Phylogeny and taxonomy of the scab and spot anthracnose fungus
Elsinoë (Myriangiales, Dothideomycetes)

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Abstract: Species of Elsinoë are phytopathogens causing scab and spot anthracnose on many plants, including some economically important crops such as avocado, citrus, grapevines, and ornamentals such as poinsettias, field crops and woody hosts. Disease symptoms are often easily recognisable, and referred to as signature-bearing diseases, for the cork-like appearance of older infected tissues with scab-like appearance. In some Elsinoë-host associations the resulting symptoms are better described as spot anthracnose. Additionally the infected plants may also show mild to severe distortions of infected organs. Isolation of Elsinoë in pure culture can be very challenging and examination of specimens collected in the field is often frustrating because of the lack of fertile structures. Current criteria for species recognition and host specificity in Elsinoë are unclear due to overlapping morphological characteristics, and the lack of molecular and pathogenicity data. In the present study we revised the taxonomy of Elsinoë based on DNA sequence and morphological data derived from 119 isolates, representing 67 host genera from 17 countries, including 64 ex-type cultures. Combined analyses of ITS, LSU, and host species DNA sequence data were used to reconstruct the backbone phylogeny of the genus Elsinoë. Based on the single nomenclature for fungi, 26 new combinations are proposed in Elsinoë for species that were originally described in Sphaceloma. A total of 13 species are epiutilified with notes on their taxonomy and phylogeny. A further eight new species are introduced, leading to a total of 75 Elsinoë species supported by molecular data in the present study. For the most part species of Elsinoë appear to be host specific, although the majority of the species treated are known only from a few isolates, and further collections and pathogenicity studies will be required to reconfirm this conclusion.

Key words: anthracnose, molecular phylogeny, scab disease, Sphaceloma, taxonomy.

Taxonomic novelties: New species: Elsinoë asclepiadea Fan, R.W. Barreto & Crous, E. citricola Fan, R.W. Barreto & Crous, E. embeliae Thirum. & Naras., E. euphorbiae Fan & Crous, E. fici-caricae Wani & Thirum., E. genipae-americanae Fan & Crous, E. jasminicola Fan & Crous, E. salicina Fan & Crous; New combinations: E. abutilonis (Bitanc. & Jenkins) Fan & Crous, E. anacardii (Wani & Thirum.) Fan & Crous, E. banksicola (Pascoe & Crous) Fan & Crous, E. barlenicola (Wani & Thirum.) Fan & Crous, E. bidentis (Bitanc. & Jenkins) Fan & Crous, E. coryl (Vegh & M. Bourgeois) Fan & Crous, E. flagae (Bitanc. & Jenkins) Fan & Crous, E. flavocarliae (Thirum. & Naras.) Fan & Crous, E. genipae (Bitanc.) Fan & Crous, E. glyciniae (Kurata & Kurb.) Fan & Crous, E. hedearae (Bitanc. & Jenkins) Fan & Crous, E. ichnocarpai (Thirum. & Naras.) Fan & Crous, E. krugii (Bitanc. & Jenkins) Fan, R.W. Barreto & Crous, E. lagoa-santensis (Bitanc. & Jenkins) Fan & Crous, E. lippiae (R.C. Baines & Cummings) Fan & Crous, E. menthae (Jenkins) Fan & Crous, E. pongamiae (Wani & Thirum.) Fan & Crous, E. populi (Sac.) Fan & Crous, E. rhois (Bitanc. & Jenkins) Fan & Crous, E. ricini (Jenkins & C.C. Cheo) Fan & Crous, E. semecarpai (Wani & Thirum.) Fan & Crous, E. sesseae (Bitanc. & Jenkins) Fan & Crous, E. siccata (Ciccar.) Fan & Crous, E. tectoriae (Cheew. & Crous) Fan & Crous, E. terminaliae (Bitanc.) Fan & Crous, E. violae (Massey & Jenkins) Fan & Crous; Epitypifications (basionyms): Autographum lepid Peck, Elsinoë brasilensis Bitanc. & Jenkins, Elsinoë erythrinae Sivan. & L.D. Gómez, Elsinoë mimosae Viégas, Elsinoë rosarum Jenkins & Bitanc., Elsinoë solidaginis Jenkins & Utkelberg, Elsinoë verbenae Bitanc. & Jenkins, Flectidoscelia veneta Burkh., Sphaceloma glycines Kurata & Kurb., Sphaceloma krugii Bitanc. & Jenkins, Sphaceloma menthae Jenkins, Sphaceloma pongamiae Wani & Thirum., Sphaceloma terminaliae Bitanc.

Available online 24 February 2017; http://dx.doi.org/10.1016/j.simyco.2017.02.001.

INTRODUCTION

All members of the genus Elsinoë (Myriangiales, Ascomycota) are specialised plant parasites causing diseases on many plant hosts, including some economically important crops such as avocado, cassava, citrus, grapevines, ornamentals such as poinsettias, field crops and woody hosts. Many species cause “signature-bearing diseases” easily recognised for their symptom-marker cork-like necrotic tissues. These are often raised, exhibiting cracks, and hence are referred to as scabs. In other Elsinoë-host associations the symptoms that result from infection are different and are often called anthracnose (such as in infected grapevines) (Barrus & Horsfall 1926, Jenkins 1947, Farr et al. 1989, Pan 1994, Phillips 1994, Gottwald 1995).

Nevertheless the use of this name for a plant disease caused by Elsinoë is somewhat confusing because of its much broader use for diseases caused by Colletotrichum. Spot anthracnose was an alternative name recommended by Jenkins (1947). Some hosts develop severe distortions of infected organs, such as stem elongation in cassava, or twisting of infected stems of Bidens spp. (Guatimosim et al. 2015). In the case of the cassava pathogen production of Gibberellin-A4 was demonstrated independently by Rademacher & Graebe (1979), and Zeigler et al. (1980), suggesting the involvement of plant growth hormone analogues produced by the fungus in other Elsinoë-plant associations. Although scab symptoms are easily recognised,
examination of specimens collected in the field is often frustrating because of the lack of fertile structures. In addition, isolation of Elsinoë in pure culture can be very challenging because of their slow growth and resulting cultures easily becoming overgrown by contaminants. Although many species of the scab fungus have been described under Elsinoë or Sphaceloma, only a few cause important diseases (Holiday 1980). Economically important diseases include avocado scab caused by E. persea, citrus scab caused by E. fawcettii and E. australis, bean scab caused by E. canalaevae and E. phaseoli, grape spot anthracnose caused by E. ampelina, and cassava superelangation caused by “Sphaceloma manihoticola” (Jenkins 1925, Shear 1929, Jenkins 1931, Bruner & Jenkins 1933, Bilancourt & Jenkins 1936a, 1936c, Boedijn 1961, Tan et al. 1998) (Fig. 1). In many cases the main impact is on the appearance of the harvested product, and its market acceptability rather than on crop productivity (Swart et al. 2001). On the positive side, several Elsinoë species cause devastating diseases on important agricultural and environmental weeds and are beneficial species in this regard. Some examples are the scab fungi attacking alligator weed (Alternanthera philoxeroides), giant sensitive plant (Mimosa diplosticha), beggar tick (Bidens pilosa) (Guatimosim et al. 2015), and wild poinsettia (Euphorbia heterophylla) (Barreto & Evans 1998, Nechet et al. 2004).

The order Myriangiales has two accepted families, namely Elsinoaceae and Myriangiaceae, which represent a sister group to Dothideales, the type order of the Dothideomycetes (Li et al. 2011, Hyde et al. 2013, Dissanayake et al. 2014, Jayawardena et al. 2014). They generally have crustose to pulvinate, irregular ascostromata, in which the scattered asci are irregularly arranged in individual locules. Ascospores are hyaline to brown, transversely septate or muriform, which are irregularly arranged and liberated only by the breakup of the stromatal layers above them (Kirk et al. 2008, Hyde et al. 2013). Asexual morphs of Elsinoaceae are acervular coelomycetous fungi with polyphialidic conidigenous cells, such as the Sphaceloma asexual morph of Elsinoë in the present study (Jenkins 1932b, Kirk et al. 2008). Since the Myriangiales was introduced by Starbäck (1899), its classification has undergone several changes. Frederick & Frederick (1947) placed four families in this order (Dothiariaceae, Elsinoaceae, Myriangiaceae and Pseudosphaeriaceae). von Arx (1963) originally reduced the Myriangiales to include the Myriangiaceae and Saccardiaceae, but later circumscribed the order to include a single family, Myriangiaceae (von Arx & Müller 1975). Subsequent treatments by other workers again saw an increase in the number of families, with Barr (1979) originally recognising seven, and later five (Eriksson & Hawksworth 1986, Barr 1987). The first multigene phylogenetic treatment was published by Schoch et al. (2006), who placed two families (Elsinoaceae and Myriangiaceae) in Myriangiales, with sister groups being delineated in subsequent studies (Tsuneda et al. 2008, Schoch et al. 2009), Kirk et al. (2008) included three families (Cookellaceae, Elsinoaceae and Myriangiaceae), while Lumbsch & Huhndorf (2010) accepted only Elsinoaceae and Myriangiaceae, and treated Cookellaceae as incertae sedis in Dothideomycetes, a conclusion that was supported by Hyde et al. (2013). The Elsinoaceae was proposed by Saccardo & Trotter (1913) after the invalid “Elsinoë” was introduced by von Höhnel (1909) as a separate family from Myriangiales, because of habitat and morphological characters. Woronichin (1914) treated this family as a synonym of Plectodiscellaceae based on a single species Plectodiscella pirii, which he found occurring on the leaves of apple and pear. Jenkins (1932a) regarded Elsinoë as valid name, and Frederick & Frederick (1947) placed Elsinoë in the Myriangiales. However, von Arx & Müller (1975) placed Elsinoë, the type genus of the Elsinoaceae, in the Myriangiaceae according to the immersed or erumpent, pulvinate or irregular ascostromata, and being restricted to foliar pathogens causing scab disease. Based on observations of their restricted hosts, Barr (1979, 1987) and Eriksson (1981) suggested that Elsinoaceae and Myriangiaceae should be maintained as two separate families in the Myriangiales.

The genus Elsinoë was introduced by Raciborski (1900) with descriptions of three species (E. antidesmae, E. canalaevae and E. menispermacearum). It is characterised by forming scab-like lesions with pseudoascostromata containing three to eight bitunicate asci inside each locule. Asci are saccate to globose with eight hyaline, oblong or fusiform, septate ascospores (Fig. 2). The asexual morph is the acervular coelomycetous Sphaceloma, which has polyphialidic conidigenous cells and hyaline, ellipsoidal, aspatulate conidia. Jenkins (1932a) treated Plectodiscella as a synonym of Elsinoë and proposed a connection between Sphaceloma and the sexual morph Elsinoë, supported by later studies using molecular data (Swart et al. 2001). More than 140 species epithets named Elsinoë and more than 160 epithets of Sphaceloma asexual species have been recorded in Index Fungorum and MycoBank, with an estimated 48 species of Elsinoë and 52 species of Sphaceloma in Kirk et al. (2008). Morphological characteristics of Elsinoë species are difficult to
observe, as the sexual morph is uncommon in nature, and the frequently observed asexual Sphaceloma morph is usually morphologically conserved. Molecular tools have therefore become increasingly important in resolving the connections between different stages of the lifecycle, and the interpretation of morphological variation (Cheewangkoon et al. 2009). Swart et al. (2001) delineated six Elsinoë species associated with scab disease of Proteaceae from Australia, California (USA), South Africa, and Zimbabwe, and proposed three new species supported by ITS rDNA sequence data. Similar studies were conducted to describe Elsinoë species associated with other plant hosts (Summerell et al. 2006, Everett et al. 2011, Crous et al. 2015b, 2016). In their phylogeny of the genus, Jayawardena et al. (2014) included 12 Elsinoë species based on multi-gene data available in GenBank at the time. Ex-type sequence data is, however, available for only a few species. The far majority of the Elsinoë species described to date will therefore need to be recollected and epitypified. To facilitate species recognition in Elsinoë therefore, a phylogenetic backbone would first have to be established. The objectives of the present study were (i) to clarify species boundaries among Elsinoë isolates from various host genera distributed over 17 countries; (ii) to provide a multigene phylogeny for the genus Elsinoë based on a large set of well-identified cultures deposited in the CBS culture collection, supplemented by freshly collected specimens; (iii) to link Elsinoë names to their Sphaceloma asexual morphs; and (iv) to try and elucidate host specificity or the relationship between Elsinoë species and their respective host plants.

MATERIAL AND METHODS

Isolates

One hundred and nineteen Elsinoë isolates from 67 host genera representing 17 countries, including 64 ex-type isolates were included in this study (Table 1). The majority of the isolates were obtained from the Westerdijk Fungal Biodiversity Institute, Utrecht, The Netherlands (CBS) (Table 1), while freshly collected specimens were placed in the working collection of Pedro Crous (CPC) housed at the Westerdijk Institute. Freeze-dried isolates were revived in 2 mL malt/peptone (50% /50% ) and subsequently transferred to 2 % malt extract agar (MEA; Crous et al. 2009), and incubated at 22 °C under a natural day-night cycle. For fresh specimens, single-conidial isolates were obtained using techniques from Crous et al. (1991). Additionally, an effort was conducted by R.W. Barreto to recollect scab fungi described in the past in Brazil allowing for epitypification of taxa lacking pure cultures. Surveys were concentrated in the State of São Paulo (from which most taxa described by A. Bitancourt and A. E. Jenkins were collected) but also included other south-eastern and southern Brazilian states, mostly in 2010 but with ad hoc collections continuing in later years.

DNA isolation, amplification and sequencing

Genomic DNA was extracted using the Wizard® Genomic DNA Purification Kit (Promega, Madison, WI, USA) following the manufacturer’s instructions, from fungal mycelium growing on MEA. The ITS region was amplified with the primers ITS5 and ITS4 (White et al. 1990), the LSU region with the primers LR0R (Rehner & Samuels 1994) and LR5 (Vilgalys & Hester 1990), the rpb2 region with primers RPB2-5F2 (Sung et al. 2007) and rRPB2-7cR (Liu et al. 1999), and the TEF1-α gene with the primers elongation-1-F and elongation-1-R (Hyun et al. 2001, 2009). The PCR mixture for the all regions consisted of 1 μL genomic DNA, 3 mM MgCl₂, 20 μM of each dNTP, 0.2 μM of each primer and 0.25 U BIOTAQ DNA polymerase (Bioline). Conditions for PCR of ITS and LSU genes constituted an initial denaturation step of 2 min at 95 °C, followed by 35 cycles of 30 s at 95 °C, 30 s at 48 °C and 1 min at 72 °C; and a final denaturation step of 8 min at 72 °C, while the TEF1-α gene was performed as described by

![Fig. 2. Elsinoë fecunda. A. Symptomatic stem. B. Subcuticular ascoma. C, D. Asci. E–G. Ascospores. Scale bars = 10 μm.](image-url)
| Species                  | Culture accession number(s) | Host                                         | Country     | GenBank accession numbers                     |
|-------------------------|----------------------------|----------------------------------------------|-------------|-----------------------------------------------|
| **Elsinoë abutilonis**  | CBS 510.50<sup>T</sup>     | Callianthe striata (syn. Abutilon striatum) | Brazil      | KX887185 KX886949 KX887068 KX886831           |
| **E. ampelina**         | CBS 208.25                  | Vitis vinifera                               | Brazil      | KX887186 KX886950 KX887069 KX886832           |
| **E. anacardii**        | CBS 211.63                  | Annona squamosa                              | India       | KX887187 KX886951 KX887070 KX886833           |
| **E. argonova**         | CBS 404.63                  | Rosa sp.                                     | India       | KX887188 KX886952 KX887071 KX886834           |
| **E. arachidis**        | CBS 470.62<sup>T</sup>     | Anacardium occidentale                        | India       | KX887189 KX886953 KX887072 KX886835           |
| **E. annona**           | CBS 228.64                  | Annona sp.                                   | USA         | KX887190 KX886954 KX887073 KX886836           |
| **E. arundae**          | CBS 511.50<sup>T</sup>     | Arachis hypogaea                             | Brazil      | KX887191 KX886955 KX887074 KX886837           |
| **E. asclepiadea<sup>N</sup>** | CPC 18544<sup>T</sup> = R WB 1202 = CBS 141937 | Asclepias melliodora (syn. A. curassavica) | Brazil      | KX887195 KX886959 KX887078 KX886841           |
| **E. australi<sup>l</sup>a** | CBS 229.64                  | Citrus aurantifolia                          | Brazil      | KX887196 KX886960 KX887079 KX886842           |
| **E. banksicola**       | CBS 113734<sup>T</sup> = CPC 1508 = CPC 1510 | Banksia prionocote                          | Australia   | KX887199 KX886963 KX887082 KX886845           |
| **E. bartericola**      | CBS 471.62<sup>T</sup>     | Barleria gibsonii                            | India       | KX887200 KX886964 KX887083 KX886846           |
| **E. bidentis**         | CBS 512.50<sup>T</sup>     | Bidens pilosa                                | Brazil      | KX887201 KX886965 KX887084 KX886847           |
| **E. brasiliensis**     | CBS 18526 = RBW 1127       | B. segetum                                   | Brazil      | KX887202 KX886966 KX887085 KX886848           |
| **E. caleae**           | CBS 314.32<sup>T</sup>     | C. aurantium                                 | Argentina   | KX887198 KX886962 KX887081 KX886844           |
| **E. centrolobii**      | CBS 18528 = RBW 1133       | Chamaesyce hyssopifolia                      | Brazil      | KX887204 N/A KX887087 KX886850               |
| **E. citricola<sup>N</sup>** | CPC 18535<sup>T</sup> = R WB 1175 | C. limonia                                 | Brazil      | KX887207 KX886970 KX887090 KX886853           |
| **E. coryli**           | CBS 221.50<sup>T</sup>     | Calea pinnafilida                            | Brazil      | KX887205 KX886968 KX887086 KX886851           |
| **E. dioxytri**         | CBS 222.50<sup>T</sup>     | Centrobium robustum                          | Brazil      | KX887206 KX886969 KX887089 KX886852           |
| **E. eurythrina<sup>l</sup>a** | CPC 18530 = RBW 1138       | Erythrina sp.                                | Brazil      | KX887212 KX886975 KX887094 KX886858           |
| **E. eucalyptica**      | CBS 132476<sup>T</sup> = CPC 13318 | Eucalyptus sp.                            | Australia   | KX887215 KX886978 KX887097 KX886861           |
| **E. eugenia<sup>N</sup>** | CPC 120084<sup>T</sup> = CPC 13052 | E. propinqua                               | Australia   | KX887216 KX886979 KX887098 KX886862           |
| **E. euphorbiae<sup>N</sup>** | CPC 401.63<sup>T</sup>     | Euphorbia parviflora (syn. Euphorbia pilulifera) | India       | KX887217 KX886980 KX887099 KX886863           |
| **E. fagaeae**          | CBS 514.50<sup>T</sup>     | Fagara nedelianum                            | Brazil      | KX887218 KX886981 KX887100 KX886864           |
| **E. fawcettii**        | CBS 139.25<sup>T</sup>     | Citrus sp.                                   | USA         | KX887219 KX886982 KX887101 KX886865           |
| **E. fraxinella**       | CBS 231.64                  | C. aurantifolia                              | USA         | KX887220 KX886983 KX887102 KX886866           |
| **E. freyni<sup>l</sup>a** | CPC 13804 = RBW 19335       | C. limon                                    | Brazil      | KX887221 KX886984 KX887103 KX886867           |
| **E. genipa**           | CBS 342.39<sup>T</sup>     | Genipa americana                             | Brazil      | KX887227 KX886990 KX887109 KX886873           |
| **E. genipae-american<sup>a</sup>a** | CBS 516.50<sup>T</sup>     | G. americana                                 | Brazil      | KX887228 KX886991 KX887110 KX886874           |
| **E. glycineae**        | CBS 389.64<sup>T</sup>     | Glycine soja                                 | Japan       | KX887229 KX886992 KX887111 KX886875           |
| **E. hederae**          | CBS 390.64                  | G. soja                                     | Japan       | KX887230 KX886993 KX887112 KX886876           |
| **E. ichneorrop<sup>l</sup>a** | CPC 475.62<sup>T</sup> = ATCC 14655 | Ichneurae frutescens                       | India       | KX887232 KX886995 KX887114 KX886878           |
| **E. jasminae**         | CBS 224.50<sup>T</sup>     | Jasminum sambac                              | Brazil      | KX887233 KX886996 KX887115 KX886879           |
| **E. jasminicola<sup>a</sup>a** | CBS 212.63<sup>T</sup>     | J. malabaricum                              | India       | KX887234 KX886997 N/A KX886880               |
Table 1. (Continued).

| Species | Culture accession number(s) | Host | Country | GenBank accession numbers |
|---------|-----------------------------|------|---------|--------------------------|
| **E. krugia** | CPC 18531 = RWB 1151 | Euphorbia heterophylla | Brazil | KX887235 KX886998 KX887116 KX886881 |
|          | CPC 18537 = RWB 1189     | E. pulcherima | Brazil | KX887236 KX886999 KX887117 KX886882 |
|          | CPC 18554 = RWB 1228     | E. heterophylla | Brazil | KX887237 KX887000 KX887118 KX886883 |
|          | CPC 18579 = RWB 211      | E. heterophylla | Brazil | KX887238 KX887001 KX887119 KX886884 |
| **E. lagos-santensis** | CBS 518.50T | Byrsonima coccolobifolia | Brazil | KX887239 KX887002 KX887120 KX886885 |
| **E. lepidei** | CBS 167.33T | Rhododendron neoglandulosum (syn. Ledum glandulosum) | USA | KX887240 KX887003 KX887121 KX886886 |
| **E. mangiferae** | CBS 225.50T | Mangifera foetida (syn. M. indica) | Cuba | KX887249 KX887012 KX887130 KX886894 |
| **E. matthiolanum** | CBS 297.64 | Arbutus unedo | Argentina | KX887250 KX887014 KX887131 KX886895 |
|          | CBS 348.36 | A. unedo | Argentina | KX887251 KX887014 KX887132 KX886896 |
| **E. menthae** | CBS 321.37 | Mentha piperita | USA | KX887252 KX887015 KX887133 KX886897 |
|          | CBS 322.37T | M. piperita | USA | KX887253 KX887016 KX887134 KX886898 |
| **E. mimosae** | CBS 141943 = CPC 18518 | Mimosa invisa | Ecuador | KX887254 KX887017 KX887135 KX886899 |
|          | CPC 19478T | M. invisa | Brazil | KX887255 KX887018 KX887136 KX886900 |
| **E. oleae** | CBS 227.59T | Olea europaea | Italy | KX887256 KX887019 KX887137 KX886901 |
| **E. othonnae** | CBS 139910T = CPC 24853 | Othonna quinquententata | South Africa | N/A N/A N/A N/A |
|          | CBS 286.64 | Persea americana | Brazil | KX887257 KX887020 KX887138 KX886902 |
|          | CBS 406.34T | P. americana | USA | KX887258 KX887021 KX887139 KX886903 |
| **E. phaseoli** | CBS 149.95 | Phaseolus vulgaris | South Africa | KX887259 KX887022 KX887140 KX886904 |
|          | CBS 150.95 | P. vulgaris | South Africa | KX887260 KX887023 KX887141 KX886905 |
|          | CBS 151.95 | P. vulgaris | Malawi | KX887261 KX887024 KX887142 KX886906 |
|          | CBS 152.95 | P. vulgaris | Malawi | KX887262 KX887025 KX887143 KX886907 |
|          | CBS 165.31T | P. lunatus | Cuba | KX887263 KX887026 KX887144 KX886908 |
|          | CBS 234.64 | P. lunatus | Cuba | KX887264 KX887027 KX887145 KX886909 |
|          | CBS 113062 = CPC 4697 | N/A | N/A | KX887265 KX887028 KX887146 KX886910 |
|          | CBS 113066 = CPC 4694 | N/A | N/A | KX887266 KX887029 KX887147 KX886911 |
| **E. piri** | CBS 163.29 | Pyrus communis | N/A | KX887267 KX887030 KX887148 KX886912 |
|          | CBS 179.82 | Malus sylvestris | New Zealand | KX887268 KX887031 KX887149 KX886913 |
| **E. pitangae** | CBS 227.50T | Eugenia pitanga | Brazil | KX887269 KX887032 KX887150 KX886914 |
| **E. poinei** | CBS 109333 | E. pulcherima | Guatemala | KX887270 KX887033 KX887151 KX886915 |
|          | CBS 109334 | E. pulcherima | Guatemala | KX887271 KX887034 KX887152 KX886916 |
| **E. pongamiae** | CBS 402.63T | Pongamia pinnata | India | KX887272 KX887035 KX887153 KX886917 |
|          | CBS 289.64 | Populus deltoides subsp. deltoides (syn. P. serotina) | Argentina | KX887273 KX887036 KX887154 KX886918 |
|          | CBS 290.64 | P. deltoides subsp. deltoides (syn. P. serotina) | Argentina | KX887274 KX887037 KX887155 KX886919 |
| **E. proteae** | CPC 1349T | Protea cynaroides | South Africa | N/A N/A N/A N/A |
| **E. protearum** | CBS 113618T | Protea sp. | Zimbabwe | KX887275 KX887038 KX887156 KX886920 |
| **E. punicae** | CPC 19968 | Punica granatum | South Africa | KX887276 KX887039 KX887157 KX886921 |
| **E. quercus-ilex** | CBS 232.61T | Quercus ilex | Italy | KX887277 KX887040 N/A KX886922 |
| **E. rhodes** | CBS 519.50T | Toxicodendron vernix (syn. Rhus vernix) | Brazil | KX887280 KX887043 KX887160 KX886925 |
| **E. ricini** | CBS 403.63 = ATCC 15030 | Ricinus communis | India | KX887281 KX887044 KX887161 KX886926 |
Hyun et al. (2009). For the rpb2 amplification, the amplification consisted of 5 cycles of 45 s at 95 °C, 45 s at 56 °C and 2 min at 72 °C, then 5 cycles with a 53 °C annealing temperature and 30 cycles with a 50 °C annealing temperature. The PCR products consisted of 5 cycles of 45 s at 95 °C, 45 s at 56 °C and 2 min at 72 °C, then 5 cycles with a 53 °C annealing temperature and 30 cycles with a 50 °C annealing temperature. The PCR products were sequenced in two directions using the PCR primers and the 

Phylogenetic analyses

DNA sequences generated by each primer combination were used to obtain consensus sequences using SeqMan v. 7.1.0 in the DNASTAR Lasergene core suite software (DNASTAR Inc., Madison, WI, USA). Sequences were aligned using MAFFT v. 6 (Katoh & Standley 2013) and edited manually using MEGA v. 6.0 (Tamura et al. 2013). A partition homogeneity test (PHT) with heuristic search and 1 000 homogeneity replicates was performed using PAUP v. 4.0b10 to test the discrepancy among the ITS, LSU, rpb2 and TEF1-α sequence datasets in reconstructing phylogenetic trees. A maximum parsimony (MP) analysis was performed using PAUP v. 4.0b10 with a heuristic search option of 1 000 random-addition sequences with a tree bisection and reconnection (TBR) branch swapping algorithm (Swofford 2003). The branches of zero length were collapsed and all equally most parsimonious trees were saved. Other parsimony scores such as tree length (TL), consistency index (CI), retention index (RI) and rescaled consistency (RC) were calculated (Swofford 2003).

MrModeltest v. 2.3 was used to estimate the best nucleotide substitution model settings for each gene (Posada & Crandall 1998). Bayesian inference (BI) was performed based on the optimized model for each individual DNA dataset from the results of the MrModeltest, using a Markov Chain Monte Carlo (MCMC) algorithm in MrBayes v. 3.1.2 (Ronquist & Huelsenbeck 2003). Two MCMC chains were run from random trees for 1 000 M generations and stopped when average standard deviation of split frequencies fell below 0.01. Trees were saved each 1 000 generations. The first 25 % of trees were discarded as the burn-in phase of each analysis, and the posterior probabilities (BPP) were calculated to assess the remaining trees (Rannala & Yang 1996). The branch support from the MP analysis was evaluated with a bootstrapping (BS) method of 1 000 replicates (Hillis & Bull 1993). Myriangium hispanicum (CBS 347.33) was selected as outgroup in all analyses. Phylogenograms were viewed using FigTree v. 1.3.1 (Rambaut & Drummond 2010). Novel sequences generated in the current study were deposited in GenBank (Table 1) and the aligned matrices used for phylogenetic analyses were maintained in TreeBASE (www.treebase.org; accession number: S19904).

Morphology

Descriptions of the sexual morph are based on host material, while those of the asexual morph are based on sporulating

| Species | Culture accession number(s) | Host | Country | GenBank accession numbers |
|---------|-----------------------------|------|---------|--------------------------|
| E. rosarumF | CBS 150.27 | Rosa sp. | N/A | KX887282 KX887045 KX887162 KX886927 |
| E. rosarum | CBS 212.33T | Rosa sp. | USA | KX887283 KX887046 KX887163 KX886928 |
| E. rosarum | CBS 213.33 | Rosa sp. | USA | KX887284 KX887047 KX887164 KX886929 |
| E. rosarum | CBS 235.64 | Rosa sp. | USA | KX887285 KX887048 KX887165 KX886930 |
| E. salicina4 | CPC 17824T | Salix sp. | USA | KX887286 KX887049 KX887166 KX886931 |
| E. semecarp | CBS 477.62T | Melanochyla caesia (syn. Semecarpus anacardium) | India | KX887287 KX887050 KX887167 KX886932 |
| E. sessae | CPC 18549 | Cestrum laevigatum? | Brazil | KX887288 KX887051 KX887168 KX886933 |
| E. sicula | CBS 398.59T | Prunus amygdalus | Italy | KX887289 KX887052 KX887169 KX886934 |
| E. solidaginis6 | CBS 191.37T | Solidago fistulosa | USA | KX887290 KX887053 KX887170 KX886935 |
| E. tricticae | CBS 124777T | E. tectifera | Australia | KX887292 KX887055 KX887172 KX886937 |
| E. terminaliae6 | CBS 343.39T | Terminalia catappa | Brazil | KX887293 KX887056 KX887173 N/A |
| E. theae | CBC 18538 | T. catapa | Brazil | KX887294 KX887057 KX887174 KX886938 |
| E. tiliae | CBS 228.50T | Camellia sinensis (syn. Thea sinensis) | Brazil | KX887295 KX887058 KX887175 KX886939 |
| E. venetia6 | CBS 350.73 | Tilia cordata | New Zealand | KX887296 KX887059 KX887176 KX886940 |
| E. venetia | CBS 164.299 | Rubus sp. | N/A | KX887297 KX887060 KX887177 KX886941 |
| E. verbenae6 | CPC 18561 | Verbena bonariensis | Brazil | KX887298 KX887061 KX887178 KX886942 |
| E. verbenae | CPC 18563 | V. bonariensis | Brazil | KX887299 KX887062 KX887179 KX886943 |
| E. violae | CBS 294.38 | Symphoricarpos albus var. laevigatus | USA | KX887300 KX887063 KX887180 KX886944 |
| E. violae | CBS 333.29 | Viola sp. | USA | KX887301 KX887064 KX887181 KX886945 |
| E. zizyphi | CBS 378.62 | Zizyphus jugosa | India | KX887302 KX887065 KX887182 KX886946 |
| Myriangium hispanicum | CBS 247.33 | Acer monspessulanum | N/A | KX887303 KX887066 KX887183 KX886947 |

T: ex-type strain; N: new species; E: epitype designated in this study.

Table 1. (Continued).
cultures (Fig. 3). Colonies were subcultured onto MEA, oatmeal agar (OA), potato dextrose agar (PDA), synthetic nutrient-poor agar (SNA), and tap water agar (WA) (Crous et al. 2009). Cultures were incubated at moderate temperatures (22 °C) under a 12 h near-ultraviolet (NUV) light (360 nm), 12 h dark cycle for 3 wk to induce sporulation. Structures were mounted in clear lactic acid, and 50 measurements determined per structure, with extremes of conidial measurements given in parentheses. Colony diameters were measured and the colony colours described after 3 wk according to the colour charts of Rayner (1970). Microscopic photographs were captured using a Nikon Eclipse 80i microscope equipped with a Nikon digital sight DS-Ri2 high definition colour camera, using differential interference contrast (DIC) illumination and the Nikon software NIS-Elements D Package v. 3.00. Adobe Bridge CS v. 6 and Adobe Photoshop CS v. 5 were used for the manual editing. Nomenclatural novelties and descriptions were deposited in MycoBank (Crous et al. 2004).

RESULTS

Phylogenetic analyses

The final combined alignment contained 119 Elsinoë ingroup strains with a total of 2,532 characters including gaps (617 characters for ITS, 744 for LSU, 751 for rpb2 and 422 for TEF1-α), of which 1,624 characters are constant, 221 variable characters are parsimony-uninformative and 687 characters are variable and parsimony-informative. MP analyses generated one tree, which is presented in Fig. 4 (TL = 4,885, CI = 0.305, RI = 0.815, RC = 0.248). For BI analyses, the general time reversible model with inverse gamma rates (GTR + I + G) was determined to be the best for the ITS, LSU and TEF1-α loci by MrModeltest, while the most appropriate model for the rpb2 locus was Hasegawa–Kishino–Yano with inverse gamma rates model (HKY + I + G). The unique site patterns were 934 (276 for ITS, 96 for LSU, 397 for rpb2 and 165 for TEF1-α). The MP bootstrap supports (BS) equal to or above 70% are shown in branches in Fig. 4. The branches with significant Bayesian posterior probabilities (BPP) equal to or above 0.95 are shown in the phylogram.

Taxonomy

At the onset of this study, it was estimated that Elsinoë contained approximately 48 species, and Sphaceloma 52 (Kirk et al. 2008). After phylogenetic analyses and morphological examination of 119 isolates, we now recognise 75 species (Table 1), of which eight are newly described, 13 are epitypified, and 26 species names are suggested as new combinations based on the single nomenclature initiative (Wingfield et al. 2012, Crous et al. 2015a). All strains proposed as new species and for epitypification based on the multi-gene phylogeny were studied morphologically. Type details and notes on the host range and geographic distribution of previously described species are also included.

Elsinoaceae Höhn. ex Sacc. & Trotter, Syll. Fung. (Abellini) 22: 584. 1913.

Type genus: Elsinoë Racib., Parasit. Alg. Plize Java’s (Jakarta) 1: 14. 1900.

Elsinoë Racib., Parasit. Alg. Plize Java’s (Jakarta) 1: 14. 1900.

Synonym: Sphaceloma de Bary, Ann. Oenol. 4: 165. 1874.

Additional synonyms in MycoBank.

Plant pathogenic, causing scab, leaf and fruit spot and anthracnose disease. Ascostroma solitary, aggregated, or gregarious, wart-like, or as small distinctively coloured elevations, or pulvinate, immersed to semi-immersed, globose to subglobose, white, pale yellow or brown, soft, multi-loculate, locules scattered in upper part of ascostroma, cells of ascostroma comprising pseudoparenchymatous cells of textura globulosa to angularis. Locules with few to numerous ascii inside each locule, ostiolar. Ostiole minute, periphyses absent. Ascii 8-spored, bitunicate, fissitunicate, saccate to globose, with a minute pedicel, and ocular chamber. Ascospores irregularly arranged, oblong or fusiform with slightly acutely rounded ends, with 2–3 transverse septa, hyaline, smooth-walled, lacking a sheath. Sphaceloma asexual morph: Acervuli or sporodochia subependal, pseudoparenchymatous. Conidiophores hyaline to pale-brown, polyhedral. Conidigenous cells formed directly from the upper cells of the pseudoparenchyma, mono- to polyhedral, integrated or discrete, determinate, hyaline to pale brown, without visible periclinal thickening. Conidia hyaline, smooth, aseptate, ellipsoidal, guttulate (adapted from Hyde et al. 2013).

Elsinoë abutilonis (Bitanc. & Jenkins) Fan & Crous, comb. nov. MycoBank MB818107.

Basionym: Sphaceloma abutilonis Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 2. 1950.

Material examined: Brazil, São Paulo, from Callianthe striata (syn. Abutilon striatum), Dec. 1937, M. Kramer, deposited by A.A. Bitancourt (ex-type culture CBS 510.50 = IB 2807).

Notes: Elsinoë abutilonis was described by (Bitancourt & Jenkins 1950) causing scab disease on leaves and branches of Abutilon striatum in São Paulo, Brazil. Information on the original description is limited to a symptom description with acervuli referred to as “invisible” and conidia as “not seen”. If not for the ex-type culture being available and now confirmed to belong to a true and distinct species of Elsinoë, this species should have been regarded as doubtful. The LSU region fails to distinguish E. australis strains CBS 229.64 and 230.64 from E. abutilonis.

Elsinoë ampelina Shear, Phytopathology 19: 677. 1929. Fig. 5.

Synonyms: Sphaceloma ampelini de Bary, Ann. Oenol. 4: 165. 1874.

Ramularia ampelophaga Pass., Boln Comiz. Agr. Parmense 9: 125. 1876.

Gloeosporium ampelophagum (Pass.) Sacc., Michelia 1(no. 2): 217. 1878.

Material examined: Brazil, from Vitis vinifera, A.E. Jenkins (culture CBS 208.25).
Fig. 3. Colonies of Elsinoë spp. on MEA after 3 wk. A. *E. australis* (CBS 314.32). B. *E. euphorbiae* (CBS 401.63). C. *E. genipae-americanae* (CBS 516.50). D. *E. glycines* (CBS 389.64). E. *E. jasminicola* (CBS 212.63). F. *E. ledi* (CBS 167.33). G. *E. menthae* (CBS 322.37). H. *E. pongamiae* (CBS 402.63). I. *E. rosarum* (CBS 212.33). J. *E. solidaginis* (CBS 191.37). K. *E. veneta* (CBS 164.29). L. *E. verbenae* (CPC 18561).
Notes: This fungus was commonly known as the causal agent of grapevine anthracnose (or grapevine spot anthracnose – as recommended by Jenkins [1947]), which appeared to be of European origin and causes heavy losses in various grape-growing countries throughout the world, requiring chemical control – particularly where grapes are grown under humid conditions (de Bary 1874, Shear 1929, Amorim & Kuniyuki 2005, Poolswat et al. 2010, Carisse & Morissette-Thomas 2013). de Bary (1874) described this species as *Sphaceloma ampelinum*, and Shear (1929) described the sexual morph as *Elsinoe ampelina*, having hyaline, 3-septate ascospores, 15–16 × 4–4.5 µm. This pathogen has been reported worldwide, but requires fresh collections to facilitate epitypification (on *Vitis vinifera*, Western Europe).

**Elsinoë anacardi** (Wani & Thirum.) Fan & Crous, *comb. nov.*

*MycoBank* MB818108.

**Basionym:** *Sphaceloma anacardi* Wani & Thirum., *Sydowia* 23: 253. 1970.

**Materials examined:** *India*, Lonavla, from *Anacardium occidentale*, Oct. 1958, M.J. Thirumalachar (*ex-type* culture CBS 470.62 = HACC 136 = IMI 092309); *Shindewadi*, from *Annona squamosa*, Dec. 1960, M.J. Thirumalachar (*culture CBS 208.25 Vitis vinifera Brazil*); *Poona*, Agricultural College, from *Rosa* sp., Jan. 1961, M.J. Thirumalachar (*culture CBS 404.63 = ATCC 15031 = IMI 100605*).
Notes: *Elsinoë anacardi* was described on cashew in India by Wani & Thirumalachar (1969a, 1970) as causing anthracnose spots on leaves and also on young shoots and fleshy peduncles that coalesce with age, turning into scabs. Symptoms include numerous greyish white leaf spots on the lower leaf surface, 0.5–2 mm diam. Acervuli dark reddish-brown, circular to oblong, intraepidermal, appearing subcuticular when erumpent, 19–31 × 26–67 μm. The cultural characteristics on PDA of this fungus are quite distinct from the usual appearance of *Elsinoë* colonies, having cottony white aerial mycelium on the surface, and green mycelium on the reverse side of the plate. The fact that the isolates studied here originate from completely distinct host families, suggests that there could have been some confusion during the culturing and subsequent deposit of these.
cultures. This matter can only be resolved based on fresh collections, as it appears highly unlikely that the same species could cause disease on these diverse hosts. The ITS, \textit{rpb2} and \textit{TEF1-\alpha} regions fail to distinguish \textit{E. anacardii} and \textit{E. semecarp}.\\

\textit{Elsinoë} annonae Bitanc. & Jenkins, Proc. Amer Sci. Congr. Wash. 1940: 157. 1942 (1940).\\

Material examined: \textbf{USA}, from \textit{Annona} sp., C.A. Salemink (culture CBS 228.64).\\

Notes: \textit{Elsinoë annonae} is known to cause spot anthracnose and leaf spots of \textit{Annona} spp. in São Paulo, Brazil. This fungus is characterised by globose to pyriform asci (20 μm diam), and hyaline, 3-septate ascospores (12–15 × 5–8 μm) (Bitancourt & Jenkins 1940a).\\

\textit{Elsinoë arachidis} (Bitanc. & Jenkins) Rossman & W.C. Allen, IMA Fungus 7: 3. 2016. \textit{Fig. 6}.\\

\textit{Elsinoë arrudai} Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 12: 8. 1941.\\

Material examined: \textbf{Brazil}, São Paulo, Tieté, from \textit{Tournefortia breviflora}, Oct. 1937, A.A. Bitancourt (\textbf{ex-isotype} culture CBS 220.50 = IB 2777).\\

Notes: \textit{Elsinoë arrudai} is known to cause leaf spots and scab of \textit{Tournefortia breviflora} in São Paulo, Brazil. Symptoms include numerous leaf spots, round or irregular, protruding, often amphigenous, or even perforated, 0.4–2 mm diam. The disease affects leaves, petioles and stems and develops into typical scab symptoms. This fungus is characterised by minute ascostromata bearing few globose asci (21–24 × 19–24 μm) and hyaline, 3-septate ascospores (11–13 × 5 μm) (Bitancourt & Jenkins 1941). The authors also included information on colonies formed in pure culture (PDA): slow-growing, compact, convolute, radially sulcate or not, olive or russet vinaceous.
**Elsinoë asclepiadea** Fan, R.W. Barreto & Crous, sp. nov. MycoBank MB818109. Fig. 7.

*Etymology:* Named after the host genus from which it was collected, *Asclepias*.

*Lesions* on branches, petioles, fruits and leaves along veins, occasionally spreading to the lamina, elliptical to irregular, raised and purplish brown at margins and greyish centrally, coalescing and developing typical scab symptoms on older infected areas, occasionally leading to the distortion of affected organ, defoliation and death of severely infected stems. *In culture:* Conidiophores subcylindrical, hyaline, verruculose, ampulliform to doliiform, 0–3-septate, 10–18 × 2–3 μm. Conidiogenous cells enteroblastic, polyphialidic, with 1–3 integrated loci, hyaline, verruculose, ampulliform to doliiform, 5–15 × 2–3 μm. Conidia hyaline, granular, aseptate, ellipsoid, apex obtuse, sometimes constricting at base to a subtruncate locus, (4–) 4.5–6(–6.5) × (2–)2.5–3.5(–4) μm.

*Culture characteristics:* Cultures on MEA, slow-growing (9–12 mm diam after 23 d), raised, cerebriform, compressing and cracking the medium, some pilose aerial mycelium centrally and over other parts of the colony, gelatinous clumps and mucilaginous drops abundant centrally, cinnamon with paler whitish periphery; reverse umber with many cracks in medium visible; colonies composed of a combination of thin-walled hyaline hyphae and dark pseudoparenchyma with muriform chlamydospores; sporulation abundant.

*Material examined:* Brazil, Rio de Janeiro, Carmo, Road Carmo-Sumidouro, next to bridge at boundary between municipalities of Sumidouro and Carmo, from *Asclepias mellodora* (= *A. curassavica*), Dec. 2010, R.W. Barreto (holotype CBS H-22745, ex-holotype culture CPC 18544 = RWB 1202 = CBS 141937).

*Notes:* Isolate CPC 18544 was initially identified as "*Sphaceloma asclepiadiis*", which is characterised by yellowish, fusiform conidia, 10–15 × 3–4 μm, based on the type material from *Asclepias curassavica* in Brazil (Bitancourt & Jenkins 1949). However, morphological examination of the freshly collected isolate (CPC 18544) indicated that it could be distinguished from "*Sphaceloma asclepiadiis*" by having smaller, ovoid conidia, 4–6.5 × 2–3.5 μm.
The morphological distinction, even if unsupported by molecular analysis, is regarded here as sufficient to allow the proposal of the new species *E. asclepiadea*. Nevertheless, recollecting *S. asclepiadis* and obtaining pure cultures of this fungus would be useful to allow further confirmation of their distinction even if occurring on the same host species.

**Elsinoë australis** Bitanc. & Jenkins, Mycologia 28: 491. 1936.  
*Fig. 3A.*

**Synonyms:** *Sphaceloma australis* Bitanc. & Jenkins, Mycologia 28: 491. 1936.

*Sphaceloma fawcettii* var. *viscosum* Jenkins, Phytopathology 23: 536. 1933.

**Materials examined:** *Argentina*, Tucuman, from *Citrus aurantium*, deposited by C.A. Salemink (culture CBS 230.64).  
*Brazil*, from *Citrus aurantium*, A.E. Jenkins (culture ex-isotype of *Sphaceloma fawcettii* var. *viscosum*, CBS 314.32); Limeira, from *Citrus aurantifolia*, dep. by C.A. Salemink (culture CBS 229.64).

**Notes:** This fungus was originally described from *Citrus sinensis* in Brazil, causing a disease known as sweet orange fruit scab, with globose to obclavate asci, and 2–4 celled ascospores, 12–20 × 4–8 μm (Bitancourt & Jenkins 1936a, b). It was also found to be similar to *Elsinoë fawcettii* but differentiating morphological characters were found, including well-developed globose ascostromata, and longer ascospores as well as different host circumscriptions (Bitancourt & Jenkins 1936a). Colonies on MEA are irregular, erumpent, folded, surface dark grey to black, with smooth margins and sparse white to grey aerial mycelium; 25–35 mm diam after 3 wk; sterile. The culture CBS 314.32, which was isolated from *Citrus* in Brazil and deposited as *“Sphaceloma fawcettii var. viscosum”*, grouped in the same clade with *E. australis* based on all four loci, instead of in the *Elsinoë fawcettii* clade as expected, and is recognised here as a synonym of *E. australis*. *Elsinoë australis* remains restricted to *Citrus*, *Banksia*, *Banksia*, *Victoria*, *Australia*. *Conidia* hyaline, aseptate, ellipsoid, (4–) 8–9(–10) × (2.5–)3–4 μm in *vitro* (Pascoe et al. 2007). Only one other species of *Elsinoë* is known from *Banksia*, namely *E. banksiae*. The two species are easily distinguished based on their symptomatology, morphology and cultural characteristics.

**Elsinoë barleriicola** (Wani & Thirum.) Fan & Crous, comb. nov. MycoBank MB818111.  
*Fig. 8.*

**Basionym:** *Sphaceloma barleriicola* Pascoe & Crous, Fungal Planet No. 14. 2007.

**Material examined:** *Australia*, Victoria, Longford, on leaves and stems of *Banksia prionotes*; leaves, up to 8 mm diam, sometimes also occurring on stems of *Banksia prionotes* in Victoria, Australia. *Conidia* hyaline, aseptate, ellipsoid, (4–) 8–9(–10) × (2.5–)3–4 μm in *vitro* (Pascoe et al. 2007). Only one other species of *Elsinoë* is known from *Banksia*, namely *E. banksiae*. The two species are easily distinguished based on their symptomatology, morphology and cultural characteristics.

**Elsinoë banksiicola** (Pascoe & Crous) Fan & Crous, comb. nov. MycoBank MB818110.  
*Fig. 8.*

**Basionym:** *Sphaceloma banksiicola* Pascoe & Crous, Fungal Planet No. 14. 2007.

**Material examined:** *Australian*, Victoria, Longford, on leaves and stems of *Banksia prionotes*; leaves, up to 8 mm diam, sometimes also occurring on stems of *Banksia prionotes* in Victoria, Australia. *Conidia* hyaline, aseptate, ellipsoid, (4–) 8–9(–10) × (2.5–)3–4 μm in *vitro* (Pascoe et al. 2007). Only one other species of *Elsinoë* is known from *Banksia*, namely *E. banksiae*. The two species are easily distinguished based on their symptomatology, morphology and cultural characteristics.
Elsinoë bidentis (Bitanc. & Jenkins) Fan & Crous, comb. nov. MycoBank MB818112. Fig. 9.

Basionym: Sphaceloma bidentis Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 5. 1950.

Materials examined: Brazil, from Bidens pilosa, Jan. 1937, A.A. Bitancourt (ex-type culture CBS 512.50 = IB 2384); Rio de Janeiro, Nova Friburgo, Riograndina, from Bidens segetum, Dec. 2010, R.W. Barreto (culture CPC 18526 = RWB 1127); São Paulo, Campos do Jordão, Belvedere near the entrance of Campos do Jordão, from Bidens segetum, Dec. 2010, R.W. Barreto (specimen CBS H-22796, culture CPC 18586 = RWB 1280).

Notes: Elsinoë bidentis is known to infect leaves and stems on Bidens pilosa, B. segetum and B. subalternans in Brazil (Guatimosim et al. 2015). Symptoms include dark, irregular or elongated lesions, 0.5–2 mm diam on leaves; numerous coalescing spots slightly protruding, 0.2–0.6 mm diam on stems. Acervuli dark, slightly protruding, 15–50 μm diam (Bitancourt & Jenkins 1950). The description provided in the original publication is rather incomplete and based on a seemingly sterile specimen. The fungus was recently recollected by Guatimosim et al. (2015) who provided a complete description, quoted below: “Lesions on leaves and stems: on leaves, mostly along secondary veins, hypophyllous, depressed, irregular, 0.4–2.2 mm diam, leading to disintegration and flecking of host tissue, pale grey in centre; on stems, typical scab symptoms with numerous rounded to irregular warts, with russet vinaceous brown halos, and vinaceous centre, slightly wrinkly. Depending on intensity, leading to distortions of growing stems that may become sinuous or twisted and accompanied by defoliation and die-back of organs above infected areas. Internal mycelium septate, branched in acute angles, 2–3 μm diam, with some enlarged rounded cells, hyaline, smooth, often producing chlamydospores. Acervuli almost indistinct, erumpent, localised over a hyaline pseudoparenchyma, formed by 2–3 layers of swollen, irregular cells, 30–100 μm diam. Conidiogenous cells ampulliform, with an acute apex, 7 μm, hyaline, smooth. Conidia subcylindrical, 3–5(–8) × 2–4 μm, hyaline, smooth. Culture characteristics: Very slow-growing (1.3–1.6 cm after 30 d), circular, compressing the medium, aerial mycelium cottony, forming a pink white subiculum, immersed mycelium forming a distinct livid red feathery periphery; reverse dark vinaceous with a distinctly feathery periphery; not sporulating.” The LSU region fails to distinguish E. arachidis, E. bidentis, E. euphorbiae, E. genipae, E. krugii, E. mimosae, E. poinsettiae, E. sesseea, and E. favcettii strain CBS 139.25.

Elsinoë brasiliensis Bitanc. & Jenkins, Proc. Amer Sci. Congr. Wash. 1940: 160. 1940 (1942). Fig. 10.

Synonyms: Elsinoë jatrophae Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 13. 1950.

Sphaceloma manihoticola Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 15. 1950.

Materials examined: Brazil, Paraiba, Alagoinhas, Agr. Exp Station, on Euphorbia brasiliensis (= Chamaesyce hyssopifolia), May 1940, J. Deslandes (holotype BPI 679185); Minas Gerais, Barao de Cocais, Road Santa Barbara-Caraça, from Euphorbia hyssopifolia (= C. hyssopifolia), Dec. 2010, R.W. Barreto (epitype designated here, MBT372703, specimen CBS H-22797, ex-epitype culture CPC 18528 = RWB 1133 = CBS 141875).

Notes: Elsinoë brasiliensis is known to cause leaf spots, petiole and stem cankers or galls on Euphorbia hyssopifolia (= Chamaesyce hyssopifolia) in Brazil (Bitancourt & Jenkins 1940a). Symptoms include small spots scattered or located at the margin, with a narrow dark border; stem cankers are circular to ellipsoid, elevated with medium to dark brown margin, 4 × 2 mm. This fungus is characterised by globose asci, 17–21 μm diam,
containing eight hyaline, 3-septate ascospores, 12–14 × 5–7 μm (Bitancourt & Jenkins 1940a). The culture CPC 18528 was isolated from the same host in Brazil, and therefore we designate it here as ex-epitype. In culture: Colonies raised, ridged, sometimes cracking at folds, cerebriform, compressing and cracking the medium, aerial mycelium absent or sparse, floccose to downy, vinaceous grey centrally with ochreous sectors and purplish grey peripheral, with mucilaginous drops; reverse dark purple to ochreous; colonies composed of thick-walled hyphae and yellowish to dark brown pseudoparenchyma; slow growing, 15 mm diam after 23 d; sporulation abundant.

The complex of species reported on Chamaesyce spp., Euphorbia spp., Manihot spp. and related euphorbiaceous genera have been investigated more closely by plant pathologists because of the relevance of the superelongation disease of cassava and the impact of scab on weedy hosts as well as the possibility of weedy and wild members of Euphorbiaceae serving as reservoirs for the disease on cassava (Zeigler & Lozano 1983, Barreto & Evans 1998, Alvarez & Molina 2000, Alvarez et al. 2003, Nechet et al. 2004). An organised attempt to clarify the identity of the fungus behind superelongation of cassava (Zeigler & Lozano 1983) based on examination of fresh and herbarium specimens, cultural features and cross inoculations of isolates obtained from various Euphorbiaceae led to the conclusion that variability and overlap of morphological and cultural characters did not allow for a clear separation of taxa in this complex. Additionally host specificity tended to vary between isolates from a single host and was also inadequate as a basis for species separation. Based on their results these authors proposed that the fungus attacking C. hyssopifolia (among other hosts) belonged to Elsinoë brasiliensis – a conclusion confirmed with the present multi-gene phylogenetic study (Fig. 4). These authors also accepted Sphaecoloma poinsettiae as a separate taxon having Euphorbia heterophylla and Eu. pulcherrima as hosts and considered Sphaecoloma krugii as its synonym. This is in disagreement with the present study. Here isolates from several of these hosts belonged to separate clades, showing that there are at least four independent species of Elsinoë attacking Chamaesyce spp., Euphorbia spp., and Manihot spp.

Elsinoë caelea Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 12: 11. 1941.

Material examined: Brazil, São Paulo, Cantareira, from Calea pinnatifida, Dec. 1937, A.A. Bitancourt (ex-isotype culture CBS 221.50 = IB 2805).

Notes: Elsinoë caelea was described by Bitancourt & Jenkins (1941) causing “spots and anthracnose” on leaves and stems of Calea pinnatifida in Brazil. On leaves lesions were circular to slightly irregular, amphiogenous, 1–2 mm diam; on petioles and stems lesions were small, and slightly elongated, 0.5 × 0.6–2 mm. The fungus was described as having globose to subpyriform asci (21–26 × 21–24 μm), and hyaline, 3-septate (sometimes with longitudinal septa) ascospores (13–17 × 6–8 μm).

Elsinoë centrolobii Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 19: 98. 1949.

Basionym: Sphaecoloma abutilonis Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 2. 1950.

Material examined: Brazil, from Centrolobium robustum, Feb. 1938, A.A. Bitancourt (ex-type culture CBS 222.50 = IB 2858).

Notes: Elsinoë centrolobii was described by Bitancourt & Jenkins (1949) causing lesions on leaves of Centrolobium robustum in Brazil. Symptoms include small, rounded or slightly irregular leaf spots, torn when larger, causing deformations, 0.1–1.2 mm diam. The fungus was characterised by globose to oblong asci, 22–26 μm diam, and hyaline, 3-septate ascospores (sometimes with a longitudinal septum), 12–15 × 4–6 μm (Bitancourt & Jenkins 1949). The LSU region fails to distinguish E. centrolobii, E. fici, E. jasminae, and E. randii.

Elsinoë citricola Fan, R.W. Barreto & Crous, sp. nov. MycoBank MB818113. Fig. 11.

Etymology: Named after the host genus from which it was collected, Citrus.

Lesions on fruits, leaves and young stems: on fruits areas of scabbed and slightly sunken skin pale brown, up to 2 cm diam, coalescing and forming irregular aggregates of various sizes or irregular rows following a runoff pattern, sometimes associated with a faint yellow periphery on immature fruits, skin at scabbed areas cracking as fruit grows and wounds often invaded secondarily by post-harvest pathogens (particularly Penicillium spp.); on leaves amphiogenous, extending through the lamina, and forming yellowish pale brown scab, circular to irregular, 0.5–3 mm diam, enlarging and coalescing to form raised, irregular, medium brown lesions, borders raised, brown to dark brown due to the ruptured epidermis, leading to major distortion of affected leaves; young stems also developing small areas of scabbed tissue. In culture: Conidiophores hyaline, verruculose, ampulliform to doliiform, 0–12 μm. Conidia enteroblastic, polyhedral, with 1–2 integrated loci, hyaline, verruculose, ampulliform to doliiform, 5–10 × 3–5 μm. Conidia hyaline, granular, aseptate, ellipsoid, apex obtuse, sometimes constricting at base to a subtruncate locus, (5.5–)6–8(–9) × (2.5–)3–4(–4.5) μm.

Culture characteristics: Colonies irregular, erumpent, folded, surface apricot, with smooth, irregular margins and sparse white aerial mycelium; 10–15 mm diam after 3 wk; sterile.

Materials examined: Brazil, from Citrus limon, Dec. 2010, R.W. Barreto (holotype CBS H-22748, ex-type culture CPC 18535 = RWB 1175 = CBS 141876); Minas Gerais, Viçosa, Piuna, Road Viçosa-Porto Firme, from Citrus limon, Dec. 2010, R.W. Barreto (specimen CBS H-22798, culture CPC 18570 = RWB 1253).

Notes: The isolate CPC 18535 was originally identified as "Sphaecoloma fawcettii". It is, however, genetically distinguished from ex-type strains of Elsinoë fawcettii (CBS 139.25) and others (CBS 231.64, CBS 232.64, CBS 233.64), based on four sequenced loci. Morphologically, E. citricola is very similar to E. fawcettii, and the two species cannot be distinguished based on conidiial size alone (5.5–9 × 2.5–4.5 vs. 5–10 × 2–5 μm) (Jenkins 1925). The ITS and LSU regions fail to distinguish E. citricola and E. fawcettii.

Elsinoë coryli (Veg & M. Bourgeois) Fan & Crous, comb. nov. MycoBank MB818114.
Basionym: Sphaceloma coryli Vegh & M. Bourgeois, Revue Mycol., Paris 40: 280. 1976.

Material examined: France, Département du Tarn, from Corylus avellana, Aug. 1965, I. Vegh (ex-type culture CBS 275.76).

Notes: Elsinoë coryli is known to cause leaf spots of Corylus avellana in France. Symptoms include depressed, elongated hypophyllous leaf spots. This fungus is characterised by hyaline, ellipsoid to oblong or subglobose conidia, 1.7–5 × 1.5–3.2 μm (Vegh & Bourgeois 1976).

Elsinoë diospyri Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 7. 1950.

Material examined: Brazil, from Diospyros kaki, May 1943, A.A. Bitancourt (ex-type culture CBS 223.50 = IB 4621).

Notes: The original description of Elsinoë diospyri by Bitancourt & Jenkins (1950) on Japanese persimmon (Diospyros kaki) in Brazil includes a description of leaf spots symptoms (but no reference to scaly lesions being formed) which are white in the middle, dark brown or black at the margin, 0.1–0.5 mm diam. The authors also described the sexual morph as characterised by globose asci, 28 μm diam, containing eight hyaline, 1–3-transversally septate ascospores, 8–10 × 4–5 μm. The asexual morph is described as sporodochial, but no conidia were observed. Attempts at recollecting fresh material of the fungus in São Paulo in the context of this work proved unsuccessful.

Elsinoë embeliae Thirum. & Naras., sp. nov. MycoBank MB818115.

Etymology: Named after the host genus on which it occurs, Embelia.

Elsinoë embeliae differs from the ex-type strain of its closest phylogenetic neighbour Elsinoë pongamiae (CBS 402.63) based on LSU positions 593 (–), 607 (T). Positions derived from respective alignments of the separate loci deposited in TreeBASE.

Material examined: India, Mahabaleshwar, on leaves and shoots of Embelia ribes, 13 Mar. 1958, M.J. Thirumalachar (holotype Herb. BPI 681720, ex-type culture CBS 472.62 = HACC 130 = IMI 092304).

Notes: The present fungus was originally deposited in CBS as Sphaceloma embeliae Thirum. & Naras. in 1962, and a holotype specimen (BPI 681720) in Beltsville, USA. However, we have
been unable to trace the original publication details of the name, and it appears that the fungus was never published. Because this is a distinct species of *Elsinoë*, the name is herewith validated. The ITS and TEF1-α regions fail to distinguish *E. embeliae* and *E. pongamiae*; rpb2 was not available for comparison.

**Elsinoë erythrinae** Sivan. & L.D. Gómez, Trans. Br. mycol. Soc. 85: 370. 1985. *Fig. 12.*

**Synonym:** *Sphaceloma erythrinae* Bitanc. & Jenkins, Arq. Inst. Biol. São Paulo 20: 9. 1950.

**Materials examined:** Brazil, São Paulo, Cantareira, on leaves and stems of *Erythrina reticulata*, 31 Jan. 1938, E. Ract, USM 90037, IB 2859, IMI 56635, **holotype** of *Sphaceloma erythrinae*; Minas Gerais, Ubá, from *Erythrina* sp., Dec. 2010, R.W. Barreto (**epitype designated here**, MBT372705, specimen CBS H-22799, **ex-epitype** culture CPC 18542 = RWB 1196); Minas Gerais, Brumadinho, Inhotim, from *Erythrina* sp., Dec. 2010, R.W. Barreto (specimen CBS H-22800, culture CPC 18540 = RWB 1192); Minas Gerais, Brumadinho, Inhotim, from *Erythrina* sp., Dec. 2010, R.W. Barreto (specimen CBS H-22801, culture CPC 18540 = RWB 1192); Minas Gerais, Brumadinho, Inhotim, from *Erythrina* sp., Dec. 2010, R.W. Barreto (specimen CBS H-22801, culture CPC 18540 = RWB 1192); Minas Gerais, Ubá, from *Erythrina* sp., Dec. 2010, R.W. Barreto (specimen CBS H-22800, culture CPC 18540 = RWB 1192); Costa Rica, Ujarraz, Cartago, on leaves of *Erythrina poepiggiana*, Aug. 1984, L.D. Gomez (**holotype** of *E. erythrinae* IMI 290265).

*Notes: Elsinoë erythrinae* was introduced as the sexual morph of *Sphaceloma erythrinae*, which was described from *Erythrina reticulata* in Brazil (Bitancourt & Jenkins 1950, Sivanesan & Gómez 1985). The culture CPC 18542 was isolated from the same host genus in Brazil, and because it is also morphologically similar, we designate it here as epitype. *Leaf spots* amphigenous, extending through the lamina, without forming prominent scab, circular, separate, 0.5–2 mm diam, forming yellowish, oblong particulates in central white lesions; borders dark brown to black due to the ruptured epidermis. *In culture:* Conidiophores hyaline, verruculose, ampulliform to doliiform, 0–1-septate, 10–20 × 3–6 μm. Conidiogenous cells enteroblastic, polyphialidic, with 1–3 integrated loci, hyaline, verruculose, ampulliform to doliiform, 7–15 × 3–5 μm. Conidia hyaline, granular, aseptate, ellipsoid, apex obtuse, sometimes constricting at base to a subtruncate locus, (5.5–)7–9–(9.5) × (2.5–)3–4(–4.5) μm. Colonies on MEA: slow growing (16 mm diam after 23 d); raised and cerebriform with large cauliflower-like irregular warted protuberances on central area, radially ridged, sometimes cracked along radial folds to expose reddish lower mycelium, partly compressing and cracking the medium, with dense felty aerial mycelium centrally becoming sparser towards the margins with narrow completely immersed border, gelatinous irregular masses or mucilaginous drops formed over colony, slightly pinkish white centrally with lavender sector and amber margins; raising and cracking the medium in reverse, blood coloured with saffron.
margins; colonies composed of narrow filiform hyaline hyphae, monilioid pigmented hyphae and pseudoparenchyma; sporulation abundant.

**Elsinoë eucalypticola** Cheew. & Crous, *Persoonia* 23: 64. 2009. Fig. 13.

*Material examined:* **Australia,** Queensland, Cairns, Kuranda Kennedy Highway, from *Eucalyptus* sp., 26 Sep. 2006, P.W. Crous (*holotype* CBS H-20283, *ex-type* culture CBS 124765 = CPC 13318), *ibid.* (cultures CPC 13319, 13320).

*Notes:* *Elsinoë eucalypticola* is known to cause visible spots on both sides of *Eucalyptus* leaves in Queensland, Australia. Asci distributed irregularly throughout the ascostromata, sub-globose to broadly obvoid, thick-walled, 8-spored, sessile, hyaline, 30–47 × 24–30 μm. Ascospores hyaline to pale brown, broadly ellipsoid with rounded ends, with more prominent taper towards the base, with 4-transverse septa, and 0–3 vertical septa, and sometimes with oblique septa; mostly slightly constricted at the median septum, (16–)17–18(–20) × (6.5–)7–8 μm (*Cheewangkoon et al. 2009*). Other species that have been recorded on *Eucalyptus* include *E. eucalypti,* *E. eucalyptorum* and *E. tectici.* Ascospores of *E. eucalypticola* (16–20 × 6.5–8 μm) are intermediate in size between those of *E. eucalyptorum* (11–15 × 4–6 μm) (*Summerell et al. 2006*) and *E. eucalypti* (20–28 × 7–8 μm) (*Park et al. 2000*). Both *E. eucalypti* and *E. eucalyptorum* form larger leaf spots than those associated with *E. eucalypticola*.

**Elsinoë eucalyptorum** Crous & Summerell, *Fungal Diversity* 23: 332. 2006. Fig. 14.

*Material examined:* **Australia,** New South Wales, 0.9 km west of Pacific Highway on Middle Brother Road, ca. 11 km south of Kew, North Coast NSW, 31 42 38 S 152 42 20 E, Alt: 40 metres; on leaves of *Eucalyptus propinqua,* Feb. 2006, B.A. Summerell (*holotype* CBS H-19746, *ex-type* culture CBS 120084 = CPC 13052).

*Notes:* *Elsinoë eucalyptorum* is known to cause leaf spots of *Eucalyptus propinqua* in Australia, not extending through the leaf lamina. Asci distributed irregularly throughout ascostromata, ovoid to globose, with rounded apex and slightly flattened base, thick-walled, 8-spored, sessile, hyaline, 19–30 × 16–20 μm. Ascospores hyaline, smooth, thin-walled, broadly ellipsoidal with rounded ends, with 1(–3) transverse septa, and 1–2 vertical or oblique septa; constricted at median septum, (11–)13–15 × (4–)5(–6) μm (*Summerell et al. 2006*).
Key to *Elsinoë* spp. occurring on *Eucalyptus*\(^1\)

1. Leaf spots absent or \(< 1.5 \text{ mm} \)……………………………………… 2
2. Leaf spots 2–10 mm diam……………………………………… 3
3. Ascostroma absent, acervuli with conidia
   4–4.5 × 2–2.5 \(\mu \text{m} \)………………………………………………………….*E. tectifera*
4. Acervuli absent, ascostroma with ascospores
   16–20 × 6–8 \(\mu \text{m} \)………………………………………………………….*E. eucalyptcola*
5. Ascospores >20 \(\mu \text{m} \) long, 20–28 × 7–8 \(\mu \text{m} \)……………………….*E. eucalypti*
6. Ascospores <20 \(\mu \text{m} \) long, 11–15 × 4–6 \(\mu \text{m} \)……………………….*E. eucalyptorum*

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**Elsinoë euphorbiae** Fan & Crous, sp. nov. MycoBank MB881816. Fig. 3B.

**Etymology:** Named after the host genus from which it was collected, *Euphorbia*.

*Elsinoë euphorbiae* differs from the ex-type strain of its closest phylogenetic neighbour *Elsinoë rhois* (CBS 519.50) based on alleles in all four loci (positions derived from respective alignments of the separate loci deposited in TreeBASE): ITS positions 107 (C), 170 (G), 381 (C), 175 (A), 176 (T), 190 (T), 193 (C), 197 (C), 230 (–), 232 (T), 438 (–), 500 (C), 531 (C); LSU positions 303 (C), 391 (C); *rpb2* positions 17 (A), 23 (C), 29 (A), 30 (T), 53 (A), 59 (T), 68 (G), 111 (T), 125 (C), 131 (A), 140 (G), 143 (T), 188 (C), 197 (T), 200 (C), 203 (A), 212 (T), 215 (G), 218 (T), 221 (T), 239 (T), 257 (C), 140 (C), 143 (A), 188 (T), 197 (C), 200 (T), 203 (G), 212 (C), 215 (G), 218 (T), 221 (T), 239 (T), 257 (C), 260 (C), 284 (A), 287 (T), 296 (T), 299 (C), 308 (C), 317 (A), 320 (C), 333 (T), 350 (A), 356 (A), 374 (C), 380 (T), 389 (C), 401 (G), 404 (C), 410 (A), 416 (T), 422 (A), 431 (T), 440 (A), 443 (C), 467 (C), 485 (T), 497 (A), 500 (C), 549 (C), 554 (T), 557 (C), 608 (T), 611 (G), 622 (G), 683 (C), 695 (C), 707 (G), 713 (C), 719 (T), 722 (C), 725 (A); *TEF1-α* positions 14 (C), 149 (A).

**Culture characteristics:** Colonies irregular, erumpent, folded, surface cinnamon to sepia, with smooth margins and white aerial mycelium in centre; 10–20 mm diam after 3 wk; sterile.

**Material examined:** *India*, Pimpiri, from *Euphorbia pilulifera* (= *Euphorbia pilulifera* = *Chamaesyce hirta*), Oct. 1961, M.J. Thrirumalchar (holotype CBS H-22732, ex-type culture CBS 401.63 = ATCC 15028 = IMI 100601).

**Notes:** Strain CBS 401.63 was initially identified as "*Sphaceloma krugii*" on "*Euphorbia prunifolia var. repanda*" (= *E. heterophylla*) in Brazil (Bitancourt & Jenkins 1950). However, a fresh isolate CPC 18531 from the same host genus and location was designed as epitype supported by other isolates (CPC18537, CPC 18554 and CPC 18579) in the current study (see below). Our analyses showed that strain CBS 401.63 grouped in a separate clade from *E. krugii* based on all four loci, supporting our decision to describe it as a new species. The LSU region fails to distinguish *E. arachidis*, *E. bidentis*, *E. euphorbiae*, *E. genipae*, *E. krugi*, *E. mimosae*, *E. poinsettiae*, and *E. fawcettii* strain CBS 139.25.

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**Elsinoë fawcettii** Bitanc. & Jenkins, Phytopathology 26: 394. 1936. Fig. 15.

**Synonym:** *Sphaceloma fawcettii* Jenkins, Phytopathology 15: 101. 1925.

**Materials examined:** USA, from *Citrus* sp., A.E. Jenkins (ex-isotype culture CBS 139.25); from *Citrus aurantifolia*, C.A. Salemink (culture CBS 231.64); Florida, from *Citrus limon*, A.A. Salemink (culture CBS 232.64). *Panama*, Canal Zone, from *Citrus aurantium*, C.A. Salemink (culture CBS 233.64).

**Notes:** *Elsinoë fawcettii* is commonly known as the causal agent of citrus scab disease, causing heavy losses on *Citrus* worldwide, particularly for the fresh fruit market. Symptoms include lesions that are rough, corky, wart-like, translucent, green or tan at first, becoming brown at the centre, but becoming purplish on fruit. Jenkins (1925) described the asexual morph, *Sphaceloma fawcettii*, as having hyaline, oblong to ellipsoid conidia, 5–10 × 2–5 \(\mu \text{m} \). Bitancourt & Jenkins (1936a) described the sexual morph of this fungus, which is characterised by scattered ascostroma containing globose to ovoid asci, 12–16 \(\mu \text{m} \) diam, and hyaline, oblong to ellipsoidal, 1–3 septate ascospores, 10–12 × 5–6 \(\mu \text{m} \). The ITS and LSU regions fail to distinguish *E. citricola* and *E. fawcettii*. In addition, the LSU region fails to distinguish *E. fawcettii* strain CBS 139.25 from *E. arachidis*, *E. bidentis*, *E. euphorbiae*, *E. genipae*, *E. krugi*, *E. mimosae*, *E. poinsettiae*, and *E. sesseae*.

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**Elsinoë fagarae** (Bitanc. & Jenkins) Fan & Crous, comb. nov. MycoBank MB811817.

**Basionym:** *Sphaceloma fagarae* Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 20: 10. 1950.

**Material examined:** Brazil, from Fagara riedelianum, Jul. 1938, A.A. Bitancourt (ex-type culture CBS 514.50 = IB 2895).

**Notes:** *Elsinoë fagarae* was originally described causing “spot anthracnose” on leaves and stems of *Fagara* sp. in Brazil (Bitancourt & Jenkins 1950). Symptoms include leaf spots that are round or slightly irregular, with a well-defined protruding margin, strongly depressed in centre, 0.3–0.8 mm diam. This fungus is characterised by yellow, oblong or fusiform conidia, 8–15 × 3 \(\mu \text{m} \).
described as: producing irregular leaf spots (2–4 mm diam); acervuli (28–144 × 26–34 μm), conidiophores (15 × 2.4 μm) and conidia not observed. Although treated as synonymous in literature, this has never been proven, and the Brazilian isolate treated here very likely represents a distinct species – a conjecture requiring recollecting the fungus on F. glomerata in Java for clarification. The ITS and TEF1-α regions fail to distinguish E. centrolobii, E. fici, E. jasminae, and E. randii.

**Elsinoë fici-caricae** Wani & Thirum. **sp. nov.** MycoBank MB818118.

**Etymology:** Named after the host from which it was collected, *Ficus carica*.

*Elsinoë fici-caricae* differs from the ex-type strain of its closest phylogenetic neighbour *Elsinoë flacourtiae* (CBS 474.62) based on alleles in all four loci (positions derived from respective

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**Fig. 14.** *Elsinoë eucalyptorum* (CBS 120084). **A.** Leaf spots. **B.** Section through an ascostroma. **C–F.** Asci. **G, H.** Ascospores. Scale bars = 10 μm.
alignments of the separate loci deposited in TreeBASE: ITS positions 100 (C), 112 (–), 120 (A), 187 (T), 192 (G), 411 (C),
494 (T); LSU positions 36 (A), 41 (T), 74 (T), 94 (T), 107 (A), 371 (C), 372 (T), 378 (T), 383 (T), 388 (A), 408 (C), 411 (G), 427 (T),
432 (T), 444 (T), 537 (T), 563 (A), 568 (T), 649 (A); rpb2 position 695 (G); TEF1–α position 47 (C).

Material examined: India, Shindewadi, on Ficus carica, 14 Apr. 1957, M.J. Thirumalachar (holotype CBS H-22747, ex-type culture CBS 473.62 = ATCC 14652 = HACC 128 = IMI 092302).

Notes: An ex-type culture of this species was originally deposited in CBS under the name Sphaceloma fici-caricaceae Wani & Thirum. However, this name does not occur in either Index Fungorum or MycoBank, nor have our colleagues in India been able to locate the name in any of the papers linked to these authors. For this reason, this name is herewith validated in the genus currently accepted for these fungi, Elsinoë. The LSU region fails to distinguish E. fici-caricaceae, E. mattirolanum, E. pin, and E. sicula. The rpb2 region failed to distinguish E. genipae, and E. mimosae.

Elsinoë flaccutia (Thirum. & Naras.) Fan & Crous, comb. nov. MycoBank MB818119.

Basionym: Sphaceloma flaccutia Thirum. & Naras., Sydowia 23: 243. 1969.

Material examined: India, Maharashtra, Poona, Law College Hill, from Flacourtia (= Flacourtia sepiaia), Dec. 1959, M.J. Thirumalachar (ex-type culture CBS 474.62 = ATCC 14654 = HACC 131 = IMI 092305).

Notes: Elsinoë flaccutia is known to cause scab disease on leaves and tender shoots of Flacourtia indica in Maharashtra, India. Symptoms include numerous small spots that are scattered or grouped to form larger patches on leaves; elongated, closely grouped to form crusts by coalescence on young shoots. This fungus is characterised by hyaline, unicellular, ovoid to oblong conidia (1.5–3 μm diam). In culture (PDA), also according to the original description, it produces heaped crustose colonies of ashy white aerial mycelium centrally with deep fawn margins and reddish brown reverse; the colonies are composed of profusely branched mycelium and abundant chlamydospore and “asexual morph fruiting bodies” (Narasimhan et al. 1969a).

The LSU region fails to distinguish E. flaccutia, E. theae and E. australis strain CBS 314.32. The rpb2 region failed to distinguish E. fici-caricaceae, and E. flaccutia.

Elsinoë freyliniae (Crous) Rossman & W.C. Allen, IMA Fungus 7: 3. 2016. Fig. 16.

Basionym: Sphaceloma freyliniae Crous, Persoonia 25: 125. 2010.

Material examined: South Africa, Western Cape, Cape Town, Kirstenbosch Botanical Garden, from leaves of Freylinia lanceolata, 8 May 2010, P.W. Crous (holotype CBS H-20485, ex-type culture CBS 128204 = CPC 18335); CPC 18336.

Notes: Elsinoë freyliniae is known to cause visible spots on leaves of Freylinia lanceolata in South Africa, a host that is endemic to this country. This fungus is characterised by hyaline, asceptate, ellipsoidal conidia, (3.5–)4–6(–7) × (2.5–)3–4 μm (Crous & Groenewald 2010). Elsinoë freyliniae is presently the only fungus reported on Freylinia lanceolata in South Africa (Crous et al. 2000, Crous & Groenewald 2010).

Elsinoë genipae (Bitanc.) Fan & Crous, comb. nov. MycoBank MB818120.

Basionym: Sphaceloma genipae Bitanc., Arq. Inst. Biol., São Paulo 8: 198. 1937.

Material examined: Brazil, São Paulo, Cantareira, from Genipa americana, Mar. 1935, A.A. Bitancourt (ex-type culture CBS 342.39).

Notes: Elsinoë genipae is known to cause leaf spots of Genipa americana in Brazil. Symptoms include elongated leaf spots, often coalescent, pale brown to reddish, 1–8 mm diam. This fungus is characterised by hyaline, ovoid to globose conidia, 3 × 3–6 μm (Bitancourt 1937). The LSU region fails to distinguish E. arachidis, E. bidentis, E. euphorbiae, E. genipae, E. krugii, E. mimosae, E. poinsettiae, E. sesseae, and E. fawcettii strain CBS 139.25. The rpb2 region failed to distinguish E. fici-caricaceae, and E. flaccutiae.

Elsinoë genipae-americanae Fan & Crous, sp. nov. MycoBank MB818121. Fig. 3C.
**Etymology:** Named after the host species from which it was collected, *Genipa americana*.

*Elsinoë genipae-americanae* differs from its closest relative, *E. punicae* (CPC 19968) based on alleles in all four loci (positions derived from respective alignments of the separate loci deposited in TreeBASE): ITS position 420 (–); LSU positions 383 (C), 466 (T); *rpb2* positions 25 (G), 50 (T), 74 (A), 101 (G), 260 (C), 335 (A), 515 (A), 524 (T), 533 (T), 653 (C), 723 (C), 733 (C), 740 (C); *TEF1-α* positions 5 (T), 71 (T), 110 (T), 134 (T), 233 (T), 359 (G).

**Culture characteristics:** Colonies erumpent, raised, surface white to pale luteous, with smooth margins and white aerial mycelium; 18–28 mm diam after 3 wk; sterile.

**Material examined:** Brazil, Paraíba state, Manitú, municipality of Bananeiras, from *Genipa americana*, Mar. 1940, A.A. Bitancourt (holotype CBS H-22726, ex-type culture CBS 516.50 = IB 3700).

**Notes:** Strain CBS 516.50 was initially identified as "Sphaceloma genipae", since it was collected from *Genipa americana*, the same host as *Elsinoë genipae* (Bitancourt 1937). However, the clear phylogenetic distinction between *Elsinoë genipae-americanae* and the ex-type culture of *E. genipae*, as well as all other strains included in this study, resulted in our decision to describe this species as new based on sequence data only. The ITS region fails to distinguish *E. australis*, *E. genipae-americanae* and *E. punicae*.

*Elsinoë glycines* (Kurata & Kurib.) Fan & Crous, *comb. nov.* MycoBank MB818122. Fig. 3D.

**Basionym:** *Sphaceloma glycines* Kurata & Kurib., Ann. Phytopath. Soc. Japan 18: 120. 1954.

**Culture characteristics:** Colonies irregular, erumpent, folded; surface saffron and purplish grey in centre, with smooth margins and sparse white to grey aerial mycelium; 14–18 mm diam after 3 wk; sterile.

**Materials examined:** Japan, Honshu Island, Chūbu, Nagano Prefecture, Naniai-Mura and Imoi-Mura, from *Glycine max* (cultivated soy bean), 29 Sep. 1948, K. Kuribayashi and H. Hurata (holotype not found); 24 Sep. 1951, K. Togashi, ex Herb. Inst Yokohama Nat. Univ. 24584, *topotype* designated in Jenkins & Bitancourt (1966) (BPI 910654; SPIB 5690); *lectotype* figs 1–3 from Kurata & Kuribayashi (1954) designated here MBT372709. Japan, from *Glycine max (= Glycine soja)*, H. Kurata (*epitype* designated here, MBT372710, preserved in metabolically inactive state, *ex-epitype* culture CBS 389.64); from *Glycine max*, H. Kurata (culture CBS 390.64).

**Notes:** *Elsinoë glycines* is a pathogen of soybean (*Glycine spp.*) that was characterised by scab symptoms on leaves, stems and pods. The disease is widely distributed in eastern Asia (China, Korea and Japan), causing severe commercial damage and significant losses to agriculture (Kurata & Kuribayashi 1954, Ford et al. 1981, Yum & Park 1989). Kurata & Kuribayashi (1954) describe conidia as being ovoid to oblong-ellipsoidal, biguttulate, hyaline, 4.7–13 × 2.1–5.6 μm. The importance of *E. glycines* for plant quarantine must be highlighted as it is a potential threat to world production of soybean and has remained restricted to the native range of the host species in Asia until now. It should be among the top priorities for plant quarantine detection services in the Americas. The original description of "Sphaceloma glycines" (Kurata & Kuribayashi 1954) was from *Glycine max* in Japan, which agrees with the epitype culture CBS 389.64 deposited in CBS (the same host genus and location) designated in the present study.
**Elsinoë hederae** (Bitanc. & Jenkins) Fan & Crous, **comb. nov.** MycoBank MB818123.

*Basionym* *Sphaceloma hederae* Bitanc. & Jenkins, J. Wash. Acad. Sci. 36: 420. 1946.

**Material examined**: Brazil, on *Hedera helix*, Mar. 1943, A.A. Bitancourt (**ex-type** culture CBS 517.50 = ATCC 11183 = IB 4591).

**Notes**: *Elsinoë hederae* is known to cause leaf spots of *Hedera helix* in Brazil. This fungus can be recognised by small, raised, round to irregular spots with reddish brown margins and greyish white, slightly depressed centres that are later sprinkled with dark fruiting bodies (Jenkins et al. 1946). Conidia are oblong, 6–11 × 5–6 μm (Jenkins & Bitancourt 1957).

**Elsinoë ichnocarpi** (Thirum. & Naras.) Fan & Crous, **comb. nov.** MycoBank MB818124.

*Basionym* *Sphaceloma ichnocarpi* Thirum. & Naras., Sydowia 23: 245. 1970.

**Material examined**: *India*, Maharashtra, Pimpri, Mahendra Hills, from *Ichnocarpus frutescens*, Nov. 1958, M.J. Thirumalachar (**ex-type** culture CBS 475.62 = ATCC 14655 = HACC 132 = IMI 092306).

**Notes**: *Elsinoë ichnocarpi* is known to infect leaves and petioles of *Ichnocarpus frutescens* in India. Symptoms include spots that are slightly raised, scab-like, leaving a depression on the lower leaf surface, circular to polygonal, greyish white in the centre, with dark brown margin, 30–60 × 15–31 μm. On PDA *E. ichnocarpi* produces colonies of fluffy ashy white aerial mycelium and blood-red in reverse; chains of chlamydospores were common (Wani & Thirumalachar 1970).

**Elsinoë jasminiae** Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 11: 53. 1940. Fig. 17.

**Material examined**: Brazil, São Paulo, São Sebastião, from *Jasminum sambac*, Jan. 1938, A.A. Bitancourt (**ex-isotype** culture CBS 224.50 = IB 2863).

**Notes**: *Elsinoë jasminiae* is known to cause warting or scab of leaves and stems of *Jasminum sambac* in Brazil. Symptoms include numerous spots, brown, rounded or more often irregular, slightly raised, with flat centre or somewhat depressed, visible on both sides of the leaves, scattered unevenly between the veins, up to 2 mm diam. This fungus is characterised by globose asci, 12–18 μm diam, and 3-septate ascospores, 10–14 × 4–6 μm (Bitancourt & Jenkins 1940b). The LSU region fails to distinguish *E. centrolobii, E. fici, E. jasminiae*, and *E. randii*.

**Elsinoë jasminicola** Fan & Crous, **sp. nov.** MycoBank MB818125. Fig. 3E.

**Etymology**: Named after the host species from which it was collected, *Jasminum malabaricum*.

*Elsinoë jasminicola* differs from the ex-type strain of its close relative *E. jasminiae* (CBS 224.50) based on alleles in three loci (positions derived from respective alignments of the separate loci deposited in TreeBASE): ITS positions 32 (T), 42–43 (C), 68 (G), 72 (G), 75 (C), 81 (–), 99 (C), 101 (A), 102 (C), 104 (T), 106 (T), 108 (T), 111–116 (–), 123–147 (–), 169 (G), 171 (A), 176 (C), 179 (–), 181 (–), 185 (C), 188–190 (–), 192–193 (CG), 196–197 (AG), 208 (–), 210 (T), 223–224 (GC), 388 (T), 405 (C), 407 (G), 412 (C), 414 (T), 416–418 (GT–), 424 (C), 427 (T), 430–435 (ATCCGA), 437 (G), 516 (T), 518 (A), 521–522 (CT), 528 (C), 530 (C); LSU positions 34 (C), 111 (C), 115 (C), 297 (C), 316 (C), 325 (C), 336 (A), 340 (C), 343 (C), 348 (C), 372 (C), 378 (T), 383 (C), 398 (C), 430 (C), 484 (C), 489 (G), 491 (C), 545 (C), 560 (C), 599 (C), 670 (A), 680 (A), 682 (A); *TEF1*-α positions 5 (T), 20 (G), 26 (T), 32 (T), 48–50 (CTG), 57(G), 62 (T), 70–120 (GTGAGTAGAATTTGCCTTGCTTGCCTGACCCGCTCTCG ATACCTTGCG), 131 (C), 149 (T), 186 (T), 248 (T), 329 (C), 392 (C).

**Culture characteristics**: Colonies irregular, raised, surface white to cinnamon, with smooth margins and white aerial mycelium; 16–21 mm diam after 3 wk; sterile.

**Material examined**: *India*, Khandala, from *Jasminum malabaricum*, Nov. 1959, M.J. Thirumalachar (**holotype** CBS H-22731, **ex-type** culture CBS 212.63 = IMI 100603).

**Notes**: Isolate CBS 212.63 was initially identified as *Elsinoë jasminiae*, which was collected from *Jasminum sambac* in Brazil. However, the new species differs on ITS (82 nt), LSU (20 nt) and *TEF1*-α (64 nt) positions from the ex-type strain of *E. jasminiae* (CBS 224.50). It clusters in a separate lineage compared to all other strains included in this study, and therefore we describe this species as new based on phylogenetic analyses.

**Elsinoë krugii** (Bitanc. & Jenkins) Fan, R.W. Barreto & Crous, **comb. nov.** MycoBank MB818126. Fig. 18.

*Basionym* *Sphaceloma krugii* Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 19: 103. 1949.

**Material examined**: Brazil, Campinas, on “Euphorbia prunifolia var. repanda” (= *Eu. heterophylla*), coll. 15 Apr. 1936, H.P. Krug (**holotype** BPI 681889); São Paulo, Aguas da Prata, Acesso ao Bairro Cascata, from *Eu. heterophylla*, Dec. 2010, R.W. Barreto (**epitype designated here** MBT372713, specimen CBS H-22803, **ex-epitype** culture CPC 18531 = RWB 1151 = CBS 141877); Rio de Janeiro, Botanic Garden of Rio de Janeiro, from *Eu. pulcherima*, R.W. Barreto (culture CPC 18537 = RWB 1189); from *Eu. heterophylla*, Dec. 2010, R.W. Barreto (specimen CBS H-22802, culture CPC 18554 = RWB 1228); Minas Gerais, Viçosa, Universidade Federal de Viçosa, Horta Nova, from *Eu.
Notes: The original description of "Sphaceloma krugii" indicated that this fungus was collected from "Euphorbia prunifolia var. repanda" (= Eu. heterophylla) in Brazil, and produced aseptate conidia, 4–6 × 2–4 μm (Bitancourt & Jenkins 1949). The ex-epitype isolate (CPC 18531), was collected from the same host genus and location, and is characterised by aseptate conidia, 4–7 × 2–3.5 μm, which is in agreement with holotype. In culture: Conidiophores hyaline, verruculose, ampulliform to doliiform, 0–2-septate, 13–30 × 3–6 μm. Conidiogenous cells enteroblastic, polyphialidic, with 1–2 integrated loci, hyaline, verruculose, ampulliform to doliiform, 3–8 × 3–6 μm. Conidia hyaline, granular, aseptate, ellipsoid to oblong, apex obtuse, sometimes tapering at base to a subtruncate hilum, (4–) 5–6.5(–7) × (2–)2.5–3(–3.5) μm. Colonies on MEA are irregular, erumpent, folded, cerebriform; central surface apricot to brown, with smooth, sinuate margins, with sparse aerial mycelium; 12–17 mm diam after 3 wk; sterile. The LSU region fails to distinguish E. arachidis, E. bidentis, E. euphorbiae, E. genipae, E. krugii, E. mimoseae, E. poinsettiae, E. sessea, and E. fawcettii strain CBS 139.25.

**Elsinoë lagoa-santensis** (Bitanc. & Jenkins) Fan & Crous, comb. nov. MycoBank MB818141.

**Elsinoë lagoa-santensis** (Bitanc. & Jenkins) Fan & Crous, comb. nov. MycoBank MB818141.

**Basionym:** Sphaceloma lagoa-santense Bitanc. & Jenkins, Proc. Amer Sci. Congr. Wash., 1940: 152. 1940 (1942).

**Material examined:** Brazil, on Byrsonima coccobolifolia, Feb. 1936, A.A. Bitancourt (ex-type culture CBS 518.50 = IB 2863).

Notes: **Elsinoë lagoa-santensis** is known to cause leaf spots of *Byrsonima coccobolifolia* in Brazil. Symptoms include numerous leaf spots, rounded or slight irregular, occurring on any part of the leaf, sometimes grouped or coalescent on upper surface, flat or shallow, black or nearly so with slightly yellowish grey centres, 0.2–4 mm diam. This fungus is characterised by narrowly ellipsoid–fusoid, broadly naviculate, sometimes cylindrical conidia, 11–19 × 4–6 μm (Bitancourt & Jenkins 1940a).

**Elsinoë ledi** (Peck) Zeller, Phytopathology 21: 965. 1931. Fig. 3F.

**Basionym:** Aulographum ledi Peck, Bull. N.Y. St. Mus. 150: 23. 1911.

**Materials examined:** USA, Michigan, Ingham County, Towan’s Swamp, East Lansing, from Ledum sp., May 1895, A.B. Cordley (holotype 7964 in O.A.C. Herb). USA, Oregon, Waconda Beach, on Rhododendron neoglandulosum (= Ledum glandulosum), Apr. 1931, S.M. Zeller, deposited by A.E. Jenkins.
Notes: *Elsinoë ledi* was formerly treated as *Aulographum ledi* on *Ledum glandulosum* in the USA (Peck 1911). Zeller & Deremiah (1931) examined some older materials and treated it as *Elsinoë ledi* based on its hyaline, subsphaeroid asci scattered in the entostroma with ellipsoid to fusoid, mostly 3-septate ascospores, 12–17.7 × 5–6.5 μm, which are similar to those of *Elsinoë ampelina*. A.E. Jenkins examined the Oregon materials studied here and identified them as *E. ledi* according to Peck’s type (Zeller & Deremiah 1931). We therefore designate this collection (CBS 167.33) as epitype, because it agrees well with the original records, having the same host and location. Colonies irregular, erumpent, folded; surface cinnamon, with white aerial mycelium and smooth, sinuate margins; 8–12 mm diam after 3 wk; sterile.

_Ampelina lepagei_ Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 12:
5. 1941.

*Material examined:* Brazil, from _Manilkara zapota_ (= _Achras sapota_), Mar. 1938, A.A. Bitancourt (ex-type culture CBS 225.50 = IB 2904).

Notes: *Elsinoë lepagei* was described causing scab on leaves and branches of _Manilkara zapota_ in Brazil (Bitancourt & Jenkins 1941). Symptoms include grey-brown, irregular, prominent, well-defined leaf spots, 0.5–2 mm diam and smaller (0.5–1 mm diam) lesions on stems. This fungus is characterised by globose asci, 16–22 × 12–21 μm, containing eight hyaline, 3-septate ascospores, 10–16 × 4–7 μm (Bitancourt & Jenkins 1941). In culture on PDA (original description): “Colonies slow-growing, compact, convoluted, downy aerial mycelium centrally, viscid marginal area, cinnamon buff.”

*Elsinoë leucospermi* L. Swart & Crous, Mycologia 93: 370. 2001. Fig. 19.

_Materials examined:* Australia, Victoria, Gembrook, from _Leucadendron_ sp., Oct. 1996, A. Ziehl (culture CBS 111671 = CPC 1504), _ibid._ (culture CBS 111672 = CPC 1503, culture CBS 111673 = CPC 1502); Queensland, from _Leucospermum cordifolium_, Mar. 1989, (culture CBS 112367 = CPC 3699). South Africa, Western Cape, Betty’s Bay, from _Leucospermum_ sp., May 1996, P.W. Crous (ex-type culture CBS 111207 = CPC 1380). Spain, Tenerife, Proteas de Canarias, Apr. 2000, S. Denman (culture CBS 115500).

Notes: *Elsinoë leucospermi* is known to cause leaf spots of _Leucospermum_ and _Leucadendron_ in Australia, South Africa, USA and Zimbabwe, and also could infect stems of _Serruria_ (Swart et al. 2001). In Australia, scab disease symptoms have been observed on many genera of _Proteaceae_, including _Banksia_, _Leucadendron_, _Mimeltes_, _Protea_ and _Serruria_ (Forsberg 1993, Pascoe et al. 1995, Crous et al. 2013). *Elsinoë* is thought to be distributed via asymptomatic nursery material and this has probably occurred on an international scale. _Asci_ ovoid to sub-globose 16–28 × 13–18 μm. _Ascospores_ hyaline, broadly ellipsoid with rounded to obtuse ends, 1–4 transverse, 1–2 vertical septa (oblique septa rare), constricted at the median septum, (10–)12–14(--19) × 4–5 μm. _Conidiomata_ acervular, folicicolous but primarily caulicolous, raised, coalescing at maturity, composed of medium brown _textura angularis_, up to 200 μm diam and 1 mm long. _Conidiophores_ subcylindrical, pale brown, verruculose, 0–2-septate, 20–30 × 3–6 μm. _Conidiogenous cells_ polyhedral, with 1–2 integrated loci, pale brown, verruculose, ampulliform to doliform, 10–15 × 3–4 μm. _Conidia_ hyaline, granular, aseptate, ellipsoid, with obtuse apex, constricted at the base to a subtruncate hilum, (2–)5–7–(8) × (1–)2.5–3 μm _in vivo_, 5–7 × 2–3 μm _in vitro_ (Swart et al. 2001).

_Elsinoë lippiae_ (R.C. Baines & Cummins) Fan & Crous, comb. nov. MycoBank MB818127.

_Basionym:_ _Sphaceloma lippiae_ R.C. Baines & Cummins, Phytopathology 29: 655. 1939.

_Material examined:* USA, on _Phyla lanceolata_ (= _Lippia lanceolata_), R.C. Baines (ex-type culture CBS 166.40).

Notes: *Elsinoë lippiae* is known to infect _Phyla lanceolata_ (previous _Lippia lanceolata_) in the USA. Symptoms include numerous spots on leaves and stems that are scattered or aggregated, centres depressed, buff-coloured, with purple margins (Baines & Cummins 1939).

_Elsinoë mangiferae_ Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 17: 218. 1946.

Fig. 19. A–D. Disease symptoms of _E. leucospermi_ on _Leucospermum_ spp.
Synonym: Spheceloma mangiferae Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 17: 215. 1946.

Material examined: Cuba, Santiago de las Vegas, on Mangifera foetida (= Mangifera indica), Aug. 1942, A.A. Bitancourt (ex-type culture CBS 226.50 = IB 4416).

Notes: Elsinoë mangiferae was described by Bitancourt & Jenkins (1946) as the etiological agent of “wart disease” (= scab) of mango (Mangifera foetida) in Chile, Cuba and the USA. Symptoms were described in detail in the original description (Bitancourt & Jenkins 1946) – in brief: small leaf spots, greyish pink, rounded to oval, slightly elevated, 0.5–15 mm diam; on shoots spots rounded to oval, closely grouped to form larger patches of crusts (scabs), 1–1.5 mm diam. This fungus is characterised by dark reddish brown, ellipsoid to lenticular acervuli, 15–30 × 23–52 μm, and small, hyaline, spherical to ellipsoid conidia, “0–1-septate, frequently in chains, 6–29 × 2–4 μm”; ascostr mata pulvinate, 80–160 μm diam and 30–48 μm thick, asci globose, 10–15 μm diam, ascospores 3-septate (sometimes with one longitudinal septum), 10–13 × 4–6 μm; “microconidia” abundant. In culture (on PDA, according to the original description): Colonies raised, thinly convoluted, mostly glabrous, white to grey to pinkish downy aerial mycelium centrally, humid periphery. The situation regarding the Denticularia was later complicated by the publication of Alcorn et al. (1999). While studying mango scab in Australia these authors examined samples from Australia and re-examined the type material and concluded that a species of Denticularia was involved in both Australian specimens and type material which fitted clearly into the description of the morphology for the asexual morph of the scab fungus included in Bitancourt & Jenkins’ publication. It had erect and well developed conidiophores or conidia in culture. The phylogenetic analysis of the type culture leaves no doubt as to the scab fungus on mango correctly belonging to Elsinoë. It is reasonable to conjecture that the Denticularia found on scabbed tissues is either a saprobe or a mycoparasite that is regularly associated with E. mangiferae and led to Bitancourt & Jenkins (1946) producing a mistaken description incorporating the information on Denticularia in their holomorph description. Later, while dealing with the complex again Alcorn et al. (1999) interpreted correctly the asexual morph present on the specimens as belonging to Denticularia but left aside the evidence provided by the description of the sexual morph in Bitancourt & Jenkins (1946) and mistakenly proposed the new combination Denticularia mangiferae. One final puzzle is why there was successful completion of Koch’s postulates by Alcorn et al. (1999) with their Denticularia isolate. A possible explanation for that might be that, while attempting to isolate Denticularia they have inadvertently obtained a pure culture of E. mangiferae to which Denticularia was associated and were then capable of reproducing the scab disease when it was used as inoculum. If that proves right, then the Denticularia on mango scab still needs to be named.

Material examined: Argentina, Buenos Aires, Moreno, from leaves of Arbutus unedo, May 1934, L. Grodsinsky (culture CBS 346.36); on A. unedo, C.A. Salemink (culture CBS 287.64).

Notes: Elsinoë mattiroloanum is known to cause leaf spots of Arbutus unedo in Italy. This fungus is characterised by ellipsoid asci, 30 × 18 μm diam, containing eight hyaline, 1-septate ascospores, 11 × 4 μm. The sexual morph was described from the same leaf spots as that of the asexual morph, and although not proven in culture, was accepted as proof of the sexual-asexual relationship (Arnaud & Bitancourt 1949), for which the new name Elsinoë mattiroloanum was introduced. The LSU region fails to distinguish E. fici-caricae, E. mattiroloanum, E. piri, and E. sicula.

Elsinoë menthae (Jenkins) Fan & Croux, comb. nov. MycoBank MB818128. Fig. 3G.

Basionym: Spheceloma menthae Jenkins, J. Wash. Acad. Sci. 27: 414. 1937.

Materials examined: USA, Michigan, from Mentha × piperita, Aug. 1937, R. Nelson (holotype BPI 681964). USA, Indiana, on Mentha piperita, Aug. 1937, R. Nelson & A.E. Jenkins, dep. A.E. Jenkins (epitype designated here, MBT372715, preserved in metabolically inactive state, ex-epitype culture CBS 322.37); Indiana, on Mentha piperita, R.C. Baines, dep. A.E. Jenkins (culture CBS 321.37).

Notes: “Spheceloma menthae” was originally described causing the disease known as leopard spot on leaves, stems and rootstocks of cultivated Mentha piperita in Michigan, USA (Jenkins 1937). Symptoms include circular, oval or irregular spots, black with white centres, up to 5 mm diam. This species is characterised by superficially erumpent acervuli with hyaline, spherical to ellipsoid conidia, 3–8 × 2.5–4 μm (Jenkins 1937). The ex-epitype strain (CBS 322.37) deposited by A.E. Jenkins was isolated from same host in Indiana (USA). Colonies irregular, erumpent, folded, cerebriform, surface brown vinaceous to black, with cinnamon, smooth, sinuate margins and white to grey aerial mycelium; 15–18 mm diam after 3 wk; sterile.

Elsinoë mimosae Viegas, Bragantia 4: 13. 1944. Fig. 20.
Materials examined: **Brazil**, São Paulo, Campinas, on *Mimosa* sp., 31 Mar. 1931, H.P. Krug & O. Zagatto (holotype Campinas No. 2836); **Brazil**, Rio de Janeiro, Itaguaí, Mazomba, on *Mimosa diplotricha* (= *Mimosa invisa*), Mar. 1999, R.W. Barreto (epitype designated here MBT372716, preserved in metabolically inactive state, ex-epitype culture CPC 19478 = RWB 154 = CBS 141878). **Ecuador**, Coca, on *Mimosa diplotricha*, Nov. 2000, R.W. Barreto (specimen CBS H-22804, culture CPC 18518 = RWB 224 = CBS 141943).

Notes: *Elsinoë mimosae* was originally recorded on *Mimosa* sp. in Brazil, with globose asci, 18–20 μm diam, distributed irregularly in ascostromata with eight hyaline, ovoid-septate, oblong-subovoid ascospores, 8–10 × 4–4.5 μm (Viégas 1944). The strain CPC 19478, which was isolated from the same host in Brazil, is designed here as ex-epitype. In culture: Conidiophores subcylindrical, hyaline, verruculose, ampulliform to doliiform, 0–1-septate, 8–25 × 2–5 μm. Conidiogenous cells enteroblastic, polyphallic, with 1–2 integrated loci, hyaline, verruculose, ampulliform to doliiform, 8–15 × 2–4 μm. Conidia hyaline, granular, asceptate, ellipsoid to oblong, apex obtuse, sometimes tapering towards the base to a subtruncate locus, (3–)3.5–5 (–6) × 2–2.5 (–3) μm.

Culture characteristics: Colonies, erumpent, folded; central surface brown, with smooth, irregular apricot margins, forming sparse white aerial mycelium; 8–15 mm diam after 3 wk; sterile.

Notes: This fungus causes a severe disease on *M. diplotricha* in South America on habitats ranging from the Ecuadorian Amazon to the highlands of the state of Rio de Janeiro (Brazil). It remains restricted to the neotropics and has clear potential for use as a classical biological control agent against its host (giant sensitive plant), which is a major pantropical weed. The LSU region fails to distinguish *E. arachidis*, *E. bidentis*, *E. euthorhiza*, *E. genipae*, *E. krugii*, *E. mimosae*, *E. poinsettiae*, *E. sesseae*, and *E. fawcettii* strain CBS 139.25. The rpb2 region failed to distinguish *E. genipae* and *E. mimosae*.

**Elsinoë oleae** Ciccar. & Graniti, Arq. Inst. Biol., São Paulo 26: 17. 1959.

Material examined: **Italy**, Catania, Santa Tecla, from leaves of *Olea europaea*, Aug. 1957, A. Graniti (ex-type culture CBS 227.59).

Notes: *Elsinoë oleae* is known to cause leaf spots of *Olea europaea* in Italy. Symptoms include prominent, circular, oval or irregular spots that become linear, rugulose, 0.2–2 × 0.1–0.5 mm. This fungus is characterised by hyaline, ovoid asci, 25–30 × 10–14 μm, containing eight hyaline, fusiform, 3-septate ascospores, 12–15 × 3–4 μm. The asexual morph of this fungus has hyaline, ellipsoid, ovoid to subglobose conidia, 2–3.5 × 3–6 μm (Ciccarnone & Granditi 1959).

**Elsinoë othonnae** Crous & A.R. Wood, Persoonia 34: 209. 2015. Fig. 21.

Material examined: **South Africa**, Western Cape Province, Brackenfell, Bracken Nature Reserve, on stems of *Othonna quinquedentata*, 10 May 2014, A.R. Wood (holotype CBS H-22239, culture ex-type CPC 24853 = CBS 139910); ibid. (culture CPC 24954).

Notes: Occurring on stems of *Othonna quinquedentata* in South Africa. Symptoms include circular to subcircular lesions, pale grey-brown with dark red-brown borders, 1–10 mm diam. In culture on SNA: Conidia hyaline, guttulate, smooth, asceptate, ellipsoid to subcylindrical, apex obtuse, base bluntly rounded to truncate, (5–)6–7 × (2.5–)3 (–4) μm *in vitro* (Crous et al. 2015b). Because not all genes were successfully amplified, *E. othonnae* was omitted from the final multigene alignment (Table 1).

**Elsinoë perseae** (Jenkins) Rossman & W.C. Allen, IMA Fungus 7: 3. 2016. Fig. 22.

Basionym: *Sphaceloma perseae* Jenkins, Phytopathology 24: 84. 1934.

Material examined: **Brazil**, Limeira, on *Persea americana*, C.A. Salemink (culture CBS 288.64); **USA**, Florida, Orlando, on *Persea americana*, A.E. Jenkins (ex-type culture CBS 406.34).

Notes: *Elsinoë perseae* was originally reported to infect leaves and fruits of *Persea americana* in the USA, causing scab disease. This fungus is characterised by hyaline, ovoid to oblong-ellipsoid, biguttulate conidia, 5–8 × 3–4 μm (Jenkins 1934). Following its initial description, it was broadly recorded in the warmer regions of the American continent (<nt.ars-grin.gov/fungaldatabases>) but also in Africa, America, Asia and New...
It causes one of the most important diseases of avocado (Piccinini et al. 2005).

Materials examined: Cuba, Wajay, Havana, on Phaseolus lunatus, Nov. 1929, C. Aguiar, dep. A.E. Jenkins (ex-type culture CBS 165.31 = IMI 303278); on Phaseolus lunatus, C.A. Salemink (CBS 234.64 = IMI 303279). Malawi, Dedza, on Phaseolus vulgaris, Mar. 1994, A. Liebenberg, dep. A.J.L. Phillips (CBS 151.95); Bunda, on Phaseolus vulgaris, Mar. 1993, A. Liebenberg, dep. A.J.L. Phillips (CBS 152.95). South Africa, KwaZulu-Natal, Greytown, on Phaseolus vulgaris, Mar. 1993, A. Liebenberg, dep. A.J.L. Phillips (CBS 149.95); KwaZulu-Natal, Cedara, on Phaseolus vulgaris cv. Helderberg, Mar. 1993, A. Liebenberg, dep. A.J.L. Phillips (CBS 150.95).

Notes: Elsinoë phaseoli is known to cause scab of beans (Phaseolus lunatus) in Cuba (Bruner & Jenkins 1933). It has subsequently been reported on Phaseolus and Vigna in Africa, America and Brazil (Lasca 1978, Phillips 1994). Symptoms include circular lesions on the leaves, occurring on the upper surface of the leaf, 2–3 mm diam; lesions on the stems elongated, white to grey, slightly sunken on green pods, turning red-brown, slightly raised, 2–3 mm diam. This fungus is characterised by ovoid to subglobose asci, 14–22 × 21–27 μm, and hyaline, oblong to ellipsoid ascospores, 10–15 × 4–5 μm, with 2–3 septa (Bruner & Jenkins 1933, Phillips 1994). The conidia are oblong to ellipsoid, 6 × 2 μm (Phillips 1994).

Elsinoë piri (Woron.) Jenkins, J. Agric. Res. 44: 696. 1932.

Basionym: Plectodiscella piri Woron., Mykol. Zentbl. 4: 232. 1914.

Materials examined: New Zealand, Auckland, from Malus sylvestris, Jan. 1982, H.J. Boesewinkel (culture CBS 179.82). Unknown origin, from Pyrus communis, 1828, A.E. Jenkins (culture CBS 163.29).

Notes: Elsinoë piri is known to cause apple and pear spot and anthracnose and is economically important in some organic orchards, but is rarely observed in orchards with a conventional fungicide regime (Scheper et al. 2013). It has a worldwide distribution and has been often recorded incorrectly spelled as “Elsinoë pyri” (Jenkins 1932a). Symptoms include whitish grey leaf spots with brown margins, having visible dark brown ascostromata in the centre of the spots. Spots on fruits can vary in colour from white to pale yellow brown, to brown in the centre and surrounded by a dark red margin. This fungus is characterised by hyaline conidia, aseptate, 4–6 × 2.5–4 μm, which may be present on acervuli on leaves and fruits (Woronichin 1914, Jenkins 1932a, Jenkins et al. 1946, Scheper et al. 2013). The LSU region fails to distinguish E. fici-caricae, E. mattiroloanum, E. piri, and E. sicula. The TEF1-α region fails to distinguish E. piri, and E. sicula.

Elsinoë pitangae Bitanc. & Jenkins, Arq. Inst. Biol., Sào Paulo 11: 51. 1940.

Material examined: Brazil, São Paulo, Cantareira, on Eugenia uniflora, Dec. 1937, A.A. Bitancourt (ex-type culture CBS 227.50 = IB 2816).

Notes: Elsinoë pitangae is known to cause lesions (referred to as anthracnose in the original description) on leaves and branches of Eugenia uniflora – a native Brazilian myrtaceous fruit crop
Elsinoë poinsettiae (Jenkins & Rühle) Rossman & W.C. Allen, IMA Fungus 7: 3. 2016. Fig. 24.

Basionym: Sphaceloma poinsettiae Jenkins & Rühle, Proc. Biol. Soc. Wash. 55: 83. 1942.

Materials examined: Guatemala, on stem lesion of Euphorbia pulcherrima, Oct. 2000, M.E. Palm (culture CBS 109333 = MEP 1503), ibid. (culture CBS 109334 = MEP 1504).

Notes: Elsinoë poinsettiae was originally described from infected leaves and branches of Euphorbia pulcherrima var. plenissima in Florida, USA (Jenkins & Rühle 1942). Scab disease of this host was subsequently found in Brazil, Guatemala, Jamaica and Puerto Rico (Rubin 1961, Wehburg 1968). Elsinoë poinsettiae may cause economic losses in ornamental poinsettia nurseries. The name S. poinsettiae has been mistakenly used for the fungus causing scab on wild poinsettia (E. heterophylla) which was studied in detail as a potential biocontrol agent to be used against this major weed (Nechet et al. 2004). The phylogenetic analysis has shown that all isolates attacking E. heterophylla in fact belong to E. krugii. Conversely, E. pulcherrima appeared as a host of E. krugii, as revealed by the results of the molecular identification of isolate CPC 18537, a surprising result since the host-range evaluations of Nechet et al. (2004) of isolates of Sphaceloma obtained from E. heterophylla (then seemingly mistakenly identified as S. poinsettiae) involving 37 plant species, including E. pulcherrima – among several members of the Euphorbiaceae – resulted only in the infection of E. heterophylla. It is known that there is variation in host range between different populations within species of Elsinoë infecting Euphorbiaceae. In order to better clarify the situation for Elsinoë attacking euphorbiaceous hosts a novel round of studies involving cross inoculations of a range of isolates from different hosts in the family following the lead of Zeigler & Lozano (1983), but supported by the results of the present molecular evaluation of these taxa and utilising modern tools for population studies is needed. The LSU region fails to distinguish E. arachidis, E. bidentis, E. euphorbiæ, E. genipæ, E. krugii, E. mimosae, E. poinsettiae, E. sessææ, and E. fawcettii strain CBS 139.25.

Elsinoë pongamiae (Wani & Thirum.) Fan & Crous, comb. nov. MycoBank MB818129. Fig. 3H.

Basionym: Sphaceloma pongamiae Wani & Thirum., Sydowia 24: 319. 1970.

Materials examined: India, Vithalwadi, Poona, on Pongamia pin-nata, 2 Jan. 1958, D.D. Wani. (holotype BPI 682603). Vithalwadi near Poona, on Pongamia pinnata, Feb. 1960, M.J. Thirumalachar (epitype designated here, MBT372717, preserved in metabolically inactive state, ex-epitype culture CBS 402.63 = ATCC 15026).

Notes: Elsinoë pongamiae was originally described as “Sphaceloma pongamiae” on Pongamia glabrae in India (Wani & Thirumalachar 1970). Symptoms include small, numerous spots on shoots and pods, often coalescing, forming greyish white crusts (= scab); numerous spots on leaves scattered, less often closely grouped with chalky-white to greyish pink margin, 1–2 mm diam. This fungus is characterised by spherical to ovoid, aseptate conidia, 1.5 × 1.5 μm (Wani & Thirumalachar 1970). The ex-epitype strain deposited at CBS (CBS 402.63) was isolated by the same collector and from the same host genus in India. In culture: Colonies circular, raised colonies, surface white to rosy buff, with smooth, sinate margins and white aerial mycelium; 15–18 mm diam after 3 wk; sterile. The ITS and TEF1-a regions fail to distinguish E. embeliae and E. pongamiae.

Elsinoë populi (Sacc.) Fan & Crous, comb. nov. MycoBank MB818130.
**Basionym:** Hadrotrichum populi Sacc., Michelia 1: 264. 1878.

**Synonym:** Sphaceloma populi (Sacc.) Jenkins, J. Agric. Res. 44: 694. 1932.

**Materials examined:** Argentina, Minos, on *Populus deltoides* subsp. *deltoides* (= *Populus serotina*), C.A. Salemink (culture CBS 289.64 = ATCC 11181); Minos, from *Populus deltoides* subsp. *deltoides*, C.A. Salemink (culture CBS 290.64).

**Notes:** *Elsinoë populi* was originally described from infected leaves of *Populus nigra* in Europe, causing scab disease (Jenkins 1932a). This fungus is characterised by hyaline, globose to ovoid conidia, 4–5 × 3 μm (Saccardo 1878, Jenkins 1932a).

**Elsinoë proteae** Crous & L. Swart, Mycologia 93: 375. 2001.

**Material examined:** South Africa, Western Cape Province, Harold Porter Botanical Gardens, Betty's bay, on leaves of *P. cynaroides*, 15 Feb. 1996, P.W. Crous (holotype PREM 54979, ex-type culture CPC 1349).

**Notes:** Occurring on leaves and petioles of *Protea* spp. in South Africa. It was described by (Swart et al. 2001) as follows: Symptoms include circular, raised leaf spots, white-grey with visible black ascostromata on both sides of leaves. Ascospores hyaline to olivaceous, broadly ellipsoid with rounded ends, with 3–5 transverse, and 1–3 vertical septa; oblique septa sometimes present; mostly slightly constricted at the median septum, (14–)16–17–(20) × (5–)6–7 μm. *Conidia* hyaline, granular, aseptate, ellipsoid, with obtuse apex, and rounded to truncate base, (5–)6–7–(8) × 2–3(–4) μm. In culture: Colonies irregular, erumpent, folded, with sinuate, smooth margins, rose to red; aerial mycelium sparse, whitish; with diffuse red pigment in the medium. Because not all genes were successfully amplified, *E. proteae* was omitted from the final multigene alignment (Table 1).

**Elsinoë protearum** (L. Swart & Crous) L. Swart & Crous, CBS Biodiversity Series 13: 250. 2013. Fig. 26.

**Basionym:** Sphaceloma protearum L. Swart & Crous, Mycologia 93: 375. 2001.

**Material examined:** Zimbabwe, Mutare, Gomo Remiti farm, on leaves and stems of *Protea eximia × susanne* cv. *Sylvia*, 5 Mar. 1998, L. Swart (holotype PREM 56301, ex-type culture CBS 113618 = CPC 2037).

**Notes:** *Elsinoë protearum* is known to cause leaf spots on *Protea* sp. in Australia and Zimbabwe (Swart et al. 2001). Ziehl et al. (2000) also demonstrated that *Elsinoë* spp. from South African *Proteaceae* could infect Australian proteaceous genera such as Banksia and Dryandra, but not *Telopea*, *Grevillea* or *Hakea*. Symptoms include circular, reddish leaf spots, erumpent with reddish sporodochia on the necrotic tissue, 5–15 mm diam. *Conidia* hyaline, aseptate, ellipsoid, with obtuse apex, constricted at the base to a subtruncate locus, (3.5–)5–6(–7) × (1.5–)2–2.5 μm in vivo. In culture: Colonies irregular, erumpent, folded with sinuate, smooth margins, blood red, with diffuse red pigment (Swart et al. 2001).

**Key to *Elsinoë* species on *Proteaceae***

1. Occurring on *Banksia* ................................................................. 2
2. On other *Proteaceae* .................................................................... 3
3. Leaf spots on *B. serrata*; colonies grey-olivaceous; optimal growth at 15 °C ................................................................. *E. banksiae*
4. Lesions on leaves and veins of *B. prionotes*; colonies blood-red; optimal growth at 20–25 °C ................................................................. *E. banksicola*
5. Occurring on *Leucadendron*, *Leucospermum* and *Serruria*; ascospores with 1–4 transverse, 1–2 vertical and rarely any oblique septa, (10–)12–14(–19) × 4–5 μm; colonies blood red, optimal growth at 20–25 °C; conidia (2–)5–7(–8) × (1–)2.5–3 μm ............................................................................. *E. leucospermi*
6. Occurring on *Protea* .................................................................... 4
7. Leaf spots on mature leaves; ascospores with 3–5 transverse, 1–3 vertical and rarely any oblique septa, (14–)16–17(–20) × (5–)6–7 μm; colonies rose to red with diffuse red pigment; optimal growth at 15–20 °C; *Sphaceloma* morph not observed on host ............................................................................. *E. proteae*
8. Shepherd’s crook and leaf spot symptoms on juvenile growth flushes, leading to shoot blight; colonies blood-red with slight diffusing red pigment; optimal growth at 20–25 °C; *Elsinoë* morph not observed on host ............................................................................. *E. protearum*
9. Leaf spots small black specks on leaves and twigs; ascospores with 1–4 transverse, 1–2 vertical, and rarely any oblique septa, (10–)11.5–12.5(–15) × (4–)4.5–5(–5.5) μm ............................................................................. *E. fecunda*
**Elsinoë punicae** (Bitanc. & Jenkins) Rossman & W.C. Allen, IMA Fungus 7: 3. 2016.  
Fig. 27.  
**Basionym:** Sphaceloma punicae Bitanc. & Jenkins, Proc. Amer Sci. Congr. Wash. 1940: 163. 1942 (1940).  
**Material examined:** South Africa, Western Cape Province, on Punica granatum (scab-like lesions on fruit and brown spots on leaves), 12 Mar. 2012, L. Mostert & W. Laubscher (culture CPC 19968).  
**Notes:** Elsinoë punicae was originally described from leaf spots of Punica granatum in Argentina, and later recorded in Brazil and Italy (Bitancourt & Jenkins 1940a). The violet to blackish purple spots spread to the midrib and veins, becoming paler at the centre upon drying (Bitancourt & Jenkins 1940a). Furthermore, Sphaceloma punicae was identified from scab-like lesions from fruit in China (Xiao-Hui et al. 2004), and rusty spots on fruit and leaves in India (Jamadar et al. 2011). The ITS region fails to distinguish *E. australis*, *E. genipae-americanae* and *E. punicae*.  

**Elsinoë quercus-ilicis** (G. Arnaud) Jenkins & Goid., Arq. Inst. Biol., São Paulo 23: 117. 1956.  
**Basionym:** Uleomyces quercus-ilicis G. Arnaud, Annls Sci. Nat. Bot. 7: 687. 1925.  
**Synonym:** Sphaceloma quercus-ilicis Martelli & Laviola, Phytopath. Mediterr. 3: 136. 1961.  
**Material examined:** Italy, Gargano promontory, on leaves of Quercus ilex, G.P. Martelli & C. Laviola (ex-type culture of Sphaceloma quercus-ilicis, CBS 232.61).  
**Notes:** The specimen information of CBS 232.61, such as host, locality, collection date and collector are the same as those given in the original description of Sphaceloma quercus-ilicis, and thus this strain is recognised here as ex-type. Conidia are ovoid to subcylindrical or subfusiform, 10–14 × 5–7 μm (Martelli & Laviola 1961).  

**Elsinoë randii** Jenkins & Bitanc., Phytopathology 28: 77. 1938.  
**Synonym:** Sphaceloma randii Jenkins & Bitanc., Arq. Inst. Biol., São Paulo 32: 68. 1965.  
**Material examined:** Brazil, São Paulo, Campinas, from Carya pecan, A.A. Bitancourt (ex-isotype culture CBS 170.38), ibid. (culture CBS 171.38).  
**Notes:** Elsinoë randii was described from infected Carya pecan in Brazil (Jenkins & Bitancourt 1938). Later it was recorded in Japan and USA but only limited in Juglandaceae (Kurosawa & Katsuki 1956, Jenkins & Bitancourt 1965). The ITS and TEF1-α regiona fail to distinguish *E. fici* and *E. randii*. The LSU region fails to distinguish *E. centrolobii*, *E. fici*, *E. jasminae*, and *E. randii*.  

**Elsinoë rhois** (Bitanc. & Jenkins) Fan & Crous, comb. nov. MycoBank MB818131.  
**Basionym:** Sphaceloma rhois Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 11: 48. 1940.  

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**Fig. 26. A–C.** Disease symptoms of *E. protearum* on Protea sp.  
**Fig. 27.** Disease symptoms of *E. punicae* on Punica granatum. (Photo credits: M. Mirabolfathy, Iran).
Material examined: Brazil, from Toxicodendron vernix (= Rhus vernix), Dec. 1937, A.A. Bitancourt (ex-type culture CBS 519.50 = ATCC 11194 = IB 2802).

Notes: Elsinoë rhois is known to infect leaves of Rhus vernix (currently Toxicodendron vernix) in Brazil. Symptoms include numerous leaf spots, rounded or irregular, often coalescing, amphigenous, depressed, black on upper surface and brown on lower leaf surface, 0.5–3 mm diam. This fungus is characterised by pale yellow, ovoid to cylindrical conidia, 8–16 × 3–6 μm (Bitancourt & Jenkins 1940b).

Elsinoë ricini (Jenkins & C.C. Cheo) Fan & Crous, comb. nov. MycoBank MB818132.

Basionym: Sphaceloma ricini Jenkins & C.C. Cheo, J. Wash. Acad. Sci. 31: 416. 1941.

Material examined: India, Chinchwad, from Ricinus communis, Oct. 1959, M.J. Thirumalachar (culture CBS 403.63 = ATCC 15030 = IMI 100604).

Notes: Elsinoë ricini was originally known to infect leaves and stems of Ricinus communis in Yunnan, China, causing castor bean scab. Symptoms are recognised by numerous leaf spots, globose or subglobose, 2–3 mm diam. This fungus is characterised by oblong, ovoid to ellipsoid conidia, 10–15 × 2.5–4.5 μm (Jenkins & Cheo 1941).

Elsinoë rosarum Jenkins & Bitanc., Mycologia 49: 98. 1957. Fig. 31.

Synonyms: Phyllosticta rosarum Pass., Erb. critt. Ital., Ser. 2, fasc.: no. 1092. 1881.

Sphaceloma rosarum (Pass.) Jenkins, J. Agric. Res. 45: 330. 1932. Gloeosporium rosarum (Pass.) Grove, British Stem- and Leaf-Fungi (Coelomycetes) (Cambridge) 2: 224. 1937.

Materials examined: USA, Oregon, Washington County, Reedsville, on Rosa pisocarpa, 18 May 1944, J. Roaf & C.G. Anderson (holotype BPI 681052). USA, New York, Ithaca, from Rosa sp., 1923, A.E. Jenkins (epitype designated here MBT372718, preserved in metabolically inactive state, ex-

epitype culture CBS 212.33); from Rosa sp., 1923, L.M. Massey, dep. A.E. Jenkins (culture CBS 213.33); New York, Ithaca, from Rosa sp., C.A. Salemink (culture CBS 235.64). Unknown origin, from Rosa sp., E.M. Wakefield (culture CBS 150.27).

Notes: Passerini (1881) described this fungus as Phyllosticta rosarum causing rose anthracnose in Italy. However, it was confused with similar pathogens, i.e., Elsinoë veneta causing bramble anthracnose and E. piri associated with apple and pear anthracnose (Jenkins 1932a). Later, Jenkins (1932b) separated them as distinct species based on the three anthracnose diseases that they caused, and treated Phyllosticta rosarum as Sphaceloma rosarum based on its typical Sphaceloma morphology of the asexual morph. Symptoms include dark, purplish black leaf spots with dull livid brown margins, occurring on any part of the leaves, including midrib and veins; lesions on stems are generally circular, or elongate, often dull livid brown, becoming white or ashen, raised, and sometimes depressed at the centre. Elsinoë rosarum was originally described from Rosa sp. collected in the USA, with hyaline, 1–3 septate ascospores measuring 10–14 × 5–7 μm (Jenkins & Bitancourt 1957). The strain CBS 212.33 deposited in CBS is from the same host genus and location, and thus is designated here as ex-epitype. In culture: Colonies circular, raised, surface fawn, with smooth margins and white to grey aerial mycelium in centre; 11–15 mm diam after 3 wk; sterile.

Elsinoë salicina Fan & Crous, sp. nov. MycoBank MB818133.

Fig. 28.

Etymology: Named after the host genus from which it was collected, Salix sp.

In culture: Conidiophores subcylindrical, hyaline, verruculose, ampulliform to doliform, 0–2-septate, 10–20 × 4–5 μm. Conidiogenous cells enteroblastic, polyphialidic, with 1–3 integrated loci, hyaline, verruculose, ampulliform to doliform, 8–14 × 4–5 μm. Conidia hyaline, granular, aseptate, ellipsoid to oblong, apex obtuse, sometimes constricted at the base to a subtruncate locus, (4.5–)5–6(–6.5) × (25–)3–4.5(–5) μm.

Culture characteristics: Colonies irregular, erumpent, folded, surface apricot, with smooth, irregular apricot margins with few sparse aerial mycelium; 14–20 mm diam after 3 wk; sterile.
Material examined: Brazil, Rio de Janeiro, Seropédica, road Rio-São Paulo, on Cestrum laevigatum, Apr. 2010, R.W. Barreto (culture CPC 18549 = RWB 1219).

Note: Elsinoë sessae is known to cause leaf spots of Sessea brasiliensis in São Paulo, Brazil. Bitancourt & Jenkins (1950) mentioned scabs on Cestrum as “other specimens of Elsinoaea on Solanaceae that deserve mentioning” after describing S. sessae. Here the isolate CPC 18549 is tentatively identified as E. sessae but it is acknowledged that this species requires recollection and epitypification. Symptoms include brown, sparse, amphigenous leaf spots that are round to irregular with elevated margins, 0.2–2 mm diam (Bitancourt & Jenkins 1950). The LSU region fails to distinguish E. arachidis, E. bidentis, E. euphorbiae, E. genipae, E. krugi, E. mimosae, E. poinsettiae, E. sesseae, and E. fawcettii strain CBS 139.25.

Elsinoë sicula (Ciccar.) Fan & Crous, comb. nov. MycoBank MB818136.

Basionym: Sphaceloma siculum Ciccar., Arq. Inst. Biol., São Paulo 26: 14. 1959.

Material examined: Italy, Palermo, Piana degli Albanesi, from leaves of Prunus amygdalus, Aug. 1957, A. Ciccarone (ex-type culture CBS 398.59 = IB 2777).

Notes: Elsinoë sicula is known to cause leaf spots of Prunus amygdalus in Italy. Symptoms include numerous leaf spots, scattered, grey-violet, 0.5–2 mm diam. This fungus is characterised by hyaline to pale yellow, ellipsoid to ovoid conidia, 3–6.5 × 1.2–3 μm (Ciccarone & Graniti 1959). The LSU region fails to distinguish E. fici-caricae, E. mattiroloanae, E. piri, and E. sicula. The TEF1-α region fails to distinguish E. piri, and E. sicula.

Elsinoë solidaginis Jenkins & Ukkelberg, J. Agric. Res. 51: 515. 1935. Fig. 3J.

Materials examined: USA, Florida, from Solidago edisoniana, 4 Aug. 1934, H.G. Ukkelberg (holotype BPI 681061); Georgia, on Solidago fistulosa, Nov. 1936, H.G. Ukkelberg, dep. A.E. Jenkins (epitype designated here MBT372720, preserved in metabolically inactive state, ex-epitype culture CBS 191.37).

Notes: Elsinoë solidaginis was originally described from Solidago chapmanii in Florida, USA, having 1–2–septate ascospores, 8–13 × 4.5–5 μm, spherical asci, 15–17 × 15–18 μm, and ovoid, oblong to ellipsoid conidia, 6.5–8.6 × 2.4–4 μm (Bitancourt 1937). The ex-epitype strain CBS 191.37 was collected on S. fistulosa growing in the USA. In culture: Colonies irregular, erumpent, folded, cerebriform, surface greyish to black, with cinnamon, smooth, sinuate margins and white to grey aerial mycelium; 12–18 mm diam after 3 wk; sterile.

Elsinoë tectiferae (Cheew. & Crous) Fan & Crous, comb. nov. MycoBank MB818137. Fig. 30.

Basionym: Sphaceloma tectiferae Cheew. & Crous, Persoonia 23: 79: 2009.

Material examined: Australia, Northern Territory, road to Robin Falls, S 14°10′20″, E 131°07′15″ on Eucalyptus tectifera, 23
Notes: *Elsinoë tecticalata* was described from leaves of *Eucalyptus tectifica* collected in Australia. **Conidiogenous cells** terminal, integrated, smooth to slightly verruculose, thin-walled, straight or geniculate, somewhat swollen to irregular, (7–) 15–20(–30) × (3–)4–5(–6) μm, with crowded conidiogenous loci in an apical rachis, denticles ≤1 μm high, flat tipped, with minutely thickened and reflective scars, visible as a circle when viewed from directly above, 1–1.3 μm diam. **Conidia** in short, branched chains; **ramoconidia** cylindrical to ellipsoid, tapering toward both ends, sometimes swollen at the crowded conidiogenous loci, aseptate, thin-walled, smooth to slightly verruculose, pale to medium brown, 7–9(–11) × 2.5–3(–4) μm; **hila** thickened along the rim, refractive, not darkened; **intercalary conidia** ellipsoid to fusiform, aseptate, pale to medium brown, 6–8(–9.5) × 2.2–3.3 μm; **terminal conidia** obovoid, pale brown, paler toward the apex, (2.5–)3.5–5 × 2–2.5 μm. **In culture:** Colonies irregular, centre strongly folded, convoluted, with sparse, pale, orange grey aerial mycelium, turning greenish grey.
and woolly when sporulating; margin feathery, pigmented the medium with reddish orange diffuse pigment; 15 mm diam after 15 d at 25 °C in the dark (Cheewangkoon et al. 2009).

**Elsinoë terminaliae** (Bitanc.) Fan & Crous, comb. nov. MycoBank MB818138. Fig. 31.

*Basionym: Sphaceloma terminaliae* Bitanc., Arq. Inst. Biol., São Paulo 8: 197. 1937.

**Materials examined: Brazil**, São Paulo, Santos, from *Terminalia catappa*, Apr. 1934, H.S. Lepage (holotype BPI 683030); Rio de Janeiro, from *Terminalia catappa*, Apr. 1939, A.A. Bitancourt (epitype designated here MBT372721, preserved in metabolically inactive state, ex-epitype culture CBS 343.39); Rio de Janeiro, Gavea, from *Terminalia catappa*, R.W Barreto (specimen CBS H-22805, culture CPC 18538 = RWB 1190a).

**Culture characteristics** (based on CPC 18538): raised, cerebriform with numerous minute elevations centrally, convoluted, irregular margins, compressing and cracking the medium at margins, no aerial mycelium, humid, greyish lilac in the dark (Cheewangkoon et al. 2009).

**Notes:** This fungus was originally described from *Terminalia catappa* in Brazil, with conidia 10–15 × 4–6 μm (Bitancourt 1937). The strain CBS 343.39 designated here as ex-epitype is from the same collector, host and location, deposited three years after the publication. It agrees well in morphology with the original description, with conidia being aseptate, 8–13 × 4–6 μm. Symptoms include numerous small spots, raised, circular to polygonal, ashy-brown pseudoparenchyma; 15 mm diam after 23 d; sporulating abundantly.

**Conidia** hyaline, granular, aseptate, ellipsoid to oblong, apex obtuse, sometimes tapering at base to a subtruncate locus, (8–)9–12(–13) × 4–5.5(–6) μm.

**Elsinoë theae** Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 10: 195. 1939.

*Synonyms:* Sphaceloma theae Kuros., Ann. phytopath. Soc. Japan 9: 130. 1939.

**Material examined:** Brazil, São Paulo, Cantareira, from Camellia sinensis (= *Thea sinensis*), Nov. 1938, A.A. Bitancourt (ex-iso-type culture CBS 228.50 = IB 3061).

**Notes:** *Elsinoë theae* was known to infect leaves and bracts of *Thea sinensis* in São Paulo, Brazil. This fungus is characterised by irregular ovoid asci, 14–22 × 12–20 μm, containing eight hyaline, 3-septate ascospores, 10–14 × 3–7 μm (Bitancourt & Jenkins 1939b). The LSU region fails to distinguish *E. flacourtiae, E. theae* and *E. australis* strain CBS 314.32.

**Elsinoë tiliae** Creelman, Mycologia 48: 555. 1956.

**Material examined:** New Zealand, Palmerston North, from leaves of *Tilia cordata*, Nov. 1972, J.C. Muirhead, dep. G.F. Laundon (culture CBS 350.73 = ATCC 24510 = LEV 6783).

**Notes:** *Elsinoë tiliae* is known to infect branches, fruits, leaves and petioles of *Tilia* spp. in Argentina, Canada and the USA. This fungus is characterised by globose, ovoid or pyriform asci, 19–25 × 17–20 μm, containing eight hyaline, irregularly arranged, obclavate, 3-septate ascospores, 11–16 × 5–6 μm. The asexual morph of this fungus has ovoid conidia, 3.7–6.5 × 1.8–2.5 μm (Creelman 1956).

**Elsinoë veneta** (Burkh.) Jenkins, J. Agric. Res. 44: 696. 1932. Fig. 3K.
Basionym: *Plectodiscella veneta* Burkh., Phytopathology 7: 91. 1917.

Materials examined: **USA**, New York, on *Rubus neglectus*, 1914, W.H. Burkholder (holotype BPI 681404); from *Rubus* sp., L.K. Jones, dep. A.E. Jenkins (epitype designated here MBT372722, preserved in metabolically inactive state, ex-epitype culture CBS 164.29 = ATCC 1833).

Notes: *Plectodiscella veneta* was originally introduced as the pathogen causing anthracnose disease of black raspberry (*Rubus idaei var. aculeatissimi, R. neglecti* and *R. occidentalis*) in Brant, New York, USA, having globose asci, 24–30 μm diam, with eight hyaline, ovoid to ellipsoid, 3-septate ascospores, 18–21 × 6.5–8 μm (Burkholder 1917). Later Jenkins (1932a) allocated this fungus to *Elsinoë*. The ex-epitype culture (CBS 164.29) was isolated from the same host and deposited in CBS by Jenkins. *In culture*: Colonies circular, erumpent, folded, cerebriform, surface rosy buff to apricot, with white, smooth margins and white to rosy buff aerial mycelium; 15–18 mm diam after 3 wk; sterile.

**Elsinoë venenae** Bitanc. & Jenkins, Arq. Inst. Biol., São Paulo 12: 9. 1941. Figs 2L, 32.

Materials examined: **Brazil**, São Paulo, Campinas, on *Verbena bonariensis* (Fig. 32), A.P. Viégas & A.S. Costa, 12 Jan. 1939 (holotype BPI 681232); São Paulo, Road Itaitiaia-Itamonte, near the top of the mountain, from *Verbena bonariensis*, Apr. 2010, R.W. Barreto (epitype designated here, MBT372723, specimen CBS H-22806, ex-epitype culture CPC 18561 = RWB 1232 = CBS 141879). **Brazil**, Rio de Janeiro, Pirai, Ponte das Laranjeiras, from *Verbena bonariensis*, Apr. 2010, R.W. Barreto (culture CPC 18563 = RWB 1238).

Notes: *Elsinoë venenae* was originally described as having globose asci, 16 μm diam, with eight hyaline, 3-septate ascospores, 15–16 × 5–7 μm, occurring on *Verbena bonariensis* from Campinas, São Paulo, Brazil (Sitancourt & Jenkins 1941). The ex-epitype culture (CPC 18561) was isolated from same host in Brazil. *In culture*: Colonies circular, erumpent, raised; surface white to salmon and straw to brown vinaceous, with smooth margins and white to grey aerial mycelium; 13–18 mm diam after 3 wk; sterile.

**Elsinoë violae** (Massey & Jenkins) Fan & Crous, comb. nov. MycoBank MB818139.

Basionym: *Sphaceloma violae* Massey & Jenkins, Mem. Cornell University Agric. Exp. Stat. 176: 7. 1935.

Materials examined: **USA**, South Carolina, Summerville, from *Viola* sp., Jan. 1933, H.M. Nichols, dep. A.E. Jenkins (ex-syn-type culture CBS 336.35); New York, Fishkill, Unknown host, Jun. 1938, A.E. Jenkins (culture CBS 294.38). **Unknown origin**, from *Symphoricarpos albus var. laevigatus*, M.F. Barrus (culture CBS 333.29).

Notes: Symptoms include enlarged spots, rounded to elongated, white, buff to grey with dark green margin on the lower surface of leaves. The strains CBS 333.29 and CBS 294.38 were originally described as “*Sphaceloma symphoricarpi*” according to their host (*Massey & Jenkins* 1935). However, the current phylogeny shows that they cluster with the ex-type culture (CBS 336.35) of *Elsinoë violae*. It is therefore conjectured that labelling problems may have occurred in the past and that strains CBS 333.29 and CBS 294.38 in fact belong to *E. violae*.

**Elsinoë zizyphi** Thirum. & Naras., Sydowia 23: 249. 1969.

Material examined: **India**, Maharashtra, Poona, Law College, from *Ziziphus rugosa*, Jan. 1959, M.J. Thirumalachar (ex-type culture CBS 378.62 = ATCC 14656 = HACC 133 = IMI 092307).

Notes: *Elsinoë zizyphi* was described causing scab disease on *Ziziphus rodundifolia* (= *Ziziphus nummularia*) in India by Narasimhan et al. (1969b). Symptoms are recognised by numerous spots, circular to oval, raised, greyish pink depressed centre with blackish brown margin, 0.1–1 mm diam. This fungus is characterised by globose asci containing eight hyaline, muri-form, 1–3-septate ascospores, 12–15 × 3–4 μm. *In culture*: Colonies raised, cerebriform, brownish red with salmon red reverse.

DISCUSSION

The order *Myriangiiales* has two families, *Elinoaceae* and *Myr-iangiaceae*, that accommodate two and 10 genera, respectively (Dissanayake et al. 2014, Jayawardena et al. 2014). The recent revision of *Myriangiaceae* by Dissanayake et al. (2014) added six genera to the family based on morphological characteristics (*Ascostratum, Buteria, Dicytocyclus, Hemimyriangium, Micularia, and Zukalopsis*). Molecular data from genera in *Myriangiaceae* are still incipient, and only two *Myriangium* species, *M. duriae* (CBS 260.36) and *M. hispanicum* (CBS 247.33), presently have
SSU, LSU, rpb2, and TEF1-α sequences available (Jayawardena et al. 2014). The same situation appeared to be the case in the Elsinoaceae, which was reassessed by Jayawardena et al. (2014) who excluded eight genera (Beelia, Bullaria, Hemimmriangium, Hyalotheles, Micularia, Saccardinula, Stephanotheca and Xenodium) and included only Elsinöe and Molleriella in this family. Prior to the present study, the available molecular dataset for Elsinöe (asexual morph Sphaceloma) proved to be rather sparse (Swart et al. 2001, Summerell et al. 2006, Crous et al. 2015b, 2016). Different authors have discussed the relationship between Elsinoaceae and Myriangiaceae, but based on morphological features and phylogenetic analyses, the two families were accepted as distinct within the order Myriangiales (Schoch et al. 2006, 2009, Lumbsch & Huhndorf 2007, 2010, Boehm et al. 2009, Hyde et al. 2013, Jayawardena et al. 2014).

In accordance with the “One Fungus = One Name” concept, a single name for polymorphic genera has generally followed the rule of choosing the oldest or the most commonly used name with the most species epithets (Hawksworth 2011, Taylor 2011, Rossman et al. 2015, 2016). In the case of Elsinöe, the younger sexual name Elsinöe Racib. (1900) was chosen for protection over that of the older asexual name, Sphaceloma de Bary (1874) (Wijayawardene et al. 2012, Rossman et al. 2015). Therefore, many names in Sphaceloma need to be formally recognised in Elsinöe, with a first set of 28 Sphaceloma species being relocated to Elsinöe in the present study.

As is the case with many phytopathogenic genera of Dothideomycetes, the most common phylogenetic problem related to Elsinöe taxonomy is that many species (e.g. E. ampelina, E. australe, E. fawcettii and E. perseae) are based on old specimens without accompanying sequence data (Jenkins 1925, 1932a, b, Bitancourt & Jenkins 1936a). In fact, until 2014 there were only 12 strains available in GenBank for multigene phylogenetic studies (ITS, LSU, TEF1-α) (Jayawardena et al. 2014). In the first taxonomic phylogenetic study of Elsinöe, Swart et al. (2001) used ITS sequence data to evaluate the phylogenetic significance of six species from Proteaceae. According to the Dictionary of Fungi, Kirk et al. (2008) recognised about 50 species in Elsinöe, although more than 140 species have been described to date (see Index Fungorum and MycoBank). A significant result of the present study was thus to extend the number of genes used in Elsinöe phylogenetic studies, as well as the number of species subject to DNA analyses.

The taxa investigated in the current study represent the largest collection of Elsinöe and Sphaceloma strains ever subject to DNA sequence analysis. A total of 73 single species lineages from 119 Elsinöe strains were recognised based on ITS, LSU, rpb2 and TEF1-α sequence data, including eight new species, 13 epitypifications and 26 new combinations (Table 1). During the course of this study it was observed that, although the ITS is a useful locus for distinguishing most species of Elsinöe (resolving 61 / 74 (82.4 %) of the species included in the phylogenetic tree), the rpb2 and TEF1-α regions performed much better at species resolution (resolving 65 / 71 (91.5 %) and 64/73 (87.7 %) of the species included in the phylogenetic tree, respectively). Specifically, the rpb2 and TEF1-α regions could distinguish the quarantine pathogen E. australis from its closest neighbours. The LSU region was able to distinguish only 51 of the 73 (69.9 %) species included in the phylogenetic tree. The total number of species counted for each of LSU, rpb2 and TEF1-α is slightly lower compared to ITS as species for which the respective gene sequence was missing was excluded from the count. This is of interest for disease diagnosis and quarantine services. The Elsinöe species treated were sampled from various plants distributed over 17 countries in different continents including Africa, Asia, Australia, Europe, Latin America and North America. In spite of the limited number of strains per species, the vast majority of Elsinöe species studied here appear to be host-specific (Fig. 1). Phylogenetic studies based on type materials are hampered by the lack of authentic cultures, and thus epitypification from fresh collections is required to create a stable and workable taxonomy. There are several excellent studies on a number of Sphaceloma and Elsinöe species associated with plant diseases in Brazil, India and the USA (Jenkins 1932a, b, Bitancourt & Jenkins 1936a, Narasimhan et al. 1969a, b, Wani & Thirumalachar 1969a, b, c), whereas very few species have any available cultures or DNA data, and thus cannot be included in recent studies of Elsinöe. Epitypification of these taxa is urgently required (Cannon et al. 2012). Here we designated 13 epitypes based on specimens and cultures deposited at CBS, but no DNA data are presently available for the type species, E. canavaliae from Canavalia gladiata in Java, Indonesia.

With regard to host associations, species of Elsinöe seem to have narrow host ranges, mostly limited to a single host species. Of the 73 species subject to multi-gene analyses, only four were found to occur on more than one host. These include E. leucospermi (from Leucospermum and Leucadendron; Proteaceae), E. anacardi [from Anacardium, (Anacardiaceae) Annona (Annonaceae) and Rosa (Rosaceae)], E. violae [from Symphoricarpos (Caprifoliaceae) and Viola (Violaceae)] and E. pini (from Malus and Pyrus; Rosaceae). These unexpectedly broad host-range species need to be recollected and critically re-examined: E. anacardi in particular, for having hosts in broadly separate plant families. Each of the other 69 species included in this study is known to occur on only one host species or genus. An unexpected result is that we have no obvious distinct geographic distributions according to the phylogenetic tree obtained, which delineated two main subclades (Fig. 4). One subclade (MP/BPP = 89/1) contains 57 species, including the important phytopathogens E. ampelina (on grapevines) and E. fawcettii (on citrus). Another subclade (MP/BPP = 97/1) contains 14 species, including E. australis (on citrus).

It is clear that the leading mycologists dealing with Elsinöe in the mid 20th century (A. Bitancourt and A.E. Jenkins) have considered scab symptoms as a major character for recognising the presence of fungi belonging to Elsinöe/Sphaceloma. To the point of having proposed new species based on disease symptoms alone, with no sporulation present on the specimens. Examples are S. allamandae and S. psidii (Bitancourt & Jenkins 1949), among others. In most instances, nevertheless, when no conidia or ascospores were found, identification had the support of successful isolations resulting in cultures having the appearance commonly found for fungi in this genus – slow growing, raised, often cerebriform or corrugated, dark red, orange or brown colonies. In cases where not even cultures were obtained such species should be regarded as doubtful until fertile specimens and pure cultures are obtained since scab symptoms on plants may arise because of other fungal agents such as Venturia inaequalis (apple scab), bacteria such as Streptomyces sacabies (potato scab), or arthropod attack.

It is necessary to acknowledge the important legacy of A. Bitancourt (Instituto Biológico de São Paulo – Brazil) and Anna E. Jenkins (USDA – USA) (Fig. 33) who have worked and published independently and in cooperation from the 1930s
to the 1960s on the Elsinoaceae, and managed to collect and describe a significant proportion of the known species of Elsinoë/Sphaceloma. This wasn’t a small feat considering the challenges involved in the collection, observation and isolation of Elsinoaceae. Many of the isolates included in the present publication were originally obtained by Bitancourt and Jenkins who cared for depositing their isolates in the CBS, and hence allowed for this work to be accomplished now. The fact that they remained viable after up to 80 yr in preservation underlines the sturdiness of Elsinoë. Isolation of these fungi in pure culture has played an important role for confirmation of a suspected scab or spot anthracnose disease as having a Elsinoë etiology. It now becomes even more important for the taxonomy of the genus, given the body of DNA sequences available following the present study. Not many publications provide descriptions of procedures for isolating these difficult microfungi, but Bitancourt & Jenkins (1939a) described a “routine procedure” which would be worthy of consideration, particularly, regarding the large number of species successfully isolated by them. Unfortunately, their “routine procedure” was based on single ascospores as starting point. As these are notoriously difficult to find, this method can hardly qualify as “routine”.

The procedure for isolation of Elsinoë spp. (used by R.W. Barreto) we advise others to use is as follows: a) always start from fresh material (herbarium material has never proven successful); b) under the dissecting microscope select a piece of scab or anthracnose tissue free of saprobes or mycoparasites; c) rub the scab lesion vigorously with cotton wool soaked with 96 % ethanol; d) allow to dry; e) with a sterile sharp scalpel peel the surface of lesion with a shallow tangential cut; f) flame the scalpel blade; g) stab the medium in the plate to cool it down, and make the point of the blade humid and sticky; h) drive the point of the blade into the inner tissue that appeared where the epidermis was peeled and remove a very small fragment of infected tissue; i) transfer it to different demarcated points on a plate containing a routine medium for fungi (MEA, PDA, or MEA with antibiotics); j) prepare several plates (success rate is low); k) follow culture development on plates closely as Elsinoë colonies are slow-growing and any contaminants may overgrow the colonies; l) choose dense, pseudostromatic, slow growing colonies arising from the fragments (often honey, orange, reddish or brown, with diffuse pigment in agar) and transfer them to fresh plates or tubes. An alternative method (used by P.W. Crous) is to simply scrape the sterile tissue surface with a scalpel, and make dilution plates (on MEA with antibiotics) of the conidiomata/ascostroma, and later pick up typical Elsinoë colonies that become visible after a 2–7 d (viewed with light from below on a dissecting microscope).

In future studies of Elsinoë, fresh specimens should be collected to help clarify the species concepts of taxa presently still lacking types linked to multigene DNA data. It is frequently difficult to observe typical sexual structures in many of these taxa represented by old specimens, and strains soon become sterile in culture. Phyllogenetically, the relationship between the two main subclades and the position of the type species Elsinoë canavaliae, also awaits to be clarified. This epitypification, supplemented by DNA data of related genera such as Molleriella and Myriangium, will significantly improve our knowledge of the evolutionary relationships within the order.

ACKNOWLEDGEMENTS

This study was partially financed by the China Scholarship Council (CSC). The authors are grateful to Chiharu Nakashima (Mie University, Japan), for helping resolve the status of Japanese specimens, as well as Marjan Vermaas (photographic plates), Arien van Iperen (cultures), and Mieke Starink-Willemse (DNA isolation, amplification, and sequencing) for their technical assistance. R.W. Barreto and O.L. Pereira wish to acknowledge the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) and the Conselho Nacional do Desenvolvimento Científico e Tecnológico (CNPq) for financial support and scholarships. J.D.P. Bezerra also thanks to CAPES, CNPq and the Fundação de Amparo à Ciência e Tecnologia de Pernambuco (FACEPE) for scholarships. We thank Mary E. Palm for making a digital copy of the photo of A.A. Bitancourt and A.E. Jenkins available for inclusion in this paper.

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