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CONTRIBUTIONS TOWARDS A MONOGRAPH OF PHOMA (COELOMYCETES) – IV

Section Heterospora: Taxa with large sized conidial dimorphs, in vivo sometimes as Stagonosporopsis synanamorphs

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The new section *Heterospora* is proposed for *Phoma* species producing not only relatively small, mainly aseptate conidia, but also distinctly larger conidia, which may become 1- or more septate: 'ascochytoid-stagonosporoid'. The majority of the conidia are always phomoid in vitro, but in vivo they may be predominantly large and septate, synanamorphs being therefore referred to *Stagonosporopsis* Died. The heterosporous species are described in vitro, with additional data on the conidial morphology in vivo. An addendum deals with eight species from other sections which display a similar conidial dimorphism. Five new species and four new combinations have been proposed: *Phoma actaeae* spec. nov., *Phoma alectorolophi* spec. nov., *Phoma nigripycnidia* spec. nov., *Phoma subboltshauseri* spec. nov. and *Stagonosporopsis dennisii* spec. nov.; *Phoma dennisii* var. *oculo-hominis* (Punith.) comb. nov., *Stagonosporopsis aquilegiae* (Rabenh.) comb. nov., *Stagonosporopsis bohemica* (Kabát & Bubák) comb. nov. and *Stagonosporopsis nigripycnidiicola* (Ondřej) comb. nov. Indices on host-fungus and fungus-host relations and a key to cultural characteristics are included as well as short comments on their ecology and distribution.

In the previous Contributions of this series – I. Section *Phoma* (de Gruyter & Noordeloos, 1992; de Gruyter et al., 1993), II. Section *Peyronellaea* (Boerema, 1993) and III. Section *Plenodomus* (Boerema et al., 1994a, 1996) – the essentials for differentiating taxa in the genus *Phoma* Sacc. in vitro were clearly described. In addition to major morphological characteristics, these may provide important secondary identification criteria, such as the presence of chlamydospores, mycelial synanamorphs and the production of specific metabolites. In vitro studies may also help with differentiation of species where characteristics are either confusingly similar or widely variable.

The differentiation of the heterosporous species treated in this paper fully depends on comparative studies in vitro where they are stable and unquestionably phomoid. Here most pycnidia contain aseptate, hyaline conidia, generally measuring 3–11 × (1–)1.5–4 (–5) µm. However, the mature pycnidia often also contain some distinctly larger conidia, usually (15–)20–25(–28) × 3.5–6(–7) µm. Similar large conidia are common in vivo but their dimensions are more variable, (8–)11–30 (occ. 45–62) × (2.5–)3–8 (occ. 12–15) µm. They may remain continuous, but often become two- or more-celled by secondary septation ('ascochytoid-stagonosporoid').

The conidial dimorphism of these species has caused much taxonomic and nomenclatural confusion. Some species always produce a mixture of small and large conidia in

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variable proportions in vivo, apparently influenced by growing conditions. These species have been formerly referred to *Phoma* ('*Phyllosticta*' on leaves), '*Ascochyta*' or '*Stagonospora*'. Depending on the conditions in vivo, other species produce either only relatively small aseptate conidia or mainly large, usually septate conidia. The latter phenotypes have always been placed in '*Ascochyta*' ('*Diplodina*' on stems) or '*Stagonospora*', but in vitro they show their phomoid identity. True species of *Ascochyta* Lib. and *Stagonospora* (Sacc.) Sacc. always produce relatively large septate conidia in vitro similar to those in vivo; this is connected with the wall-thickening septation of their conidia; see Boerema & Bollen (1975: fig. 3 'distoseptation') and Boerema (1984: fig. 7). [The present generic concepts of *Phyllosticta* Pers. and *Diplodina* Westend. differ from those previously accepted (based on 'leaf and stem specificity' e.g. see Sutton, 1980) and now encompass species which used to be known in *Phyllostictina* H. Sydow and *Discella* Berk. & Br.]

The dominant 'ascochytoid-stagonosporoid' phenotypes shown by various heterosporous *Phomas* in vivo, may be described as separate synanamorphs and then referred to the genus *Stagonosporopsis* Diedicke (1912a: 141–142). The latter was originally separated from *Ascochyta* on the basis of occasional multiseptate conidia (comp. Buchanan, 1987: 8). Diedicke (l.c.: 141) indicated that seven species belonged to this genus. The first species combination described, *Stagonosporopsis actaeae* (Allescher) Died. (l.c.: 144), interpreted by many authors as the type species, represents the 'ascochytoid-stagonosporoid' phenotype of *Phoma actaeae*, no. 3 in this paper. *Stagonosporopsis boltshauseri* (Sacc.) Died. (1912b: 397) chosen as lectotype by Clements & Shear (1931), represents the 'ascochytoid-stagonosporoid' phenotype of *Phoma subboltshauseri*, no. 9 in this paper.

The connection of these heterosporous species with Diedicke's *Stagonosporopsis* was first noticed in the seventies (Boerema & Verhoeven, 1979: 150; Boerema & Dorenbosch, 1981). Their classification in a separate section of *Phoma* was introduced only recently (Boerema, Pieters & Hamers, 1993: 17 and Boerema, de Gruyter & Noordeloos, 1994b). The section still needs to be formally proposed:

Phoma section Heterospora Boerema, de Gruyter & Noordel., *sect. nov.*

Species generis *Phoma* quae praeter conidia parva continua etiam conidia multi maiora, saepe 20–25 × 3.5–6 µm vel ultra, formant. Conidia maiora constanter continua vel deinde septis secundariis divisa, *Ascochytae* vel *Stagonosporae* similia. In nonnullis speciebus conidia maiora praedominantia in vivo quae synanamorphosis ad *Stagonosporopsim* Died. pertinet.

Typus sectionis: *Phoma heteromorphospora* van der Aa & van Kesteren (1980).

The description is as follows: Species which produce not only relatively small continuous phomoid conidia but also distinctly large conidia, often 20–25 × 3.5–6 µm or larger. The latter may remain continuous, or become more-celled by secondary septation ('ascochytoid or stagonosporoid'). With some species the latter phenotypes are dominant in vivo, these synanamorphs being referred to *Stagonosporopsis* Died. Type of the section: *Phoma heteromorphospora* v.d. Aa & v. Kest. 1980.

The large conidial phenotype of the type species (no. 1 in this paper) illustrates well the various possibilities of the large sized conidial dimorph in *Phoma* sect. *Heterospora*. In vivo, *P. heteromorphospora* always produces the small and large conidia in the same pyc-

nidium. This also occurs with some other species of the section, but, as already noted above, in most species in vivo the pycnidia contain either only small or mainly large conidia (often differentiated as a *Stagonosporopsis* synanamorph).

Most species of the section are pathogens specific to particular hosts. The two types of conidia may play different roles in the life cycle. Some species produce small conidia especially on dead host material, whereas pycnidia with large conidia only develop in association with disease symptoms. The large conidia generally develop with fluctuating humidity and with desiccation, whereas only small conidia are often formed in humid conditions. This may occur in the same pycnidium and appears to be reversible. Temperature may also be important. Large conidia sometimes break (split) easily at the septa, and usually germinate more quickly than the smaller ones.

Only one species of this section is known as a plurivorous necrophyte. None has been experimentally connected with a teleomorph, but in one case a single identity with a species of *Didymella* Sacc. ex Sacc. is suggested.

The Addendum includes *Phoma* species which actually show the *Heterospora* conidial dimorphism, but which are placed in other sections due to other characteristics. This refers to three species of section *Phyllostictoides* (van der Aa et al., 1990), ordinarily producing only relatively small septate conidia, but which sometimes also form large 'ascochytoid' conidia; two species with dictyochlamydospores, already discussed under section *Peyronellaea* (Boerema, 1993) and three species distinguished by thick-walled poroid pycnidia, characteristic of the section *Sclerophomella* (compare de Gruyter & Noordeloos, 1992).

Finally it should be noted that a comparable *Phoma*/*Stagonospora*-like conidial dimorphism is recorded in anamorphs of some species of the Ascomycete genera *Leptosphaeria* Ces. & de Not. and *Phaeosphaeria* Miyake (Sivanesan, 1984; Leuchtmann, 1984). However, in those anamorphs the relatively large septate conidial phenotype commonly dominates, not only in vivo but also in vitro. Therefore they are usually only referred to *Stagonospora* (Sacc.) Sacc. char. emend. Leuchtmann (l.c.). Most of the 'associated microconidial forms', '*Aposphaeria* or *Phoma*-like' (Leuchtmann l.c.), do not have a specific name, but one exception (*Phoma meliloti* Allescher) is discussed in the Addendum of Contribution III–1 on *Phoma* taxa with a *Leptosphaeria* teleomorph (Boerema et al., 1994a).

MATERIAL AND METHODS

The isolates and original samples studied were present in the collections of the Plant Protection Service as freeze-dried cultures or herbarium specimens. The methodology applied conforms with that described in Contributions I–1 & I–2 of this series (de Gruyter & Noordeloos, 1992 and de Gruyter et al., 1993). The single identity of pycnidia with only small aseptate conidia and pycnidia with large sized, mainly septate conidia was confirmed in vitro.

KEY TO THE SPECIES TREATED IN THIS PAPER

Differentiation based on characteristics in vitro

The distinguishing character of the heterosporous species treated in this paper, the large sized conidial dimorph, is most conspicuous in vivo conditions. In vitro the conidia

are always mostly small and aseptate; large and septate conidia may be wanting, especially in old isolates. Direct identification of these species in vitro is therefore often difficult. Most heterosporous species are pathogens with a restricted host range and/or distribution. Thus the host-fungus index on p. 341 including a code indicating conidial variability in vivo, may be very helpful in identification of species.

1a. Pycnidia with predetermined ostiole (initiated in primordium) 2
b. Pycnidia relatively thick-walled, at first closed, then opened by a secondary pore [species with *Heterospora*-like conidial dimorphism in vitro and/or in vivo, but belonging to sect. *Sclerophomella*] 18
2a. Colonies producing multicellular chlamydospores, commonly known as dictyochlamydospores, unicellular chlamydospores may also be present [species with *Heterospora*-like conidial dimorphism in vivo, but classified in sect. *Peyronellaea*] 20
b. Dictyochlamydospores absent, but unicellular chlamydospores or unicellular chlamydospore-like structures may be present 3
3a. Pycnidia containing usually aseptate as well as some 1-septate phomoid conidia of normal size, but sometimes a few distinctly large, septate ascochytoid conidia are also present [species with occasional *Heterospora*-like conidial dimorphism, but belonging to sect. *Phyllostictoides*] 16
b. Pycnidia producing either only normal sized aseptate phomoid conidia or a mixture of these with large, often 1-septate ascochytoid conidia; intermediate aseptate or septate conidial forms may also occur 4
4a. Conidia hyaline, associated with disease symptoms 5
b. Conidia with a typical yellow tinge, they are usually somewhat curved and attenuated at one end, aseptate, 4–8.5 × 1.5–3 µm, or 1(–2)-septate, 7–16 × 2–3 µm; a common saprophyte in Eurasia and North America [in vivo, conidia much more variable, small-aseptate or large and 1–3-septate, sometimes up to 25 × 3.5 µm, synanam. *S. fraxini*] ..... 11. *P. samarorum*
5a. Growth-rate slow, < 35 mm in one week, on *Chenopodium* spp. 6
b. Growth-rate moderate to fast, > 35 mm in one week 7
6a. Conidia usually of two different types; mainly small, aseptate, usually 4–7 × 1.5–2 µm, but some much larger, mostly 1–2-septate, 12.5–26.5 × 3–5 µm; common pathogen of *Chenopodium* spp. in Europe [in vivo, also heterosporous; the large sized conidia mostly aseptate, but sometimes 1(–3)-septate, up to 27 × 7 µm] 1. *P. heteromorphospora*
b. Conidia always aseptate phomoid, 3–5.5 × 1.5–2 µm; common pathogen of *Chenopodium* spp. in North and South America [in vivo, conidia always dimorphic, partly small-aseptate, partly large-aseptate or 1(–2)-septate, up to 25 × 7 µm] 2. *P. dimorphospora*
7a. Colonies producing a diffusable pigment, staining the agar yellowish to ochre.. 8
b. Colonies greenish olivaceous to olivaceous, not producing a diffusable pigment 11
8a. Yellow-green crystals are formed on MA, NaOH reaction reddish (not an E+ reaction), phomoid conidia (sub)cylindrical to ellipsoidal..... 9
b. No crystals are formed, NaOH reaction yellow-green, gradually changing to red (E+ reaction), phomoid conidia ellipsoidal to more or less obclavate-fusiform..... 10

9a. On OA diffusable pigment staining the agar pale luteous to amber-ochraceous, often with a distinct yellow pigmentation around the pycnidia, conidia of two types, phomoid aseptate, 4.5–9.5 × 2–3 µm, or ascochytoid 1-septate, 14–28.5 × 4–7 µm, guttulate; pathogen of *Actaea* and *Cimicifuga* spp. [in vivo, conidia sometimes small-aseptate, but usually large and 1(–2)-septate, up to 28.5 × 7 µm, synanam. *S. actaeae*] ..... 3. *P. actaeae*

b. On OA diffusable pigment staining the agar primrose to olivaceous buff, no distinct yellow pigmentation around the pycnidia, conidia usually aseptate phomoid, 4–6.5 × 1.5–2 µm, without or with a few, small guttules, occasionally large and 1-septate, ascochytoid, 14.5–24 × 4–7 µm; on *Solidago* spp. [in vivo, conidia small-aseptate or mainly large and 1–2-septate, up to 28 × 6 µm, synanam. *S. dennisii*]
4a. *P. dennisii* var. *dennisii*

Note: A similar fungus, but lacking the diffusable pigment and with somewhat smaller 1-septate conidia, has once been isolated from a human cornea, United States
4b. *P. dennisii* var. *oculo-hominis*

10a. On OA growth-rate 78–82 mm, diffusable pigment staining the agar saffron to fulvous, conidia usually aseptate, 6–10.5 × 2–4 µm, occasionally 1-septate up to 13 × 5 µm; on various Papaveraceae [in vivo, conidia similar or larger, occasionally aseptate, mostly 1(–2)-septate, sometimes distinctly large, up to 23 × 6 µm, synanam. *S. chelidonii*] ..... 5. *P. glaucii*

b. On OA growth-rate 56–75 mm, diffusable pigment staining the agar rosy buff to honey, conidia usually aseptate, 5–8 × 2–2.5 µm, occasionally 1-septate, up to 15 × 5 µm; pathogen of *Aquilegia* and perennial *Aconitum* spp., occasionally also on other Ranunculaceae [in vivo, conidia similar or mostly larger and mainly 1(–2)-septate, often 13–20 × 4–5 µm, synanam. *S. aquilegiae*] ..... 6. *P. aquilegiicola*

11a. Conidia of two types, phomoid aseptate or 1-septate conidia, up to 15 × 5 µm, and distinctly large septate ascochytoid-stagonosporoid conidia up to 22–45 µm in length 12

b. Conidia of one type, phomoid, usually aseptate, but occasionally also 1-septate, up to 16 × 6 µm 13

12a. L/b ratio phomoid aseptate conidia > 3.5, usually 5.5–9 × 1.5–2 µm, occasionally 1-septate, mostly 9–15 × 2–4 µm (in fresh cultures distinctly larger and often more-celled, stagonosporoid); pathogen of *Vicia cracca* and other *Vicia* spp. in south-eastern Europe [in vivo, conidia sometimes small-aseptate, but usually very large and 1–2(–4)-septate, up to 45 × 12 µm, synanam. *S. nigripycnidiicola*] 7. *P. nigripycnidia*

b. L/b ratio phomoid aseptate conidia < 3.5, usually 4–15 × 1.5–5 µm, 1-septate ascochytoid conidia 15.5–22 × 4–5 µm, usually guttulate, ellipsoidal to fusiform-allantoid; pathogen of *Delphinium* spp., but also recorded on *Aconitum* sp. [in vivo, conidia may be small-aseptate, but also large and 1(–2)-septate, often 15–22 × 4–5 µm, synanam. *S. delphinii*] ..... 8. *P. delphinii*

13a. NaOH test positive, yellow-green, later red (E+ reaction), conidia ellipsoidal to more or less obclavate-fusiform, on Ranunculaceae 10b

b. NaOH test negative or not specific (E–) 14

14a. Pycnidia initially honey coloured, later black. Conspicuous ostioles 15

b. Pycnidia already initially black, ostiole inconspicuous 12a

15a. Colony with coarsely floccose aerial mycelium on OA, pycnidia globose to subglobose, conidia usually aseptate, 3.5–9 × 1.5–2.5 µm, occasionally 1-septate, up to 11 × 3.5 µm; pathogen of *Phaseolus vulgaris* and *Vigna unguiculata* [in vivo conidia always predominantly large, 1–3(–5)-septate, up to 34 × 9 µm, synanam. *S. hortensis*] ..... 9. *P. subboltshauseri*

b. Colony with floccose aerial mycelium on OA, usually sparse after 14 days, pycnidia globose to papillate, sometimes with an elongated neck, conidia usually aseptate, 4–8.5 × 1.5–3 µm, occasionally 1-septate, 7–16 × 2–3.5 µm; pathogen of *Campanula* and *Trachelium* spp. [in vivo, conidia sometimes all small and aseptate, or larger and mainly 1(–2)-septate, up to 23 × 6 µm, synanam. *S. bohemica*] .... 10. *P. trachelii*

16a. NaOH test positive, yellow-green later red (E+ reaction), conidia mostly aseptate, usually 3.5 –7.5 × 2–3 µm, 1-septate conidia mostly between 9–15 × 3–5 µm, but sometimes distinctly larger, ascochytoid, up to 23 × 8 µm; pathogen of *Chrysanthemum morifolium* ..... Addendum 12. *P. ligulicola* var. *ligulicola*, teleom. *Didymella ligulicola* var. *ligulicola*

b. NaOH test negative (E–) 17

17a. Both aseptate and 1-septate conidia with about the same dimensions, 4–10.5 × 2–5 µm, but occasionally with some larger 1-septate ascochytoid conidia, 12–20.5 × 3.5–5 µm; pathogen of *Lycium halimifolium* ..... Addendum 13. *P. protuberans*

b. Conidia mostly aseptate, 4–8 × 2–3 µm, when 1-septate, up to 10 × 4.5 µm; occasionally producing a *Didymella* teleomorph; pathogen of Cucurbitaceae, especially *Cucumis* spp. and *Citrullus vulgaris* [in vivo, some strains produce distinctly large 1-septate ascochytoid conidia, up to 20–24 µm long] Addendum 14. *P. cucurbitacearum*, teleom. *Didymella bryoniae*

18a. Conidia phomoid, aseptate, variable in size, mostly 4–7.5 × 2–3.5 µm, occasionally larger, ascochytoid, up to 18 × 8 µm, NaOH reaction yellow-green, then red (E+ reaction); on semi-parasitic *Melampyrum, Rhinanthus* and *Pedicularis* spp. Addendum 15. *P. alectorolophi*, teleom. *Didymella alectorolophi*

b. Conidia phomoid, aseptate or also septate, up to 10 × 4 µm, crystals absent, NaOH reaction negative 19

19a. Growth-rate moderate on OA, 47–48 mm, conidia always aseptate, small, uniform, up to 5.5 × 2.5 µm, chains of globose, greenish olivaceous chlamydospores present; pathogen of *Dictamnus albus* [on leaf spots, distinctly large, mainly 1-septate ascochytoid conidia are produced, up to 16 × 4.5 µm] .. Addendum 16. *P. dictamnicola*

b. Growth-rate fast on OA, 60–82 mm, conidia variable in shape and dimensions, always mainly aseptate, usually 4–10 × 2–3 µm, in some strains also 1-septate and distinctly larger, ascochytoid, up to 34 × 10 µm, chlamydospores absent; on Umbelliferae ..... Addendum 17. *P. complanata*

20a. Growth-rate moderate, 45–55 mm on OA, colony colourless to olivaceous grey, needle-like crystals may be formed, dictyochlamydospores usually intercalary, conidia usually 4–8.5 × 2–3 µm, frequently also 1-septate, up to 13 × 4 µm; pathogen of *Clematis* spp. [in vivo, also distinctly large 1-septate ascochytoid conidia may be produced, up to 28 × 6.5 µm] ..... Addendum 18. *P. clematidina*

b. Growth-rate fast, 80–84 mm on OA, colony grey olivaceous, or olivaceous grey to dull green, crystals absent, dictyochlamydospores usually intercalary and solitary, conidia mostly 4–7.5 × 2.5–3.5 µm, occasionally septate, up to 15 × 5.5 µm; pathogen of Amaryllidaceae, esp. *Narcissus* and *Hippeastrum* spp. [in vivo, distinctly large, mainly 3-septate stagonosporoid conidia are often also produced, up to 28 × 8 µm, synanam. *S. curtisii*] ..... Addendum 19. *P. narcissi*

HOST–FUNGUS INDEX

The number of the species in the descriptive part is listed [incl. addendum (add.)] with additional data on distribution. The conidial variability found in vivo in different pycnidia (,) or in the same pycnidium (+) is coded as follows:

o = aseptate relatively small phomoid conidia
ɵ = secondarily 1-septate phomoid conidia
O = aseptate distinctly large conidia
Θ = secondarily 1(–2)-septate large conidia ('ascochytoid')
ϴ = secondarily 1–3(–5)-septate large conidia ('stagonosporoid')

Plurivorous species [found in necrotic tissue of herbaceous, gramineous and woody plants]	no. 11 *P. samarorum*: o ,+ (O+)ϴ(+Θ) (synanam. *S. fraxini*) [apparently a widespread soil fungus in Eurasia and North America]
With specific or preferred host	
Amaryllidaceae esp. *Narcissus* and *Hippeastrum* spp. (Disease: Leaf Scorch, Neck Rot, Red Spot Disease, Red Leaf Spot)	no. 19 *P. narcissi*: o(+ɵ) , (O+)Θ + ϴ [add.; sect. *Peyronellaea*] (synanam. *S. curtisii*) [world-wide pathogen]
Campanulaceae *Campanula* and *Trachelium* spp. (Disease: Leaf, Stem and Flower Spot)	no. 10 *P. trachelii*: o ,+ (O+)Θ (synanam. *S. bohemica*) [seed-borne pathogen known from Eurasia, North and South America]
Chenopodiaceae *Chenopodium* spp. Disease: Leaf Spot, Stem Lesions)	no. 2 *P. dimorphospora*: o + O + Θ(+ϴ) [so far only known from North and South America] no. 1 *P. heteromorphospora*: o + O + Θ + ϴ [so far only known from Europe]

Compositae	
Chrysanthemum morifolium (Disease: Chrysanthemum Ray (flower) Blight, Black Leaf Blotches and Stem Lesions)	no. 12 *P. ligulicola* var. *ligulicola*: o(O) + ɵ(Θ) (+Θ) [add.; sect. *Phyllostictoides*] teleom. *Didymella ligulicola* var. *ligulicola*) [world-wide pathogen]
Solidago spp. [no data on pathogenicity]	no. 4a *P. dennisii* var. *dennisii*: o , (O+)Θ(+Θ) (synanam. *S. dennisii*) [recorded in Europe and North America; *Solidago* spp. are possibly also the natural source of the var. *oculo-hominis* (4b)]
Cucurbitaceae	
wild plants and cultivars of *Cucumis, Cucurbita* and *Citrullus* spp. (Disease: Gummy Stem Blight, Leaf Spot, Stem Canker, Vine Wilt and Black Fruit Rot)	no. 14 *P. cucurbitacearum*: o ,+ ɵ ,+ Θ) [add.; sect. *Phyllostictoides*] (teleom. *Didymella bryoniae*) [world-wide seed-borne pathogen]
Leguminosae	
esp. *Vicia cracca*, but also on other *Vicia* spp. (Disease: Leaf Spot, Stem Lesions)	no. 7 *P. nigripycnidia*: o , Θ + Θ (synanam. *S. nigripycnidiicola*) [frequently recorded in South-East Europe]
Phaseolus vulgaris *Vigna unguiculata* (Disease: Leaf Spot Disease)	no. 9 *P. subboltshauseri*: o + (O+)Θ + Θ (synanam. *S. hortensis*) [world-wide pathogen of beans]
Papaveraceae	
e.g. wild species of *Chelidonium*, *Corydalis, Dicentra* and *Glaucium*	no. 5 *P. glaucii:* o(+ɵ) , (O+)Θ(+Θ) (synanam. *S. chelidonii*) [frequently recorded in Europe]
Ranunculaceae	
esp. *Aconitum* and *Aquilegia* spp., but also on perennial *Delphinium* spp. (Disease: Leaf Spot, Collar Rot)	no. 6 *P. aquilegiicola*: o(+ɵ) , (O+)Θ(+Θ) (synanam. *S. aquilegiae*) [recorded in Australasia, Europe and North America]
Actaea and *Cimicifuga* spp. (Disease: Leaf Blackening)	no. 3 *P. actaeae*: o , (O+)Θ(+Θ) (synanam. *S. actaeae*) [recorded in Europe and North America]
Clematis spp. (Disease: Wilt, Leaf Spot and Stem Lesions)	no. 18 *P. clematidina*: o(+ɵ) ,+ (O+)Θ(+Θ) [add.; sect. *Peyronellaea*] [known from Australasia, Eurasia and North America]

esp. *Delphinium* spp., but also recorded on *Aconitum* (Disease: Leaf Spot, Stem Rot)	no. 8 *P. delphinii*: o(+ϴ) ,+ (O+)ϴ(+ϴ) (synanam. *S. delphinii*) [only recorded in Europe]
Rutaceae *Dictamnus albus* (Disease: Leaf Spot)	no. 16 *P. dictamnicola*: o(+ϴ) , (O+)ϴ(+ϴ) [add.; sect. *Sclerophomella*] [recorded in Eurasia and North America]
Scrophulariaceae semi-parasitic species of *Melampyrum, Pedicularis* and *Rhinanthus*	no. 15 *P. alectorolophi*: o ,+ ϴ) [add.; sect. *Sclerophomella*] (teleom. *Didymella alectorolophi*) [only recorded in Europe]
Solanaceae *Lycium halimifolium* (Disease: Leaf Spot)	no. 13 *P. protuberans* (o + ϴ) [add.; sect. *Phyllostictoides*] [occasionally recorded in Europe and North America]
Umbelliferae wild plants and cultivars of *Daucus carota, Pastinaca sativa* and *Petroselinum crispum* (Disease: Canker, Leaf Spot)	no. 17 *P. complanata*: o ,+ ϴ ,+ ϴ) [add.; sect. *Sclerophomella*] [common in temperate Eurasia and North America]

FUNGUS–HOST INDEX

P. actaeae (3)
(synanam. *S. actaeae*)
P. alectorolophi (15; addendum)
[sect. *Sclerophomella*]
(teleom. *Didymella alectorolophi*)
P. aquilegiicola (6)
(synanam. *S. aquilegiae*)

P. clematidina (18; addendum)
[sect. *Peyronellaea*]
P. complanata (17)

P. cucurbitaceae (14; addendum)
[sect. *Phyllostictoides*]
(teleom. *Didymella bryoniae*)
P. delphinii (8)
(synanam. *S. delphinii*)

Actaea and *Cimicifuga* spp.
(Ranunculaceae)
Melampyrum, Pedicularis and *Rhinanthus* spp., esp. *R. angustifolius*
(semi-parasitic Scrophulariaceae)
esp. *Aquilegia* and *Aconitum* spp., but also on perennial *Delphinium*
(Ranunculaceae)
Clematis spp.
(Ranunculaceae)
Umbelliferae
wild plants and cultivars of *Daucus carota, Pastinaca sativa* and *Petroselinum crispum*
Cucurbitaceae
wild plants and cultivars of *Cucumis, Cucurbita* and *Citrullus* spp.
esp. *Delphinium* spp., but also recorded on *Aconitum*
(Ranunculaceae)

P. dennisii var. *dennisii* (4a) (synanam. *S. dennisii*)	*Solidago* spp. (Compositae)
P. dictamnicola (16; addendum) [sect. *Sclerophomella*]	*Dictamnus albus* (Rutaceae)
P. dimorphospora (2)	*Chenopodium* spp., esp. *C. quinoa* (Chenopodiaceae)
P. glaucii (5) (synanam. *S. chelidonii*)	Papaveraceae e.g. wild species of *Chelidonium, Corydalis, Dicentra* and *Glaucium*
P. heteromorphospora (1)	*Chenopodium* spp., esp. *C. album* (Chenopodiaceae)
P. ligulicola var. *ligulicola* (12; addendum) [sect. *Phyllostictoides*] (teleom. *Didymella ligulicola* var. *ligulicola*)	*Chrysanthemum morifolium* (Compositae)
P. narcissi (19; addendum) [sect. *Peyronellaea*] (synanam. *S. curtisii*)	esp. *Narcissus* and *Hippeastrum* spp. (Amaryllidaceae)
P. nigripycnidia (7) (synanam. *S. nigripycnidiicola*)	*Vicia* spp., esp. *V. cracca* (Leguminosae)
P. protuberans (13; addendum) [sect. *Phyllostictoides*]	*Lycium halimifolium* (Solanaceae)
P. subboltshauseri (9) (synanam. *S. hortensis*)	*Phaseolus vulgaris* and *Vigna unguiculata* (Leguminosae)
P. trachelii (10) (synanam. *S. bohemica*)	*Campanula* spp., esp. *C. isophylla*, *Trachelium* spp. (Campanulaceae)

DESCRIPTIVE PART

Section Heterospora

1. **Phoma heteromorphospora** v.d. Aa & v. Kest. — Fig. 1A

Conidial dimorph large, aseptate and 1(2–3)-septate. Ascochytoid-stagonosporoid.

Phoma heteromorphospora van der Aa & van Kesteren, Persoonia 10 (4) (1980) 542. — *Phoma variospora* van der Aa & van Kesteren, Persoonia 10 (2) (Nov. 1979) 268; not *Phoma variospora* Shreemali, Indian J. Mycol. Pl. Path. 8 (July 1979 ['1978']) 221. — *Phyllosticta chenopodii* Westendorp, Bull. Acad. r. Sci. Lett. Beaux-Arts Belg. [Bull. Acad. r. Belg. Cl. Sci.] II, 2 (1857) 567; not *Phoma chenopodii* Ahmad, Sydowia 2 (1948) 79 [belongs to sect. *'Macrospora'* (Boerema, in prep.)]. — *Septoria westendorpii* Winter, Hedwigia 26 (1887) 26; not *Phoma westendorpii* Tosquinet in Westendorp, Bull. Acad. r. Sci. Lett. Beaux-Arts Belg. [Bull. Acad. r. Belg. Cl. Sci.] II, 2 (1857) 564.

Selected literature. Van der Aa & van Kesteren (1979).

Description in vitro

OA: growth rate 11–14 mm (14 days: 29 mm), somewhat irregular, with velvety, white aerial mycelium; colony pale luteous; reverse similar.

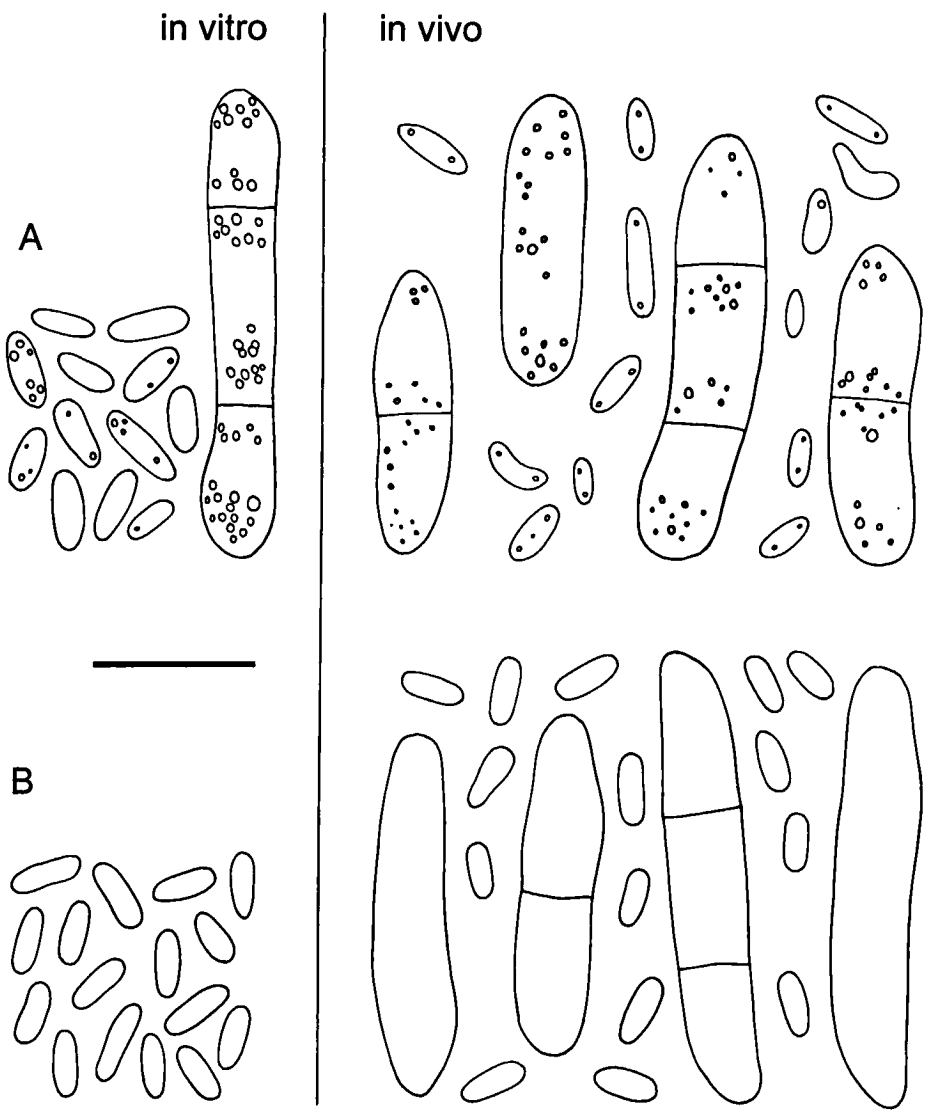


Fig. 1. A. *Phoma heteromorphospora*, type species of section *Heterospora*. Conidial shape and size. In vitro the pycnidia contain mainly small aseptate conidia, but also a few large and mostly 1–2-septate conidia are usually present. In vivo the pycnidia are always heterosporous; the macroconidia vary in shape, size and septation. — B. *Phoma dimorphospora*, closely related to the type species. Conidia generally eguttulate. In vitro the pycnidia usually contain only small aseptate conidia. Bar 10 µm.

MA: growth rate 12–15 mm (14 days: 28 mm), somewhat irregular, with compact velvety-finely woolly, white to some grey olivaceous aerial mycelium, covering the colony; reverse pale luteous with grey olivaceous, citrine green and hazel patches.

CA: growth rate 19–22 mm (14 days: 30–31 mm), somewhat irregular, with finely floccose or velvety, white aerial mycelium, covering the colony; reverse saffron to ochraceous, centre chestnut.

Pycnidia on the agar, 120–350 µm diam., globose to subglobose, solitary or aggregated, glabrous or with mycelial outgrowths, with 1(–8) papillate ostioles; honey-citrine to cinnamon, later olivaceous black; walls made up of 5–10 layers, outer layers pigmented; conidial exudate white to primrose. Micropycnidia also present, 50–100 µm diam. Conidiogenous cells 5–7 × 3.5–8 µm. Conidia of two types: mainly small and aseptate, (3–)4–7 × (1–)1.5–2(–2.5) µm, av. 4.6 × 1.7 µm, Q = 2.0–3.8, av. Q = 2.7, subcylindrical to ellipsoidal, without or with some inconspicuous guttules; but also much larger, mostly 1–2-septate, 12.5–26.5 × 3–5 µm, av. 21 × 4 µm, Q = 3.6–6.9, av. Q = 5.0, subcylindrical with abundant guttules.

Chlamydospores absent.

NaOH spot test: negative.

Crystals absent.

Description in vivo (especially on *Chenopodium album*)

Pycnidia (in pale yellowish brown or whitish leaf spots with narrow purplish-brown border) similar to those in vitro, but up to 550 µm diam. and usually distinctly papillate. Conidia always heterosporous: partly small, narrow, 3–6 × 1–1.5 µm, aseptate, subcylindrical to ellipsoidal, sometimes curved, minutely biguttulate; some clearly larger, but very variable in dimensions, (8–)15–20(–27) × (3–)3.5–4.5(–7) µm, mostly aseptate, but sometimes 1-septate or, rarely, 2–3-septate, ellipsoidal-cylindrical or somewhat irregular in shape, irregularly multiguttulate.

Ecology and distribution. A very common pathogen on various species of *Chenopodium* in Europe: Leaf Spot. Very similar and closely related to the American *Phoma dimorphospora* (Speg.) v.d. Aa & v. Kest. (no. 2). In vitro, they can be distinguished easily by the fact that the latter does not produce large conidia on artificial media.

Cultures studied. CBS 513.77 (PD 76/1022) and CBS 115.96 (PD 94/1576) ex *Chenopodium album*, the Netherlands.

Note. Owing to the septate macroconidia this fungus is sometimes confused with *Ascochyta caulina* v.d. Aa & v. Kest., teleomorph *Pleospora calvescens* (Fr. ex Desm.) Tul. Most *Ascochyta-*, *Stagonospora-* and *Stagonosporopsis* binomials reported on Chenopodiaceae refer to *Ascochyta caulina*, see van der Aa & van Kesteren l.c. and Boerema, Loerakker & Hamers, 1987.

2. **Phoma dimorphospora** (Speg.) v.d. Aa & v. Kest. — Fig. 1B

Conidial dimorph large, aseptate and 1(occ.2)-septate. Ascochytoid(-stagonosporoid) [Not obtained in vitro.]

Phoma dimorphospora (Speg.) van der Aa & van Kesteren, Persoonia 10 (2) (1979) 269–270. — *Phyllosticta dimorphospora* Spegazzini, An. Mus. nac. Host. nat. B. Aires III, 20 (1910) 334.

Stagonospora chenopodii Peck, Rep. N.Y. St. Mus. nat. Hist. 40 (1887) 60 [erroneously sometimes ascribed to House in Bull. N.Y. St. Mus. 219/220 (1920) = reprint of Peck's Report]; not *Phoma chenopodii* Ahmad, Sydowia 2 (1948) 79 [belongs to sect. '*Macrospora*' (Boerema, in prep.)].

Selected literature. Van der Aa & van Kesteren (1979).

Description in vitro

OA: growth rate 21–23 mm (14 days: 28–36 mm), regular, with finely felted, white aerial mycelium; colony colourless to pale luteous; reverse pale luteous to cinnamon.

MA: growth rate 25–28 mm (14 days: 44–50 mm), regular, with compact, felted, white aerial mycelium; colony citrine green; reverse pale luteous to citrine green, later ochraceous to isabelline.

CA: growth rate 28–31 mm (14 days: 45–61 mm), regular, with finely floccose, white aerial mycelium; colony colourless with grey tinge, centre with olivaceous tinges; reverse vinaceous buff with fawn or hazel concentric zones.

Pycnidia on the agar, 110–470 µm diam., globose to subglobose, solitary or aggregated, glabrous ot with mycelial outgrowths, with 1(–8) papillate ostioles; honey-citrine to cinnamon, later olivaceous to olivaceous black; walls made up of 4–10 layers of cells, outer layers pigmented; conidial exudate sordid white to buff or saffron. Micropycnidia also present, 60–100 µm in diam. Conidiogenous cells 4–6 × 4–6 µm in diam., globose to bottle-shaped. Conidia always aseptate, 3–5.5 × 1.5–2 µm, av. 4–4.5 × 1.5 µm, Q = 2.0–3.6, av. Q = 2.6–3.0, cylindrical to ellipsoidal without guttules.

Chlamydospores absent.

NaOH spot test: negative, but on OA and MA a non-specific reddish discolouring may occur.

Crystals absent.

Description in vivo (especially on *Chenopodium quinoa*)

Pycnidia (in very pale brown leaf spots or in eye-shaped lesions on stems) resembling those in vitro, but seldom over 300 µm diam. and only with rather flat papillae. Conidia always dimorphic: some small, mostly 4–5 × 2–2.5 µm, aseptate, short cylindrical or ellipsoidal, eguttulate; some much larger, 16–22.5(–25) × 4–4.5(–7) µm, mostly aseptate, but also 1-, or seldom 2-septate, ellipsoidal to cylindrical, straight or slightly curved, mostly without guttules.

Ecology and distribution. A common pathogen on species of *Chenopodium* in North and South America: Leaf and Stem Spot. Closely allied to the European *Phoma heteromorphospora* v.d. Aa & v. Kest. (no. 1), but easy to distinguish in vitro by the absence of large conidia.

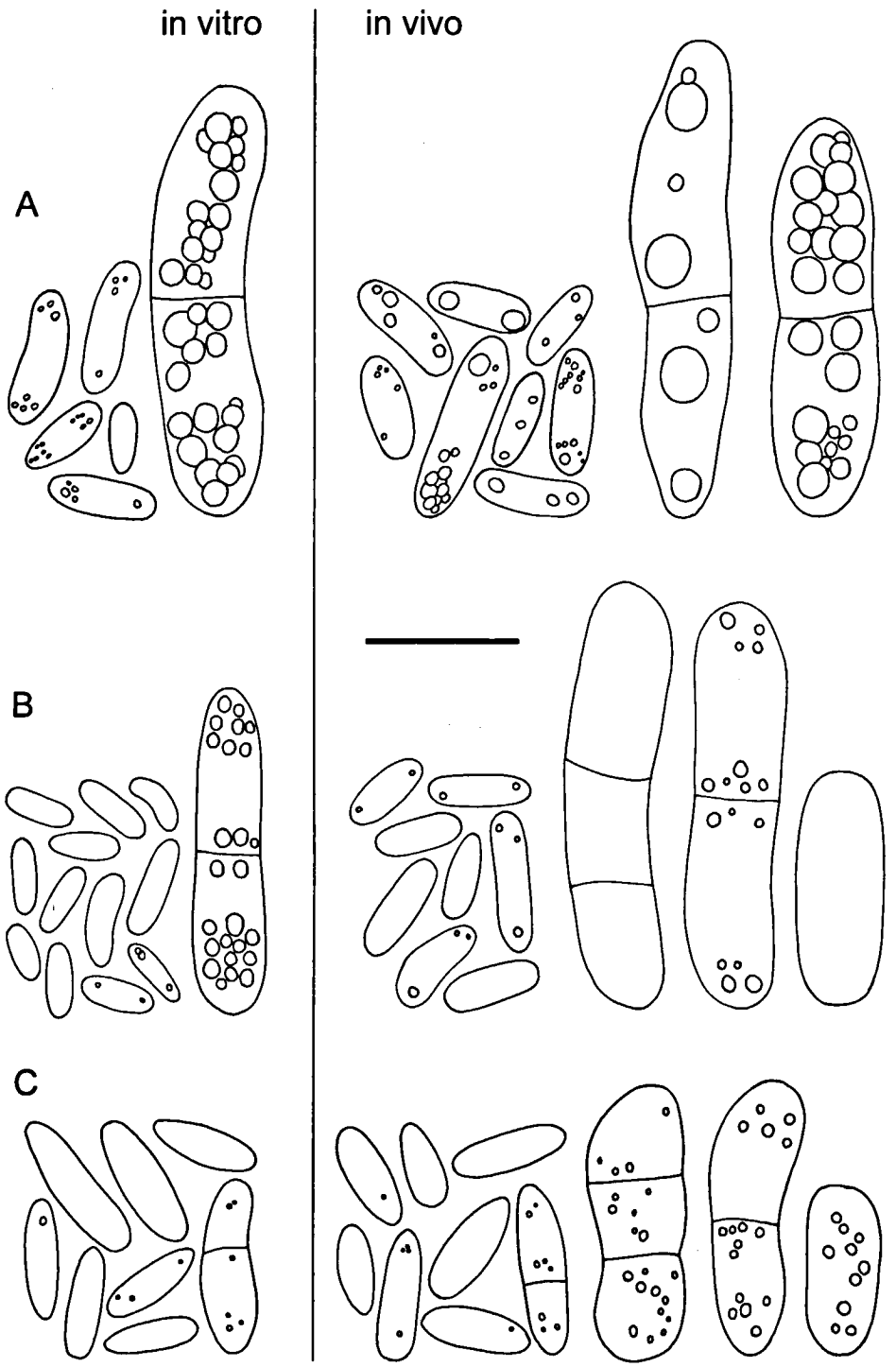
Cultures studied. CBS 165.78 (PD 77/884) and CBS 345.78 (PD 76/1015) ex *Chenopodium quinoa* (Chenopodiaceae), Peru.

3. **Phoma actaeae** Boerema, de Gruyter & Noordel., *spec. nov.* — Fig. 2A

Conidial dimorph large, 1(occ.2)-septate. Ascochytoid(-stagonosporoid): *Stagonosporopsis actaeae*, see below.

Pycnidia in vitro 80–250 µm diam., irregulariter globosa, solitaria vel confluentia, nonnullis hyphis emanentibus, uno (vel duobus) ostiolis papillatis vel non-papillatis praedita. Cellulae conidiogenae 4–8 × 3–8 µm, globosae vel lageniformes; conidia unicellularia, 4.5–10 × 2–3 µm, (sub-)cylindrica vel ellipsoidea, nonnullis guttulis plus minusve polaribus repleta. [Nonnumquam nonnulla conidia maiora, septata praesentia, synanamorphae *Stagonosporopsidis* similia.]

Holotypus: L 992.167-501, cultura exsiccata, viva CBS 106.96 (PD 94/1318), isolatus e macula foliari ad *Actaeam spicatam*, Schaelsbergerbos prope Valkenburg (Limburg), in Neerlandia, Septembre 1994.


in vitro
in vivo
A
B
C

Synanamorph: *Stagonosporopsis actaeae* (Allescher) Diedicke, Annls mycol. 10 (1912) 141. — *Actinonema actaeae* Allescher, Ber. bayer. bot. Ges. 5 (1897) 7.

Marssonia actaeae Bresadola, Hedwigia 32 (1893) 33. — *Ascochyta actaeae* (Bres.) J.J. Davis, Trans. Wis. Acad. Sci. Arts Lett. 19 (1919) 656.

Selected literature. Diedicke (1912a) and Davis (1919; as *Ascochyta actaeae*).

Description in vitro

OA: growth rate 65–82 mm, regular to somewhat irregular, with finely floccose to coarsely floccose-woolly, pale olivaceous grey aerial mycelium; colony pale luteous to amber-ochraceous, due to a diffusable pigment; reverse pale luteous to ochraceous-sepia, with citrine due to crystal production.

MA: growth rate 65–76 mm, slightly irregular, with compact, fine woolly-floccose, white to pale olivaceous grey-greenish grey aerial mycelium; colony pale luteous with amber-fulvous to umber-sepia; reverse similar, with citrine green due to abundant crystal production.

CA: growth rate 65–82 mm, regular, with finely floccose to floccose-woolly, white to pale olivaceous grey aerial mycelium; colony pale luteous to amber-ochraceous, due to a diffusable pigment production, reverse similar, with partly citrine-green due to crystal production.

Pycnidia on and in the agar, also in aerial mycelium, 80–250 µm diam., irregularly globose, solitary or confluent, glabrous or with some hyphal outgrowths, with 1(–2) non-papillate or papillate ostioles; honey to sienna at first, darkening with age to cinnamon-olivaceous finally olivaceous black, often with a yellowish pigmentation in the agar around the pycnidia; walls made up of 3–6 layers of cells, outer layers pigmented; conidial exudate white to salmon. Micropycnidia also present, 40–80 µm diam. Conidiogenous cells 4–8 × 3–8 µm, globose to bottle-shaped. Conidia mostly aseptate, 4.5–10 × 2–3 µm, av. 6.4 × 2.1 µm, Q = 1.6–3.7, av. Q = 2.6–2.8, (sub-)cylindrical to ellipsoidal, with several small, more or less polar guttules; occasionally some much larger and 1-septate, 14–28.5 × 4–7 µm, av. 20.7–21.4 × 4.9–5.8 µm, Q = 2.5–5.5, av. Q = 3.7–4.2, usually with several large guttules, resembling the conidia of the *Stagonosporopsis* synanamorph commonly occurring in vivo, see below.

Chlamydospores absent.

NaOH spot test: positive, on OA and MA a scarlet-vinaceous discolouring occurs.

Crystals needle-like, citrine green, especially on MA, on OA also small yellowish-brownish crystals are formed in the agar.

Description in vivo (especially on *Actaea spicata*)

Pycnidia (on indefinite blackened areas of the leaves, epiphyllous, scattered) mostly 100–130 µm diam., subglobose with 1(–2) more or less papillate ostioles. Conidia some-

Fig. 2. A. *Phoma actaeae*. In vitro conidia variable, mainly relatively small and aseptate, occasionally larger and 1-septate. In vivo the pycnidia sometimes contain only small aseptate phomoid conidia, but usually only large 1(–2)-septate conidia, synanamorph *Stagonosporopsis actaeae*. — B. *Phoma dennisii*. In vitro conidia are mainly small and aseptate, but occasionally also some larger 1-septate conidia are present. In vivo pycnidia usually contain only small aseptate conidia, but also pycnidia with large, mainly 1–2-septate conidia may occur, synanamorph *Stagonosporopsis dennisii*. — C. *Phoma glaucii*. In vitro conidia variable phomoid, mostly aseptate, occasionally 1-septate. In vivo pycnidia may contain similar phomoid conidia, but also much larger 0–2-septate conidia, synanamorph *Stagonosporopsis chelidonii*. Bar 10 µm.

times small and aseptate, but usually large and septate, characteristic for the synanamorph *Stagonosporopsis actaeae*: cylindrical, straight or somewhat curved, usually with several guttules, 1(–2)-septate, mostly 17–24 × 5–6 µm, hyaline but becoming somewhat olivaceous with age.

Ecology and distribution. In Europe and North America (USA) the *Stagonosporopsis* synanamorph is recorded on living and wilting leaves of wild and cultivated *Actaea* and *Cimicifuga* species. The fungus seems to be a specific pathogen of these perennial plants belonging to the Ranunculaceae.

Cultures studied. CBS 105.96 (PD 74/230) ex *Cimicifuga simplex* (Ranunculaceae), the Netherlands; CBS 106.96 (PD 941318) ex *Actaea spicata* (Ranunculaceae), the Netherlands.

4a. **Phoma dennisii** Boerema var. **dennisii** — Fig. 2B

Conidial dimorph large, mainly 1–2-septate. Ascochytoid-stagonosporoid: *Stagonosporopsis dennisii*, see below.

Phoma dennisii Boerema, Trans. Br. mycol. Soc. 67 (1976) 307, var. *dennisii* [autonym created by the separation of the variety *oculo-hominis*, see below]. — *Phoma oleracea* var. *solidaginis* Saccardo, Michelia 2 (2) (1881) 337; Sylloge Fung. 3 (1884) 135; not *Phoma solidaginis* Cooke, Grevillea 13 (1885) 95.

Synanamorph: ***Stagonosporopsis dennisii, synanamorphis nov. Phomae dennisii.***

Pycnidia in vitro *Phomae dennisii* similia, sed conidia maiora, plerumque 15.5–28 × 4–6 µm, plerumque 1–2-septata (*Ascochytae* similia).

Holotypus: L 996.047-028 in caulis *Solidaginis virgaureae*, Wageningen in Neerlandia, lectus a M.M.J. Dorenbosch, Octobre 1976 (isol. PD 76/842).

Selected literature. Boerema & Bollen (1975), Boerema (1976).

Description in vitro

OA: growth rate 68–78 mm, regular, with coarsely floccose, white to smoke grey aerial mycelium; colony colourless to primrose-olivaceous buff, due to a diffusable pigment, often with dull green to olivaceous sectors, with salmon appearance due to conidial exudate; reverse similar.

MA: growth rate 72–83 mm, regular, with compact floccose to woolly, white to pale olivaceous grey aerial mycelium; colony luteous, due to a diffusable pigment; reverse luteous to sienna with chestnut and leaden grey to leaden black sectors, and partly citrine-green due to crystal production.

CA: growth rate 82–83 mm, regular, with floccose, white aerial mycelium; colony salmon with iron grey tinges; reverse ochraceous to fulvous, with iron grey to leaden black sectors.

Pycnidia mainly on the agar, sometimes formed in the agar, 80–260 µm in diam., globose to irregular, confluent, glabrous, with 1–2 non-papillate or papillate ostioles, often developing a long neck, pale citrine-sienna at first, darkening with age to olivaceous black; walls made up of 2–5 layers of cells, outer layer pigmented; conidial exudate white to buff. Conidiogenous cells 3–7 × 4–8 µm, globose to bottle-shaped. Conidia usually aseptate, 4–6.5 × 1.5–2 µm, average 5.1–1.8 µm, Q = 2.1–3.6, av. Q = 2.9, ellipsoidal to cylindrical with or without a few, small guttules. Occasionally some large secondarily 1-septate conidia are produced, 14.5–24 × 4–7 µm ('ascochytoid').

Chlamydospores absent.

NaOH spot test: on OA and MA a coral discolouration occurs.

Crystals are usually formed abundantly on MA. They are of the '*foveata*-type', i.e. look like the yellow-green crystals of the anthrachinon pigment-complex found in old cultures of *Phoma foveata* Foister (sect. *Phyllostictoides*; for a coloured plate of the crystals see Tichelaar, 1979).

Description in vivo (especially on *Solidago virgaurea*)

Pycnidia (superficial on dead stems) mostly 100–150 µm diam. and globose ostiolate. In most collections they contain only aseptate conidia resembling those of *Phoma dennisii* in vitro, (4–)5–6(–7) × 1.5–2(–2.5) µm. Sometimes, however, pycnidia with large, mainly 1–2-septate conidia also occur, synanamorph *Stagonosporopsis dennisii*: conidia subcylindrical-ellipsoidal, usually with several guttules, 15.5–28 × 4.0–6.0 µm (single identity proved by cultures).

Ecology and distribution. In Europe and North America (Canada) found on, and isolated from last year's dead stems of golden rod, i.e. *Solidago* species of both Eurasian and North American origin. The fungus is especially frequently recorded on *S. canadensis*. So far no data on pathogenicity.

Cultures studied. CBS 631.68 (PD 68/147) ex *Solidago floribunda*, the Netherlands; CBS 110.96 (PD 94/1575) ex *Solidago virgaurea*, the Netherlands; CBS 135.96 (PD 95/4756) ex *Solidago canadensis*, Canada.

Note. The dimensions of the 'ascochytoid' conidia are in the same range of size as those recorded for *Ascochyta solidaginis* (Schw.: Fr.) Starbäck, Bih. K. svenska VetensAkad. Handl. 19, Afd. III (2) (1894) 52, and *Ascochyta solidaginis* (Thümen) Keissler, Beih. bot. Centbl. [Zentbl.] II, 29 (1912) 427. However, both these names refer to the anamorph of a mycoparasite of rusts, *Sphaerellopsis filum* (Biv.-Bern.: Fr.)Sutton, commonly known as *Darluca filum* (Biv.-Bern.: Fr.) Cast. [teleom. *Eudarluca caricis* (Fr.) O. Eriksson], see Melnik (1977: 195).

4b. **Phoma dennisii** var. **oculo-hominis** (Punith.) Boerema, de Gruyter & Noordel., *comb. nov.*

Conidial dimorph large, mainly 1-septate. Ascochytoid [only known in vitro].

Phoma oculo-hominis Punithalingam, Trans. Br. mycol. Soc. 67 (1976) 142–143 (basionym; holotype IMI 193307).

Selected literature. Punithalingam (1976: original description on PDA).

Description in vitro

On all media growth rate and cultural characteristics about the same as those of *P. dennisii* var. *dennisii*; on OA and MA differing in the absence of a diffusable pigment. In general *P. dennisii* var. *oculo-hominis* has a more dull green appearance.

Pycnidia do not differ essentially from those of the type variety, but the conidia are more variable in shape and size. The 1-septate conidia are in comparison with those of the type variety relatively small, mostly 9–16 × 4.5 µm.

Chlamydospores absent.

NaOH spot test: no coral discolouration on OA and MA as in cultures of the type variety.

Crystals of '*foveata*-type', similar to those of the type variety, may be formed abundantly on MA.

Ecology and distribution. Once isolated from a human cornea (ulcer) in the United States (Tennessee). The cultural characteristics of this fungus suggest a natural relation with the 'golden rod fungus', *P. dennisii* (var. *dennisii*, No. 4a; e.g. common on dead stems of *Solidago canadensis*).

Culture studied. IMI 193307 (CBS 634.92).

5. **Phoma glaucii** Brun. — Fig. 2C

Conidial dimorph large, occ. aseptate, mostly 1(–2)-septate. Ascochytoid-stagonosporoid: *Stagonosporopsis chelidonii*, see below.

Phoma glaucii Brunaud, Annls Soc. Sci. nat. La Rochelle (1892) 97 [= Glanules mycol. III: p. 5] [as '*glauci*']; not *Phoma glaucii* Therry, Revue mycol. 13 (1891) 10 [nomen nudum; cf. Roum., Fungi gall. No. 5561 an immature ascomycete].

Diplodina glaucii Cooke & Massee, Grevillea 17 (1889) 79. — *Ascochyta glaucii* (Cooke & Massee) Diedicke, Krypt.-Fl. Mark Brandenb. 9, Pilze 7 (1915) 383–384 [in both cases as '*glauci*'].

Ascochyta dicentra Oudemans, Ned. kruidk. Archf III, 2 (3) (1902) 721–722.

Diplodina chelidonii Naumov, Bull. Soc. oural Amat. Sci. nat. [= Zap. ural' Obshch. Lyub. Estest.] 35 (1915) 32 [extrait].

Diplodina chelidonii Ade, Mitt. bad. Landesver. Naturk. II [N.F.], 1 (1924) 332 [illegitimate as later homonym].

Phyllosticta corydalina Picbauer, Sb. vys. Sk. zeméd. Brné Fak. hospodárska/lesnická 18 (1931) 20.

Ascochyta papaveris var. *dicentra* Grove, Br. Coelomycetes 1 (1935) 301.

Phoma chelidonii Brezhnev, Bot. Mater. Ofd. spor. Rast. Bot. Inst. Akademii nauk SSSR 7 (1951) 190.

Synanamorph: *Stagonosporopsis chelidonii* (Bres.) Diedicke, Krypt.-Fl. Mark Brandenb. 9, Pilze 7 (1912) 398. — *Phyllosticta chelidonii* Bresadola, Hedwigia 35 (1896) 199.

Ascochyta chelidoniicola Melnik, Nov. Sist. niz. Rast. 12 (1975) 204. — *Ascochyta chelidonii* Kabát & Bubák, Hedwigia 46 (1907) 290 [illegitimate as a later homonym of *Ascochyta chelidonii* Libert, Pl. cryptog. Ard. Fasc. 3 (1834) No. 204 (≡ *Septoria chelidonii* (Lib.) Desm.)].

Description in vitro

OA: growth rate 78–82 mm, regular, with scarce to abundant, coarsely floccose, white aerial mycelium; colony colourless, sometimes pale citrine-green at margin, the agar staining saffron to fulvous due to a diffusable pigment; reverse similar.

MA: growth rate 71–84 mm after 6 days, regular, with compact floccose to woolly, white, sometimes more like olivaceous grey aerial mycelium; colony colourless to olivaceous-olivaceous grey to dull green in a stellate pattern, the agar staining pale luteous to amber due to a diffusable pigment; reverse similar, or leaden grey to fulvous.

CA: growth rate 73–83 mm after 6 days, regular, with floccose, white to pale olivaceous grey aerial mycelium; colony colourless to olivaceous grey in a stellate pattern, the agar staining scarlet, due to a diffusable pigment production; reverse rust, scarlet, blood-colour or cinnamon, sometimes with olivaceous tinges.

Pycnidia abundant, on and in the agar, and in aerial mycelium, 90–320 µm diam., globose to irregular, solitary or confluent, glabrous or with mycelial outgrowths, with 1 or 2(–4) often papillate ostioles, honey to cinnamon-olivaceous; walls made up of 2–5 layers of cells, outer layer(s) pigmented; conidial exudate rosy buff to salmon-saffron. Micropycnidia also present, 60–90 µm diam. Conidiogenous cells 3–8 × 4–7 µm, globose to bottle-shaped. Conidia aseptate, 6–10.5 × 2–4 µm, av. 6.9–8.2 × 2.2–3.0 µm, Q = 2.0–4.0, av. Q = 2.7–3.2, subcylindrical-ellipsoidal to more or less obclavate-fusiform, without distinct guttules. Occasionally some 1-septate conidia are present, up to 13 × 5 µm.

Chlamydospores absent.
NaOH spot test: positive on OA and MA: greenish, then red (E+ reaction).
Crystals absent.

Description in vivo (especially on *Chelidonium majus*)

Pycnidia (subepidermal on irregular yellowish brown leaf spots with darker border; also in long stretches on dead stems, on dried seed capsules and on fading or dead leaves) mostly 100–200 µm diam., usually depressed globose to ellipsoidal, brown to black with 1 small inconspicuous ostiole. The conidia usually display about the same range of variability as those of *P. glaucii* in vitro, subcylindrical to fusiform, often aseptate, mostly 7–8 (–8.5) × (2.5–)3(–3.5) µm, but frequently becoming 1-septate, (7–)10–13(–15) × (2.5–)3–4 µm; they are often microguttulate. Sometimes, especially under dry circumstances, the pycnidia may contain distinctly larger conidia, representing the synanamorph *Stagonosporopsis chelidonii*, (13.5–)15–21(–23) × 4–5(–6.5) µm, subcylindrical to ellipsoidal and rounded at the ends, mostly 1-septate, but occasionally also aseptate or 2-septate; they may be very pale brown tinged and always have small guttules.

Ecology and distribution. This fungus has been isolated and reported from quite different wild Papaveraceae throughout Europe, e.g. species of *Chelidonium, Corydalis, Dicentra* and *Glaucium*. It is known as a pathogen causing a leaf spot, but most records and synonyms refer to phomoid phenotypes (aseptate and 1-septate conidia) colonising fading leaves and dead stems.

Cultures studied. CBS 113.96 (PD 74/140) ex *Glaucium flavum* (Papaveraceae), the Netherlands; CBS 112.96 (PD 79/765) ex *Dicentra* sp. (Papaveraceae), the Netherlands; CBS 111.96 (PD 75/855) ex *Corydalis* sp. (Papaveraceae), the Netherlands; CBS 114.96 (PD 94/888) ex *Chelidonium majus*, the Netherlands.

Note. The German collection on leaves of *Chelidonium majus* studied by Bresadola (l.c.) illustrates the influence of desiccation on the occurrence of *Stagonosporopsis* conidia. In the pycnidia of the fresh collection apparently only phomoid conidia ('7–8 × 3 µm, becoming 1-septate and 10–3.5 µm') were present, but during the drying process numerous large, mainly septate (ascochytoid-stagonosporoid) conidia (13.5–23 × 4.5–5 µm, in holotype; compare Diedicke l.c.) have developed. These changes have been observed in reverse with a Dutch collection on leaves of *Chelidonium majus*: pycnidia with many large, mainly septate conidia, contained numerous small phomoid conidia after 5 days under humid conditions (single identity proved by conidial isolates).

6. **Phoma aquilegiicola** Petrov — Fig. 3A

Conidial dimorph large, occ. aseptate, mostly 1(–2)-septate. Ascochytoid-stagonosporoid: *Stagonosporopsis aquilegiae*, see below.

Phoma aquilegiicola Petrov, Acta Inst. Bot. Acad. Sci. USSR Pl. crypt. [Trudy bot. Inst. Akad. Nauk SSSR] Fasc. 1 (1933) 281.

Phyllosticta aquilegiicola Brunaud, Act. Soc. linn. Bordeaux 54 (1890) 244 [Misc. mycol. 2 (1889) 33] [as '*aquilegicola*'].

Sclerophomella aconiticola Petrak, Hedwigia 65 (1925) 308. — *Phoma aconiticola* Petrak, Fungi polon exs. (1921) No. 643 [nomen nudum; syntype U].

Phoma aconiticola Nagai, Shishido & Tsuyama, J. Fac. Agric. Iwate Univ. 10 (1) (1970) 23.

Synanamorph: ***Stagonosporopsis aquilegiae*** (Rabenh.) ***comb. nov.***

Depazea aquilegiae Rabenhorst, Klotzschii Herb. mycol. Cent. 17 (1852) No. 1651 (basionym; syntype B). — *Ascochyta aquilegiae* (Rabenh.) Höhnel, Annls mycol. 3 (1905) 406 [later homonym of *A. aquilegiae* (Roum. & Pat.) Sacc., see below].

Phyllosticta aquilegiae Roumeguère & Patouillard, Revue mycol. 5 (1883) 28. — *Ascochyta aquilegiae* (Roum. & Pat.) Saccardo, Sylloge Fung. 3 (1884) 396. — *Ascochytella aquilegiae* (Roum. & Pat.) Tassi, Boll. R. Orto bot. [Boll. Lab. Bot. Orto bot.] Siena 5 (1902) 27. — *Actinonema aquilegiae* (Roum. & Pat.) Grove, J. Bot., Lond. 56 (1918) 343.

Diplodina delphinii Laskaris, Phytopathology 40 (1950) 620 [July][1]. — *Ascochyta laskarisii* Melnik, Nov. Sist. niz. Rast. (1971) 211; Mikol. Fitopatol. 7, 2 (1973) 142[2].

Diplodina delphinii Golovin, Cent. Asian Univ. Studies II [N.S.] 14, 5 (1950) 34 [December; illegitimate as later homonym].

Selected literature. Laskaris (1950, as *Diplodina delphinii*), Cejp (1965: 346 as *Phyllosticta aquilegiicola*) and Buchanan (1987: 17–18 as *Ascochyta aquilegiae*).

Description in vitro

OA: growth rate 56–75 mm, regular, with finely woolly-floccose, white to pale olivaceous grey aerial mycelium; colony colourless, some isolates staining the agar rosy buff-saffron with a diffusible pigment; reverse similar.

MA: growth rate 58–80 mm, regular, with finely woolly-floccose, white to pale olivaceous grey aerial mycelium; colony olivaceous buff to honey with a diffusible pigment, tinged peach by conidial exudate, margin greenish olivaceous; reverse umber with pale luteous and isabelline patches.

CA: growth rate 67–79 mm, regular, with finely woolly-floccose, white to pale olivaceous grey aerial mycelium; colony colourless, some isolates staining the agar scarlet with a diffusible pigment; reverse of these isolates scarlet to rust, otherwise honey to isabelline.

Pycnidia abundant, on and in the agar, and in aerial mycelium, 120–300 µm diam., globose to subglobose, solitary, glabrous or with mycelial outgrowths, with usually 1 non-papillate or slightly papillate ostiole; colour of saffron becoming partly olivaceous black; walls made up of 3–7 layers of cells, outer layers pigmented; conidial exudate white, occasionally rosy buff. Micropycnidia also present, 30–60 µm diam. Conidiogenous cells 4–7 × 4–7 µm, globose. Conidia usually aseptate, 5–8 × 2–2.5 µm, av. 6.3–6.5 × 2.3 µm, Q = 2.2–3.9, av. Q = 2.7–2.8, ellipsoidal to more or less obclavate-fusiform, with or without guttules. Occasionally some larger 1-septate conidia are present, up to 15 × 5 µm.

Chlamydospores absent, but chains and clusters of dark swollen cells may be formed especially on CA.

NaOH spot test: positive on OA and MA: greenish, then red (E+ reaction). Crystals absent.

Description in vivo (especially on *Aquilegia vulgaris*)

Pycnidia (subepidermal on leaf lesions which are usually marginal, grey to brown with a dark brown border and sometimes with radiating mycelial fibrils; also on carpels and old stems) mostly 80–170 µm diam., relatively thick-walled, globose to subglobose with 1 distinct ostiole. Conidia in pycnidia on leaf lesions mostly large and septate, ascochytoid,

1) Type specimens should be deposited in NY, but are apparently lost; neotype designated herein: BPI, collection F.J. Berek on *Delphinium* sp., Washington DC., 4 June 1956.

2) Created as substitute name for *Diplodina delphinii* Laskaris l.c. to avoid homonymy with *Ascochyta delphinii* Melnik, Nov. Sist. niz. Rast. (1968) 173, a synonym of *Phoma delphinii* Rabenh., no. 8 in this paper.

typical of the synanamorph *Stagonosporopsis aquilegiae*: cylindrical or somewhat irregular, guttulate or eguttulate, 1(–2) septate and occasionally broken at the septa, but sometimes aseptate, mostly (10–)13–20 × (3–)4–5(–5.5) µm. In pycnidia on withered leaves, stems and on carpels phomoid conidia often predominate, mostly aseptate but occasionally

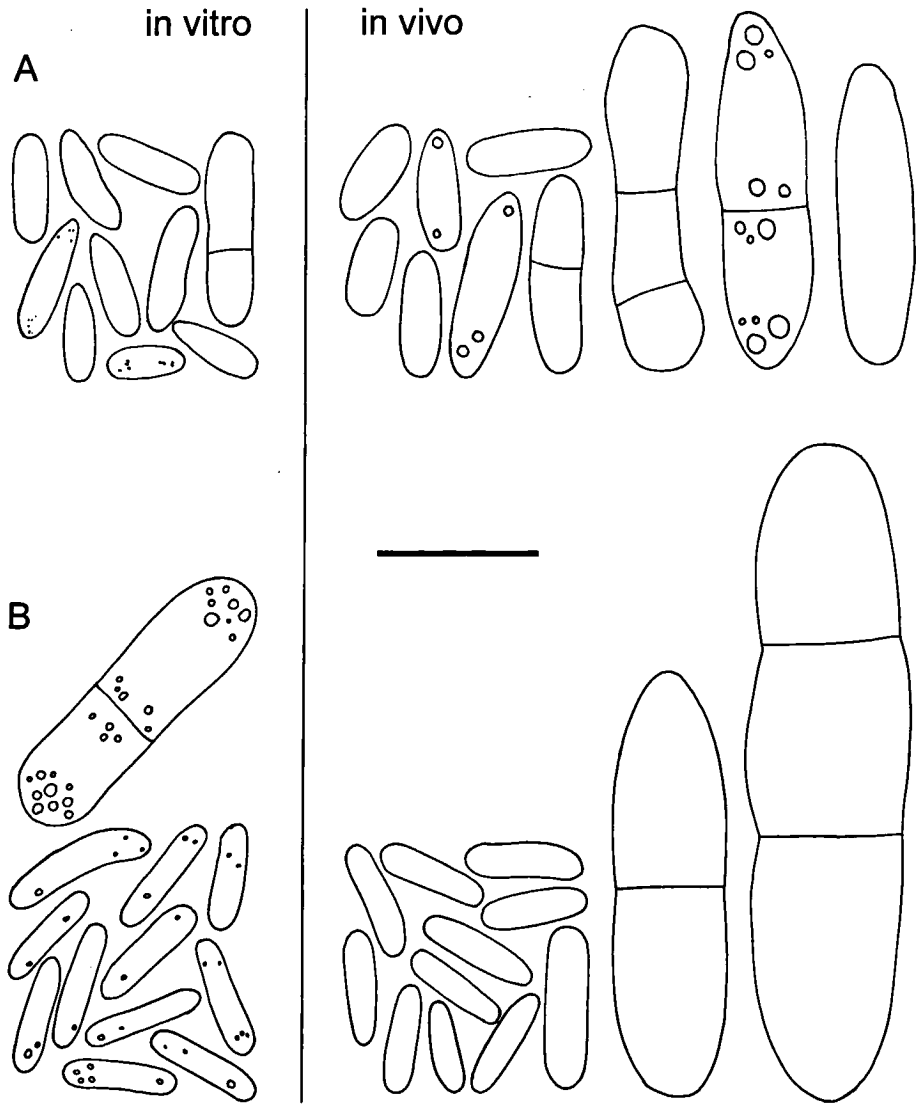


Fig. 3. A. *Phoma aquilegiicola*. Conidia phomoid in vitro, usually aseptate, but some larger ones 1-septate. Pycnidia in vivo may contain similar conidia, aseptate and occasionally 1-septate, but mostly much larger conidia, usually 1(–2)-septate, synanamorph *Stagonosporopsis aquilegiae*. — B. *Phoma nigripycnidia*. Conidia usually small and aseptate in vitro but some large 1-septate conidia may be present, especially in fresh cultures. Pycnidia sometimes contain only small aseptate conidia in vivo, but usually only very large 1–2(–4)-septate conidia are present, synanamorph *Stagonosporopsis nigripycnidiicola*. Bar 10 µm.

1-septate, similar to conidia produced in vitro, but they are usually larger and more variable in shape, eguttulate or guttulate, (5–)6–9(–14) × (2–)2.5–3.5(–5) µm.

Ecology and distribution. In Eurasia this fungus is frequently found in association with dark leaf spots and stem lesions on wild and cultivated *Aquilegia* spp. (perennials), especially *A. vulgaris*. However, it occurs also on other Ranunculaceae, e.g. perennial *Aconitum* and *Delphinium* spp. In the United States it has been an important cause of crown rot of cultivated Delphiniums (as *Diplodina delphinii*). In Japan the fungus has recently caused severe damage on cultivated Aconitums (as *Phoma aconiticola*). The *Stagonosporopsis* synanamorph is also recorded in Australasia (New Zealand). *Phoma aquilegiicola/S. aquilegiae* differs from the related *P. delphiniicola/S. delphinii* (no. 8) by faster growth rate, positive E-reaction and different shape and size of the conidia (compare the figures 3A and 4A).

Cultures studied. CBS 108.96 (PD 79/611) and CBS 109.96 (PD 83/832) ex *Aquilegia* sp. (Ranunculaceae), the Netherlands; CBS 107.96 (PD 73/598) ex *Aconitum pyramidale* (Ranunculaceae), the Netherlands.

Note. Didymella inaequalis Corbaz (1957: 397–400), described from dead stems of *Aconitum lycoctonum* in southern France, may represent the teleomorph of the fungus. The conidia of the pycnidial anamorph of *D. inaequalis* resemble those of *Phoma aquilegiicola* on dead stems of *Aconitum* spp., but the cultures could not be compared.

7. **Phoma nigripycnidia** Boerema, de Gruyter & Noordel., *spec. nov.* — Fig. 3B

Conidial dimorph large, 1–2(occ.3–4)-septate. Stagonosporoid: *Stagonosporopsis nigripycnidiicola*, see below.

Pycnidia in vitro nigris, 220–360 µm diam., irregulariter globosa, plerumque solitaria, glabra, ostiolo inconspicuo praedita, nonnumquam papillata. Cellulae conidiogenae 5–10 × 4–8 µm, globosae vel lageniformes. Conidia unicellularia, 5.5–9 × 1.5–2 µm, cylindrica vel allantoidea, nonnullis guttulis parvis repleta. [Nonnumquam conidia paulo maiora, septata praesentia, illis synanamorphae *Stagonosporopsidis* similia.]

Holotypus: L 992.163-150 cultura exsiccata, viva CBS 116.96 (CCMF 243, PD 95/7930), isolatus ab M. Ondřej e macula foliari ad *Viciam craccam*, Libina prope Šumperk, in Republica Czechia, Augusto 1969.

Synanamorph: ***Stagonosporopsis nigripycnidiicola*** (Ondřej) *comb. nov.*
Ascochyta nigripycnidiicola Ondřej, Biológia, Bratisl. 23 (1968) 8116 (basionym; holotype PR).
Selected literature. Ondřej (1968), Ondřej (1970), Boerema & Bollen (1975).

Description in vitro

OA: growth rate 61–63 mm, regular, with floccose, white to olivaceous grey aerial mycelium; colony colourless to dull green, becoming pale luteous-citrine; reverse similar.

MA: growth rate 59–61 mm, regular, with compact velvety to floccose, white to citrine-grey olivaceous aerial mycelium; colony covered by aerial mycelium, later with honey to amber background; reverse grey olivaceous to honey, partly olivaceous black.

CA: growth rate 54–57 cm, regular, with compact floccose white to dull green aerial mycelium; colony covered by aerial mycelium; reverse buff, olivaceous in centre.

Pycnidia on the agar and in the aerial mycelium, 220–360 µm diam., irregularly globose, usually solitary, glabrous, ostiole(s) not clear, sometimes papillate, olivaceous black; walls made up to 8 layers of cells, outer layers pigmented; conidia exudate not observed. Conidiogenous cells 5–10 × 4–8 µm, globose to bottle-shaped. Conidia usually aseptate, 5.5–9 × 1.5–2 µm, av. 6.8 × 1.8 µm, Q = 3.2–4.5, av. Q = 3.8, cylindrical to

allantoid, with some small guttules; some 1-septate conidia may be present, often 9–15 × 2–4 µm, but in fresh cultures they may be three or four times as large and more-celled, resembling those of *Stagonosporopsis nigripycnidiicola* in vivo.

Chlamydospores absent.

NaOH spot test: negative, but a weak non-specific greenish discolouring may occur.

Crystals absent.

Description in vivo (on *Vicia cracca*)

Pycnidia (subepidermal, scattered in ochreous-brown circular leaf spots and elongated stem lesions) 120–250 µm diam., subglobose-papillate, dark with inconspicuous ostiole. Conidia usually very large, mostly 20–45 × 7–12 µm, 1–2(occasionally 3–4)-septate, i.e. stagonosporoid, typical of the synanamorph *Stagonosporopsis nigripycnidiicola*. Sometimes, however, the dark papillate pycnidia in the leaf spots contain only small aseptate conidia, resembling those of *Phoma nigripycnidia* in vitro.

Ecology and distribution. This fungus is in south-eastern Europe (esp. Czech Republic and Slovakia) frequently recorded as a pathogen of *Vicia cracca*: Leaf and Stem Spot. The fungus has been found occasionally on *Vicia sepium* and *V. sativa* (susceptibility proved by inoculation).

Cultures studied. CBS 116.96 (CCMF 243, PD 95/7930) ex *Vicia cracca* (Leguminosae), Czechia.

8. **Phoma delphinii** (Rabenh.) Cooke — Fig. 4A

Conidial dimorph large, mostly 1(–2)-septate. Ascochytoid(-stagonosporoid): *Stagonosporopsis delphinii*, see below.

Phoma delphinii (Rabenh.) Cooke, Grevillea 20 (1892) 113 [misapplied, see Grove, Br. Coelomycetes 1 (1935) 80]. — *Sphaeria delphinii* Rabenhorst, Klotzschii Herb. mycol., ed. 2, Cent. 8 (1845) No. 747 [Fiedler's Exs.].

Phyllosticta delphinii Lobik, Bolez. Rast. 17 [1928] 3–4 [Morbi plant. 17 (1929) 167] [holotype LE).

Ascochyta delphinii Melnik, Nov. Sist. niz. Rast. (1968) 173 [holotype LE; according to Melnik (1977: 183) referring to *Phyllosticta ajacis* Thümen (≡ *Phoma ajacis* (Thümen) v.d. Aa & Boerema, see de Gruyter et al., 1993), but the occasional occurrence of septate phomoid conidia points to *P. delphinii*].

Synanamorph: *Stagonosporopsis delphinii* Lebedeva, Notul. syst. Inst. cryptog. Horti bot. petropol. 1, 8 (1922) 156.

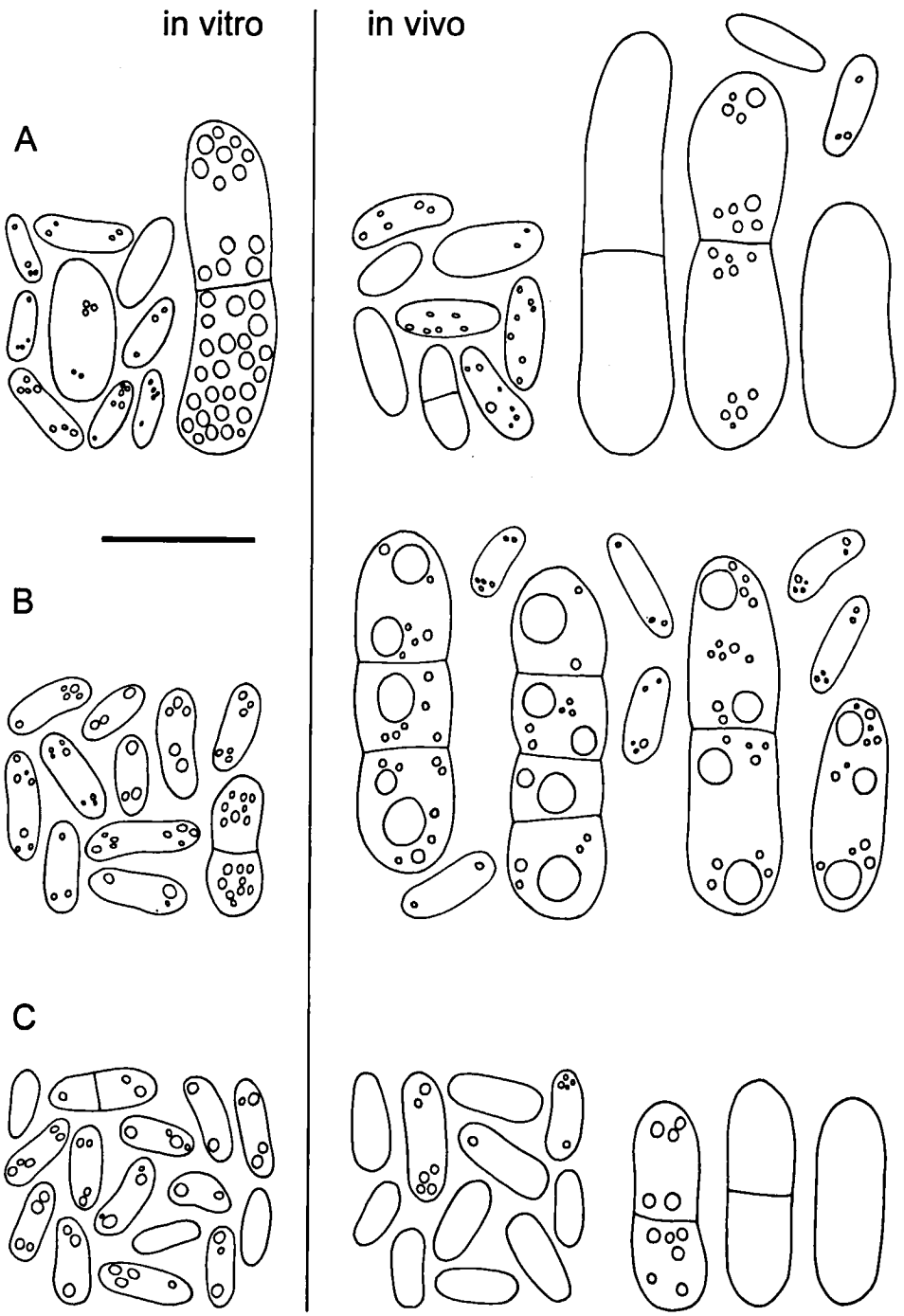
Description in vitro

OA: growth rate 33–45 mm, regular, with scarce, finely woolly, pale olivaceous grey aerial mycelium; colony colourless to grey olivaceous; reverse olivaceous buff to grey olivaceous.

MA: growth rate 30–50 mm, regular, with finely floccose to woolly, white to olivaceous grey-dull green aerial mycelium; colony greenish olivaceous to grey olivaceous, at centre olivaceous black; reverse similar, with leaden grey.

CA: growth rate 21–49 mm, regular, with finely floccose, pale olivaceous grey to grey olivaceous aerial mycelium; colony grey olivaceous to olivaceous-olivaceous black, buff at the margin; reverse similar, with leaden black.

Pycnidia abundant, on and in the agar, and in aerial mycelium, 90–300 µm diam., globose to subglobose, solitary or aggregated, glabrous, with 1–2 ostioles; citrine to honey,


in vitro
in vivo
A
B
C

later olivaceous to olivaceous black; walls made up of 2–4 layers of cells, outer layers pigmented; conidial exudate rosy buff to salmon-saffron. Micropycnidia also present, 30–70 µm diam. Conidiogenous cells 4–8 × 4–6 µm, globose to bottle-shaped. Conidia of two types: aseptate conidia, 4–15 × 1.5–5 µm, av. 5.7–8.5 × 2.0–3.2 µm, Q = 1.6–4.8, av. Q = 2.7–2.9, ellipsoidal to fusiform-allantoid, usually with several guttules, 1-septate conidia 15.5–22 × 4–5 µm, av. 18.2 × 4.5 µm, Q = 3.2–5.3, av. Q = 4.1 (ascochytoid).

Chlamydospores absent, but clusters of dark swollen cells may be present.

NaOH spot test: a weak greenish bluish discolouration may occur, but does not change to red (E-negative).

Description in vivo (especially on *Delphinium consolida*)

Pycnidia (subepidermal scattered in dark brown leaf spots, also superficial on capsules and old stems), mostly 120–270 µm diam., globose to subglobose, initially light brown, then black, with 1(–3) distinct non-papillate ostiole(s). The conidia may be all aseptate phomoid, (3–)4–7.5 × 1.5–2.5 µm, but often they are mixed with some larger, ultimately septate conidia, 15–22(–25) × 4–5(–5.5) µm. Sometimes these large, 1(–2)-septate ascochytoid conidia predominate, synanamorph: *Stagonosporopsis delphinii.*

Ecology and distribution. Most records of this fungus are on species of *Delphinium* (inclusive *Consolida*) in Europe. In Russia it has also been reported from a species of *Aconitum* (same tribus as *Delphinium*). The most common host seems to be Forking Larkspur, *D. consolida* (*Consolida regalis*). The fungus causes angular, often marginal, dark leaf spots and appears as necrophyte on capsules and old stems. It closely resembles *Phoma aquilegiicola* (synanam. *Stagonosporopsis aquilegiae*), no. 6 in this paper, which also may occur on *Delphinium* and *Aconitum* spp. *Phoma delphinii* can be easily differentiated in vitro from *P. aquilegiicola* by its slower growth rate, the negative E-reaction and different shape and size of the conidia (compare the figures 3A and 4A).

Finally it should be noted that frequently also a *Phoma* species of the section '*Macrospora*' occurs on *Delphinium* spp. in Europe (Boerema, in prep.), which may produce large 1-septate conidia.

Cultures studied. CBS 134.96 (PD 84/676) ex *Delphinium consolida*, the Netherlands.

Note. In the '*Ascochyta*-monograph' by Melnik (1977) *Stagonosporopsis delphinii* Lebedeva (l.c.) is erroneously listed as a synonym of '*Ascochyta*' (*Stagonosporopsis*) *actaeae* (treated in this paper under *Phoma actaeae*, no. 3). Melnik's interpretation was apparently based on the similarity in conidial dimensions of both pathogens, but they clearly differ in their cultural characters.

Fig. 4. A. *Phoma delphinii.* Conidia in vitro mostly aseptate and notably variable in shape and size, but always including a number of large 1-septate conidia. Pycnidia in vivo may contain mainly aseptate conidia, but these are usually less variable than in vitro; most conidia, however, may also be large and 1(–2)-septate; synanamorph *Stagonosporopsis delphinii.* — B. *Phoma subboltshauseri.* Conidia in vitro phomoid, mostly aseptate, occasionally 1-septate. Conidia in vivo, predominantly large and 1–3(–5)-septate, synanamorph *Stagonosporopsis hortensis*; but the pycnidia usually also contain some small aseptate conidia. — C. *Phoma trachelii.* Conidia in vitro, phomoid, usually aseptate, occasionally the larger ones 1-septate. Conidia in vivo, sometimes all relatively small and aseptate (phomoid), but usually much larger, 0–1(–2)-septate; synanamorph *Stagonosporopsis bohemica.* Bar 10 µm.

9. **Phoma subboltshauseri** Boerema, de Gruyter & Noordel., *spec. nov.* — Fig. 4B

Conidial dimorph large, 1–3(–5)-septate. Stagonosporoid: *Stagonosporopsis hortensis*, see below.

Pycnidia in vitro 90–230 µm diam., globosa vel subglobosa, solitaria, nonnumquam confluentia, glabra, uno ostiolo non-papillato aperientia. Cellulae conidiogenae 4–8 × 3–7 µm, globosae cel lageniformes. Conidia plerumque unicellularia, 3.5–9 × 1.5–2.5 µm, cylindrica vel ellipsoidea, una vel compluribus guttulis utrinque praedita. [Nonnumquam conidia paulo maiora, 1-septata praesentia, 11 × 3.5 µm.]

Holotypus L 992.165-395 cultura exsiccata, viva CBS 380.96 (PD 71/604), isolatus e macula foliari ad Phaseolum vulgarem, Wageningen in Neerlandia, Julio 1971.

Synanamorph: *Stagonosporopsis hortensis* (Sacc. & Malbr.) Petrak, Annls mycol. 19 (1921) 21. — *Hendersonia hortensis* Saccardo & Malbranche, Michelia 2 (3) (1882) 629 [as '*Hendersonia (Stagonospora) hortensis*']. — *Stagonospora hortensis* (Sacc. & Malbr.) Saccardo & Malbranche, Sylloge Fung. 3 (1884) 446. — *Ascochyta hortensis* (Sacc. & Malbr.) Jörstad [Jørstad], Meld. St. plpatol. Inst. 1 (1945) 74; not *Ascochyta hortensis* Kabát & Bubák, Hedwigia 44 (1905) 353.

Stagonosporopsis boltshauseri (Sacc.) Diedicke, Annls mycol. 10 (1912) 141–142; Krypt.-Fl. Mark Brandenb. 9, Pilze 7 (1912) 400. — *Ascochyta boltshauseri* Saccardo in Boltshauser, Z. PflKrankh. 1 [Midsummer] (1891) 136. — *Stagonospora boltshauseri* (Sacc.) Grigoriu, Annls Inst. phytopath. Benaki II, 11 (1975). — *Phoma boltshauseri* (Sacc.) Boerema, Pieters & Hamers, Neth. J. Pl. Path. 99, Suppl. 1 (1993) 17 [proposed with the intention to cover both conidial phenotypes].

Stagonopsis phaseoli Eriksson, Bot. Cent. [Zentbl.] 12 [47, Sept.] (1891) 298.

Selected literature. Grigoriu (1975), Boerema & Verhoeven (1979), Boerema, Pieters & Hamers (1993).

Description in vitro

OA: growth rate 46–57 mm, regular, with coarsely floccose, white to olivaceous grey aerial mycelium; colony greenish olivaceous, grey olivaceous or dull green, margin usually more like citrine green; reverse olivaceous at centre, towards margin greenish olivaceous, grey olivaceous to citrine green.

MA: growth rate 52–54 mm, regular to somewhat irregular, with compact woolly-floccose, white to pale olivaceous grey aerial mycelium; colony greenish olivaceous to grey olivaceous, margin citrine green; reverse olivaceous black with leaden grey patches, margin grey olivaceous to citrine green.

CA: growth rate 46–62 mm, regular to irregular, with floccose to woolly, white to grey olivaceous aerial mycelium; colony grey olivaceous to olivaceous; reverse olivaceous-ochraceous with fuscous black or grey olivaceous patches, sometimes also leaden grey.

Pycnidia on or in the agar, and in aerial mycelium, 90–230 µm diam., globose to subglobose, solitary, sometimes confluent, glabrous, with one non-papillate ostiole; honey to olivaceous later olivaceous black; walls made up of 2–5 layers, outer layer pigmented; conidial exudate white to buff. Micropycnidia usually also present, 30–70 µm diam. Conidiogenous cells 4–8 × 3–7 µm, globose to bottle-shaped. Conidia usually aseptate, 3.5–9 × 1.5–2.5 µm, av. 5.8–6.2 × 2.1–2.2 µm, Q = 1.8–4.2, av. Q = 2.7–2.9, cylindrical to ellipsoidal, 1–several small guttules, at each end. Occasionally some 1-septate conidia are formed, up to 11 × 3.5 µm.

Chlamydospores absent.

NaOH spot test: negative, but on MA a non-specific reddish brown discolouration may occur.

Crystals absent.

Description in vivo (on *Phaseolus vulgaris*)

Pycnidia (subepidermal in concentric rings on reddish-brown leaf spots; and occasionally scattered in sunken dark reddish-brown lesions on stems and pods) mostly 100–200 µm diam., globose to subglobose with 1 distinct ostiole. Large conidia always predominate and are 1–3(–5)-septate, i.e. stagonosporoid, typical of the synanamorph *Stagonosporopsis hortensis*: cylindrical with obtuse ends, constricted at the septa and usually with four large and several small guttules, mostly (16–)18–22(–34) × (4–)5–8(–9) µm. Usually the pycnidia also contain some relatively small aseptate conidia, 5–10 × 1.5–2.5 µm, resembling those of *Phoma subboltshauseri* in vitro.

Ecology and distribution. A world-wide pathogen of dwarf beans (*Phaseolus vulgaris*), causing stunting and red-brown blotches on stems, leaves and pods: Leaf Spot Disease. Recently the fungus has also been found on cowpea, *Vigna unguiculata*; this is not surprising because the African genus *Vigna* and the American genus *Phaseolus* are closely related and susceptible to their mutual pathogens.

Cultures studied. CBS 572.85 (PD 79/269) and CBS 131.96 (PD 79/1158) ex *Phaseolus vulgaris* (Leguminosae), the Netherlands; CBS 130.96 (PD 87/525) ex *Phaseolus vulgaris* (Leguminosae), Colombia.

10. **Phoma trachelii** Allescher — Fig. 4C

Conidial dimorph large, 1(–2)-septate. Ascochytoid: *Stagonosporopsis bohemica*, see below.

Phoma trachelii Allescher, Fungi bavar. exs. [Ed. Allescher & Schnabl] Cent. 4 (1894) No. 360; Allg. bot. Z. 1 (1895) 26.

Phyllosticta alliariae-foliae Allescher, Rabenh. Krypt.-Fl. [ed. 2] Pilze 6 [Lief. 60] (1898 [vol. dated '1901'] 109. — *Phyllosticta fallax* Allescher, Hedwigia 36 (1897) 159; not *Phyllosticta fallax* Saccardo & Roumeguère, Michelia 2 (3) (1882) 620.

Synanamorph: **Stagonosporopsis bohemica** (Kabát & Bubák) *comb. nov.*

Ascochyta bohemica Kabát & Bubák in Bubák & Kabát, Hedwigia 44 (1905) 352–353 (basionym; cf. Kabát & Bubák, Fungi imp. exs. No. 261 in B). — *Stagonospora bohemica* (Kabát & Bubák) Tobisch, Öst. bot. Z. 83 (1934) 142.

Selected literature. Sauthoff (1962), Boerema & Bollen (1975).

Description in vitro

OA: growth rate 41–45 mm, regular, initially with white, floccose aerial mycelium, but without obvious aerial mycelium after 14 days; colony rather colourless, but with greenish grey olivaceous centre, or with grey olivaceous to olivaceous sector; reverse similar.

MA: growth rate 29–51 mm, irregular, with rather compact woolly-floccose, olivaceous grey aerial mycelium; colony olivaceous grey to grey olivaceous or olivaceous black, with nearly colourless margin; reverse similar.

CA: growth rate 60–66 mm, regular, with poorly developed, finely velvety, white to pale olivaceous grey aerial mycelium; colony colourless with grey olivaceous, olivaceous or olivaceous black sectors; reverse similar.

Pycnidia abundant, mostly on, or partly in the agar, 110–300 µm diam., globose or compressed to more or less bottle-shaped, solitary or confluent, glabrous, with 1 to 3 distinct, papillate ostioles, sometimes with elongated necks; citrine to honey, later olivaceous to olivaceous black; walls made up of 3–7 layers of cells, outer layers pigmented, conidial

exudate sordid white to pale vinaceous-buff. Conidiogenous cells 4–8 × 3–7 µm, globose to bottle-shaped, thin-walled. Conidia usually aseptate, 4–8.5 × 1.5–3 µm, av. 5.6 × 1.9 µm, Q = 2.2–4.0, av. Q = 3.0, ellipsoidal to cylindrical, sometimes eguttulate but usually with distinct polar guttules. Occasionally some 1-septate conidia occur, 7–16 × 2–3.5 µm (i.e. intermediate between the common aseptate conidia and the large septate ascochytoid conidia found in vivo).

Chlamydospores absent.

NaOH spot test: negative.

Crystals absent.

Description in vivo (especially on *Campanula isophylla*)

Pycnidia (subepidermal, usually concentrically arranged in large grey brown to black leaf spots; also on roundish or elongated lesions on petals and stems) resembling those in vitro, mostly 75–255 µm diam., depressed globose to ellipsoidal, with 1, only slightly papillate dark bordered ostiole. Conidia sometimes all relatively small and aseptate, similar to those of *Phoma trachelii* in vitro. However, the pycnidia may also contain many large conidia, which mostly become 1(–2)-septate. These ascochytoid conidia are cylindrical in shape, rounded at both ends, often slightly curved and mostly eguttulate, (11–)13–23 × 4–6 µm. The mature 1-septate conidia easily break into two parts and are typical of the synanamorph *Stagonosporopsis bohemica*. Together with the ascochytoid conidia some small aseptate phomoid conidia usually occur (see note).

Ecology and distribution. A common seed-borne pathogen of wild and cultivated species of *Campanula* and *Trachelium* in Eurasia and in North and South America. Found most frequently on *C. isophylla* 'Alba', the 'Star of Bethlehem'; causing Leaf, Stem and Flower Spot.

Cultures studied. CBS 379.91 (PD 77/675) ex *Campanula isophylla* (Campanulaceae), the Netherlands; CBS 380.91 (PD 88/162) ex *Trachelium* sp. (Campanulaceae), the Netherlands.

Note. Experiments by Sauthoff (l.c.) have shown that the phomoid aseptate conidia develop at high humidity, whereas the large septate ascochytoid conidia are produced at varying humidity and with desiccation. This links up with an observation we made in vitro. In pycnidia of an old plate culture on OA the conidiogenous layer had many large cylindrical cells resembling initials of the large conidial phenotype; however, wetting the pycnidia, these cells became phialidic conidiogenous cells producing numerous small aseptate conidia (Boerema & Bollen l.c.: fig. 6c). The large septate conidia germinated much more quickly than the small aseptate conidia.

11. **Phoma samarorum** Desm. — Fig. 5

Conidial dimorph large, 1–3-septate. Stagonosporoid: *Stagonosporopsis fraxini* (Allescher) Died., see below.

Phoma samarorum Desmazières, Pl. cryptog. N. France [ed. 1] Fasc. 7 (1828) No. 349. — *Phomopsis samarorum* (Desm.) Höhnel, Hedwigia 62 (1921) 87 [misapplied]. — *Diplodina samarorum* (Desm.) Nevodovsky, Fungi of the USSR Fasc. 1 (1952) No. 14 [as '*samararum*']. — *Septoria samarorum* (Desm.) Wollenweber & Hochapfel, Z. ParasitKde 8 (1936) 604. — *Stagonospora samarorum* (Desm.) Boerema, Persoonia 6 (1970) 25.

Phoma fusispora Wehmeyer, Mycologia 38 (1946) 320–321 (holotype Herb. Wehmeyer No. 1090).

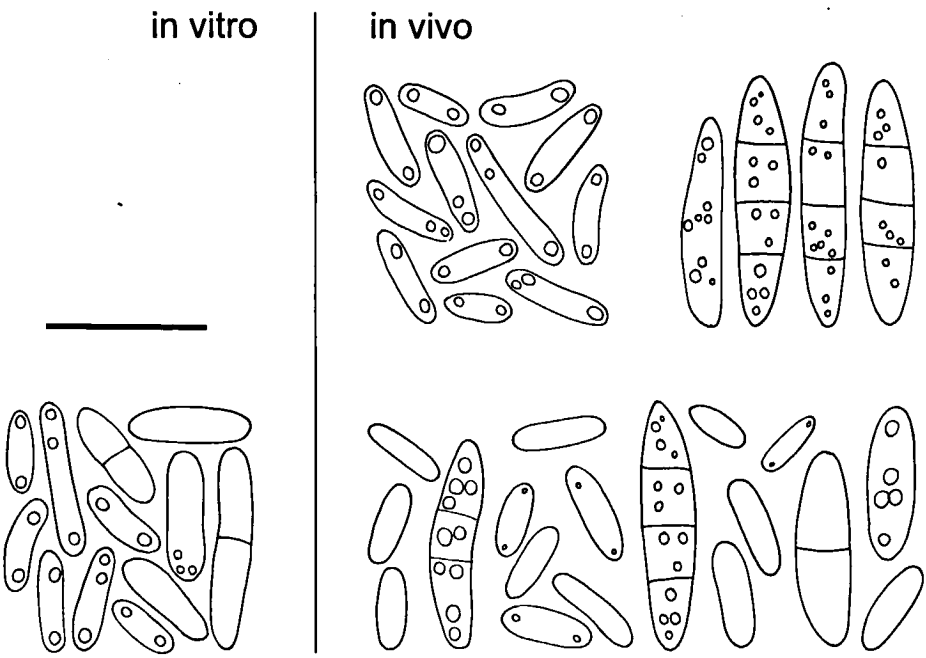


Fig. 5. *Phoma samarorum.* Conidia in vitro, phomoid and variable, mainly aseptate, but the larger ones often 1(–2)-septate. Conidia in vivo, sometimes mostly aseptate phomoid and sometimes mainly larger, fusoid in shape and 1–3-septate; synanamorph *Stagonosporopsis fraxini.* However, mixtures with various intermediate conidia forms may also occur. Bar 10 µm.

Synanamorph: *Stagonosporopsis fraxini* (Allescher) Diedicke, Krypt.-Fl. Mark Brandenb. 9, Pilze 7 (Heft 2) (1912) 399 [as '(Oud.) Died.'; description literally adopted from Allescher, see after this]. — *Diplodina fraxini* Allescher, Rabenh. Krypt.-Fl. [ed. 2], Pilze 6 (Lief. 69) (1899 [vol. dated '1901']) 687 [based on *Ascochyta fraxini* Oudemans, Ned. kruidk. Archf II, 5 (1889) 497, but the latter name is illegitimate as a later homonym of *Ascochyta fraxini* Libert, Pl. cryptog. Ard. Fasc. 1 (1830) No. 48; the resultant combination therefore has to be treated as a new name dating from 1899 (Art. 72.1)]. — *Ascochytella fraxini* (Allescher) Petrak in H. Sydow & P. Sydow, Annls mycol. 22 (1924) 266 [as '(Oud.)']. — *Pseudodiplodia fraxini* (Allescher) Petrak, Sydowia 7 (1953) 304 [as '(Oud.)'].

For other synonyms see Boerema & Dorenbosch (1973).

Description in vitro

OA: growth rate 21–27 mm (14 days: 47–52 mm), regular, with felted to finely floccose-woolly, white aerial mycelium; colony colourless to primrose or rosy buff to salmon, due to a diffusable pigment, later with olivaceous grey tinges; reverse similar.

MA: growth rate 21–23 mm (14 days: 30–41 mm), regular, with compact finely floccose to woolly, white to pale olivaceous grey or smoke grey aerial mycelium; colony buff to olivaceous grey with straw to citrine green centre; reverse similar with saffron to luteous centre, partly tinged bluish green.

CA: growth rate 25–27 mm (14 days 50–51 mm), regular, with finely floccose to woolly, white to citrine green or glaucous aerial mycelium; colony pale olivaceous grey to citrine green-dull green in centre, margin colourless; reverse saffron with dark herbage green to dull green, olivaceous patches.

Pycnidia on the agar, 120–270 µm diam., globose to irregularly shaped, solitary or confluent to large pycnidial bodies up to 900 µm, with mycelial outgrowths, and 1–3 usually papillate ostioles, sometimes developing long necks, honey to olivaceous black, walls made up to 10 layers of cells, outer layers pigmented; conidial exudate ochraceous. Conidiogenous cells 3–5 × 3–7 µm, subglobose to bottle-shaped. Conidia mainly aseptate, mostly 4–8.5 × 1.5–3 µm, av. 6.0 × 2.2 µm, Q = 1.4–4.0, av. Q = 2.8, sometimes larger and often 1(–2)-septate, 7–16 × 2–3 µm, slightly yellowish, with or without distinct polar guttules, ellipsoidal to cylindrical, usually attenuate at one end.

Chlamydospores absent.

NaOH spot test: negative.

Crystals absent.

Description in vivo

Pycnidia (in necrotic host tissue) resemble those in vitro, usually solitary, often with interwoven hyphae and obvious papillate ostioles. The conidia always show the characteristic yellow tinge as noted above; they are much more variable in size and shape than those in vitro, sometimes fusoid. Pycnidia may contain only aseptate conidia, 5.5–10 × 1.5–3 µm, only 1–3-septate conidia, up to 17 × 3.5 µm, or a mixture of both types of conidia. Sometimes the conidia are explicitly large, 17–25 × 2.5–3.5 µm. They may be distinctly guttulate, but also eguttulate.

Ecology and distribution. The sources of the isolates indicate that it is a common saprophytic soil fungus in the whole of Eurasia. The fungus also has been isolated and described from different substrata in North America (USA). It has been found on necrotic tissue of quite different herbaceous and gramineous plants as well as deciduous trees and shrubs. The epithet of the species refers to key-fruits (samarae) of ash.

Cultures studied. CBS 138.96 (PD 82/653) ex *Phlox paniculata* (Polemoniaceae), the Netherlands; CBS 139.96 (PD 82/905) ex undetermined Gramineae, the Netherlands.

Addendum (12–19)

12. **Phoma ligulicola** Boerema var. **ligulicola**

Conidia usually of normal phomoid size with secondary septation (sect. *Phyllostictoides*), but sometimes distinctly large, aseptate or 1(–2)-septate (ascochytoid) conidia occur.

Teleomorph: *Didymella ligulicola* (Baker et al.) von Arx, var. *ligulicola*

Phoma ligulicola Boerema in Van der Aa, Noordeloos & de Gruyter, Stud. Mycol. 32 (1990) 9, var. *ligulicola*. — *Ascochyta chrysanthemi* F.L. Stevens, Bot. Gaz. 44 (1907) 246; not *Phoma chrysanthemi* Voglino, Malpighia 15 (1902) 332.

For nomenclature see Van der Aa, Noordeloos & de Gruyter (1990).

Characters in vitro

A detailed description in vitro will be given under sect. *Phyllostictoides* (in prep.). A distinctive taxonomic characteristic in that section is the usual presence of some 1-septate conidia of normal phomoid size. The aseptate conidia of this species are mostly 3.5–7.5 (–12) × 2–3(–4) µm (av. 5.4–5.6 × 2.4–2.5 µm), ellipsoidal to oblong, with several small

guttules. The dimensions of the 1-septate conidia usually range between 9–15 × 3–5 µm (av. 11.3 × 3.5 µm), but sometimes they are distinctly large, up to 23 × 8 µm. Pseudothecia have not been observed in vitro.

Characters in vivo (on *Chrysanthemum morifolium* [*indicum*])

Conidia from pycnidia on the host (in black leaf blotches and stem lesions, blackened petals) are mostly irregular, cylindrical-ellipsoidal and extremely variable in size, usually either aseptate (10–40%), (6–)8.5–13(–22) × 2.5–8 µm, or 1(–2)-septate, (9–)13–15.5 (–23) × (3–)4–5(–6.5) µm. Pseudothecia occur only occasionally.

Ecology and distribution. A specific pathogen of florists' chrysanthemum, *Chrysanthemum morifolium* (Compositae), at present occurring nearly everywhere the host is cultivated. The disease is known as Chrysanthemum Ray (flower) Blight, but all plant parts, roots, stems, leaves and flowers may be attacked. Cuttings, being easily infected, are the main cause of the world-wide spread of the fungus.

Representative culture. CBS 137.96 (PD 84/75) ex *Chrysanthemum morifolium* (Compositae), the Netherlands.

13. **Phoma protuberans** Lév.

Conidia mostly of normal phomoid size with secondary septation (sect. *Phyllostictoides*), but occasionally in vitro some distinctly large, 1-septate (ascochytoid) conidia occur.

Phoma protuberans Léveillé, Annls Sci. nat. (Bot.) III, 5 (1846) 281.
Phyllosticta lycii Ellis & Kellerman, Am. Nat. 17 (1883) 1166.

Characters in vitro

A detailed description will appear under sect. *Phyllostictoides* (in prep.). The usual presence of some 1-septate conidia, at times becoming extremely large (ascochytoid) in agar-cultures, is distinctive. The common aseptate or 1-septate conidia are 4–10.5 × 2–5 µm, ellipsoidal to subcylindrical and without guttules. The occasional large ascochytoid conidia (up to 12–20.5 × 3.5–5 µm) usually have some guttules.

Characters in vivo (on *Lycium halimifolium*)

The pycnidia (scattered in circular leaf spots, initially brown but turning pale-yellow or whitish) usually produce mainly variably sized aseptate conidia with only a few 1-septate ones, 6–10 × 2–3 µm. Large ascochytoid conidia are sofar not recorded in the fields.

Ecology and distribution. A specific pathogen of *Lycium halimifolium* occasionally found in Europe and North America, causing Leaf Spot. The shrubby solanaceous host is indigenous to southern Eurasia; the fungus probably occurs wherever the host has become naturalized or planted.

Representative culture. CBS 381.96 (PD 71/706) ex *Lycium halimifolium* (Solanaceae), the Netherlands.

14. **Phoma cucurbitacearum** (Fr.: Fr.) Sacc.

Conidia usually of normal phomoid size with secondary septation (sect. *Phyllostictoides*), but in vivo some strains also produce distinctly large, 1-septate (ascochytoid) conidia.

Teleomorph: *Didymella bryoniae* (Auersw.) Rehm

Phoma cucurbitacearum (Fr.: Fr.) Saccardo, Sylloge Fung. 3 (1884) 148. — *Sphaeria cucurbitacearum* Fries: Fries, Syst. mycol. 2 [Sect. 2] (1823) 502 [type material not known to be extant; the anamorphic interpretation is confirmed by a collection of *S. cucurbitacearum* Fr. in Schweinitz's herbarium, PH, being predominantly anamorphic with only a few immature ascomata].

Ascochyta cucumis Fautrey & Roumeguère, Revue mycol. 13 (1891) 79.

Full synonymy will be given under section *Phyllostictoides* (in prep.).

Characters in vitro

A detailed description in vitro will appear under sect. *Phyllostictoides*. The presence of some 1-septate normal phomoid sized conidia and the occasional development of pseudothecia in the cultures are distinctive features.

Aseptate conidia, mostly 4–8 × 2–3 µm (av. 5.3 × 2.2–2.3 µm), ellipsoidal to cylindrical with several small guttules. The 1-septate conidia are usually at most 10 × 4.5 µm, but the observations in vivo (see below) suggest that some strains may produce larger, ascochytoid conidia up to 20–24 µm in length.

Characters in vivo (Cucurbitaceae)

Pycnidia (in yellow-brown lesions on stems and leaves, also on infected seedlings and in dark, cracked, sunken lesions on fruits) usually followed by pseudothecia. Conidia variable in size and septation. Sometimes mostly aseptate with some 1-septate and a few 2-septate; but usually 1(–2)-septate, with a small percentage unicellular. Commonly (6–)8–10(–13) × (2.5–)3–4(–5) µm, but with some strains producing extremely large 1-septate ascochytoid conidia up to 20–24 × 4–5 µm. On seed coats pycnidia usually contain only small aseptate conidia, resembling those in vitro.

Ecology and distribution. A world-wide seed-borne pathogen of Cucurbitaceae causing the disease, known as Gummy Stem Blight, which includes various symptoms such as leaf spot, stem canker, vine wilt and black fruit rot.

Representative culture. CBS 133.96 (PD 79/127) ex *Cucurbita pepo* (Cucurbitaceae), New Zealand.

15. **Phoma alectorolophi** Boerema, de Gruyter & Noordel., *spec. nov.*

Pycnidia sclerophomoid (sect. *Sclerophomella*).

Conidia usually of normal phomoid size, with occasionally some distinctly large, 1-septate (ascochytoid) conidia.

Teleomorph: *Didymella alectorolophi* Rehm

Pycnidia in vitro 90–310 µm diam., globosa vel forma irregularia, uno vel duobus poris, saepe indistinctis, nonnumquam papillatis aperientia, fere crassitunicata. Cellulae conidiogenae 4–7 × 5–9 µm, lageniformes. Conidia plerumque unicellularis, forma et magnitudine variabilia, plerumque 4–7.5 × 2–3.5 µm, cylindrica vel oblonge ellipsoidalia, nonnullis guttulis parvis praedita vel eguttulata. Nonnumquam pauca conidia maiora, ellipsoidea vel ovoidea, extra medium uniseptata, (10–)14–18 × (4–)5–6(–8) µm, praesentia.

Holotypus L 992.167-515 cultura exsiccata, viva CBS 132.96 (PD 93/853) isolatus e calyce exsiccato *Rhinanthi angustifolii*, Wageningen in Neerlandia, Junio 1993.

Characters in vitro

A detailed description will be given under sect. *Sclerophomella* (in prep.). Distinguished by the initially closed pycnidia, which are relatively thick-walled and pseudoparenchymatous (contents of inner hyaline wall cells stain red with JKJ). The conidia are usually aseptate, variable in size, 4–9(–14) × 2–6 µm, but mostly 4–7.5 × 2–3.5 µm (av. 5.2–

6.0 x 2.2–2.8 µm), cylindrical to oblong ellipsoidal, with or without a few small guttules. Occasionally some large 1-septate ascochytoid conidia occur, (10–)14–18 x (4–)5–6(–8) µm, ellipsoidal or ovoid, septum usually not medianly.

Characters in vivo (on semi-parasitic Scrophulariaceae)

Pycnidia (on dry calyces, capsules, peduncles and stems) usually followed by pseudothecia (single identity proved by Corbaz, 1957); pycnidial primordia stromatic ('pycnosclerotia'), often indistinguishable from immature ascocarps. Conidia mostly oval to cylindrical and less variable than those in vitro, (4–)5–7(–9) x 2–2.5(–4) µm. Large ascochytoid conidia have so far only been found occasionally in old pycnidia.

Ecology and distribution. The records of this fungus are on dead tissue of various semi-parasitic Scrophulariaceae in Europe: species of *Melampyrum, Rhinanthus* and *Pedicularis.* Immature ascomata have been reported under different Coelomycete names, e.g. as '*Phoma deusta* Fuckel' and '*Phoma melampyri* Karsten'.

Representative culture. CBS 132.96 (PD 93/853) ex *Rhinanthus angustifolius* (Scrophulariaceae), the Netherlands.

16. **Phoma dictamnicola** Boerema, de Gruyter & Noordel.

Pycnidia sclerophomoid (sect. *Sclerophomella*).
Conidia of normal phomoid size, but in vivo also distinctly large and mainly 1-septate (ascochytoid).
Chlamydospores solitary or catenate.

Phoma dictamnicola Boerema, de Gruyter & Noordeloos in de Gruyter & Noordeloos, Persoonia 15 (1) (1992) 90–91. — *Ascochyta nobilis* Kabát & Bubák, Öst. bot. Z. 54 (1904) 3; not *Phoma nobilis* Saccardo, Michelia 2 (3) (1882) 16 [= *Phomopsis* sp.].

Additional data in the provisional treatment under sect. *Sclerophomella* in Contribution I–1 no. 20 (de Gruyter & Noordeloos, 1992).

Characters in vitro

A detailed description in vitro is given in Contribution I–1. Most distinctive are the subglobose, initially closed thick-walled pycnidia, greenish olivaceous in colour. Conidia relatively small, always aseptate, 4–5.5 x 1.5–2.5 µm (av. 4.6 x 1.8 µm), ellipsoidal to reniform, eguttulate. Usually intercalary chains of chlamydospores develop.

Characters in vivo (on *Dictamnus albus*)

The pycnidia in host tissue (irregular leaf spots and dead stems) are subglobose-conical with a central pore, dark brown to black in colour. The conidia may be extremely variable. Those from pycnidia on dead stems are usually aseptate, 4–5 x 2 µm, resembling conidia in vitro, but sometimes also larger, 6–8 x 3–4 µm and then often 1-septate. The pycnidia on leaf spots always contain relatively large conidia, usually some aseptate, (8–)11–14(–14.5) x 3–3.5 µm, but most ascochytoid, 1(–2)-septate, 13.5–15.5(–16) x 3.5–4(–4.5) µm.

Ecology and distribution. A specific pathogen of the 'firework plant', *Dictamnus albus* (Rutaceae), frequently recorded in Eurasia and North America. The fungus causes a Leaf Spot, white or light-brown irregular spots on the tips or margins of the leaves. Pycnidia on dead stems may enable the fungus to survive from one season to the next.

Representative culture. CBS 507.91 (PD 74/148) ex *Dictamnus albus* (Rutaceae), the Netherlands.

17. **Phoma complanata** (Tode: Fr.) Desm.

Pycnidia sclerophomoid (sect. *Sclerophomella*).

Conidia of normal phomoid size, but in some strains distinctly large and 1-septate (ascochytoid) also occur.

Phoma complanata (Tode: Fr.) Desmazières, Annls Sci. nat. (Bot.) III, 16 (1851) 299–300. — *Sphaeria complanata* Tode, Fungi mecklenb. Sel. 2 (1791) 22: Fries, Syst. mycol. 2 [Sect. 2] (1823) 508. — *Sclerophomella complanata* (Tode: Fr.) Höhnel, Hedwigia 59 (1918) 238.

Full synonymy will appear under sect. *Sclerophomella*, for which it represents the type (Boerema, in prep.).

Characters in vitro

A detailed description will be given later. Most distinctive are the massive pycnidia, initially closed, at first yellow-brown, ultimately black. The conidia are variable in shape and dimensions, mainly aseptate, (3–)4–10(–11) × (1.5–)2–3(–4) µm, but in some strains also 1-septate and then often much larger, (10–)20–34 × (4–)6–10 µm, thus ascochytoid; they are usually ellipsoidal to cylindrical, but also fusiform or globose, eguttulate or with several small guttules.

Characters in vivo (Umbelliferae)

Pycnidia (on dead stems and in lesions on leaves, petioles and roots) often contain only aseptate ellipsoidal conidia, mostly between 5–9 × 2–3.5 µm, but in some strains a high percentage of the conidia becomes larger and 1-septate, often 10–15 × 2.5–3.5 µm. Pycnidia on old stem lesions may contain distinctly large 1-septate ascochytoid conidia, often 27 × 8 µm, resembling those sometimes found in vitro. In pycnidia from stored root tissue, many swollen, dark septate conidia may occur.

Ecology and distribution. In temperate Eurasia and North America a very common fungus on the previous year's dead stems of wild Umbelliferae. A seed-borne pathogen, it is known on parsnip (*Pastinaca sativa*), parsley (*Petroselinum crispum*) and carrot (*Daucus carota*) causing Canker (lesions on petioles and roots) and a Leaf Spot.

Representative culture. CBS 268.92 (PD 75/3) ex *Angelica sylvestris* (Umbelliferae), the Netherlands.

18. **Phoma clematidina** (Thümen) Boerema

Conidia of normal phomoid size, but in vivo some are also distinctly larger and 1(–2)-septate (ascochytoid).

Chlamydospores uni- and multicellular (sect. *Peyronellaea*).

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

For additional synonyms see the treatment under sect. *Peyronellaea*, Contribution II no. 11 (Boerema, 1993).

Characters in vitro

A description in vitro is given in Contribution II. Most distinctive are the irregular dictyo/phragmosporous chlamydospores, 3–50 × 12–25 µm, usually with some unicellular chlamydospores, 8–10 µm in diam. Conidia mostly (3.5–)4–8.5(–9) × 2–3(–3.5) µm,

occasionally larger and 1-septate, 9–13 × 3–4 µm, subellipsoidal to cylindrical, usually guttulate.

Characters in vivo (*Clematis* spp.)

Pycnidia (subepidermal in leaf spots, also in stem lesions and on dead stubs) may contain conidia quite different in size. They are generally phomoid, but larger than those in vitro, aseptate or 1-septate, (6–)8–10(–13) × 3–4 µm (av. 9.5 × 3.2 µm). Sometimes, however, the septate conidia are considerably larger, i.e. ascochytoid, (10–)12–22(–28) × 4.5–6(–6.5) µm (av. 18.5 × 5.8 µm). In old pycnidia the conidia become dark and occasionally 2-septate.

Ecology and distribution. Frequently found in association with leaf spots and stem lesions on naturally-wilting cultivars and hybrids of *Clematis* spp. in Eurasia, Australasia and North America.

Representative culture. CBS 108.79 (PD 78/522) ex *Clematis* sp. (Ranunculaceae), the Netherlands.

19. **Phoma narcissi** (Aderh.) Boerema, de Gruyter & Noordel.

Conidia of normal phomoid size, but in vivo some are also distinctly larger and mostly 3-septate (stagonosporoid): synanamorph *Stagonosporopsis curtisii.*

Chlamydospores uni- and multicellular (sect. *Peyronellaea*).

Phoma narcissi (Aderh.) Boerema, de Gruyter & Noordeloos in Boerema, Persoonia 15 (2) (1993) 215. — *Phyllosticta narcissi* Aderhold, Centbl. [Zentbl.] Bakt. ParasitKde Abt. 2, 6 (1900) 632–633.

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

For additional synonyms see the treatment under sect. *Peyronellaea*, Contribution II, no. 10 (Boerema, 1993).

Characters in vitro

A description in vitro is given in Contribution II. Most distinctive are the irregular, often curved, botryoid-dictyosporous chlamydospores, usually bearing droplet-like deposits. Conidia are usually aseptate, 4–7.5(–8) × (2–)2.5–3.5(–4) µm, occasionally larger and septate, 8–15 × 3–5.5 µm, broadly ellipsoidal, with numerous small guttules.

Characters in vivo (Amaryllidaceae)

The pycnidia (subepidermal in dead leaf tips and in spots on leaves and scales) often contain mainly aseptate conidia and only a few 1-septate ones, 4.5–8(–10) × 2.5–4(–5) µm (av. 6.8–7.5 × 3–3.8 µm). However, the pycnidia in vivo sometimes produce larger conidia, which are in majority 3-septate, 13.5–28 × 5–8 µm (av. 21 × 6.5 µm): synanamorph *Stagonosporopsis curtisii.* In this case aseptate conidia are relatively rare, but 1-septate ones may also be present, 8–16 × 3–6.5 µm (av. 11.5 × 4.5 µm).

Ecology and distribution. A world-wide pathogen of *Narcissus, Hippeastrum* and various other Amaryllidaceae causing Leaf Scorch, Neck Rot, Red Spot Disease, Red Leaf Spot.

Representative culture. CBS 251.92 (PD 86/1145) ex *Nerine* (Amaryllidaceae), the Netherlands.

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