**Coniochaeta (Lecythophora), Collophora gen. nov. and Phaeomoniella species associated with wood necroses of Prunus trees**

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**Key words**

Collophora  
Coniochaeta  
EF-1α  
GAPDH  
ITS  
Lecythophora  
LSU  
pathogenicity  
Phaeomoniella  
Prunus  
SSU  
systematics

**Abstract**  
Species of the genus Coniochaeta (anamorph: Lecythophora) are known as pathogens of woody hosts, but can also cause opportunist human infections. Several fungi with conidial stages resembling Lecythophora were isolated from necrotic wood samples of Prunus trees in South Africa. In order to reveal their phylogenetic relationships, these fungi were studied on a morphological and molecular (5.8S nrDNA, ITS-1, ITS-2, GAPDH, EF-1α, 28S nrDNA, 18S nrDNA) basis. Some of the isolates were identified as Coniochaeta (Sordariomycetes), including *C. velutina* and two new species, *C. africana* and *C. prunicola*. The majority of the isolates, however, formed pycnial or pseudopycnial synanamorphs and were not closely related to Coniochaeta. According to their 28S nrDNA phylogeny, they formed two distinct groups, one of which was closely related to Helotiales (Leotiomycetes). The new genus Collophora is proposed, comprising five species that frequently occur in necrotic peach and nectarine wood, namely *Co. africana*, *Co. capensis*, *Co. paarl*, *Co. pallida* and *Co. rubra*. The second group was closely related to *Phaeomoniella chlamydospora* (Eurotiomycetes), occurring mainly in plum wood. Besides *P. zymoides* occurring on *Prunus salicina*, four new species are described, namely *P. dura*, *P. effusa*, *P. prunicola* and *P. tardicola*. In a preliminary inoculation study, pathogenicity was confirmed for some of the new species on apricot, peach or plum wood.

**INTRODUCTION**

Gams & McGinnis (1983) reintroduced the genus *Lecythophora* (Melin & Nannfeldt 1934), confining it to anamorphs of *Coniochaeta*, and excluding it from *Phialophora* sensu Schol-Schwarz (1970), who placed these fungi in the *Phialophora hoffmannii* or *Phialophora lignicola* groups. *Lecythophora* is characterised by its hyaline hyphae and its mostly intercalary phialides with very short lateral necks, periclinal wall thickening and flaring collarettes (Gams 2000). Weber studied the morphology and LSU phylogeny of a number of *Lecythophora* species, several of which were linked to species of the ascomycetous genus *Coniochaeta* (Weber 2002, Weber et al. 2002). Currently, 17 *Coniochaeta* species and one *Barrina* species are known to form *Lecythophora* anamorphs, including anamorphs that can be considered as *Lecythophora*, but were described as *Phialophora* or *Homoneema* (Moreau & Moreau 1949, Cain 1961, Minoura et al. 1977, Udagawa & Furuya 1979, Hawksworth & Yip 1981, Mahoney & La Favre 1981, Udagawa & Sugiyama 1982, Yokoyama & Ito 1988, Kamiya et al. 1995, Ramaley 1997, Romero et al. 1999, Weber 2002, Asgari & Zare 2006). Other *Coniochaeta* species form different anamorphs, or have not yet been linked to any anamorph (Garcia et al. 2006, Asgari et al. 2007). The most recent key comprises 54 well-documented *Coniochaeta* species (Asgari et al. 2007). However, only 21 *Coniochaeta* species were included in the latest published DNA phylogeny of the genus (Garcia et al. 2006). *Coniochaeta* and *Barrina polyspora* belong to the *Coniochaetales* (Molloch & Cain 1971) within the *Coniochaetales* (Huhndorf et al. 2004, Garcia et al. 2006). *Coniochaeta* is homothallic, and usually produces perithecia in culture (Raju & Perkins 2000). However, in some species/strains these perithecia remain infertile (Weber 2002).

Species of *Coniochaeta* and their *Lecythophora* anamorphs occur on dung of various animals (mainly mammals), in woodpulp, on wood or bark of different trees, in water (even with extremely low pH and high concentrations of heavy metals), in soil, leaves, and leaf litter, and rarely in non-woody host plants like *Gramineae* (Melin & Nannfeldt 1934, Eriksson 1992, López-Archilla et al. 2004, Asgari et al. 2007). *Coniochaeta/ Lecythophora* species have been isolated from asymptomatic, dormant buds and young plants of *Vitis vinifera* (Dugan et al. 2002, Casieri et al. 2009). *Coniochaeta ligniaria* was isolated from decaying bark of *Prunus avium* in the Netherlands (CBS 178.75). Popushoi (1971) reported several species on fruit trees in Moldova: *C. ambiguа* on dry twigs of apricot and cherry, *C. calva* on twigs of quince, cherry and plum, *C. ligniaria* on dry twigs and wood of pear and plum and *C. velutina* on wood of apple and pear trees.

Some species such as *Lecythophora hoffmannii* (teleomorph: *Coniochaeta ligniaria*) and *L. mutabilis* are also known as human pathogens involved in keratitis, subcutaneous abscesses, peritonitis, endocarditis and septic shock (de Hoog et al. 2000, Drees et al. 2007, Taniguchi et al. 2009). They have also been isolated from food, e.g., butter (Samson et al. 2004). On the other hand, some *Coniochaeta* species have been found to exhibit useful biochemical properties. For example, a strain of *Coniochaeta ellipsoidea* forms the newly discovered antibiotic coniosetin, which has a pronounced antibacterial and antifungal action, inhibiting even drug-resistant strains of *Staphylococcus aureus* (Segeth et al. 2003). *Coniochaeta ligniaria* is effective...
in biological detoxification of lignocellulosic biomass and can potentially be used to convert it to fuels and chemicals (López et al. 2004). Colonisation of torrefied grass fibres with the same fungus resulted in reduced phytotoxicity and increased plant growth (Trifonova et al. 2009).

While intercalary phialides with short lateral necks are characteristic for the genus *Lecythophora*, several other genera are known that also commonly form intercalary hyphal cells with conidigenous protrusions that are not separated from the hyphal cell by a septum, or are even reduced to short necks or openings with collarettes. Examples include *Phialemonium* (Gams & McGinnis 1983), the *Calosphaeriophora* anamorph of *Calosphaeria africana* (Damm et al. 2008a), two newly described *Pheaeoniella* species (Lee et al. 2006), *Phialophora sessilis* and *Phialophora repta*ns (de Hoog et al. 1999) and *Neotyphodium* (Morgan-Jones & Gams 1982, Glenn et al. 1996). Also, *Cladorrhinum* almost exclusively produces intercalary phialides with widely flaring collarettes (von Arx & Gams 1967). Weber (2002) described two species, *Lecythophora* spp. 1 and 2, that are similar to *Lecythophora*, but not closely related to it (Weber et al. 2002). In the following overview, we will refer to genera with phialidic conidogenesis that mainly form reduced intercalary phialides. These variant phialides range in form from adelophialides, which are hyphal cells with longer or shorter protrusions or necks, often opening with a collarette and not delimited by a basal septum, to aphanophialides, which are verticillately arranged, reduced, flask-shaped phialides with a narrow neck, often seen in groups of several per hyphal cell, to pleurophialides, which are intercalary hyphal cells with mostly one lateral opening with collarette (Gams 1971) as seen in *Lecythophora*-like fungi (Gams 2000). Many other genera or species form intercalary phialides as well – for example *Acremonium*, *Pheaeacremonium* (where they are called type I phialides), *Lecanicillium dimorphum* and *L. tenuipes*, anamorphs of *Jattaea* species, *Pheaeocrella aercosa*, *Calosphaeriophora pulchella* and diverse *Phialophora* species. In these genera and species, though, discrete phialides are usually the predominant conidiogenous structures formed (Gams & McGinnis 1983, Zare & Gams 2001, Réblová et al. 2004, Mostert et al. 2006b, Damm et al. 2008a, b, Essaki et al. 2008, Marinicowitz et al. 2008).

Many fungi resemble *Lecythophora*-like taxa in forming masses of conidia on reduced conidiogenous cells directly on their hyphae, and often undergo microcyclic conidiation, resulting in a yeast-like appearance in culture, e.g. *Aureobasidium*, *Hormonema*, *Exophiala*, and the anamorph of *Treromopsis microtheca*. Even microscopically they can easily be confused with the species studied here, since the structures are very small and the conidiogenous cells difficult to recognise. However, *Aureobasidium* forms conidia synchronously on minute denticles (Hermanides-Nijhof 1977, Zalar et al. 2008) and *Auroehyphozyma*, *Exophiala*, *Hormonema*, *Hyphozyma*, the hyphozyma-like anamorphs of *Treromopsis microtheca* and *Valsaria insitiva* produce conidia laterally from hyphae with holoblastic-percurrent conidiogenesis (Hermanides-Nijhof 1977, de Hoog 1977, Giawe 1985, de Hoog & Smith 1986, Hosoya & Otani 1995, Weber 2002). If the conidiogenesis is phialidic as in *Lecythophora*-like fungi, pericilal thickening or collarettes are usually visible, but no denticles or annellides.

During a survey in stone fruit orchards, we isolated various fungi with hyaline, aseptate conidia released from intercalary phialides, mainly reduced to hyphal cells with short necks or small openings with collarettes. The phialides resembled the conidiogenous cells of *Lecythophora* species. Most of them did not form teleomorph structures, but formed pycnidial or pseudopycnidial sannamorphs in culture. The objective of the current study was to investigate the phylogenetic relationships of these different *Lecythophora*-like fungi, as well as to describe the new species and test their pathogenicity on *Prunus*.

**MATERIALS AND METHODS**

**Sampling and fungal isolation**

Fungi were isolated from branches of trees with dieback or necrotic symptoms. Samples were taken in stone fruit (*Prunus* spp.) orchards in the Western Cape and the Limpopo Provinces of South Africa according to the method described in Damm et al. (2007). Single-conidial isolates were obtained from the strains for further study. Reference strains are maintained in the culture collection of the Department of Plant Pathology, University of Stellenbosch (STE-U) in Stellenbosch, South Africa, and the CBS-KNAW Fungal Biodiversity Centre (CBS) Utrecht, The Netherlands. Isolates used for morphological and sequence analyses and in the preliminary pathogenicity test are presented in Table 1.

**Morphological analysis**

To enhance sporulation, double-autoclaved pine needles or double autoclaved grapevine wood pieces were placed onto the surface of synthetic nutrient-poor agar medium (SNA; Nirenberg 1976), and incubated at 25 °C in the dark for 2 wk (anamorphs) or 2–3 mo (teleomorphs). Measurements, photographs of characteristic structures and vertical sections through ascomata and conidiomata were made according to Damm et al. (2007). Microscopic preparations were made in clear lactic acid or water, with 30 measurements per structure, and observations were made with a Nikon SMZ680 dissecting microscope (DM) or with a Nikon Eclipse E600 microscope using differential interference contrast (DIC) illumination. Colony characters and pigment production were noted after 2 wk of growth on malt extract agar (MEA, 2 % malt extract, Oxoid Ltd., England; 1.5 % agar, Difco, USA) and 2 % potato-dextrose agar (PDA; Crous et al. 2009) incubated at 25 °C. Colony colours were rated according to Rayner (1970). Growth characteristics were studied on MEA plates incubated in the dark at temperatures ranging from 5–35 °C, in 5° intervals.

**Phylogenetic analysis**

Genomic DNA of the isolates was extracted using the method of Damm et al. (2008b). The 5.8S nuclear ribosomal gene with the two flanking internal transcribed spacers (ITS-1 and ITS-2), a 200-bp intron of the glyceraldehyde-3-phosphate dehydrogenase (GAPDH), a partial sequence of the translation elongation factor 1α (EF-1α), of the 28S nrDNA (LSU) and of the 18S nrDNA (SSU) were amplified and sequenced using the primer pairs ITS-1F-ITS-2R (Gardes & Bruns 1993) + ITS-4 (White et al. 1990), GDF1 + GDR1 (Guerber et al. 2003), EF1-728F + EF1-968R (Carbone & Kohn 1999), NL1 + NL4 (O’Donnell 1993) and NS1 + NS8 (White et al. 1990) or NS1 + NS24 (Gargas & Taylor 1992), respectively. Additional primers were used for sequencing the SSU, NS2–NS5 (White et al. 1990). The LSU sequences were added to the outgroup (Lipomyces starkeyi U45824 and Saccharomyces cerevisiae J01355) and sequences obtained from GenBank (www.ncbi.nlm.nih.gov). The alignment was assembled and manually adjusted using Sequence Alignment Editor v2.0a11 (Rambaut 2002). Phylogenetic analysis was performed using PAUP (Phylogenetic Analysis Using Parsimony) v4.0b10 (Swofford 2000). Alignment gaps were treated as missing and all characters were unordered and of equal weight. Maximum parsimony analysis was performed using the heuristic search option with 100 random sequence additions and tree bisection and reconstruction (TBR) as the branch-swapping algorithm. The robustness of the trees obtained was evaluated by 1 000 bootstrap replications with 100
Table 1 Species names, accession numbers, isolation details and GenBank accession numbers of isolates studied.

| Species               | Accession No. | Host | Location                        | Collector | Patho test | GenBank accessions |
|-----------------------|---------------|------|---------------------------------|-----------|------------|--------------------|
|                       |               |      |                                 |           |            | ITS LSU SSU GAPDH EF |
| *Collophora africana* | STE-U 6113/CBS 120872* | Prunus salicina | Paarl, Western Cape, South Africa | U. Damm   | x          | GQ154570 GQ154609 GQ154630 GQ154648 GQ154643 |
| *Collophora capensis* | STE-U 6199/CBS 120879* | P. salicina | Franschhoek, Western Cape, South Africa | U. Damm   | x          | GQ154571 GQ154610 GQ154631 GQ154649 GQ154644 |
|                       | STE-U 0339    | P. salicina | Franschhoek, Western Cape, South Africa | U. Damm   |            | GQ154572 |
|                       | STE-U 0340    | P. salicina | Franschhoek, Western Cape, South Africa | U. Damm   |            | GQ154573 |
|                       | STE-U 0341    | P. salicina | Franschhoek, Western Cape, South Africa | U. Damm   |            | GQ154574 |
| *Collophora paarsa*   | STE-U 6114/CBS 120877* | P. salicina | Paarl, Western Cape, South Africa | U. Damm   | x          | GQ154598 GQ154613 GQ154634 GQ154651 GQ154646 |
| *Collophora pallida*  | STE-U 6197/CBS 120878* | P. salicina | Franschhoek, Western Cape, South Africa | U. Damm   | x          | GQ154575 GQ154611 GQ154632 |
|                       | STE-U 6185    | P. salicina | Franschhoek, Western Cape, South Africa | U. Damm   |            | GQ154576 |
|                       | STE-U 6115/CBS 121443 | P. salicina | Mookgopong, Limpopo, South Africa | U. Damm   | x          | GQ154577 GQ154612 GQ154634 GQ154651 GQ154646 |
| *Collophora rubra*    | STE-U 6109/CBS 120873* | P. persica | Paarl, Western Cape, South Africa | U. Damm   | x          | GQ154547 GQ154606 GQ154627 |
|                       | STE-U 6329    | P. persica | Paarl, Western Cape, South Africa | U. Damm   |            | GQ154546 |
|                       | STE-U 6330    | P. persica var. nucipersica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154548 |
|                       | STE-U 6354    | P. persica var. nucipersica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154549 |
|                       | STE-U 6355    | P. persica var. nucipersica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154550 |
|                       | STE-U 6198/CBS 121441 | P. persica var. nucipersica | Mookgopong, Limpopo, South Africa | U. Damm   | x          | GQ154551 GQ154607 GQ154628 GQ154647 GQ154642 |
|                       | STE-U 6196    | P. persica var. nucipersica | Mookgopong, Limpopo, South Africa | U. Damm   | x          | GQ154552 |
|                       | STE-U 6331    | P. persica var. nucipersica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154553 |
|                       | STE-U 6111/CBS 121442 | P. salicina | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154554 |
|                       | STE-U 6135    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154555 |
|                       | STE-U 6137    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154556 |
|                       | STE-U 6136    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154557 |
|                       | STE-U 6138    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154558 |
|                       | STE-U 6112    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154559 |
|                       | STE-U 6333    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154560 |
|                       | STE-U 6110    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154561 GQ154601 GQ154629 |
|                       | STE-U 6334    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154562 |
|                       | STE-U 6367    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154563 |
|                       | STE-U 6336    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154564 |
|                       | STE-U 6337    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154565 |
|                       | STE-U 6338    | P. persica | Mookgopong, Limpopo, South Africa | U. Damm   |            | GQ154566 |
|                       | STE-U 6414    | P. dulcis | Tubag, Western Cape, South Africa | Unknown²  |            | GQ154567 |
|                       | STE-U 6415    | P. dulcis | Tubag, Western Cape, South Africa | Unknown²  |            | GQ154568 |
|                       | STE-U 6416    | P. dulcis | Tubag, Western Cape, South Africa | Unknown²  |            | GQ154569 |
| *Coniochaeta africana* | STE-U 5952/CBS 120868* | Prunus salicina | Mookgopong, Limpopo, South Africa | U. Damm   | x          | GQ154539 GQ154601 GQ154621 |
random sequence additions (Hillis & Bull 1993). Tree length, consistency index (CI), retention index (RI), rescaled consistency index (RC) and homoplasy index (HI) were calculated for the resulting tree. Since we could not assign or differentiate some of the taxa, we used SSU, LSU, ITS and for some taxa EF-1α and GAPDH sequences for sequence comparisons and in BLASTn searches (www.ncbi.nlm.nih.gov). Sequences derived in this study were lodged at GenBank, the alignment in TreeBASE (www.treebase.org/treebase-web/home.htm), and taxonomic novelties in MycoBank (www.MycoBank.org; Crous et al. 2004).

Pathogenicity tests
The preliminary pathogenicity test was conducted with 15 taxa on detached apricot (cv. ‘Belida’), peach (cv. ‘San Pedro’) and plum (cv. ‘Southern Bell’) shoots. Depending on strain availability, one or two isolates per taxon were used and treated as subsamples in statistical analysis. Vegetative shoots were prepared and inoculated with colonised agar plugs from 2-wk-old PDA cultures according to Damm et al. (2007), except for the surface sterilisation (40 s in 0.1 % solution of a patented didecyldimethylammonium chloride formulation; Sporekill, ICA International Chemicals Pty. Ltd., Stellenbosch, South Africa). Eutypa lata (STE-U 6081) was used as positive (pathogen) control and Acrobotryum stricturn (STE-U 6296) and uncolonised PDA plugs as negative (non-pathogen) controls. Shoots were incubated at 25 °C in moist chambers (> 93 % RH) for 2 wk, after which the bark was peeled off and lesions visible on the surface of the xylem tissue measured. Each treatment combination consisted of one shoot, which was replicated four times in each of three blocks (= moist chambers). Re-isolations were made from the leading edges of lesions and the resulting cultures identified. The layout of the trial was a randomised block design. Lesion length data were subjected to analyses of variance using SAS v8.1 (SAS Institute, Cary, North Carolina USA) and Student’s t-test for Least Significant Difference was calculated at the 5 % significance level to compare the treatment means.

RESULTS
Phylogeny
The LSU analyses combined 36 taxa and 644 characters including the alignment gaps, of which 231 characters were parsimony-informative, 69 variable and 344 constant. After a heuristic search, four most parsimonious trees were retained (length = 1 142 steps, Cl = 0.452, Rl = 0.656, RC = 0.296, HI = 0.548) of which one is shown in Fig. 1. The main clades in the phylogeny represent different classes within the ascomycete subphylum Pezizomycotina. Isolates STE-U 6109, 6113, 6114 (GenBank GQ154606, GQ154609–GQ154611, GQ154613) form two groups (100 % bootstrap support) in the Leotiomycetes clade, next to Coniophoraefusa (STE-U 6123) and taxa of the Helotiales clade (66 %). BLASTn searches of LSU, EF-1α and GAPDH sequences for sequence comparisons derived in this study were lodged at GenBank, the alignment in TreeBASE, with sequences of the genera Collophora, Coniophora, Phaeomoniella and taxonomic novelties in MycoBank (www.MycoBank.org; Crous et al. 2004).
--- 10 changes

Erysipe aquilegiae AB022405
Leuconeurospora pulcherrima AF096193
Pseudeurotium zonatum AF096198
Collophora rubra GQ154606
Collophora africana GQ154609
Collophora capensis GQ154610
Collophora pallida GQ154611
Collophora paarla GQ154613
Crinula caliciformis AYS4660
Usnea spachalata DQ883693
Lecanora hybocarpa DQ782910
Botryosphaeria dothidea DQ377852
Pleospora herbarum DQ768049
Ajellomyces capsulatus AF038353
Aspergillus sparsus U17910
Exophiala pisciphila AF050273
Capronia semiimmera AF050279
Moristroma japonicum AY254052
Pheaeomoniella prunicona GQ154614
Pheaeomoniella dura GQ154617
Pheaeomoniella zymoides GQ154620
Pheaeomoniella effusa GQ154618
Pheaeomoniella tardiola GQ154619
Coniochaeta ligniaria AF355586
Coniochaeta africana GQ154601
Coniochaeta prunicona GQ154602
Coniochaeta velutina GQ154604
Chaetomium globosum U47825
Sordaria fimicola AF132330
Daldinia concentrica U47828
Xylaria hypoxylon AF132333
Hypocre a rufa AF127146
Nectria viilor U57348
Lipomyces starkeyi U45824
Saccharomyces cerevisiae J01355

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Leotiomycetes
Lecanoromycetes
Dothidiomycetes
Eurotiomycetes
Sordariomycetes
Saccharomycetes

Fig. 1 One of 4 most parsimonious trees obtained from heuristic searches of LSU gene sequences of Pezizomycotina (length = 1 142 steps, CI = 0.452, RI = 0.656, RC = 0.296, HI = 0.548). Bootstrap support values (1 000 replicates) above 50 % are shown at the nodes. Lipomyces starkeyi U45824 and Saccharomyces cerevisiae J01355 were used as outgroup. Isolates analysed in this study are emphasized in bold.

Taxonomy
The Lecythophora-like fungi isolated from Prunus wood could be assigned to 13 species representing three phylogenetically distinct genera: Collophora gen. nov., Coniochaeta (anamorph: Lecythophora) and Pheaeomoniella. Five species of Collophora, two species of Coniochaeta and four species of Pheaeomoniella proved distinct from known species, and are newly described.

**Collophora** Damm & Crous, gen. nov. — MycoBank MB516622
Teleomorph. unknown.
Colonies tarde crescentibus, humidis, albidos, cremeis vel rubicundis, mycelio aeriis sparse evolute vel nullo. Conidiophora unicellularia. Cellulae conidiogenae enteroblasticae, intercalares, redactae ad adnemiales breves, saepe cum collaretis sicut in hyphis. Conidia aggregata circum hyphae et in pagina agari. Conidiofusae pseudopycnidiales, solitaria vel aggregate, subglobosa, superficialia vel semiimmera, unilocularia vel multilocularia, pariete ex textura epidermoidea crassitunicata composito, irregulariter dehiscentiae.

**Coniochaeta** Damm & Crous, gen. nov. — MycoBank MB516622
Teleomorph. unknown.
Colonies slow-growing, moist, white, cream or reddish colours, with sparse or lacking aerial mycelium. Conidia reduced to conidiogenous cells. Conidiogenous cells enteroblastic, intercalary, reduced to very short adnemalides or more often with collarettes formed directly on hyphal cells. Conidia aggregated in masses around the hyphae and on the agar surface. Conidiomata pseudopycnidiales, satellitaria vel aggregate, subglobosa, superficialia vel semiimmera, unilocularia vel multilocularia, pariete ex textura epidermoidea crassitunicata composito, irregulariter dehiscentiae.

Type species. Collophora rubra Damm & Crous, sp. nov.

*Etymology.* Hyphae carry short necks or, more often, mere collarettes that release conidia (collaret Lat. = neckband, phorus Gr. = carrying).

*Colonies* slow-growing, moist, white, cream or reddish colours, with sparse or lacking aerial mycelium. Conidiophores reduced to conidiogenous cells. Conidiogenous cells enteroblastic, intercalary, reduced to very short adnemalides or more often with collarettes formed directly on hyphal cells. Conidia aggregated in masses around the hyphae and on the agar surface. Conidiomata pseudopycnidiales, satellitaria vel aggregate, subglobosa, superficialia vel semiimmera, unilocularia vel multilocularia, pariete ex textura epidermoidea crassitunicata composito, irregulariter dehiscentiae.

*Conidiophores* hyaline, branched, septate, filiform. Conidia pseudopycnidiales, satellitaria vel aggregate, subglobosa, superficialia vel semiimmera, unilocularia vel multilocularia, pariete ex textura epidermoidea crassitunicata composito, irregulariter dehiscentiae.

Notes — The genus Collophora usually forms conidiomata in culture but no teleomorph, which distinguishes it from Lecythophora anamorphs of Coniochaeta species (Weber 2002) and the anamorph of Mycocicum scheffleriae (Samuels & Buchanan 1983) that form perithecia or apothecia in culture,
respectively. Other Lecythophora-like anamorphs that do not form conidiomata may differ in colony colour, which is orange-yellow in Barrina polyspora (Ramaley 1997), or in pigmentation of the apical region, as in the Calosphaeria anamorph of Calosphaeria africana (Damm et al. 2008a), or in the shape of the intercalary phialides, as in the anamorph of Ignecoccum yuccae (Ramaley 2003), which has short, narrow necks that are often wider than long. ‘Lecythophora’ sp. 1 described by Weber (2002) forms discrete, ventricose phialides in old cultures. These phialides are often aggregated on dendroid conidiophores, and the vegetative hyphae are often very narrow (< 1 µm). These features were not observed in Collophora species. The anamorph of Munkovasaria rubra produces a red pigment as do some Collophora species. However, cultures emit a strong odour of m-cresol and form no conidiomata. Intercalary phialides are arranged in irregularly branched conidiophores (Aptroot 1995).

Conidia of Phialemonium are formed on discrete, short-stalked conidial heads (Gams & McGinnis 1983), while conidia of Collophora usually emerge from collarettes attached directly to hyphae and become aggregated in masses around those hyphae and on the agar surface. Phialides of Humicolopsis are similar to those of Phialemonium. Also, Humicolopsis colonies turn grey to black due to the presence of dark chlamydospores (Marchand et al. 1976) that are not found in Collophora. Conidiogenous necks of Neotyphodium anamorphs of Epichloë are even longer than those of Phialemonium, and are aculeate (Morgan-Jones & Gams 1982, Glenn et al. 1996, Chen et al. 2009).

Some Phaeomoniella species and ‘Lecythophora’ sp. 2 (Weber 2002) produce conidia in conidiomata as well as from dispersed conidiogenous cells. However, the conidiomata are pycnidial and not pseudopycnidial, which means they are usually not stromatic and unilocular. The conidiomatal wall is composed of textura angularis in Phaeomoniella and of textura globulosa in ‘Lecythophora’ sp. 2, but not of textura epidermoidea as in Collophora. Also, the acropleurogenious conidiogenous cells of Collophora are distinctive in this comparison (Crous & Gams 2000, Weber 2002, Lee et al. 2006, this paper). Colonies of most Phaeomoniella species and of ‘Lecythophora’ sp. 2 produce greenish pigments that do not occur in Collophora. Phialophora sessilis and Phialophora reptans colonies also differ in colour from Collophora: they are olivaceous-black due to pigmented hyphae and conidiogenous cells (de Hoog et al. 1999).

In the genus Cyphellophora, conidia are septic, often sickle-shaped and pigmented (Decock et al. 2003), while in Collophora conidia are aseptate, hyaline to subhyaline and differently shaped. Cladorrhinum anamorphs of Apiosoraria and Cercocephora form a reticulate system of hyaline or pale ochraceous, branched conidiophores, each cell with a lateral phialidic opening with widely flaring collarettes. Conidia of most species are dacyroid (Mouchacca & Gams 1993). Conidiogenous cells in Collophora differ by not being arranged as conidiophores or parts thereof. Collophora does not form aphanophilialides as are characteristically seen in Aphanocladium (Gams 1971) and some species of Lecanicillium (Zare & Gams 2001). Usually, in Collophora, collarettes or periclinal wall thickenings are visible and several conidia are formed from each conidiogenous cell in basipetal succession.

There are few other fungal genera known to form conidiomata with filiform, acropleurogenously branched conidiophores (Sutton 1980). Among the genera with these characters is Catenophora, which produces conidiomata that are acervular, containing holoblastic conidiogenous cells, and pale brown conidia. Pyenochaeta, Pleurophoma and Sirophoma have phialides and acropleurogenously branched conidiophores, but these structures are formed in pycnidia composed of thick-walled textura angularis, and have a single central, circular ostiole, while conidiomata of Collophora are pseudopycnidial with a wall formed by thick-walled texture epidermoidea and irregular dehiscence. Sirodothis (anamorph of Tympa) differs in developing unilocular pycnidium-like structures on a basal stroma. Its conidiomatal wall is composed of textura angularis, while pseudopycnidia of Collophora are sessile or semi-immersed, often multilocular, and have a wall formed of thick-walled texture epidermoidea. Cytonea develops a characteristic rostrate ostiole, while conidiomata of Collophora open by irregular rupture.

Collophora is closely related to Pseudeurotium and other Pseudeurotiaceae (Fig. 1). However, Collophora species have phialidic conidiogenesis, while Teberdinia, the anamorph of Pseudeurotium, has sympodial conidiogenesis (Sogonov et al. 2005).

Collophora africana Damm & Crous, sp. nov. — MycoBank MB516623; Fig. 2

Collophora rubrae similis, sed in vitro tarde crescentibus, conidiophoris pseudopycnidiaux magis ramosis, ramulis divergentibus, saepe < 2 µm latis, conidia sicut in hyphis formatis, (2.5–3.5–5.5(–8) × 1–2(–2.5) µm, conidiomata 3–3.5(–4.5) × 1–1.5 µm.

Etymology. Named after its continent of origin, Africa.

Vegetative hyphae hyaline, 1–2 µm wide, smooth-walled, lacking chlamydospores. Sporulation abundant, conidia formed on hyphae and in pseudopycnidia. Conidiophores on hyphae reduced to conidiogenous cells. Conidiogenous cells entero-blastic, reduced to very short adeloophialides or more often with collarettes formed directly on hyphal cells; necks cylindrical, 0.5–3 × 0.5–1 µm; collarettes cylindrical to narrowly funnel-shaped, very thin-walled, 0.5–2 long, opening 0.5–1 µm wide, often inconspicuous. Conidia aggregated in masses around the hyphae, hyaline, 1-celled, cylindrical to oblate, smooth-walled, with both ends obtuse or with a papillate apex, smooth-walled, containing small droplets, (2.5–)3.5–5.5(–8) × 1–2(–2.5) µm, mean ± SD = 4.5 ± 1.5 ± 0.3 µm, L/W ratio = 3.1. Microcyclic conidiation occurs, with conidia developing into mother cells, becoming > 10 µm long, 2–3 µm wide, and sometimes septate, with minute collarettes at one or both ends. Conidomata pseudopycnidial, produced on pine needles, on SNA and on MEA in 2–4 wk; on pine needles solitary, subglobose, superficial, 50–250 µm wide; on agar medium solitary or within a stroma, dark brown, uni- to multilocular; wall 10–30 µm thick, composed of several layers of reddish brown texture epidermoidea with thick-walled, indistinctly delimited cells; opening by irregular rupture, often appearing cup-shaped when mature, surrounded by hyaline hyphal appendages. Conidiophores lining the inner conidiomatal cavity, hyaline, septate, usually not constricted at septa, 10–35 µm long, branched at the base and above, branches diverging, straight, filiform. Conidiogenous cells entero-blastic, hyaline, monosphialic, with conidiogenous loci formed intercalary immediately below the septum (acropleurogenously) as well as terminally, cylindrical when terminal, tapering slightly towards the tip, 4–7 × 1–1.5 µm, basal cells up to 2.5 µm wide; collarettes 0.5–1 µm long, opening < 0.5–1 µm, periclinal thickening visible. Conidia hyaline, 1-celled, cylindrical to ellipsoidal, straight, with both ends obtuse or with a slightly acute apex, smooth-walled, containing small droplets, 3–3.5–(4.5) × 1–1.5 µm, mean ± SD = 3.3 ± 0.3 × 1.4 ± 0.1 µm, L/W ratio = 2.4.

Culture characteristics — Colonies on PDA convex, slimy, with entire margin, white to pale rosy-buff and pale luteous, with thinly white to pale flesh floccose aerial mycelium; reverse white to pale luteous to rosy-vinaceous, turning red with age; entire medium scarlet to red due to diffuse pigment; on MEA umbonate, folded towards the centre, with radial growth rings
Fig. 2  *Collophora africana*. a. Longitudinal section through a pseudopycnidium; b, c. pseudopycnidia on pine needle (b), and MEA medium (c); d, e, h. conidiophores lining the inner wall of pseudopycnidia; n. conidia formed in pseudopycnidia; f, g, j–m. conidiogenous cells on hyphal cells (arrow head: openings in plan view); i. conidia formed on hyphal cells. All from ex-type culture CBS 120872. a, d–n: DIC; b, c: DM. — Scale bars: a = 10 µm; b, c = 100 µm; d = 5 µm; d applies to d–n.

Fig. 3  *Collophora capensis*. a. Longitudinal section through a pseudopycnidium; b. conidia oozing from pseudopycnidia on pine needles; d–f. conidiophores lining the inner wall of pseudopycnidia; g. conidia formed in pseudopycnidia; h. conidia formed on hyphal cells; i–n. conidiogenous cells on hyphal cells. All from ex-type culture CBS 120879. a, d–n: DIC; b, c: DM. — Scale bars: a = 20 µm; b = 100 µm; d = 5 µm; b applies to b, c; d applies to d–n.
and undulate margin; surface = pale rosy-vinaceous to vinaceous-grey, with black spots and white, floccose-felt aerial mycelium in the centre; reverse peach to coral to dark vinaceous; sparse amounts of a red pigment released into medium; 5 mm diam in 2 wk (25 °C in the dark), min 5 °C, max 30 °C, opt 20 °C.

Specimen examined. SOUTH AFRICA, Western Cape Province, Paarl, from reddish brown necrosis in wood of *P. salicina*, 10 June 2004, U. Damm, CBS H-19993 holotype, culture ex-type CBS 120872 = STE-U 6113.

Notes — *Collophora africana* and *Co. rubra* both form red pigments that colour the colony and surrounding medium. The species are distinct in that the conidiomatal conidiophores of *Co. africana* branch basistomously and mesostomously with divergent branches, usually <2 µm wide, while those of *Co. rubra* are less often branched and almost parallel in arrangement. The growth rate of *Co. rubra* is similar to that of *Co. capensis*, but conidia formed both in conidiomata and on hyphae are shorter.

The closest relative of *Co. africana* (STE-U 6113) is *Co. capensis* (STE-U 6199). The two species show only a few differences in sequence: two substitutions in ITS (99 % identity), three substitutions in LSU, one intron in SSU and five substitutions within the common introns (the ones that all *Collophora* species have), but no differences in GAPDH and EF-1α. Further, the ITS sequences of both *Co. africana* STE-U 6113 (GQ154570) and *Co. capensis* STE-U 6199 (GQ154571) are 96 % identical with those of *Co. rubra* STE-U 6109 (GQ154547) and 93 % identical with those of *Co. pallida* STE-U 6117 (GQ154575) and *Co. paarlensis* STE-U 6114 (GQ154586).
Specimen examined. SOUTH AFRICA, Western Cape Province, Paarl, from dark brown necrosis in wood of *P. persica*, 10 June 2004, U. Damm, CBS H-19996 holotype, culture ex-type CBS 120877 = STE-U 6114.

Notes — *Collophora paarla* is similar to *C. pallida* in growth rate, initial colony colour and formation of endoconidia, but forms larger conidia (av. 5.8 µm) on intercalary hyphae than *C. pallida* (av. 3.9 µm). Also, the vegetative hyphae are wider (1.5–5 µm) than those of *C. pallida* (1–2 µm). *Collophora paarla* sometimes forms yellow pigments on PDA or reddish pigments on MEA; these coloured metabolites are not seen in *C. pallida*. However, *C. paarla* cultures do not turn scarlet as do those of *C. rubra* and *C. africana*.

There are only a few differences in the DNA sequences between *C. paarla* (STE-U 6114) and *C. pallida* (STE-U 6197). Compared to *C. pallida*, (STE-U 6197) *C. paarla* (STE-U 6114) has one insertion in ITS, which is 99 % identical. It has four differences in EF-1α (which is 98 % identical), two additional introns in SSU, five substitutions within the introns that all *Collophora* species have, but no differences in LSU and GAPDH sequences. In relation to *C. africana*, *C. rubra* and *C. tardicola*, however, *C. paarla* and *C. pallida* show many differences in ITS (≥ 33 bp; 92–93 % identical), LSU (≥ 22 bp, 95 %), SSU (≥ 18 bp, incl. four additional introns and one less intron, 99 % identical), GAPDH (≥ 28 bp, > 70 %) and EF-1α (≥ 96 bp, hardly alignable).

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**Fig. 4** *Collophora paarla*. a–c. Conidiogenous cells on hyphal cells; d. conidia formed on hyphal cells; e, f. microcyclic conidiation; g, h. endoconidia. All from ex-type culture CBS 120877. a–h: DIC. — Scale bar: a = 5 µm; a applies to a–h.

**Fig. 5** *Collophora pallida*. a. Longitudinal section through a pseudopycnidium; b, c. conidia oozing from pseudopycnidium on grapevine wood; d, e. conidiophores lining the inner wall of pseudopycnidia; f–i, k, l. conidiogenous cells on hyphal cells; m. endoconidia; n. microcyclic conidiation; o. conidia formed on hyphal cells. All from ex-type culture CBS 120878. a–o: DIC; b, c: DM. — Scale bars: a = 20 µm; b = 100 µm; d = 5 µm; d applies to d–o.
Collophora pallida Damm & Crous, sp. nov. — MycoBank MB516626; Fig. 5

Collophora rubrae similis, sed in vitre sinne pigmento rubro, conidiophoris in pseudopycnidis cum collaretis longe infundibularibus, conidiis in hyphis intercalariis (2.5–)3–5(–7) × 1–1.5(–2) μm, conidiis in conidiotomatis hyalinais, aseptatis, cylindraceis, utrinque obtusis, (2.5–)3–3.5(–4) × 1–1.5(–2) μm.

Etymology. Named after the pale colour of the colony (pallidus Lat. = pale).

Vegetative hyphae hyaline, 1–2 μm wide, lacking chlamydo-sporides. Sporulation abundant, conidia formed on hyphal cells, in hyphae (endospores) and in pseudopycnidia. Conidiophores on hyphae mostly reduced to conidigenous cells, directly formed on hyphae; conidiophores rare, hyaline, septate, branched, 6–12 × 2–3 μm. Conidiogenous cells enteroblastic, mostly reduced to mere openings with collarettes formed directly on hyphal cells, adellophilial des or discrete phialides rare; necks of adellophilidales 1–3.5 × 1–2 μm, discrete phialides doliiform or ampulliform, often constricted at the base, 4–6 × 2–2.5 μm; collarettes cylindrical or flaring, frayed, < 0.5–1(–2) μm long, opening ≤ 0.5 μm. Conidia aggregated in masses around the hyphae, hyaline, 1-celled, cylindrical, with both ends obtuse or a papillate apex, smooth-walled, (2.5–)3–5(–7) × 1–1.5(–2) μm, mean ± SD = 3.9 ± 1.1 ± 0.2 μm, L/W ratio = 3.4. Microcyclic conidiation occurs, with conidia developing into mother cells often becoming > 10 μm long, 2–2.5 μm wide and sometimes septate and possessing minute collarettes at one or both ends. Endoconidia uniseriate within hyphae, hyaline, 1-celled, cylindrical to obovate, with both ends obtuse, smooth-walled, 3–4.5(–5) × 1–1.5 μm, mean ± SD = 3.3 ± 0.7 × 1.5 ± 0.1 μm, L/W ratio = 2.6. Conidiomata pseudopycnidial, produced on pine needles, on SNA and on MEA in 2–4 wk, subglobose, pale to dark brown, 100–900 μm diam, uni- to multilocular, wall composed of several layers of brown textura epidermoidea with thick-walled, indistinctly delimited cells, glabrous, opening by irregular rupture. Conidiophores lining the inner conidiomatal cavity, hyaline, smooth-walled, filiform, septate, constricted at the septa, branched (3–4 ×) at the base and above, 20–50 μm long, basal cell pigmented and 3.5–4.5 μm wide. Conidiogenous cells enteroblastic, hyaline, monophialidic, conidigenous loci terminally, sometimes intercalary immediately below the transverse septa, 3.5–8 × 1.5–2.5 μm; collarette very long, tuft-like/funnel-shaped, 1–3 × 1–3 μm, openings 1–1.5 μm, periclinal wall thickening conspicuous. Conidia hyaline, aseptate, smooth-walled, cylindrical with obtuse ends, (2.5–)3–3.5(–4) × 1–1.5(–2) μm, mean ± SD = 3.2 ± 0.3 ± 1.4 ± 0.2 μm, L/W ratio = 2.2

Culture characteristics — Colonies on PDA flat, moist, none or sparse floccose or villose aerial mycelium, surrounded by appressed fuscicolus mycelium, with undulate margin; white to very pale rosy-buff; on MEA: flat to umbonate, moist, mycelium appressed fuscicolus, with sparse, villose or lacking aerial mycelium and lobate margin; rosy-buff, 16 mm diam in 2 wk on PDA (25 °C dark), min 5 °C, max 30 °C, opt 20 °C.

Specimens examined. SOUTH AFRICA, Western Cape Province, Paarl, from necrosis close to pruning wound in wood of P. persica, 10 June 2004, U. Damm, CBS H-19995 holotype, culture ex-type CBS 120878 = STE-U 6197; Limpopo Province, Moekgopong, from necrosis in wood of P. salicina, 31 Aug. 2004, U. Damm, CBS 121443 = STE-U 6115.

Notes — Collophora paarla and Co. pallida are the only Collophora species for which endoconidia have been observed. Conidia formed on intercalary hyphae of Co. pallida are shorter (av. 3.9 μm) than those of Co. rubra (av. 4.8 μm), Co. africana (av. 4.5 μm), Co. capensis (av. 5.5 μm) and Co. paarla (av. 5.8 μm). Conidiophores in conidiomata differ from those of Co. rubra, Co. africana and Co. capensis in having very long collarettes (often 3 μm long). Unlike the four other species, Co. pallida has not observed to release any pigments into the surrounding medium. The colonies stay white to very pale rosy-buff. Collophora pallida is the closest relative of Co. paarla and shows only a few differences from it in the DNA sequences examined (see above).

Collophora rubra Damm & Crous, sp. nov. — MycoBank 516627; Fig. 6

Conidia enteroblastico-formed, in conidiophoris redactis ad orificia cum collar- ettis sicut in hyphis et conidia acropleurogena vel terminalia, in conidiophoris filiformibus, ramosis, septatis, in pseudopycnidis formatis. Conidia in hyphis (3.5–)4.5–5(–8) × 1–2(–3) μm et in conidiomatis (3.3–5.4–4(–5) × 1–1.2) μm. In vitro conidium pigmento rubro.

Etymology. Named after the red colour of the colony and the pigment exuded by the fungus (ruber Lat. = red).

Vegetative hyphae hyaline, 1–3 μm wide, smooth-walled, lacking chlamydo-sporides. Sporulation abundant, conidia formed on hyphae directly and in pseudopycnidia. Conidiophores on hyphae reduced to conidigenous cells. Conidiogenous cells enteroblastic, reduced to very short adellophilialdes or more often with collarettes formed directly on hyphal cells; necks cylindrical, 1–4 × 0.5–2 μm; collarettes cylindrical or narrowly funneled-shaped; very thin-walled, 0.5–3 μm long, opening 0.5–1(–2) μm wide. Conidia aggregated in masses around the hyphae, hyaline, 1-celled, cylindrical to obovate, often slightly bent, with both ends obtuse or with a papillate apex, smooth to verruculose, (3.5–)4.5–5(–8) × 1–2(–3.5) μm, mean ± SD = 4.8 ± 0.9 × 1.5 ± 0.5 μm, L/W ratio = 3.25, containing small droplets. Microcyclic conidiation occurs, with conidia developing into mother cells, often becoming > 10 μm long, 2–3 μm wide, and sometimes septate, with minute collarettes at one or both ends. Conidiomata pseudopycnidial, produced on pine needles, on SNA and on MEA in 2–4 wk; on pine needles solitary, sub-globose, with irregular surface, superficial or semi-immersed, 90–600 μm wide; on agar medium solitary or within a stroma, unito multicolar; wall up to 60 μm thick, composed of several layers of reddish brown textura epidermoidea with thick-walled, indistinctly delimited cells, opening with an irregular rupture, mature conidiomata often appearing cup-shaped, surrounded by hyaline to brown hyphal appendages, nearly glabrous to completely covered with hairs. Conidiophores lining the inner conidiomatal cavity, hyaline, septate, slightly constricted at the base, sometimes branched at the base, more rarely above, filiform, straight or slightly zigzag-shaped, in almost parallel arrangement, 20–60 μm long. Conidiogenous cells enteroblastic, hyaline, monophialidic, conidigenous loci formed intercalary, immediately below the septum (acropleurogenously) as well as terminally, 4–8 × 2–2.5 μm; collarettes cylindrical, short, often inconspicuous, 0.5–1 μm long, opening 0.5–1 μm. Conidia hyaline, cylindrical to ellipsoidal, with both ends obtuse or one end slightly acute, sometimes slightly curved, smooth-walled, containing small droplets, (3.3–)5.4–(4.5) × (1–)2 μm, mean ± SD = 3.7 ± 0.4 × 1.5 ± 0.2 μm, L/W ratio = 2.5.

Culture characteristics — Colonies on PDA flat, moist, undulate margin, rust to apricot in the centre, pale luteous or saffron towards margin, with black spots and little white to rust floccose aerial mycelium in middle, turning red to blood colour with age; reverse same colours, entire medium scarlet to red due to diffuse pigment; on MEA flat, undulate margin, colony centre vinaceous to dark vinaceous with black spots and white to pale flesh aerial mycelium, margin and entire medium red to scarlet due to diffuse pigment; reverse blood colour in the centre, red to scarlet at margin; 10 mm diam in 2 wk (25 °C dark), min 5 °C, max 30 °C, opt 20 °C.

Specimens examined. SOUTH AFRICA, Western Cape Province, Paarl, from reddish brown V-shaped necrosis close to several pruning wounds in wood of P. persica, 10 June 2004, U. Damm, CBS H-19992 holotype, culture ex-type
Fig. 6 Collophora rubra. a. Longitudinal section through a pseudopycnidium; b–d. pseudopycnidia on pine needle (b), grapevine wood (c) and MEA medium (d); e. conidia formed in pseudopycnidia; f. conidiophores lining the inner wall of a pseudopycnidium; g. hyphae on PDA medium; h–p. conidiogenous cells on hyphal cells; q–r. microcyclic conidiation; s. conidia formed on hyphal cells. All from ex-type culture CBS 120873. a, e, f, h–s: DIC; b–d, g: DM. — Scale bars: a = 20 µm; b, c = 100 µm; d, g = 200 µm; e, h = 5 µm; e applies to e, f; h applies to h–s.
U. Damm et al.: Coniochaeta, Collophora and Phaeomoniella

CBS 120873 = STE-U 6109; Limpopo Province, Mookgopong, from brown necrosis close to pruning wound in wood of P. persica var. nucipersica, 10 June 2004. U. Damm. CBS 121441 = STE-U 6198.

Notes — The formation of a red pigment is the most striking character of Co. rubra. It shares this character with Co. africana, but the latter differs in growth rate and in producing more strongly branched conidiophores formed within conidiomata.

Collophora capensis, which occasionally exudes small amounts of a reddish pigment, produces larger conidia both on hyphae and in conidiomata.

The ITS sequence of Co. rubra STE-U 6109 (GQ154547) is 96 % identical with that of Co. africana STE-U 6113 (GQ154570) and Co. capensis STE-U 6199 (GQ154571) and 92 % identical with ITS sequences of Co. pallida STE-U 6197 (GQ154575) and Co. paarla STE-U 6114 (GQ154586).

Coniochaeta africana Damm & Crous, sp. nov. — MycoBank MB516628; Fig. 7

Anamorph. Lecythophora sp.

Lecythophorae statui anamorphi Coniochaetaceae lignariae similis, sed collis bifurcata ramosis cum polyphialidibus, conidiis cylindraceis, leniter curvatis, 3.5–5.5(–7) × 1.5–2 µm.

Etymology. Named after its continent of origin, Africa.

Ascomata perithecial, solitary, superficial on pine needles, and superficial or immersed in SNA, subglobose; outer wall consists of dark brown textura angularis, setose, with a central ostiole, up to 140 µm diam, remaining immature (no asci or ascospores). Setae brown, cylindrical, tapering to a round tip, generally straight, aseptate, smooth-walled or verruculose, 2–3 µm wide, up to 40 µm long. Vegetative hyphae hyaline, 1.5–3 µm wide, lacking chlamydospores. Conidiophores mainly reduced to conidiogenous cells; discrete conidiophores rare, cylindrical to ventricose. Conidiogenous cells enteroblastic, hyaline, often polyphialidic, mainly intercalary; discrete phialides cylindrical to ventricose, 10–13 × 2 µm; necks of intercalary phialides may be short cylindrical, with or without a broad base tapering to the tip, or bifurcately branched with two openings, or ampulliform, with necks 1–7 µm long (including collarette), 1–3.5 µm wide; collarettes short, cylindrical, 0.5–1 µm long, opening 0.5–1 µm wide, with indistinct periclinal wall thickening.

Sporulation abundant. Conidia aggregated in heads, hyaline, 1-celled, smooth-walled, cylindrical with round ends or with one end slightly acute, sometimes slightly curved, occasionally biguttulate, 3.5–5.5(–7) × 1.5–2 µm, mean ± SD = 4.5 ± 0.9 × 1.7 ± 0.2 µm. Microcyclic conidiation occurs.

Culture characteristics — Colonies on PDA flat, with felt-like aerial mycelium and fimbriate margin; ochraceous to luteous in middle, white to amber at margin; 15 mm diam in 2 wk (25 °C dark), min 5 °C, max > 35 °C, opt ≥ 35 °C.

Specimen examined. South Africa, Limpopo Province, Mookgopong, from necrosis in wood of P. salicina, 31 Aug. 2004, U. Damm, CBS H-19990 holotype, culture ex-type CBS 120868 = STE-U 5952.

Notes — The key in Weber (2002) leads to C. ligniaria; however, C. africana forms polyphialides on bifurcately branched necks, while C. ligniaria does not. Additionally, cultures of C. africana are slower growing than those of C. ligniaria, reaching only 15 mm in 14 d, and remain in shades of yellow, while cultures of C. ligniaria reach 25–40 mm in 14 d, and become salmon with age. These characters also do not apply to any other Coniochaeta species with a Lecythophora anamorph.

A BLASTn search showed that the LSU sequence of C. africana isolate STE-U 5952 (GQ154601) differed in ≥ 5 bp (99 % identity) from LSU sequences of L. mutabilis (e.g. EF517490, AB100628), 8 bp (99 % identity) from C. ligniaria AY198388 and 9 bp (98 % identity) from L. lignicola AB261978. The ITS sequence of C. africana (GQ154539) differs from that of C. velutina isolates STE-U 5950 and 6105 (GQ154542, GQ154584), 36 bp (97 % identity) from C. velutina isolate STE-U 6105 (GQ154584).

Fig. 7 Coniochaeta africana. a, b. Immature perithecia; c. setae; d–l. conidiogenous cells; m. conidia. All from ex-type culture CBS 120868. a, c–m: DIC; b: DM. — Scale bars: a = 50 µm; b = 100 µm; c = 10 µm; d = 5 µm; d applies to d–m.
Fig. 8 Coniochaeta prunicola. a. Longitudinal section through a perithecium; b. perithecium; c. perithecium with asci; d. peridium; e. setae; f–h. asci with ascospores; i, j. ascospores; k–r. conidiogenous cells; s. conidia. All from ex-type culture CBS 120875. a, c–s: DIC; b: DM. — Scale bars: a, c = 50 µm; d, f = 10 µm; e = 20 µm; i, k = 5 µm; a applies to a, b; f applies to f–h; i applies to i, j; k applies to k–s.
isolates produce larger ascospores than Coniochaeta africana (94% identical), transferred into U. Damm & Crous, sp. nov. — MycoBank MB516630; Fig. 8

Coniochaeta africana isolates displays polyphialides; collarette distinct, cylindrical, 1–2(–4) µm long, opening 0.5–1 µm wide, with cylindrical necks, 1–2

Coniochaeta prunicola Dam & Crous, sp. nov. — MycoBank MB516629; Fig. 8

Coniochaetaceae velutinae similis, sed coloniae in vitro non atro-brunescens. Ascosporae uniseriatae, unicellularis, brunneae, laeves, late amygdaliformes, cum rima germinali longitudinali, (7.5–)8.5–10(–11) × (5–)6–7.5(–8) × (3–)4–5 µm. 

**Notes** — The key in Asgari et al. (2007) leads to C. velutina, except that the ascospores of that species have guttules. However, cultures of C. prunicola do not turn dark as those of C. velutina (Weber 2002) do; the latter was also isolated in this study. Coniochaeta prunicola isolates produces larger ascospores than C. velutina, which produced ascospores measuring 5.5–8 × 4.4–5 × 3–4 µm. These dimensions correspond to those provided by Munk (1957), (6–8 × 4–6 × 3–4 µm). The anamorph of C. prunicola is also similar to that of C. velutina, but the collarette in the latter is shorter, up to 1 µm long, and the conidia are wider and not regularly allantoid. All former Coniochaetium, Ephemeromus and Phoroniochaeta species transferred into Coniochaeta by García et al. (2006) differed from C. prunicola by having ornamented or broadly umbonate ascospores, or by lacking Lecythophora anamorphs. Most of the remaining Coniochaeta species have different ascospore sizes, except for C. calligoni, C. pilifera and C. trivialis (syn.: Hypocora pilosiella). Asci of these three exceptional species are longer and narrower than those of C. prunicola, respectively, measuring 70–110 × 6–9 µm, 96–139 × 7–8 µm and 80–90 × 7–8 µm (Saccardo 1891, Bayer 1924, Byzova & Vasyagina 1981).

While LSU sequences of isolates STE-U 6105 and 5950 (GU154605, GU154604) are identical to that of C. velutina AF35394 (CBS 110474), confirming these isolates as C. velutina, the sequences of C. prunicola isolates STE-U 5953 and 6107 (GU154603, GU154602) differ from C. velutina (EU999180, AF35394) sequences (98% identity), Other closely related species, C. mutabilis (e.g. AY219880) and C. ligniaria (AY198388), have 99% and 98% sequence identity, respectively, with the LSU sequences of C. prunicola. The most similar ITS sequences derived from identified strains and found in our own comparisons were those accessed in GenBank as DQ404354 (L. luteoviridis), AY198390 (C. ligniaria), AY781227 (L. hoffmannii), GU154544 and GU154542 (C. velutina) and GU154539 (C. africana) are 93% identical.

**Phaeonomiella dura** Dam & Crous, sp. nov. — MycoBank MB516630; Fig. 9

Phaeonomiellae prunicolae similis, sed culturis abidalis vel buxalibus, solidis et phialidibus in pycnidio aggregatis in conidiophorisamentis, conidios in pycnidio hyalinis, unicellularibus, cylindraceis, interdum leniter curvatis, utrinque obtusi, (2.5–)3–3.5(–4) × (1–1.5) µm, conidios in hyphis formatis hyalinis, unicellularibus, interdum septatis, cylindraceis, extremo unico obtuso, extremo altero attenuato, 3–6(–10) × 1–2(–3) µm. 

**Notes** — The tough mycelium (durus Lat. = tough).

**Vegetative hyphae** hyaline, 1–2.5 µm wide, smooth-walled, lacking chlamydospores; mycelium on PDA tough, leathery. Sporulation abundant; conidia formed on hyphal cells and in pycnidia. Conidiophores on hyphae often reduced to conidiogenous cells, rarely 2-celled. Conidiogenous cells enteroblastic, adeloophialides either short cylindrical or with a broader base tapering to the tip or ampulliform, 3–6 × 1–3 µm; discrete phialides ampulliform, often constricted at the basal septum and sometimes attenuated at the base, 4–15 × 2.5–3.5 µm, generally monophialides, but sometimes polyphialides; collarette distinct, cylindrical, 1–2(–4) µm long, opening 0.5–1 µm wide, periclinal wall thickening indistinct. Sporulation abundant. Conidia aggregated in heads, hyaline, 1-celled, smooth-walled, mainly allantoid, sometimes cylindrical or ovoid, (2.5–)3.5–6(–8) × 1–2(–3.0) µm, mean ± SD = 4.8 ± 1.2 × 1.3 ± 0.5 µm. Microcyclic conidiation not observed.

**Culture characteristics** — Colonies on PDA flat, with sparse aerial mycelium; pale saffron, pale buff to white; 28 mm diam in 2 wk (25 °C dark), min 5 °C, max > 35 °C, opt ≥ 35 °C. 

Specimens examined. **SOUTH AFRICA**, Western Cape Province, Robertson, from olivaceous V-shaped necrosis in wood of *P. amenaica*, 23 Aug. 2005, U. Damm, CBS H-19991 holotype, culture ex-type CBS 120875 = STE-U 6107; Limpopo Province, Mookgopong, from necrosis in wood of *P. salicina*, 31 Aug. 2004, U. Damm, CBS 121445 = STE-U 5953.

Notes — The chief characteristic of this species is the formation of discrete phialides, mostly reduced to adeloophialides or more often with collarettes formed directly on hyphal cells; collarettes distinct, cylindrical, 0.5–1 long, opening 0.5 µm wide, with cylindrical to conical necks, 1–2 × 1–2 µm; discrete phialides cylindrical to subcylindrical, sometimes constricted at the base, 5–7 × 1–1.5 µm. Conidia aggregated in masses around the hyphae, hyaline, 1-celled, sometimes septate when very large, cylindrical, with one end obtuse and the other end attenuated; smooth-walled, sometimes bisporellate with tiny droplets, 3–6(–10) × 1–2(–3.5) µm, mean ± SD = 4.5 ± 1.3 × 1.3 ± 0.5 µm, L/W ratio = 3.5. Microcyclic conidial formation rare. Conidiomata pycnidial, produced on pine needles on SNA and on MEA in 2–4 wk; on pine needles solitary, subglobose, superficial, 50–240 µm wide, unilocular, opening by irregular rupture, with wall composed of brown textura angularis. Conidiophores hyaline, branched and septate. Conidiogenous cells enteroblastic, hyaline, consisting of discrete phialides that are ampulliform to conical, 3–6 × 2–4 µm; with cylindrical collarettes, 0.5–1 µm long, opening 0.5–1 µm. Conidia hyaline, 1-celled, cylindrical, sometimes slightly curved, with both ends obtuse, smooth-walled, sometimes bisporellate with tiny droplets, (2.5–3–3.5–4) × (1–1.5) µm, mean ± SD = 3.1 ± 0.3 × 1.1 ± 0.1 µm, L/W ratio = 2.9.

**Culture characteristics** — Colonies on PDA flat, moist to slimy, folded towards the centre, with entire margin and sparse, villoose, white, aerial mycelium; surface white to pale buff with tiny black spots, sometimes pale honey at centre; on MEA flat, folded towards the centre, with undulate margin, grey-
Fig. 9  *Phaeomoniella dura*. a. Longitudinal section through a pycnidium; b. conidia oozing from pycnidium on pine needle; d. e. conidiogenous cells lining the inner wall of pycnidia; f. conidia formed in pycnidia; g–m. conidiogenous cells on hyphal cells; n. conidia formed on hyphal cells. All from ex-type culture CBS 120882. a, d–n: DIC; b, c: DM. — Scale bars: a = 20 µm; b = 100 µm; d = 5 µm; b applies to b, c; d applies to d–n.

Fig. 10  *Phaeomoniella effusa*. a. Longitudinal section through a pycnidium; b. conidia oozing from pycnidium on pine needle; c. conidia formed in pycnidia; d, e. conidiogenous cells lining the inner wall of pycnidia; f–k, m–o. conidiogenous cells on hyphal cells; l. conidia formed on hyphal cells. All from ex-type culture CBS 120883. a, c–o: DIC; b: DM. — Scale bars: a = 20 µm; b = 500 µm; c = 5 µm; c applies to c–o.
olivaceous with tiny black spots towards the centre, buff at the margin; 20 mm in diam after 2 wk (25 °C dark), min 5 °C, max 30 °C, opt 20 °C.

Specimen examined. SOUTH AFRICA, Limpopo Province, Mogopong, from necrosis in wood of P. salicina, 31 Aug. 2004, U. Damm, CBS H-19997 holotype, culture ex-type CBS 120862 = STE-U 6122.

Notes — Conidia formed in the mycelium are longer than those of most species, except P. zymoides (mainly 3.5–6 × 0.8–1.9 µm, Lee et al. 2006). Colonies of P. dura are, however, much faster growing than P. zymoides and lack any greenish or greyish colours.

BLASTn results show that the ITS sequence of P. dura strain STE-U 6122 (GQ154597) displays differences from sequences of P. pinifoliorum (DQ270240, 88 % identical), P. chlamydospora (e.g. AF197973, 86 % identical), P. zymoides (e.g. DQ270242, 85 % identical) and P. capensis (FJ37239, 84 % identical). ITS sequences of P. prunicola (GQ154590), P. effusa (GQ154598), P. tardicola (GQ154599) are 88 %, 86 % and 86 % identical.

Phaeomoniella effusa Damm & Crous, sp. nov. — MycoBank MB516631; Fig. 10

Phaeomoniellae prunicolae similis, sed in vitro pigmentis viridibus uniformiter dispersis. Differ ab omnibus speciebus generis phialidibus in pycnidio late ellipsoidibus, lenier angularibus, periclinaler distincro inacessatia, sed sine collaretis distinctis, conidios in pycnidio hyalinis, unicellularibus, cylindraceis, interdum leniter curvatis, utrinque obtusis, (2–)2.5–5(–6) × 1–1.5(–2) µm, et co-nidios in hyphis formatis hyalinis, unicellularibus, cylindraceos vel obovatios, interdum leniter curvatis, utrinque obtusis, (2–)2.5–4(–4.5) × 1–1.5(–1.5) µm.

Etymology. Named after the effuse growth of the colonies (effusus Lat. = effuse).

Vegetative hyphae hyaline, 1–3 µm wide, smooth-walled, lacking chlamydospores. Sporulation abundant; conidia formed on hyphae and in pycnidia. Conidiophores on hyphae mainly reduced to conidigenous cells, few 2-celled conidiophores, sub-cylindrical to navicular, 12–22 × 2 µm. Conidiogenous cells enteroblastic, discrete phialides rare, mostly reduced to very short adelophialides or more often with collarettes formed directly on hyphal cells; with cylindrical to conical necks, 1.5–3 × 1–2 µm, distinct phialides navicular or elongate-ampulliform and attenuated at the base, 7–12 × 2 µm; collarettes and periclinal thickening conspicuous, collarettes cylindrical to narrowly funnel-shaped, thin-walled, 0.5–2 long, opening 0.5–1 µm wide. Conidia aggregated in masses around the hyphae, hyaline, 1-celled, cylindrical to obovate, sometimes slightly curved, both ends obtuse, smooth-walled, containing small droplets, (2–)2.5–3.5(–4.5) × 1–1.5 µm, mean ± SD = 3.0 ± 0.6 × 1.2 ± 0.1 µm, L/W ratio = 2.4. Mycrocyclic conidiation not observed. Conidiomata pycnidial, produced on pine needles on SNA and on MEA in 2–4 wk; on pine needles solitary, subglobose, superficial, 100–350 µm wide, unilocular, opening by irregular rupture, wall composed of brown textura angularis. Conidiophores reduced to conidigenous cells. Conidiogenous cells enteroblastic, hyaline, broadly ellipsoid, somewhat angular, resembling wall cells, 3–5 × 4–6 µm; opening 0.5 µm, periclinal thickening as a broad ring around opening, collarette very short or inconspicuous. Conidia hyaline, 1-celled, cylindrical, sometimes slightly curved, both ends obtuse, smooth-walled, containing small droplets, (2–)2.5–3.5(–6) × 1–2 µm, mean ± SD = 3.5 ± 0.7 × 1.5 ± 0.2 µm, L/W ratio = 2.3.

Culture characteristics — Colonies on PDA flat, moist, with sparse aerial mycelium in the centre and undulate to lobate margin; herbage-green, dark herbage-green to olivaceous, white at the margin and sometimes in the centre; on MEA flat, moist, with radial growth rings, very little villose, olivaceous-grey aerial mycelium, with entire margin; olivaceous-grey to pale olivaceous-grey; 32 mm diam in 2 wk (25 °C dark), min 5 °C, max 35 °C, opt 30 °C.

Specimen examined. SOUTH AFRICA, Western Cape Province, Paarl, from necrosis in wood of P. persica, 10 June 2004, U. Damm, CBS H-19998 holotype, culture ex-type CBS 120883 = STE-U 6121.

Notes — Phaeomoniella effusa is similar to P. prunicola, but greenish pigments are more uniformly distributed in the culture or emerge in radial growth rings. Phialides in pycnidia of P. effusa are broadly ellipsoid, somewhat angular, with pronounced periclinal thickening, but with inconspicuous collarette, while those of P. prunicola are ampulliform with a cylindrical collarette.

BLASTn results of the ITS sequence of P. effusa strain STE-U 6121 (GQ154598) display differences to sequences of P. pinifoliorum (DQ270240, 88 % identical), P. capensis (FJ37239, 87 % identical), P. zymoides (e.g. DQ270242, 86 % identical) and P. chlamydospora (e.g. AB278179, 84 % identical). ITS sequences of P. prunicola (GQ154590), P. tardicola (GQ154599), P. dura (GQ154597) are 89 %, 88 % and 86 % identical.

Phaeomoniella prunicola Damm & Crous, sp. nov. — MycoBank MB516632; Fig. 11

Phaeomoniellae chlamydosporae similis, sed conidios in mycelio persaepe enteroblasticiformis ad orificia lateralia hypharum, unicellularibus, cylindraceis vel ellipsoidibus, utrinque obtusis et apice papillato, (2–)2.5–4(–4.5) × 1–1.5(–2) µm, et conidios in phialidibus simplicibus in pycnidio hyalinis, cylindraceis vel ellipsoidibus, (2–)2.5–4 × 1–1.5 µm.

Etymology. Named after the host genus, Prunus.

Vegetative hyphae hyaline to pale yellow-green, 1.5–2.5 µm wide, lacking chlamydospores. Sporulation abundant, conidia formed on hyphae and in pycnidia. Conidiophores on hyphae hyaline, mainly reduced to conidigenous cells, few 2-celled cylindrical conidiophores present, 11 × 2.5 µm. Conidiogenous cells enteroblastic, discrete phialides rare, intercalary phialides dominating, often collarettes directly on openings in hyphal cells, necks short cylindrical or with a broader base tapering to the tip, 0.5–5 × 0.5–2 µm; collarettes cylindrical, 0.5–2 µm long, opening 0.5–1(–2) µm wide, periclinal thickening inconspicuous, discrete phialides cylindrical, 3–7 × 1.5–2 µm. Conidia aggregated in heads and in masses around the hyphae, hyaline, 1-celled, cylindrical to ellipsoidial, with both ends obtuse or obtuse base and papillate apex, smooth-walled, (2–)2.5–4(–4.5) × 1–1.5(–2) µm, mean ± SD = 3.2 ± 0.6 × 1.2 ± 0.2 µm, L/W ratio = 2.6, a few exceptionally large conidia occur that are obovate, up to 6.5 × 3 µm, some biguttulate (very small droplets). Microcyclic conidiation observed. Conidiomata pycnidial, produced on pine needles on SNA and on MEA in 2–4 wk; on pine needles solitary, globose, superficial, up to 150 µm wide, on agar medium inside a stroma, brown, unilocular, opening by irregular rupture, wall 2–4 cell-layers thick, composed of brown thick-walled textura angularis. Conidiophores hyaline, mainly reduced to conidigenous cells. Conidiogenous cells enteroblastic, hyaline to pale brown, ampulliform tapering towards a neck with a cylindrical collarette, 3–5 × 2.5–5 µm; collarettes 0.5–1.5 µm long, opening 0.5–1 µm, periclinal thickening sometimes visible. Conidia hyaline, cylindrical to ellipsoidial, (2–)2.5–4 × 1–1.5 µm, mean ± SD = 3.1 ± 0.5 × 1.2 ± 0.2 µm, L/W ratio = 2.6.

Culture characteristics — Colonies on PDA flat, moist, surface folded towards the centre, lacking aerial mycelium, with fimbriate margin; pale luteous to pale buff, centre, margin or sectors of the colony turn dark greenish to grey-olivaceous with age; on MEA flat, moist, olivaceous-black in the centre and at the margin, zone between smoke-grey and olivaceous-black, mottled, fimbriate margin; 22 mm diam after 14 d (25 °C dark), min 5 °C, max 35 °C, opt 20 °C.
Fig. 11 Phaeomoniella prunicola. a. Longitudinal section through a pycnidium; b. conidia oozing from pycnidium on pine needle; c, d. conidiogenous cells lining the inner wall of pycnidia; e. conidia formed in pycnidia; f–k. conidiogenous cells on hyphal cells (arrow heads: openings in plan view); l. conidia formed on hyphal cells. All from ex-type culture CBS 120876. a, c–l: DIC; b: DM. — Scale bars: a = 20 µm; b = 50 µm; c = 5 µm; c applies to c–l.

Fig. 12 Phaeomoniella tardicola. a. Longitudinal section through a pycnidium; b. pycnidium ruptured by slide preparation showing one-cell layered wall cells acting as conidiogenous cells (arrow head); c. conidia oozing from pycnidia on pine needle; d–f. conidiogenous cells lining the inner wall of pycnidia; g. conidia formed in pycnidia; h. conidia formed on hyphal cells; i–l. n–o. conidiogenous cells on hyphal cells (arrow head: opening in hyphae with collarette); m. microcyclic conidiation. All from ex-type culture CBS 121757. a, b, d–o: DIC; c: DM. — Scale bars: a = 10 µm; b, d = 5 µm; c = 50 µm; d applies to d–o.
Specimens examined. **South Africa**, Limpopo Province, Modleng, from necrosis in wood of *P. persica*, 31 Aug. 2004, U. Damm, CBS H-19997 holotype, culture ex-type CBS 120876 = STE-U 6118; Western Cape Province, Paarl, from necrosis in wood of *P. salicina*, 10 June 2004, U. Damm, STE-U 6117.

Notes — Conidia formed in the mycelium are narrower than those of *P. pinifoliorum*, and shorter than conidia of *P. dura* and *P. zymoides* (Lee et al. 2006). Unlike in *P. chlamydospora*, discrete phialides or conidiophores are rare (Crous et al. 1996, Crous & Gams 2000). Colonies are much faster-growing than those of *P. tardashica*. The species differs from *P. eusista* by the irregular emergence of defined areas of dark greenish pigment in cultures, either in the centre or margin of the colony or in patches, spots or sectors.

**Phaeomoniella tardashica**

**Damm & Crous, sp. nov. — MycoBank** MB816633; Fig. 12

*Phaeomoniellaceae* pseudociliata similis, sed cultura tarda crescentibus, albidos vel bubalinis et pseudinis 15–80 µm diam, cum conidiosa unicellulareus, hyalina, cylindraceae vel obovatis, 2–4.5(–7) × 1.1–1.5(–2) µm, conidios in hypha hyalina, unicellulareus, leniter curvatis, 3–3.5(–4) × 1–1.5 µm.

*Etymology.* Named after the slow growth of the fungus ( tardus Lat. = slow, -cola Lat. = growing).

Vegetative hyphae hyaline, 1–2 µm wide, septate, lacking chlamydospores. Sporulation abundant, conidia formed on hyphae and in pycnidia. *Conidiophores on hyphae* reduced to conidiogenous cells. *Conidiogenous cells* enteroblastic, reduced to mere openings formed directly on hyphal cells, rarely to short necks, discrete phialides very rare; necks 0.5–1(–5) µm long, 0.5–1 µm wide; collarettes mostly inconspicuous, opening ≤ 0.5 µm wide. *Conidia*: 1-celled, hyaline, cylindrical to obovate, smooth-walled, 3–5 µm; collarettes 0.5–1 µm long, opening 0.5–1 µm.

Culture characteristics — Colonies on PDA umbonate or raised, moist, lacking aerial mycelium, with a folded surface, and fine dentate margin; white to pale buff; on MEA dome-shaped, moist, none or very little short, villose aerial mycelium, strongly folded surface, sometimes bursting at the edges, with lobate margin; white, pale rosly-buff to buff; 4 mm in 14 d (25 °C), min 15 °C, max 30 °C, opt 25 °C.

*Specimen examined. South Africa*, Western Cape Province, Robertson, from pale brown necrosis in wood of *P. armeniaca*, 23 Aug. 2005, U. Damm, CBS H-20000 holotype, culture ex-type CBS 121757 = STE-U 6123.

Notes — The typical feature of this species is the extremely slow growth of the umbonate, raised or dome-shaped, white to buff cultures and the very small pycnidia. These features distinghish this species from the two other species with pale colony colours, *P. dura* and *P. pinifoliorum*. While most of the species grow at 5 °C, the minimum growth temperature of *P. tardashica* is 15 °C, a trait it shares only with *P. chlamydospora*.

**Pathogenicity**

All the isolates studied were isolated from brownish wood necroses or discolorations inside tree branches of various *Prunus* species. In cross-section, the lesions were irregular or round. The bark was often bulging and cracked laterally along the branch above the necrotic areas. *Lecythophora*-like fungi were isolated from these lesions mostly in combination with other fungi, for example *Alternaria, Cytospora, Diplodia* and *Phaeomoniella* species. There were, however, many specimens (mostly peach and nectarine) where these fungi, especially *Co. rubra*, were isolated as the only fungus.

Analyses of variance of the lesion length data on apricot, peach and plum cane sections indicate a significant treatment effect (*P* < 0.001; Anova tables not shown). *Collophora africana* (mean 82.9 mm), *Co. rubra* (69.3 mm), *C. prunicola* (64.3 mm) and *P. dura* (57.2 mm) caused lesions on the xylem of apricot shoots that were significantly longer than the negative controls (27.3–28.7 mm), but also significantly shorter than lesions caused by the pathogen control, *Eutypa lata* (120.0 mm; Table 2). On the xylem of peach shoots, *Co. pallida* (82.8 mm), *C. africana* (77.9 mm) and *P. zymoides* (72.2 mm) caused lesions that were significantly longer than the negative controls (18.4–37.8 mm), although lesions caused by the last two taxa were significantly shorter than those caused by *E. lata* (112.8 mm). Only *Co. paarla* (47.9 mm) and *Co. pallida* (43.9 mm) caused lesions on the xylem of plum shoots that were significantly longer than those caused by the negative controls (15.5–24.9 mm). Again, these lesions were significantly shorter than those caused by *E. lata* (115.0 mm). The *Lecythophora*-like species that caused the longest lesions on peach, plum and apricot shoots were, respectively, *Co. pallida*, *Co. paarla* and *C. africana*.

**Table 2** Means of lesion lengths caused by different *Lecythophora*-like species on detached green apricot, peach and plum shoots.

| Fungal species | Mean of lesion length (mm)* |
|----------------|-----------------------------|
| **Apricot**    |                             |
| *Eutypa lata*  | 120.0 a                     |
| *Collophora africana* | 82.9 b                |
| *Collophora capensis* | 50.2 cdef            |
| *Collophora paarla* | 22.4 g                  |
| *Collophora pallida* | 48.0 cdef             |
| *Collophora rubra* | 69.3 bc                 |
| *Coniochaeta africana* | 47.8 cdefg         |
| *Coniochaeta prunicola* | 64.3 bcd            |
| *Coniochaeta velutina* | 42.6 defg            |
| *Phaeomoniella dura* | 57.2 bcde            |
| *Phaeomoniella effusa* | 50.3 cdef             |
| *Phaeomoniella prunicola* | 25.0 fg               |
| *Phaeomoniella tardica* | 35.5 efg             |
| *Phaeomoniella zymoides* | 42.7 defg           |
| *Phaeomerum STRICTUM* | 28.7 fg               |
| **Peach**      |                             |
| *Agar plug*    | 27.3 fg                     |
| *LSD (P < 0.05)* | 26.6                   |
| **Plum**       |                             |

1 *Pathogen control.
2 *Non-pathogen controls.
3 Means followed by the same letter are not significantly different (*P* > 0.05), means significantly different from the non-pathogen controls are emphasized in **bold**.
Additionally to the lesions in xylem, we also frequently observed lesions on the bark surface of apricot and especially of peach canes, mostly in the form of narrow, dark brown rings around the inoculation site. Such lesions were frequently observed on peach canes inoculated with Co. pallida, C. africana, P. zymoides, Co. africana, Co. rubra, P. effusa and P. prunicola, and also on apricot shoots inoculated with Co. capsensis. Other species formed surface lesions on apricot and peach canes less frequently, while on plum, lesions on the bark surface were rarely observed. Bark lesions were also observed on apricot and peach canes inoculated with Eutypa lata (positive control), but never in negative controls.

The fungi could be reisolated, except in the case of P. zymoides, P. dura, P. tardicola and A. strictum. None of the Lecythophora-like species was isolated from the negative controls.

**DISCUSSION**

Wood of Prunus species showing necrosis symptoms is often colonised by different species of fungi with reduced phialides, resembling Lecythophora, the anamorph of Coniochaeta. In spite of their similar anamorphs, the fungi studied here belong to three genera that are not closely related to each other. In fact, they belong to three different classes within the Eurotiomycetes, namely Sordariomycetes, (order Coniochaetales, genus Coniochaeta), Eurotiomycetes, (order Chaetothyriales, genus Phaeomoniella) and Leotiomycetes (order uncertain, genus Collophora).

Some of these fungi were identified as Coniochaeta. This is the first report of C. velutina on Prunus and the first report of the genus Coniochaeta in South Africa. Coniochaeta velutina has been found on many different substrates and hosts (Mahoney & La Favre 1981). Endophytic strains have been grown from birch (Betula spp.) leaves in Finland (Helander et al. 2007). ITS sequences of C. prunicola show high similarities (one substitution in EF420012, EF420005, and additionally one deletion in EF419915) to those of a fungal endophyte of asymptomatic photosynthetic tissue of Platycladus orientalis from Arizona, USA (Hoffman & Arnold 2008). This finding suggests that this species also occurs in cupressaceous trees, at least in that area. According to Mahoney & La Favre (1981), Coniochaeta species are of low virulence on most hosts, usually appearing on dead tissue or as opportunistic invaders of previously infected, wounded or senescent tissue. Isolates from stained and decayed wood of Acer saccharum were always associated with trunk wounds, but also with other fungi (Basham et al. 1969). In the present study, Coniochaeta species were isolated from wood samples that rarely showed necrosis, and were always found in combination with other fungi, like P. prunicola, Phaeoacremonium spp., other Coniochaeta spp. and basidiomycetes. According to the preliminary pathogenicity test, C. velutina is not pathogenic to any of the host plants tested, while C. prunicola is pathogenic to apricot and C. africana to peach.

The second group of fungi we obtained the Collophora species, belong phylogenetically to the class Leotiomycetes (Wang et al. 2006). However, there is a diversity of fungi closely related to it in the orders Helotiales and Erysiphales, as well as the family Pseudeurotiaceae; most of these fungi form either apothecia or cleistothecia. The lack of teleomorph formation in Collophora species makes it difficult to suggest phylogenetic affiliation with a specific order of Leotiomycetes. Although these species form two clades in the LSU phylogeny, they are placed in one genus, because of their similar morphological features and the lack of morphological characters distinguishing the two clades. Schol-Schwarz (1970) mentioned some pale, cream-coloured strains in the Phialophora hoffmannii group that developed either apothecia or a pycnidial or sporodochial state, often containing branched conidiophores. They could not be identified at that time. It is possible that some of these strains belong to Collophora.

The third group of fungi is closely related to Phaeomoniella chlamydospora (Crous & Gams 2000), P. zymoides, P. pilolorum (Lee et al. 2006), P. capensis (Crous et al. 2008), Moristroma quercinum and M. japonicum (Nordén et al. 2005). Phaeomoniella chlamydospora and Moristroma have both been shown to belong to the Chaetothyriales (Gronewald et al. 2001, Nordén et al. 2005). Colonies of Chaetothyriales (black yeasts) are typically very dark-olivaceous, compact, yeast-like and slow-growing (Gams 2000, Badali et al. 2008, Li et al. 2008). The newly described Phaeomoniella species have a yeast-like appearance, are more or less slow-growing; just two of them turn dark-olivaceous. However, while Moristroma species develop ascostroma and pycnidia on Quercus wood (Nordén et al. 2005), none of the Phaeomoniella species studied here or elsewhere formed any teleomorph structures. While Moristroma forms only holoblastic hyphomycetous conidia, Phaeomoniella species produce enteroblastic conidia in pycnidia and usually in the mycelium as well.

There are some characters that most of the known and newly described Phaeomoniella species share: white to greenish, moist to slimy colonies with little aerial mycelium and the production of phialocinoida in pycnidia and in the mycelium. The type species, P. chlamydospora, is the only species of the genus that mainly produces distinct conidiophores and dark chlamydosporas (Crous & Gams 2000). Other species, described in this paper and by Lee et al. (2006), produce conidia only on short phialides or necks of intercalary phialides or on mere openings in hyphal cells. They have no or only hyaline chlamydosporas. Colonies of P. capensis do not form conidia in the mycelium at all and are salmon, apricot or flesh coloured (Crous et al. 2008).

In Phaeomoniella, conidigenous cells and pycnidial conidio- phores vary, ranging from simple short cells that are hardly distinguishable from wall cells to branched conidiophores with ampulliform or cylindrical phialides. Crous et al. (2008) considered this complex to represent more than one genus and placed P. capensis here mainly because of its phylogenetic relationship to P. chlamydospora. In spite of the morphological and molecular variability and the fact that they do not form a monophyletic clade apart from Moristroma, the new species have been described as Phaeomoniella species in this paper, because at this stage we are hesitant to introduce more new genera in this complex. The species are all closely related to P. chlamydospora and share some of the characters with this species or with some of the other species presently accommodated in this genus.

One of the five Phaeomoniella species could be identified as P. zymoides. Phaeomoniella zymoides was originally isolated from needles of Pinus densiflora in Korea, but also as an endo-phyte of Cornus sanguinea and on lichens on Pinus sylvestris in Spain (CBS 122753, CBS 122752). This is the first report of P. zymoides from Prunus as well as from South Africa. The other four Phaeomoniella species were described as new species, P. dura, P. effusa, P. prunicola and P. tardicola. Phaeomoniella prunicola was frequently isolated from wood of P. salicina and occurs in two provinces in South Africa. The other species were isolated only from plum (P. zymoides, P. dura), peach (P. effusa) or apricot wood (P. tardicola).

Most of the species newly described in this study were probably undiscovered because of the lack of investigations on the fungal flora of Prunus wood in South Africa. The slow, yeast-like growth of most of the species in culture may have also caused these species to be overlooked, as may the difficulties involved in identifying such relatively nondescript cultures.
The fungi might have been overlooked or overgrown or even considered as yeasts and discarded as miscellaneous unknown fungi by persons looking for familiar pathogens. The isolation technique can also play a role. Lee et al. (2008) considered the low pH (3.7) of their media to be an aid in detecting the slow-growing acid-tolerant P. zyomoides and P. pinophilorum. In this study, however, we isolated species of all three genera, including P. zyomoides, on common media (SNA, PDA) with a pH between 6 and 7. The more frequent species, Co. rubra, Co. palilida and P. prunicola did not show preference for one of the two media used.

While P. chlamydospora is a well-known grapevine trunk disease pathogen (Petri grapevine decline, Crous & Gams 2000, FOURIE & HALLEEN 2004, MOSTERT et al. 2006a,c), P. zyomoides and P. pinophilorum were isolated from healthy looking pine needles (Lee et al. 2006) and P. capensis from leaf blight symptoms on Encephalartos (Crous et al. 2008). However, all species studied in this paper have been isolated from Prunus wood with necrosis symptoms. Some of the new fungi even occurred abundantly on peach and nectarine (Co. rubra) or on plum (P. prunicola, Co. palilida). All three fungi were found both in the Western Cape and the Limpopo Province of South Africa. Collophora rubra, originally isolated from 35 wood specimens, was often (on 10 specimens) the only fungus isolated from the specimen with necrotic symptoms. Because of the origin of the isolates and the results of the preliminary pathogenicity tests we consider some of the new fungi as potential pathogens on Prunus wood. However, of the three more common species, only Co. palilida caused lesions on the Prunus species from which it had been isolated, that is, peach and plum. Collophora rubra caused lesions only on apricot shoots and P. prunicola did not cause lesions at all. Further studies are necessary to discover the role of the newly described fungi in wood, and estimate their economic impact on fruit production.

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