBSTRATUM–FUNGUS INDEX

Plurivorous (but often with special host or substratum relation, see below): *P. americana, P. chrysanthemicola, P. epicoccina, P. glomerata, P. jolyana* var. *sahariensis, P. jolyana* var. *jolyana, P. jolyana* var. *circinata, P. pomorum* var. *pomorum, P. pomorum* var. *calorpreferens, P. sorghina, P. subglomerata.*

Isolated from soil: *P. chrysanthemicola, P. cyanea, P. glomerata, P. jolyana* var. *sahariensis, P. jolyana* var. *jolyana, P. jolyana* var. *circinata, P. pimprina, P. pomorum* var. *pomorum, P. pomorum* var. *calorpreferens, P. sorghina.*

Isolated from seeds and fruits: *P. epicoccina, P. glomerata, P. jolyana* var. *jolyana, P. pomorum* var. *pomorum, P. sorghina.*

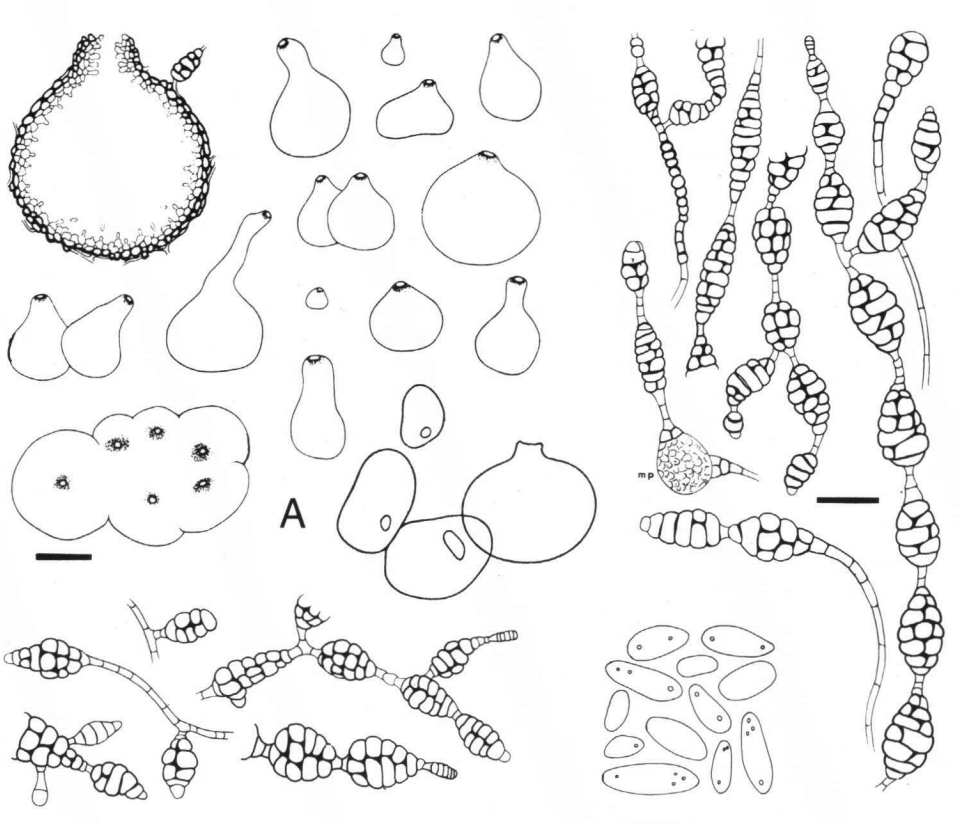
Isolated from substrata of animal (human) and inorganic origin: *P. epicoccina, P. glomerata, P. pomorum* var. *pomorum, P. sorghina.*

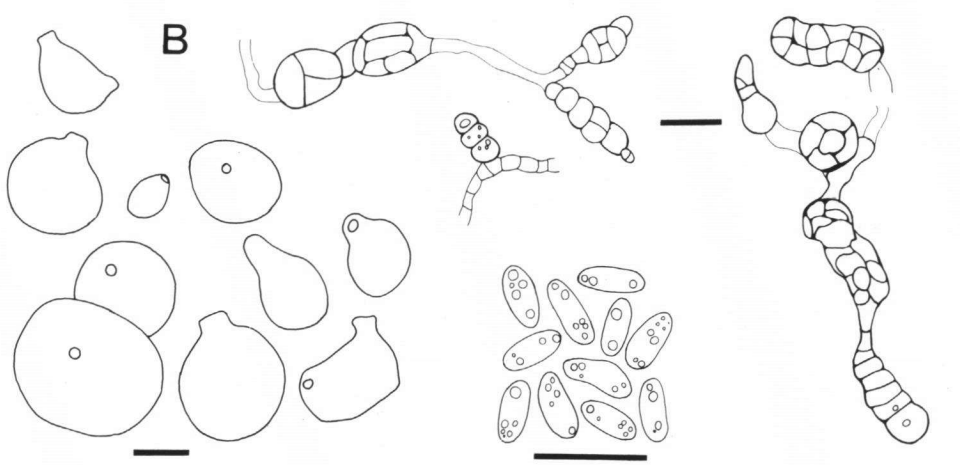
Frequently isolated from specific plants:

Amaryllidaceae (esp. *Narcissus* and *Hippeastrum*)	*P. narcissi*
Zantedeschia aethiopica (Araceae)	*P. zantedeschiae*
Chrysanthemum morifolium (Compositae)	*P. chrysanthemicola* f. sp. *chrysanthemicola*
Gramineae	*P. americana*
Gramineae (esp. in warm regions)	*P. sorghina, P. subglomerata*
Clematis spp. (Ranunculaceae)	*P. clematidina*
Pomoideae (Rosaceae)	*P. pomorum* sensu lato
Fragaria × *ananassa* (Rosaceae)	*P. pomorum* var. *pomorum*
Viola spp. (Violaceae)	*P. violicola*
Vitis vinifera (Vitaceae)	*P. glomerata*

FUNGUS–HOST INDEX

P. americana	Gramineae
P. chrysanthemicola f. sp. *chrysanthemicola*	*Chrysanthemum morifolium* (Compositae)
P. clematidina	*Clematis* spp. (Ranunculaceae)
P. glomerata	e.g. *Vitis vinifera* (Vitaceae)
P. narcissi	Amaryllidaceae, esp. *Narcissus* and *Hippeastrum* spp.
P. pomorum var. *pomorum*	e.g. *Fragaria* × *ananassa*; Pomoideae (Rosaceae)
P. sorghina	Gramineae
P. subglomerata	Gramineae
P. violicola	*Viola* spp. (Violaceae)
P. zantedeschiae	*Zantedeschia aethiopica* (Araceae)


A
mp


B

DESCRIPTIVE PART

Section Peyronellaea

1. **Phoma cyanea** Jooste & Papendorf — Fig. 1B

Chlamydospore-anamorph uni- and multicellular. Alternarioid.

Phoma cyanea Jooste & Papendorf, Mycotaxon 12 (2) (1981) 444–447.

Description in vitro

OA: growth-rate 50–60 mm, regular, mycelium cottony-floccose, consisting of hyaline or light to dark cyan blue hyphae, occasionally encrusted in cyan blue crystals, colony colour conspicuous dark cyan blue.

MA: growth-rate 60–70 mm.

Pycnidia 100–300 µm diam., mostly solitary, subglobose to globose, usually with a short neck and a wide 'collaretted' ostiole, conspicuous cyan blue. Conidial exudate whitish. Conidia (4–)5–7(–10) × 2–3(–4) µm, oblong ellipsoidal or obovoid, sometimes slightly curved, occasionally clavate, usually with minute guttules.

Chlamydospores variable and irregular, uni- or multicellular; unicellular mostly 8–10 µm diam., usually in short chains, intercalary or terminal, with somewhat thick walls encrusted in blue crystals; multicellular, variable-dictyosporous, 14–50 × 9–20 µm, common in older cultures, solitary, or in chains of 2 or rarely 3 elements, intercalary or terminal on branched hyphae, often in combination with unicellular chlamydospores, with relatively thick walls encrusted in blue crystals.

Ecology and distribution. This fungus is so far only known from wheat field debris in South Africa. The blue pigment is unique among *Phoma* species.

Representative culture. (type) CBS 388.80.

2. **Phoma glomerata** (Corda) Wollenw. & Hochapf. — Fig. 1A

Chlamydospore-anamorph multicellular. Alternarioid.

Phoma glomerata (Corda) Wollenweber & Hochapfel, Z. ParasitKde 8 (1936) 592. — *Coniothyrium glomeratum* Corda, Icon. Fung. 4 (1840) 39. — *Aposphaeria glomerata* (Corda) Saccardo, Sylloge Fung. 3 (1884) 175. — *Peyronellaea glomerata* (Corda) Goidanich, Atti Accad. nac. Lincei Rc. VIII, 1 (1936) 455, 658 (name of the genus not validly published, Art. 43) ex Togliani, Annali Sper. agr. II, 6 (1952) 93.

For full synonymy see Boerema, Dorenbosch & van Kesteren (1977). It includes 15 other combinations in *Phoma* and also 15 in *Peyronellaea*. The dictyochlamydosporal anamorph in vitro has been described three times in *Alternaria*.

Fig. 1. A. *Phoma glomerata*, type species of the section. Structure of pycnidia, conidia and alternarioid multicellular chlamydospores as found in cultures of different strains of the fungus. Note the variable shape and size of the latter, depending mainly on genetic strain differences; mp = micropycnidium; bar pycnidia = 100 µm, chlamydospores = 20 µm and conidia = 10 µm (collage of drawings from Boerema et al., 1965 and 1977). – B. *Phoma cyanea*, differentiated by its cyan-blue pycnidia, hyphae and chlamydospores. The latter are variable, unicellular and multicellular-alternarioid.

Description in vitro

OA: growth-rate 35–70 mm, most variable in appearance, strains (sectors) with rather sparse aerial mycelium and abundant production of pycnidia and strains (sectors) with abundant aerial mycelium, dense and woolly in places, olivaceous, greenish olivaceous, olivaceous buff or dull green; reverse dark olivaceous to blackish beneath sectors with dense mycelium, paler elsewhere.

MA: growth-rate 65–75 mm.

Pycnidia 100–300 µm diam., subglobose to obpyriform, papillate or with necks of various length, usually solitary but sometimes coalescing. Conidial exudate at first rosy-buff to salmony, later becoming olivaceous-brown. In aerial mycelium and arising from a single dictyochlamydospore cell frequently fertile micropycnidia occur, 20–50 µm diam. Conidia (3.5–)4–8.5(–10) × 1.5–3(–3.5) µm, variable in shape and dimensions, mostly ovoid-ellipsoidal, sometimes slightly curved, usually biguttulate (sometimes at one pole more guttules), hyaline but with age becoming pale olive-brown and minutely roughened.

Chlamydospores highly variable in shape and dimensions, but generally multicellular-dictyosporous, occasionally solitary-terminal, but usually in branched or unbranched chains of 2–20 or more elements, smooth at first, later roughened, dark brown to black, (18–)30–65(–80) × (12–)15–25(–35) µm.

Ecology and distribution. A ubiquitous soil-borne fungus, isolated from various kinds of plants as well as from animal (human) and inorganic material. It occurs frequently on dead seed coats and has been found in association with a variety of blights, rots and other diseases (ex.: *Vitis vinifera,* Blight of vine flowers and grapes). Generally it is considered to be a secondary invader or opportunistic parasite. The cosmopolitan distribution explains its wide variability and the numerous synonyms.

Representative culture. CBS 528.66.

3. **Phoma subglomerata** Boerema, de Gruyter & Noordel., *nom. nov.* — Fig. 2A

Chlamydospore-anamorph uni- and multicellular. Alternarioid.

Ascochyta trachelospermi Fabricatore, Annali Sper. agr. II, 5 (1951) 1445; not *Phoma trachelospermi* Tassi, Boll. R. Orto bot. (Boll. Lab. Orto Bot.) Siena 3 (2) (1900 ['1899']) 30.

Description in vitro

OA: growth-rate 50–60 mm, usually only sparse greyish green aerial mycelium and abundant production of pycnidia.

Pycnidia 135–225 µm diam., subglobose to obpyriform, papillate, usually solitary but sometimes coalescing. Conidial exudate usually salmony in colour. Fertile micropycnidia frequently occur. Conidia (5–)7–12(–15) × 2–3.5(–4) µm, variable in shape and dimensions, generally oblong ellipsoidal, with two or more polar guttules, mostly continuous but frequently longer and becoming 1-septate and constricted at the septum, (8.5–)12–17 × 3–4(–4.5) µm.

Chlamydospores mostly multicellular-dictyosporous, partly in short branched and unbranched chains; partly solitary on hyphal branches and lateral from hyphal strands, dark brown to black, mostly measuring 30–65 × 15–35 µm. In addition chains of unicellular chlamydospores and series of irregular short, olivaceous cells may occur.

Ecology and distribution. The original description of this species refers to an isolate from leaves of the star jasmine *Trachelospermum jasminoides* in Italy (spots often embedded in lesions). The fungus appeared to be a plurivorous opportunistic parasite also found in Central America (Mexico) and South Africa (especially in association with leaf spotting on Gramineae: triticale, wheat and maize). Owing to the production of chains of alternarioid dictyochlamydospores the fungus has been repeatedly mistaken for *Phoma glomerata* (no. 2; compare Boerema et al., 1965 and Hosford, 1975).

In the original paper by Fabricatore it was suggested that species which under certain conditions may produce *Ascochyta*-like uniseptate conidia, should be included in '*Peyronellaea*'.

Representative culture. CBS 110.92.

4a. **Phoma pomorum** Thüm. var. **pomorum** — Fig. 2B-a

Chlamydospore-anamorph uni- and multicellular. Alternarioid.

Phoma pomorum Thümen, Fungi pomicoli (1879) 105, var. *pomorum.*

Depazea prunicola Opiz, Malá Encyclop. Nauk. Náklad cesk. Mus. 10 (1852) 120 (nomen nudum).

Phyllosticta prunicola Saccardo, Michelia 1 (2) (1878) 157 [as '(Opiz?) Sacc.']. — *Phoma prunicola* (Sacc.) Wollenweber & Hochapfel, Z. ParasitKde 8 (1936) 595 [as '(Opiz) n.c.']; not *Phoma prunicola* Schweinitz, Trans. Am. phil. Soc. II, 4 (1832) 249 ('1834' = Synopsis Fung. Am. bor.). — *Coniothyrium prunicola* (Sacc.) Husz, Magy. kertész Föisk. Közl. 5 (1939) 23 (as '*prunicolum*'). — *Peyronellaea prunicola* (Sacc.) Goidanich, Atti Accad. Nac. Lincei Rc. VIII, 1 (1946) 455 [as '(Opiz) comb. nov.'; genus then not valid, Art. 43]. — *Sphaceloma prunicola* (Sacc.) Jenkins, Arg. Inst. Biol. S. Paulo 39 (1971) 233 (misapplied).

Phoma cyperi Upadhyay, Strobel & Hess, Can. J. Bot. 68 (1990) 2059–2064; cf. holotype IMI 330492 (erroneously cited as '330402' and '230492').[1]

For full synonymy and discussion of the complicated nomenclatural history of this fungus (formerly commonly known as *Phoma prunicola*) see Boerema, Dorenbosch & van Kesteren (1971, 1977). The synonymy of the fungus includes 6 other combinations in *Phoma*, 5 in *Phyllosticta* and 6 in *Peyronellaea.*

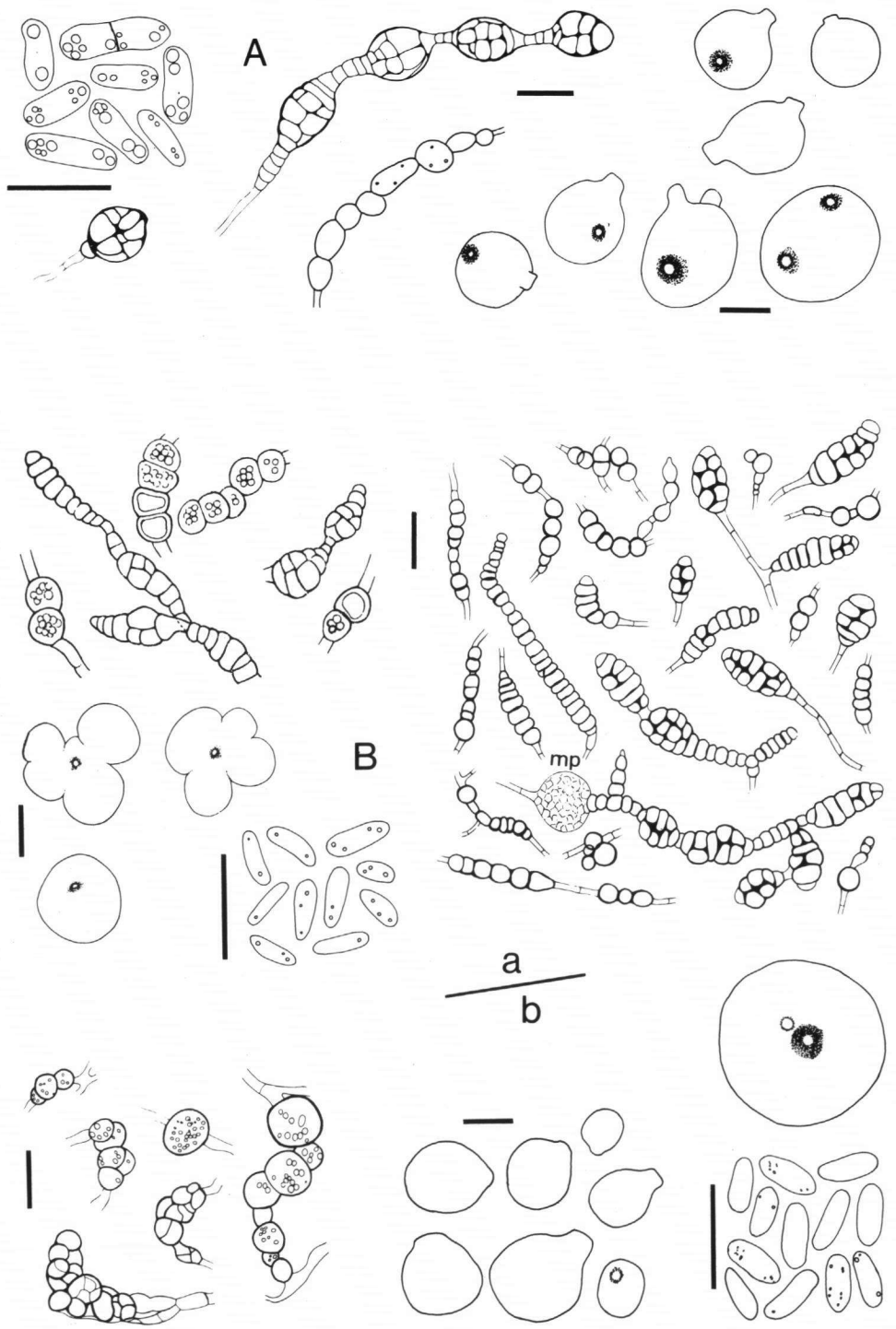
Description in vitro

OA: growth-rate 45–60 mm, variable in appearance, strains with abundant olivaceous aerial mycelium and scattered pycnidia, others with flat colonies and pycnidia in sectors; reverse brownish to blackish beneath dense mycelium, cream-coloured elsewhere.

MA: growth-rate 55–75 mm. (In contrast with var. *calorpreferens* the various strains of *P. pomorum* s.s. did not grow at 30°.)

Pycnidia mostly 100–200 µm diam., usually subglobose-ampulliform with a distinct ostiole, and often furrowed surface, solitary but frequently confluent in groups up to 1000 µm diam. Conidial exudate usually whitish to cream, often later darkening to olivaceous brown. Fertile micropycnidia frequently occur. Conidia (4–)5–7(–8) × 1.5–2.5(–3) µm, variable in shape and dimensions, mostly ovoid-ellipsoidal, frequently with one large guttule and several slightly smaller ones, hyaline, but with age becoming light brown.

[1] The description of this most recent synonym also fits in completely with *P. pomorum.* The distinction as a separate species was mainly based on the differences from *P. glomerata* (no. 2) which it was first mistaken for.


A
B
mp
a
b

Chlamydospores highly variable in shape, unicellular and multicellular, i.e. dictyosporous-phragmosporous, where unicellular often in long chains, usually guttulate, thick-walled, smooth or roughened, pale brown to brown, 8–10 µm diam., where multicellular usually dictyosporous, mostly terminal, on mycelial branches, occasionally intercalary in combination with chains of unicellular chlamydospores, smooth later roughened, brown to black, mostly 18–60 × 12–30 µm.

Ecology and distribution. A world-wide recorded soil- and seedborne opportunistic parasite. Records from tropical regions may refer to the warmth preferring variety *calorpreferens* treated below. The fungus is frequently found in association with leaf spots on the Pomoideae of the Rosaceae (apple, pear, stone fruits). In Europe it is also often isolated from roots of stunted strawberry plants, *Fragaria* × *ananassa* (Black root rot complex).

Representative culture. CBS 539.66.

4b. **Phoma pomorum** var. **calorpreferens** Boerema, de Gruyter & Noordel., *var. nov.* — Fig. 2B-b

Chlamydospore-anamorph uni- and multicellular. Alternarioid.

A varietate typica differt circa 30°C crescens.
Holotypus: Siccus in L conservatus est no. 990.290 418.

Description in vitro

OA: growth-rate similar to that of var. *pomorum,* often abundant production of pycnidia and tufts of whitish aerial mycelium; reverse usually with yellowish (citrine) tinges. (In contrast with var. *pomorum,* the various strains of this variety grow well at 30°C.)

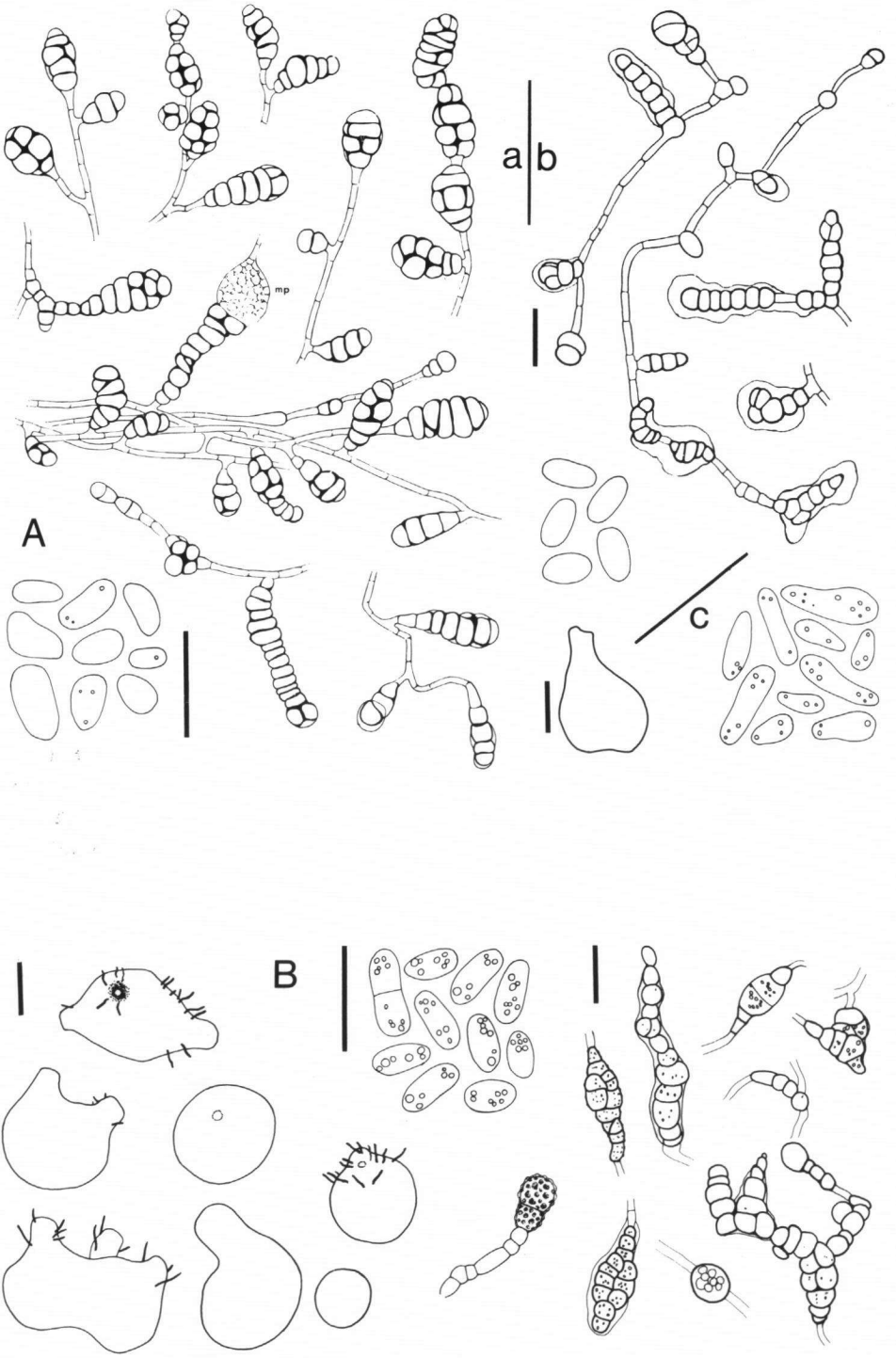
Pycnidia similar to those of var. *pomorum,* subglobose non-papillate, but usually smooth and not furrowed, conidial exudate usually pinkish and not whitish-cream as in var. *pomorum.* Conidia (4–)5–8.5(–12) × 2–3(–3.5) µm, in average larger than those of var. *pomorum,* and often oblong-ellipsoidal.

Chlamydospores like those of var. *pomorum* highly variable, unicellular and multicellular-dictyosporous; the unicellular chlamydospores may be very dark and sometimes extremely large, up to 25 µm diam.

Ecology and distribution. This newly recognized warmth preferring variety of *Phoma pomorum* has been found in Europe as well as in North America. The isolate sources indicate a plurivorous behaviour, corresponding to that of var. *pomorum.* Various records of the latter may refer in fact to var. *calorpreferens.*

Representative culture. CBS 109.92.

Fig. 2. A. *Phoma subglomerata,* e.g. characterized by short chains and solitary alternarioid multicellular chlamydospores. Conidia relatively long and sometimes two-celled. – B. Varieties of *Phoma pomorum.* Complex unicellular and alternarioid multicellular chlamydospores. Above (a) var. *pomorum,* often producing divided pycnidia; mp = micropycnidium (collage of drawings from Boerema et al., 1965 and 1977). At bottom (b) the southern var. *calorpreferens* without divided pycnidia and often somewhat larger conidia.


a
b
A
mp
c
B

5a. **Phoma jolyana** Pirozynski & Morgan-Jones var. **jolyana** — Fig. 3A-a

Chlamydospore-anamorph multicellular. Alternarioid.

Phoma jolyana Pirozynski & Morgan-Jones, Trans. Br. mycol. Soc. 51 (June, 1968) 200, var. *jolyana.*

Peyronellaea musae Joly, Revue mycol. 26 (July, 1961) 97. — *Phoma musae* (Joly) Boerema, Dorenbosch & van Kesteren, Persoonia 4 (1965) 63; not *Phoma musae* (Cooke) Saccardo, Sylloge Fung. 3 (1884) 163; not *Phoma musae* Carpenter, Rep. Hawaii agric. Exp. Stn 1918 (1919) 39.

Phoma jolyi Morelet, Bull. Soc. Sci. nat. Archéol. Toulon Var 177 (July, 1968) 9.

Peyronellaea nainensis Tandon & Bilgrami, Curr. Sci. 30 (Dec., 1961) 344; not *Phoma nainensis* Bilgrami, Curr. Sci. 32 (1963) 175.

Description in vitro

OA: growth-rate 50–55 mm, aerial mycelium felted, blackish, greenish olivaceous to dull black; reverse dark olivaceous buff to amber. (Optimum growth at c. 25°C; no growth at 30°C.)

Pycnidia 150–200 µm diam., subglobose to obpyriform, papillate, mostly uniostiolate and solitary. Conidial exudate usually salmony in colour. In aerial mycelium frequently fertile micropycnidia occur. Conidia (3.5–)4–7(–8.5) × 2–4 µm, variable in shape and dimensions, mostly broad ellipsoidal to obovoid or somewhat allantoid, often biguttulate but also eguttulate.

Chlamydospores generally multicellular-dictyo/phragmosporous, occasionally intercalary, but frequently as terminal elements of short lateral branches, sometimes becoming lateral through continued growth of a constituent cell, usually solitary, smooth or irregular roughened, tan to dark brown, 13–45(–50) × 7–20(–25) µm.

Ecology and distribution. A common soil-borne fungus in subtropical regions of Eurasia and Africa. In Siberia and in the Sahara adapted varieties of the fungus occur, see below (var. *circinata* and var. *sahariensis*). Although *P. jolyana* occasionally has been recorded as a plant pathogen this fungus is probably always only a secondary invader of diseased or weakened plant tissue.

Representative culture. CBS 463.69.

5b. **Phoma jolyana** var. **circinata** (Kuznetz.) Boerema, Dorenbosch & van Kesteren Fig. 3A-c

Chlamydospore-anamorph multicellular. Alternarioid.

Phoma jolyana var. *circinata* (Kuznetz.) Boerema, Dorenbosch & van Kesteren, Kew Bull. 31 (3) (1997) 535 ('1976'). — *Peyronellaea circinata* Kuznetzova, Nov. Sist. Nas. Rast 8 (1971) 189.

Peyronellaea nigricans Kuznetzova, Nov. Sist. Nas. Rast 8 (1971) 191.

Fig. 3. A. Varieties of *Phoma jolyana.* Terminal alternarioid multicellular chlamydospores becoming more or less lateral by continued growth of the hyphae. Note the alternating arrangement. Left (a) var. *jolyana,* right (b) var. *sahariensis* and bottom right (c) var. *circinata* (drawings after Boerema et al., 1965, 1977 and Boerema, 1983). – B. *Phoma americana,* pycnidia often covered by hyphae (semi-pilose), conidia (occasionally two-celled), chlamydospores variable, unicellular and alternarioid multicellular. The latter may become heavily melanized and roughened like *Epicoccum*-conidia (drawing from Morgan-Jones & White, 1983).

Description in vitro

OA: growth-rate about the same as that of var. *jolyana,* differing in the powdery appearance (clusters of dictyochlamydospores) and honey discolouration below the colony.

MA: reverse citrine-olivaceous. (No growth at 30°C.)

Pycnidia similar to those of var. *jolyana.* Conidia (3.5–)5–9 × 2–3.5 µm, i.e. generally somewhat longer, smaller and more irregular in shape than those of var. *jolyana,* often with several small polar guttules.

Chlamydospores multicellular-dictyo/phragmosporous, similar to those of var. *jolyana,* but much more abundant, forming large irregular clusters.

Ecology and distribution. This variety refers to Russian isolates made in Novosibirsk. The abundant production of thick-walled dictyochlamydospores may be interpreted as an adaptation to the cool continental climate.

Representative culture. CBS 285.76.

5c. **Phoma jolyana** var. **sahariensis** (Faurel & Schotter) Boerema, Dorenbosch & v.d. Aa — Fig. 3A-b

Chlamydospore-anamorph multicellular. Alternarioid.

Phoma jolyana var. *sahariensis* (Faurel & Schotter) Boerema, Dorenbosch & van der Aa apud Boerema, Versl. Meded. Plziektenk. Dienst Wageningen 159 (Jaarb. 1982) (1093) 27. — *Sphaeronaema sahariense* Faurel & Schotter, Revue mycol. 30 (1965) 156; not *Phoma sahariensis* Faurel & Schotter, Revue mycol. 30 (1965) 154.

Description in vitro

OA: growth-rate about the same as that of var. *jolyana,* but distinguished by conspicuous yellow-olivaceous aerial mycelium and a somewhat *Epicoccum*-like appearance, yellow discolouration below the colony and absence of pycnidia. (Optimum growth and pycnidia production at c. 28–30°C.)

Pycnidia occur only at temperature ranges of 28–30°C, but do not differ essentially from those of var. *jolyana*; however, they may have a pronounced neck. Conidia 4–5.5 (–6) × (2–)2.5–3 µm, ellipsoidal-obovoid, somewhat shorter and much more consistent in shape than those of var. *jolyana,* usually eguttulate.

Chlamydospores multicellular-dictyo/phragmosporous, similar to those of var. *jolyana,* but often with a kind of halo.

Ecology and distribution. This variety is recorded from hare droppings in Central Sahara, desert soil in Egypt and seed of *Cucumis sativus* of European origin. Apparently a variety adapted to relatively high temperatures. The frequently occurring pronounced neck of the pycnidia explains its originally classification in the genus *Sphaeronaema.*

Representative culture. CBS 448.83.

6. **Phoma americana** Morgan-Jones & White — Fig. 3B

Chlamydospore-anamorph uni- and multicellular. Alternarioid.

Phoma americana Morgan-Jones & White, Mycotaxon 16 (2) (1983) 406–412.

Description in vitro

OA: growth-rate 52–58 mm diam., aerial mycelium tenuous, particularly in a wide marginal zone, underground greenish olivaceous, reverse also greenish olivaceous. (At 30°C also fast-growing, even up to 65 mm diam.)

MA: growth-rate always rather slow, usually c. 35 mm diam.

Pycnidia 100–220 µm diam., subglobose, papillate or with a short cylindrical neck, often multiostiolate and confluent reaching up to 850 µm diam., covered to varying degrees by hyphae. Conidial exudate salmony in colour. Conidia mostly 5–8(–8.5) × 2–3(–3.5) µm, irregular cylindrical-ellipsoidal, frequently biguttulate, occasionally 1-septate, 8–12(–13.5) × 3–3.5(–4) µm.

Chlamydospores very variable, terminal or intercalary, solitary or in chains, uni- or multicellular, when septate phragmosporous or dictyosporous, smooth or roughened, pale brown to brown, occasionally heavily melanized and roughened as in *Epicoccum*-conidia, mostly 15–25 µm diam. Unicellular chlamydospores mostly 7–18 µm diam. and with conspicuous guttules.

Ecology and distribution. This seems to be a plurivorous soil-borne fungus of American origin. The isolates were obtained from the southeastern United States, mainly in regions with a subtropical climate. This explains its ability to grow fast at 30°C. The host-plants so far recorded are Gramineae (wheat, maize). The fungus resembles in some respects *Phoma pomorum* var. *calorpreferens*.

Representative culture. CBS 185.85

7. **Phoma sorghina** (Sacc.) Boerema, Dorenbosch & van Kesteren — Fig. 4A

Chlamydospore-anamorph uni- and multicellular. Botryoid-alternarioid.

Phoma sorghina (Sacc.) Boerema, Dorenbosch & van Kesteren, Persoonia 7 (1973) 139. — *Phyllosticta sorghina* Saccardo, Michelia 1 (2) (1878) 140.

Phoma insidiosa Tassi, Boll. R. Orto Bot. Siena 1 ('1897') (1898) 8.

Peyronellaea indianensis Deshpande & Mantri, Mycopath. Mycol. appl. 30 (1966) 341–344. — *Phoma indianensis* (Deshpande & Mantri) Boerema, Dorenbosch & van Kesteren, Persoonia 5 (2) (1968) 203.

Peyronellaea stemphylioides Kuznetzova, Nov. Sist. Niz. Rast 8 (1971) 199.

For full synonymy see Boerema, Dorenbosch & van Kesteren (1977). It includes 4 other combinations in *Phoma* and 10 in *Phyllosticta*.

Description in vitro

OA: growth-rate 50–70 mm diam., aerial mycelium fluffy, sometimes compact with greyish-green or whitish-salmon pink tinges and occasionally reddish exudate droplets; reverse often with reddish discolouration and occasionally needle-like crystals (anthraquinone pigments; yellow in acid conditions). About 50 percent of the strains showed a positive reaction with the sodium hydroxide test: on application of a drop NaOH green → red (E+).

MA: growth-rate 50–80 mm diam.

Pycnidia 50–200 µm diam., subglobose, usually with a distinct straight or somewhat curved neck up to 80 µm long, occasionally touching but usually not confluent. Conidial exudate usually salmony in colour. In aerial mycelium occasionally aberrant small non-osti-

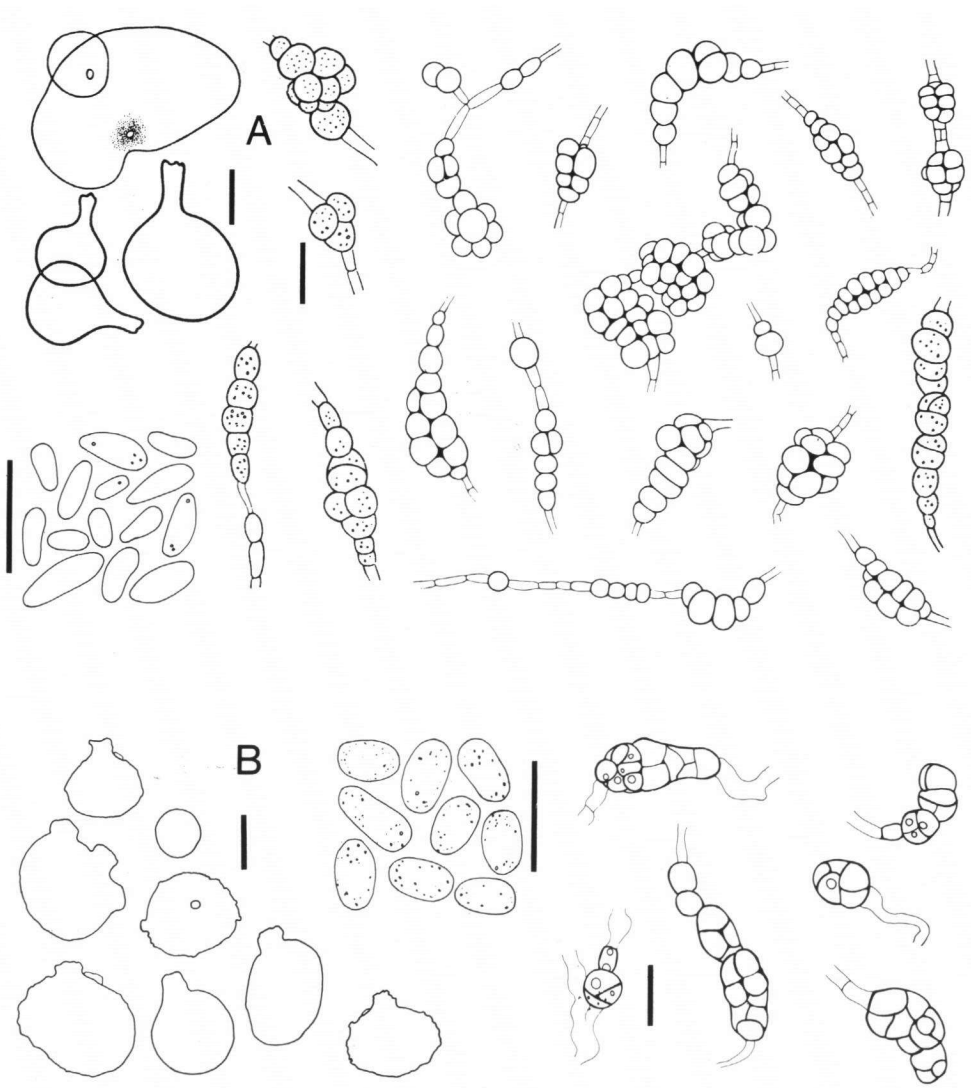


Fig. 4. A. *Phoma sorghina*, characterized by irregular, botryoid-alternarioid multicellular chlamydospores and intermediate stages between unicellular and multicellular chlamydospores. The pycnidia of this species are often rostrate (collage of drawings from Boerema et al., 1968 and 1977). – B. *Phoma pimprina*, resembles multicellular chlamydospores and pycnidia of *P. sorghina*, but easily differentiated by the broad conidia.

olate pycnidia occur, 5–23 µm diam. Conidia (4–)4.5–7(–8.5) × (1.5–)2–3(–3.5) µm, most variable in shape and dimensions, mostly ovoid-ellipsoidal, sometimes curved, mostly eguttulate, occasionally with 1–3 polar guttules, hyaline, or sometimes very pale brown.

Chlamydospores highly variable and irregular, uni- or multicellular, mostly intercalary, sometimes terminal-lateral, solitary or in chains, when septate usually dictyosporous, of-

ten with a botryoid configuration, smooth, verrucose or, rarely, tuberculate, subhyaline to brown, 8–35 µm diam., non-septate chlamydospores 5–15 µm diam.

Ecology and distribution. A common soil-borne fungus in the tropics and subtropics, which occasionally also has been recorded in temperate regions – especially on plants in glasshouses – and in regions with a continental climate. The fungus is most frequently associated with Gramineae, such as rice, sorghum, sugar-cane and wheat: spots on leaves, glumes and seed; root-rot and dying-off. Usually, the fungus only behaves like a weak parasite and secondary invader of diseased or weakened plants. Some strains of the fungus can produce a metabolite which is toxic to rats, chickens and insects. *Phoma sorghina* is further reported as an opportunistic pathogen of man and mammal (erethematous lesions on the skin).

Representative culture. CBS 284.77.

8. **Phoma pimprina** Mathur, Menon & Thirumalachar — Fig. 4B

Chlamydospore-anamorph uni- and multicellular. Botryoid-alternarioid.

Phoma pimprina Mathur, Menon & Thirumalachar apud Mathur & Thirumalachar, Sydowia 13 (1959) 146a–147.

Description in vitro

OA: growth-rate 40–55 mm, flat, with scarce aerial mycelium and abundant production of pycnidia; reverse often with lilac-pinkish discolouration.

Pycnidia mostly 115–230 µm diam., subglobose to globose, usually with pronounced necks and wide ostioles, mostly solitary and not confluent. Conidial exudate salmony. Conidia (4–)6–7(–8.5) × (3–)3.5–4(–4.5) µm, broad oblong-ovate, usually fine guttulate.

Chlamydospores usually scanty, variable and irregular, uni- or multicellular, intercalary or terminal, mostly solitary, when septate usually dictyosporous, often somewhat botryoid, smooth-verrucose, subhyaline to brown, 8–35 µm diam., when non-septate usually in chains, 5–15 µm diam.

Ecology and distribution. This fungus is thus far only known from soil in India (various isolates). The fungus in many respects resembles *Phoma sorghina,* treated before (no. 7), but can be differentiated very easily by the consistent broad oblong-ovate conidia.

Representative culture. CBS 246.60.

9. **Phoma zantedeschiae** Dippenaar — Fig. 5B

Chlamydospore-anamorph multicellular. Irregular botryoid-alternarioid.

Phoma zantedeschiae Dippenaar, S. Afr. J. Sci. 28 (1931) 284.

Phyllosticta richardiae Halsted, Rep. New Jers. agric. Coll. Exp. Stn 6 [= Rep. New Jers. St. agric. Exp. Stn 14 (1893)] (1894) 400 (without description).

Phyllosticta richardiae Brooks, Ann. appl. Biol. 19 (1932) 18, 19; not *Phoma richardiae* Mercer, Mycol. Centbl. (Mykol. Zentbl.) 2 (1913) 244, 297, 326 [= *Phoma glomerata* (Corda) Wollenw. & Hochapf.].

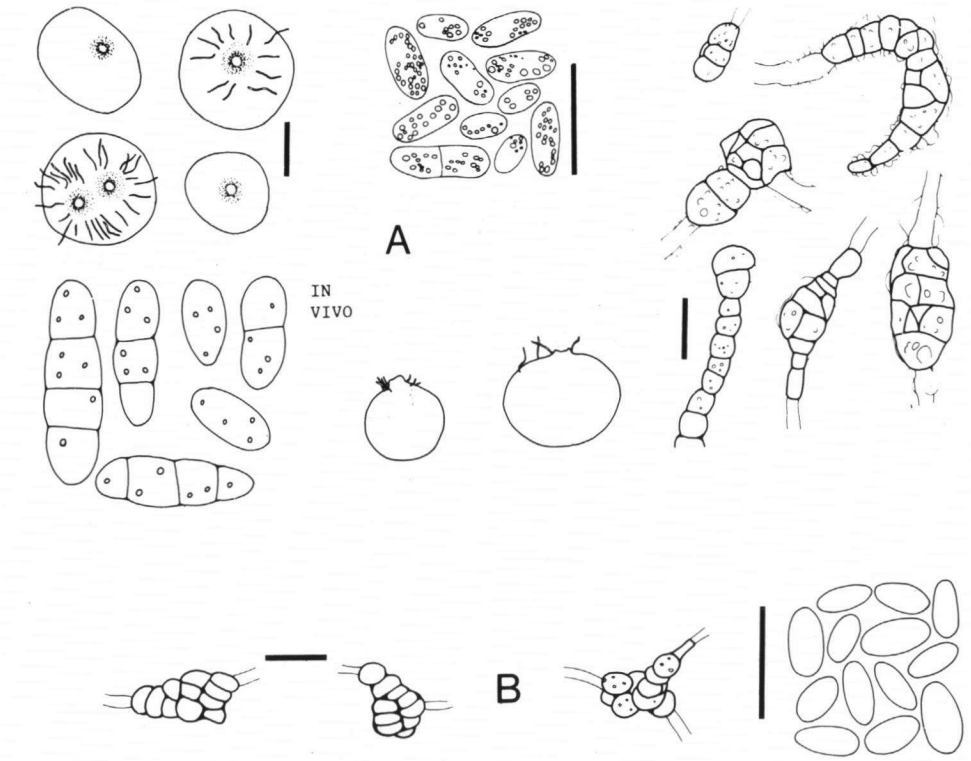


Fig. 5. A. *Phoma narcissi*, produces irregular complex unicellular chlamydospores and botryoid-alternarioid multicellular chlamydospores. Pycnidia often covered by hyphae (semi-pilose). Conidia fine guttulate and occasionally two-celled; in vivo often much larger and 2–3-septate. – B. *Phoma zantedeschiae*, characterized by irregular botryoid-alternarioid multicellular chlamydospores. Conidia eguttulate, unicellular and variable in dimensions (reproduced from Jauch, 1947).

Description in vitro (partly adopted from Brooks, 1932 and Jauch, 1947)

Growth-rate 70–80 mm, aerial mycelium fairly abundant, white when young but rapidly becoming greyish brown; reverse grey to almost black in the centre.

Pycnidia 90–180 µm diam., subglobose or depressed, usually uni-ostiolate, mostly solitary, sometimes compound. Conidial exudate greyish. Conidia variable in dimensions, (3–)4–7(–8) × (2–)2.5–3.5(–4) µm, oval or ellipsoidal, often pointed at one end, eguttulate.

Chlamydospores variable-multicellular, mostly intercalary, occasional terminal, usually solitary, irregular botryoid-dictyosporous, dark brown, 15–40 µm diam.

Ecology and distribution. This fungus may cause large brown blotches on the leaves and 'flowers' (i.e. spathes) of the arum- or calla lily, *Zantedeschia aethiopica* (formerly *Richardia africana*). The disease – known as Leaf Blotch – is recorded from South Africa (centre of diversity for *Zantedeschia* spp.), western Europe, North and South America.

The fungus has been confused with the ubiquitous *Phoma glomerata* (no. 2); compare Boerema & Hamers (1990).

Representative culture. CBS 267.31 (type culture of *Phyllosticta richardiae* Brooks).

10. **Phoma narcissi** (Aderh.) Boerema, de Gruyter & Noordel., *comb. nov.* — Fig. 5A

Chlamydospore-anamorph uni- and multicellular. Irregular botryoid-alternarioid.

Phyllosticta narcissi Aderhold, Centbl. (Zentbl.) Bakt. ParasitKde Abt. 2, 6 (May, 1900) 632, 633 (basionym).

Hendersonia curtisii Berkeley apud Cooke, Nuovo G. bot. ital. 10 (1878) 19 ('Berk., herb. Curt.'); not *Phoma curtisii* Saccardo, Sylloge Fung. 3 (1884) 860. — *Stagonospora curtisii* (Berk.) Saccardo, Sylloge Fung. 3 (1884) 451. — *Stagonosporopsis curtisii* (Berk.) Boerema apud Boerema & Dorenbosch, Versl. Meded. Plziektenk. Dienst Wageningen 157 (Jaarb. 1980) (1981) 19, 20.

Phyllosticta narcissi Oudemans, Ned. kruidk. Archf III, 2 (1) (August, 1900) 227. — *Phyllosticta oudemansii* Saccardo & P. Sydow, Sylloge Fung. 16 (1902) 849.

Stagonospora narcissi Hollós, Annls hist.-nat. Mus. natn. hung. 5 (1906) 354, 355.

Stagonospora crini Bubák & Kabát, Hedwigia 47 (1908) 361.

Phyllosticta hymenocallidis Seaver, N. Am. Flora 6 (1) (1922) 12 (second impression 1961).

Phoma amaryllidis Kotthoff & Friedrichs, Obst- u. Gartenbau Ztg 18 (1929) 32, 33.

Phyllosticta gemmipara Zondag, Tijdschr. PlZiekt. 35 (1929) 97–107.

Description in vitro

OA: growth-rate 80–84 mm, aerial mycelium compact woolly-fluffy, smoky-grey; reverse grey-olivaceous to olivaceous-grey, locally leaden-grey, centre olivaceous-black.

Pycnidia 110–275 µm diam., globose, usually somewhat compressed, with a definite ostiole, often covered by hyphae. Conidial exudate rosy-buff. Conidia usually one-celled, broadly ellipsoidal, finely guttulate, 4–7.5(–8) × (2–)2.5–3.5(–4) µm, occasionally larger and two-celled, 8–15 × 3–5.5 µm. (In vivo the conidia may be extremely large and mainly 2–4-celled, in length varying from 8–28 µm and in width from 3–8 µm!)

Chlamydospores uni- and multicellular, where unicellular usually intercalary in short chains, dark brown, 8–15 µm diam., where multicellular mostly intercalary, occasionally terminal, usually solitary, sometimes in series of 2–3 elements, irregular botryoid-dictyosporous, mostly somewhat curvate and very dark brown, 8–35 µm diam. Hyphae and chlamydospores often bearing more or less hemispherical or flattened droplet-like deposits, which, when becoming darker give an impression of ornamentation.

Ecology and distribution. A world-wide recorded pathogen of *Narcissus, Hippeastrum* and various other Amaryllidaceae: Leaf Scorch, Neck Rot, Red Spot Disease, Red Leaf Spot. The synonymy reflects, apart from its plurivorous character, the extreme variability of its conidia.

On leaves and scales the fungus produces mostly pycnidia with only relatively small aseptate *Phoma*-like conidia, similar to those in vitro, but pycnidia with much larger multiseptate *Stagonospora*-like conidia often also occur (Fig. 5A). On account of this phenomenon there has been much discussion about the generic classification of the fungus. Formerly the solution to this difficulty was by the placement of this pathogen (and similar fungi) in a separate genus, viz. *Stagonosporopsis* Died.; compare Boerema & Hamers

(1989). However, on the basis of the characteristics in culture (identification-possibility in vitro) the fungus has to be classified in *Phoma*, as done above. A similar case is *Phoma clematidina* (no. 11).

Representative culture. CBS 251.92.

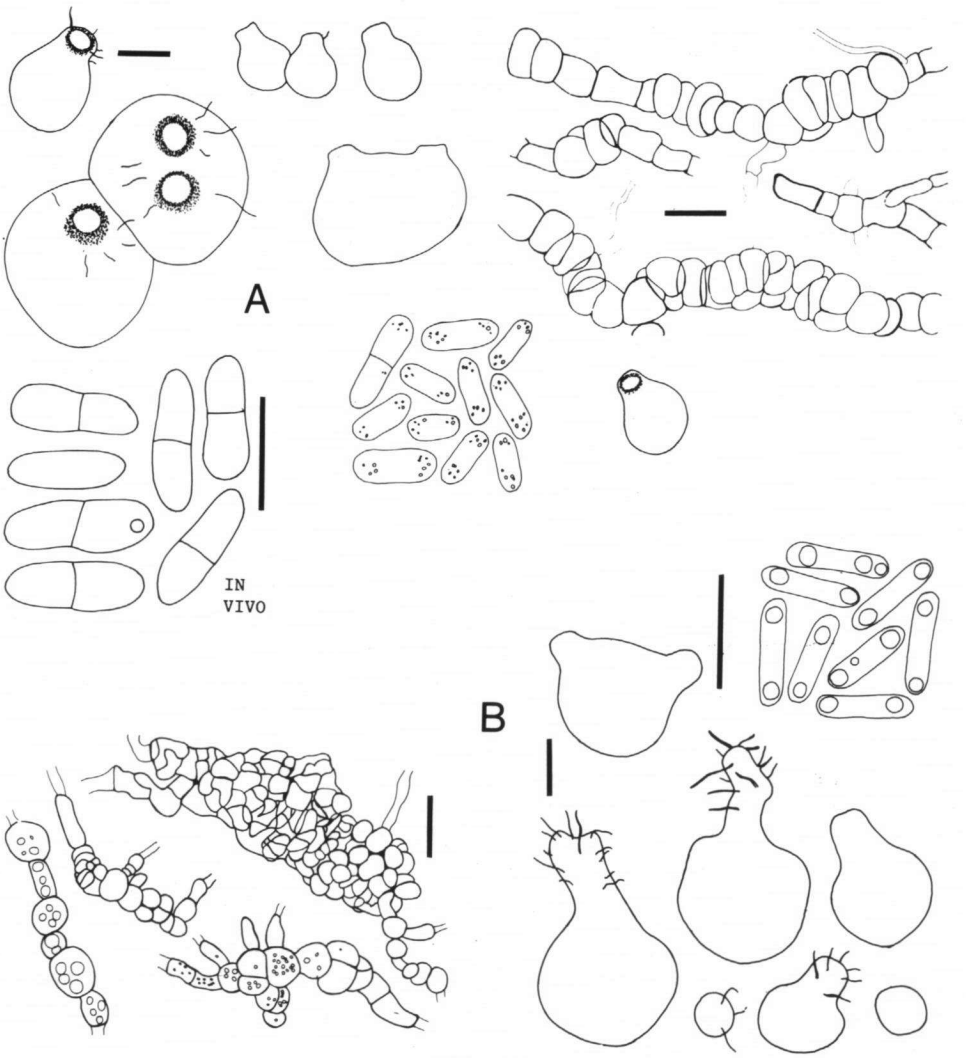


Fig. 6. A. *Phoma clematidina*, produces irregular complexes and series of unicellular and multicellular botryoid-alternarioid chlamydospores. The pycnidia may have some hyphae around the ostiole (semi-pilose). The large conidia are occasionally two-celled; in vivo they are usually much larger and mainly two-celled. – B. *Phoma violicola*, characterized by various intermediate stages between irregular botryoid-alternarioid and pseudosclerotioid chlamydosporal structures. The necks of the pycnidia are often covered by hyphae (semi-pilose). Conidia relatively large, with two conspicuous guttules.

11. Phoma clematidina (Thüm.) Boerema — Fig. 6A

Chlamydospore-anamorph uni- and multicellular. Irregular botryoid-alternarioid.

Phoma clematidina (Thüm.) Boerema apud Boerema & Dorenbosch, Versl. Meded. Plziektenk. Dienst Wageningen 153 (Jaarb. 1978) (1979) 17, 18. — *Ascochyta clematidina* Thümen, Bull. Soc. imp. Nat. Moscou 55 (1880) 98.

Diplodina clematidina Fautrey & Roumeguère apud Roumeguère, Revue mycol. 14 (1892) 105.

Ascochyta vitalbae Briard & Hariot apud Briard, Revue mycol. 13 (1891) 17. — *Diplodina vitalbae* (Briard & Har.) Allescher, Rabenh. Krypt.-Flora (ed. 2) Pilze 6 (Lief. 69) (1900) 683.

Ascochyta indusiata Bresadola, Hedwigia 35 (1896) 199.

Ascochyta davidiana Kabát & Bubák, Öst. bot. Z. 54 (1909) 25.

Description in vitro

OA: growth-rate 45–55 mm, aerial mycelium whitish to olivaceous-grey, reverse buff-yellowish, often with needle-like crystals (anthraquinone derivatives).

MA: growth-rate 25–40 mm. Hyphae often conspicuously curved.

Pycnidia 110–120 µm diam., usually subglobose with dark circumvallated ostioles, often with some hyphae around, mostly solitary. Conidial exudate honey-coloured or salmony. Conidia usually (3.5–)4–8.5(–9) × 2–3(–3.5) µm, occasionally larger and 1-septate, 9–13 × 3–4 µm, variable in shape, subellipsoidal to cylindrical, usually guttulate. (In vivo the conidia may vary in length from 6 to 28 µm and in width from 3 to 6 µm!)

Chlamydospores usually scanty, uni- or multicellular, where unicellular usually intercalary in short chains, guttulate, thick-walled, green-brown, 8–10 µm diam., where multicellular, irregular dictyo/phragmosporous, often somewhat botryoid and in combination with unicellular chlamydospores, tan to dark brown 3–50 × 12–25 µm.

Ecology and distribution. In Eurasia, Australasia and North America this fungus is frequently found in association with leaf spots and stem lesions on naturally-wilting cultivars and hybrids of *Clematis* spp. It may be regarded as an opportunistic parasite.

As noted above, in vivo the conidia of this fungus are extremely variable in dimensions; besides they are mainly two-celled (Fig. 6A). This explains the extensive synonymy of the fungus in the genera *Ascochyta* Lib. (on leaves) and *Diplodina* Auct. (on stems). In old pycnidia the conidia may become dark coloured and occasionally three-celled. Such conidia were found in an isotype of *A. clematidina* [LE; see Mel'nik (1977) 181: "= *Phaeostagonosporopsis* sp."]. Compare the note under *Phoma narcissi* (no. 10).

Representative culture. CBS 108.79.

12. Phoma violicola P. Syd. — Fig. 6B

Chlamydospore-anamorph uni- and multicellular. Irregular botryoid-alternarioid and pseudosclerotioid.

Phoma violicola P. Sydow, Beibl. Hedwigia 38 (1899) 137.

Phyllosticta violae f. *violae-hirtae* Allescher, Rabenh. Krypt.-Fl. (ed. 2) Pilze 6 (Lief. 61) (1898) 156 (vol. dated '1901').

Phyllosticta violae f. *violae-sylvaticae* Fragoso, Trab. Mus. nac. Cienc. nat. (Bot). Madr. 7 (1914) 35.

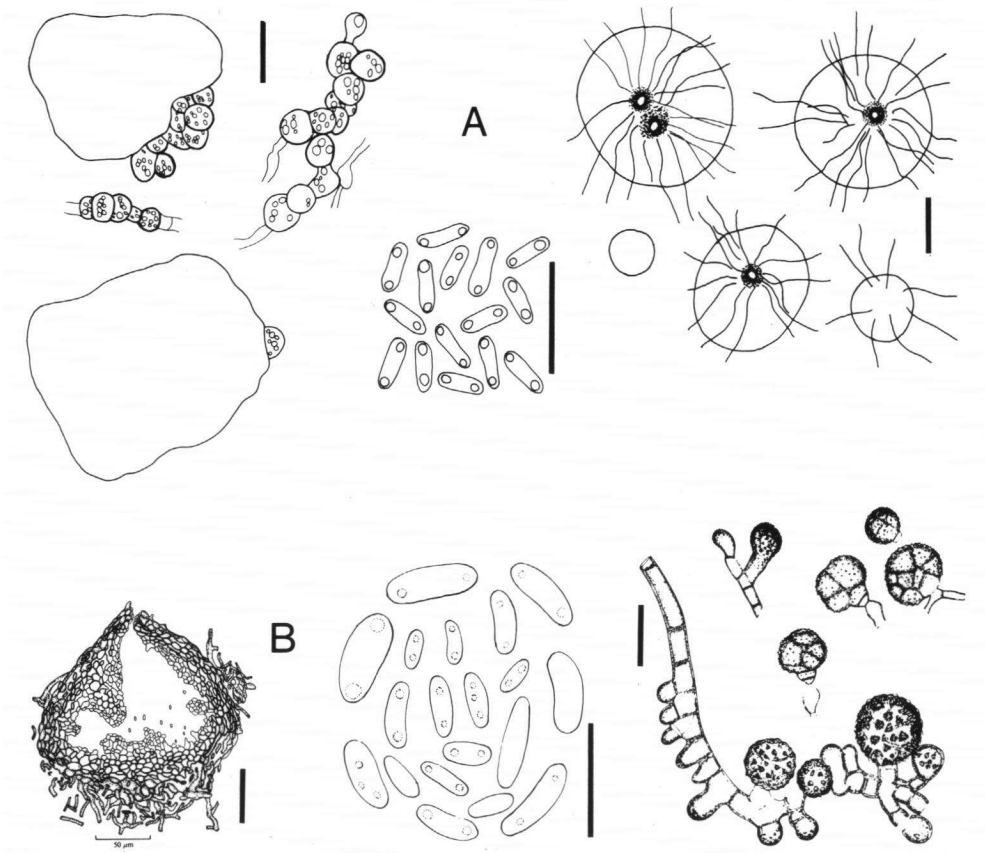


Fig. 7. A. *Phoma chrysanthemicola*, characterized by aggregates of unicellular chlamydospores forming large irregularly-shaped pseudosclerotioid masses. Pycnidia usually semi-pilose, conidia biguttulate, and often somewhat dumb-bell shaped. – B. *Phoma epicoccina*, in vitro characterized by the presence of a typical *Epicoccum*-anamorph. Pycnidia more or less stromatic, usually intermixed with pycnosclerotia. Conidia highly variable in shape and dimensions (drawings after Punithalingam, Tulloch & Leach, 1972).

Description in vitro

OA: growth-rate 18–20 mm diam., aerial mycelium felted, whitish to pale olivaceous-grey, underground grey-olivaceous to dull-green, with olivaceous-black concentric zones of pycnidia, reverse similar.

Pycnidia 125–250 µm diam., usually subglobose, mostly uniostiolate, sometimes papillate or with a cylindrical neck of variable length, often covered by hyphae, mostly solitary but sometimes aggregated; exudate whitish. Fertile micropycnidia also occur, 60–100 µm diam., both in aerial mycelium and in the agar. Conidia (7.5–)9–10(–11) × 2–3 µm, cylindrical usually biguttulate.

Chlamydospores highly variable and irregular, mostly intercalary but sometimes terminal, where unicellular usually in short chains, olivaceous-brown, 5–11 µm diam., where multicellular forming dictyosporous-botryoid configurations or pseudosclerotioid structures, olivaceous-brown in colour and very different in size and shape.

Ecology and distribution. In Europe this fungus is repeatedly found in association with leaf spots on various wild species of *Viola*. It seems to be an opportunistic parasite which may also affect cultivated *Viola* spp. In some reports the fungus has been identified as '*Phyllosticta violae* Desm. s.s.', but the holotype of that species refers to unripe ascomata (pers. inform. Dr. H.A. van der Aa, CBS-Baarn).

Representative culture. CBS 306.68.

13. **Phoma chrysanthemicola** Hollós (sensu lato) — Fig. 7A

Chlamydospore-anamorph uni- and multicellular. Pseudosclerotioid.

Phoma chrysanthemicola Hollós, Annls hist.-nat. Mus. natn. hung. 5 (1907) 456.

Description in vitro

OA: growth-rate 30–40 mm, regular, but variable in appearance, strains with abundant woolly aerial mycelium, and strains with less conspicuous loose velvety mycelium, in both cases pale olivaceous-grey, the agar grey-olivaceous to dull green; reverse similar, but in most strains after a few days a sienna discolouration of the agar occurs, associated with the formation of orange-red crystals. Occasionally the discolouration is more red-violet and sometimes yellow (apparently a complex of pigments is involved). Addition of NaOH causes the colour to fade.

Pycnidia 150–350 µm diam., subglobose, papillate or flask-shaped, solitary but often coalescing to large irregular fructifications with many ostioles, usually covered by hyphae. Fertile micropycnidia frequently occur, 40–100 µm diam. Conidial exudate white-yellowish. Conidia (3.5–)4–5.5(–6.5) × 1.5–2(–2.5) µm, cylindrical with two guttules, often somewhat dumb-bell shaped, hyaline.

Chlamydospores numerous, globose or subglobose, 5–11 µm diam., olivaceous, single or in long chains and often aggregated into large irregularly-shaped olivaceous-black pseudosclerotioid masses. These structures may be present in abundance in the aerial mycelium; however, it may take several weeks before they appear.

Ecology and distribution. A common saprophytic soil fungus in most temperate regions. It has been isolated from roots and stems of various Compositae and other herbaceous plants in central and western Europe, southeastern Asia, North America and Australasia. In Belgium the fungus is frequently found in association with stunted roots of scorzonera (in the Netherlands ascribed to free living nematodes).

f. sp. **chrysanthemicola** [Schneider & Boerema, Phytopath. Z. 83 (1975) 242.]

The selected type of the species refers to a specialized pathogenic form on florists' chrysanthemums, *C. morifolium* (*indicum*). This pathogen has been recorded in western Europe and North America (United States and Canada): Root Rot or Basal Stem Rot.

Representative cultures. CBS 522.66, CBS 172.70.

14. **Phoma epicoccina** Punith., Tulloch & Leach — Fig. 7B

Chlamydospore-anamorph multicellular. Epicoccum sp.

Phoma epicoccina Punithalingam, Tulloch & Leach, Trans. Br. mycol. Soc. 59 (1972) 341–344.

Description in vitro

OA: growth-rate 60–70 mm, aerial mycelium floccose, extremely variable in pigmentation, mostly yellowish to bright yellow or pink to purple-red. The pigment also diffuses into the agar, but the colour of the mycelium and the agar are not always the same; reverse also variable in colour, but mostly grey to almost black in the centre.

Pycnidia 120–200 µm diam., subglobose to globose, solitary or confluent, intermixed among 'pycno'sclerotia, 200–400 µm diam. Pycnidial wall and sclerotia composed of compressed brown cells, heavily pigmented and thick-walled on the outer side. Conidial exudate whitish. Conidia 3–7(–10) × 1.5–3(–3.5) µm, most variable in shape and dimensions, usually shortly cylindrical, sometimes slightly curved, eguttulate or with 2–3 polar guttules.

Chlamydospores produced in sporodochia (representing the *Epicoccum*-anamorph), multicellular-phragmosporous, but the septa being obscured by the dark-brown to black verrucose outer wall, subglobose-pyriform, often with a paler basal cell, variable in dimensions, but mostly 15–35 µm diam., arising in gradually growing clusters as solitary, terminal elements of mycelial side branches, from a more or less globose pseudoparenchymatous stroma. The sporodochia may be present in abundance, scattered or aggregated.

Ecology and distribution. A world-wide recorded seed-, air- and soil-borne saprophyte. It appeared to be a common contaminant of grass seeds. The fungus has been isolated once from a human toe-nail. The *Epicoccum*-anamorph is indistinguishable from *Epicoccum nigrum* Link; therefore it is quite possible that *P. epicoccina* has often been confused with the latter.

Representative culture. CBS 173.73 (= IMI 164070 = ATCC 24428).

REFERENCES

Aa, H.A. van der, M.E. Noordeloos & J. de Gruyter. 1990. Species concepts in some larger genera of the Coelomycetes. Stud. Mycol. 32: 3–19.

Boerema, G.H. 1983. Mycologisch-taxonomisch onderzoek. Phoma-soorten van de sectie Peyronellaea. Versl. Meded. Plziektenk. Dienst Wageningen 159 (Jaarb. 1982): 25–27.

Boerema, G.H. & M.M.J. Dorenbosch. 1973. The Phoma and Ascochyta species described by Wollenweber and Hochapfel in their study on fruit-rotting. Stud. Mycol. 3.

Boerema, G.H., M.M.J. Dorenbosch & H.A. van Kesteren. 1965. Remarks on species of Phoma referred to Peyronellaea. Persoonia 4 (1): 47–68.

Boerema, G.H., M.M.J. Dorenbosch & H.A. van Kesteren. 1968. Remarks on species of Phoma referred to Peyronellaea II. Persoonia 5 (2): 201–205.

Boerema, G.H., M.M.J. Dorenbosch & H.A. van Kesteren. 1971. Remarks on species of Phoma referred to Peyronellaea III. Persoonia 6 (2): 171–177.

Boerema, G.H., M.M.J. Dorenbosch & H.A. van Kesteren. 1973. Remarks on species of Phoma referred to Peyronellaea IV. Persoonia 7 (2): 131–139.

Boerema, G.H., M.M.J. Dorenbosch & H.A. van Kesteren. 1977. Remarks on species of Phoma referred to Peyronellaea V. Kew Bull. 31 (3, '1976'): 533–544.

Boerema, G.H. & M.E.C. Hamers. 1989. Check-list for scientific names of common parasitic fungi. Series 3b: Fungi on bulbs: Amaryllidaceae and Iridaceae. Neth. J. Pl. Path. 95, Suppl. 3: 1–32.

Boerema, G.H. & M.E.C. Hamers. 1990. Check-list for scientific names of common parasitic fungi. Series 3c: Fungi on bulbs: 'additional crops' belonging to the Araceae, Begoniaceae, Compositae, Oxalidaceae and Ranunculaceae. Neth. J. Pl. Path. 96, Suppl. 1: 1–23.

Brooks, F.T. 1932. A disease of the arum lily caused by Phyllosticta richardiae, n.sp. Ann. appl. Biol. 19: 16–20.

Dorenbosch, M.M.J. 1970. Key to nine ubiquitous soil-borne Phoma-like fungi. Persoonia 6 (1): 1–14.

Ellis, M.B. 1971. Dematiaceous Hyphomycetes. CMI Kew.

Gruyter, J. de & M.E. Noordeloos. 1992. Contributions towards a monograph of Phoma (Coelomycetes) I–1. Section Phoma. Taxa with very small conidia in vitro. Persoonia 15 (1): 71–92.

Hauptmann, G. & F. Schickedanz. 1986. In vitro-Untersuchungen und mikroskopischen Studien zur Entwicklung von Phoma chrysanthemicola Hollós f. sp. chrysanthemicola, dem Erreger einer Wurzel- und Stengelgrundfäule der Chrysantheme. J. Phytopath. 116: 289–298.

Hosford, R.M. 1975. Phoma glomerata, a new pathogen of wheat and triticales, cultivar resistance related to wet period. Phytopathology 65: 1236–1239.

Jauch, Cl. 1947. Una nueva enfermedad de las calas en la Argentina. An. Soc. cient. argent. 144: 447–456.

Jooste, W.J. & M.C. Papendorf. 1981. Phoma cyanea sp. nov. from wheat debris. Mycotaxon 12 (2): 444–448.

Lacoste, L. 1955. De la morphologie et de la physiologie de Peyronellaea stipae nov. sp. C.r. hebd. Séanc. Acad. Sci., Paris 241: 818–820.

Luedemann, G.M. 1959. The dictyochlamydospore of Peyronellaea glomerata (Corda) Goidanich ex Togliani contrasted with the dictyoporospore of Alternaria tenuis Auct. Mycologia 51: 772–780.

Mel'nik, V.A. 1977. Opredelitel' gribov roda Ascochyta Lib. Akad. NAUK SSSR. Bot. Inst. Komarova. Leningrad.

Morgan-Jones, G. & K.B. Burgh. 1987. Studies in the genus Phoma. IX. Concerning Phoma jolyana. Mycotaxon 30: 239–246.

Morgan-Jones, G. & J.F. White. 1983. Studies in the genus Phoma. I. Phoma americana sp. nov. Mycotaxon 16 (2): 403–413.

Punithalingam, E., M. Tulloch & G.M. Leach. 1972. Phoma epicoccina sp. nov. on Dactylis glomerata. Trans. Br. mycol. Soc. 59: 341–345.

White, J.F. & G. Morgan-Jones. 1983. Studies in the genus Phoma. II. Concerning Phoma sorghina. Mycotaxon 18 (1): 5–13.

White, J.F. & G. Morgan-Jones. 1986. Studies in the genus Phoma. V. Concerning Phoma pomorum. Mycotaxon 25 (2): 461–466.

White, J.F. & G. Morgan-Jones. 1987. Studies in the genus Phoma VII. Concerning Phoma glomerata. Mycotaxon 28 (2): 437–445.