

## Fungi from palms. XXXVIII. The genera *Mycosphaerella* and *Sphaerella*

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Species in the genera *Mycosphaerella* and *Sphaerella* which have been described from palms are reviewed in this paper. *Mycosphaerella cocoes* comb. nov. and *Mycosphaerella serrulata* are retained and illustrated. *Mycosphaerella chamaeropsis*, *Mycosphaerella palmae* and *Mycosphaerella palmicola* are also accepted and discussed. Several other species are either synonymous with these species or with *Mycosphaerella tassiana*. The remaining species are doubtful or have been disposed in other genera.

Key words: Mycosphaerellaceae, Palmae, taxonomy.

*Mycosphaerella* Johan. contains approximately 500 species. The genus is cosmopolitan and associated with diseases on a wide variety of hosts (Tomlin, 1979; Hawksworth & al., 1995). It was introduced to accommodate species of *Sphaeria* Haller (nom. rej.) which had been placed in the subgenus *Sphaerella* Fr. on the basis of their immersed, inconspicuous ascomata (Corlett, 1988). *Mycosphaerella* species have small, roughly globose ascomata which may be erumpent or immersed in the host tissue. Their asci are bitunicate, oblong, elongate, ovoid, saccate or occasionally clavate, and are arranged in fascicles (Hanlin, 1990). Pseudoparaphyses are absent, although pseudoparenchymatous, cellular remnants may be present (Barr, 1987). The ascospores are two-celled with a central, or nearly central septum, they are usually hyaline, sometimes becoming pale brown, and variable in shape (fusiform, oblong, obovate or elongate). The ascospore wall is smooth or occasionally roughened with age and sometimes surrounded with a thin sheath (Hanlin, 1990). *Mycosphaerella* has an unusually diverse array of anamorphs including members of the Hyphomycetes (*Cercoseptoria* Petr., *Cercospora* Fresen., *Cercosporella* Sacc., *Cladosporium* Link, *Ovularia* Sacc., *Passalora* Fr., *Polythrincium* Kunze and *Ramularia* Sacc.) and the Coelomycetes (*Ascochyta* Lib., *Phloeospora* Wallr., *Phoma* Sacc., and *Septoria* Sacc.) (Hawksworth & al., 1995).

The subgenus *Sphaerella* has been elevated to generic level twice, but both *Sphaerella* (Fr.) Rabenh. and *Sphaerella* Ces. & De Not. are now considered to be synonyms of *Mycosphaerella* (Corlett, 1988; Hawksworth & al., 1995). A very large number of *Mycosphaerella* and *Sphaerella* names can be found in the literature, but a world monograph of the genus is still lacking (Tomlin, 1979).

*Mycosphaerella* is placed in the Mycosphaerellaceae by Hawksworth & al. (1995), or Dothideaceae by Barr (1987), which she includes in the Dothideales. Barr (1987) provides a key to the Dothideaceae which separates *Mycosphaerella* from similar taxa (such as *Dothidea* Fr., *Scleropleella* Höhn. and *Sphaerulina* Sacc.) on the basis of its uniloculate ascospores without a surrounding stroma and its two-celled ascospores. Another genus likely to be confused with *Mycosphaerella* is *Didymella* Sacc. (Dothideales *inc. sed.*). *Didymella* species have broader, more constricted ascospores, a parallel arrangement of asci, obvious pseudoparaphyses, larger ascospores and different anamorphs (Hyde & Fröhlich, 1995). The species of *Mycosphaerella* and *Sphaerella* described from palms are treated below and presented in Tab. 1.

Tab. 1. Comparison of species of *Mycosphaerella* on palms.

Species	Ascus ( $\mu\text{m}$ )	Ascospores ( $\mu\text{m}$ )	Palm host
<i>Mycosphaerella cocoes</i>	30–40 $\times$ 10–13	10–15 $\times$ 3–4.5	<i>Calamus</i> , <i>Cocos</i> , <i>Mauritia</i>
<i>Mycosphaerella chamaeropsis</i>	40–50 $\times$ 15–18	18–25 $\times$ 4–5	<i>Chamaerops</i>
<i>Mycosphaerella palmae</i>	45–50 $\times$ 17	30–35 $\times$ 4–5	Unnamed
<i>Mycosphaerella palmicola</i>	95–137 $\times$ 12.5–20	27.5–40 $\times$ 5–7.5	Cocos
<i>Mycosphaerella serrulata</i>	33–40 $\times$ 6–7.5	8–10 $\times$ 2.5	<i>Acrocomia</i> , <i>Cocos</i> , <i>Maximiliana</i> , <i>Sabal</i>
<i>Mycosphaerella tassiana</i>	50–55 $\times$ 15	15–18 $\times$ 5–6	Washingtonia

## Taxonomy

### Key to *Mycosphaerella* species from palms

1. Ascospores less than 18  $\mu\text{m}$  long ..... 2
1. Ascospores longer than 18  $\mu\text{m}$  ..... 4
2. Ascospores 8–10  $\times$  2.5  $\mu\text{m}$  ..... *M. serrulata*
2. Ascospores longer and wider than this ..... 3
3. Ascospores 10–15  $\times$  3–4.5  $\mu\text{m}$  ..... *M. cocoes*
3. Ascospores 15–18  $\times$  5–6  $\mu\text{m}$  ..... *M. tassiana*
4. Ascospores 18–25  $\times$  4–5  $\mu\text{m}$ , on *Chamaeropsis* ..... *M. chamaeropsis*
4. Ascospores longer than 27  $\mu\text{m}$  ..... 5

5. Ascospores  $30-35 \times 4-5 \mu\text{m}$  ..... *M. palmae*  
 5. Ascospores  $27.5-40 \times 5-7.5 \mu\text{m}$ , on *Cocos* ..... *M. palmicola*

**Notes on accepted species of *Mycosphaerella* described from palms**

1. *Mycosphaerella cocoes* (Rehm) J. Fröhl. & K. D. Hyde, comb. nov.  
 Figs. 1–11.

- ≡ *Sphaerella bambusae* Pat. var. *cocoes* Rehm, Hedwigia 40, 110. 1901.  
 = *Sphaerella frenumbensis* Speg., Revista Museo de La Plata 15 (ser. 2, vol. 2), 19. 1908.  
 = *Mycosphaerella frenumbensis* (Speg.), M. Barros & Garcia de Orta, Estudios Agronomicos 1, 33. 1973.

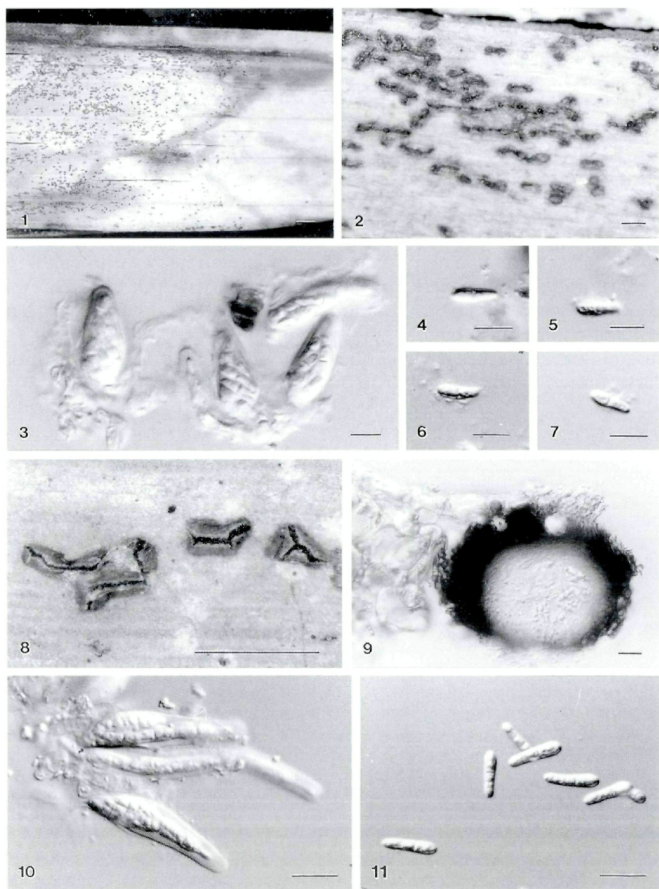
Leaf spot on frond ca  $6 \times 1$  cm, brown at margin, silvery within, dotted with small, black, ascomata (Figs. 1, 2, 8). – Ascospores  $47-88 \mu\text{m}$  wide,  $6.2-11.3 \mu\text{m}$  high, immersed, spherical, with a central, periphysate ostiole (Fig. 9). – Peridium  $17-23 \mu\text{m}$  thick, composed of 5 layers of irregular cells,  $46 \mu\text{m}$  in diam., with thin, dark brown walls. – Pseudoparaphyses absent. – Asci  $30-51 \times 7.5-13 \mu\text{m}$ , 8-spored, obclavate, pedicellate and bitunicate (Figs. 3, 10). – Ascospores  $10-15 \times 3-4.5 \mu\text{m}$ , 2–3-seriate, cylindrical-clavate, unequally bicelled (upper cell larger), hyaline, not constricted at the septum and surrounded by a thin mucilaginous sheath (Figs. 4–7, 11).

Known palm hosts. – *Calamus*, *Cocos*, *Mauritia*.

Known distribution. – Brazil, Ecuador, Hong Kong, Indonesia (East Timor).

Material examined. – BRAZIL, on leaves of *Cocos* sp., H. Bresl., E. Ule, 1185 (S, holotype of *Sphaerella bambusae* var. *cocoes*). – Sao Paulo, Frenumbè, on wilted pinnae of palm, Usteri 46 (LPS 6343, holotype of *Sphaerella frenumbensis*). – ECUADOR, Oriente, *Reserva de Produccion Faunistica Cuyabeno* (Cuyabeno Reserve), Rio Cuyabeno, forest near the Laguna Grande, Canangucho, Path A, in leaf spot of otherwise healthy frond blade of *Mauritia flexuosa*, Aug. 1993, J. Fröhlich (HKU(M) JF156). – HONG KONG, Hong Kong Island, Tai Tam, Tai Tam Country Park, in leaf spot of otherwise healthy frond blade of *Calamus thysanolepis*, June 1993, J. Fröhlich & K. D. Hyde (HKU(M) JF25). – Hong Kong Island, Aberdeen, Aberdeen Country Park (Old Wood), in leaf spot on otherwise healthy frond blade of *Calamus tetradactylus*, Aug. 1994, J. R. Fellowes (HKU(M) JF421).

A review of *Mycosphaerella* and *Sphaerella* species found associated with palms facilitated the identification of two collections of *Sphaerella bambusae* var. *cocoes* (here renamed *Mycosphaerella cocoes*) from palm hosts in Hong Kong. These collections were identical in ascomal, ascus and ascospore morphology to the type (Tab. 2).



Figs. 1-11. - *Mycosphaerella cocoas*, three collections, the holotype (1-7), HKU(M) JF 25 (9) and HKU(M) JF 156 (8, 10, 11). - 1. Diseased leaf tissue spotted with ascomata. - 2, 8. Appearance of fungus on host surface. - 3. Asci. 4-7. Ascospores. - 9. Vertical section through an ascoma. - 10. Asci. - 11. Ascospores. - Scale bars: 1, 8 = 1 mm, 2 = 100  $\mu$ m, 3-7, 9-11 = 10  $\mu$ m.

This species is not *Mycosphaerella bambusae* Pat. which has narrower ascospores ( $11-13 \times 2-2.5 \mu\text{m}$ ) and a bamboo host (Patouillard & Gaillard, 1888). This is the second report of *M. cocoes* in South America, but the first in Hong Kong. Both *Calamus* and *Mauritia* are new hosts for the taxon.

*Sphaerella frenumbensis* is also considered conspecific as it has similar sized asci ( $34-50 \times 10-12 \mu\text{m}$ ) and ascospores ( $13-15 \times 3.5-4 \mu\text{m}$ ). It was not possible to locate material of *Mycosphaerella braheae* or *Sphaerella sabilidis*. The protologues of these taxa (Sienmaszko, 1923) are similar to *Mycosphaerella bambusae* and they may be the same species.

Tab. 2. Comparison of *Mycosphaerella cocoes* collections with the type (measurements made from the holotype).

Taxa	Ascus ( $\mu\text{m}$ )	Ascospore ( $\mu\text{m}$ )
HKU(M)JF 25	38-51 $\times$ 7.5-11.5	11.5-15 $\times$ 3-4.5
HKU(M)JF 156	35-44 $\times$ 10-14	10.5-14 $\times$ 3-4
<i>Sphaerella bambusae</i> var. <i>cocoes</i> (holotype)	30-40 $\times$ 10-13	11-13 $\times$ 3-4

2. ***Mycosphaerella chamaeropsis*** (Traverso) Tomilin, Opredelitel' gribov roda *Mycosphaerella* Johans 56. 1979.  
 = *Sphaerella chamaeropsis* Traverso, Malpighia 15, 8 1901.

Known palm host. – *Chamaerops*.

Known distribution. – Italy, Russia.

Type. – ITALY, Cadenabbia, Norella, on living leaves of *Chamaerops humilis* (not seen).

This was accepted as a species of *Mycosphaerella* by Tomilin (1979) and is reported to have asci which are  $40-50 \times 15-18 \mu\text{m}$  and ascospores which are  $18-25 \times 4-5 \mu\text{m}$ . We have been unable to locate type material.

3. ***Mycosphaerella palmae*** Miles, Illinois Academy of Science Papers on Botany 10, 252. 1917.  
 = *Sphaerella palmae* (Miles) Trotter, Sylloge Fungorum 24, 881. 1928.

Known palm host. – Unnamed Palm.

Known distribution. – Puerto Rico.

Type. – PUERTO RICO, Guanica, on leaves of unnamed palm, 1912/13, F. L. Stevens 2107 (not seen).

It has not been possible to obtain type material. Ascospores are reported to be  $30\text{--}35 \times 4\text{--}5 \mu\text{m}$  and fusoid and this species is associated with small, oval leaf spots, which may be long and narrow, on an unnamed palm (Miles, 1917).

4. ***Mycosphaerella palmicola*** Chaudhury & P. N. Rao, Mycopathologia et Mycologia Applicata 22, 221. 1964.

Known palm host. – *Cocos*.

Known distribution. – Australia, India, Indonesia, Papua New Guinea.

Type. – INDIA, Bangalore, on living leaves of *Cocos nucifera*, 15 June 1963, Vaidehi, OUB 169.

This species is redescribed by Hyde & Fröhlich (1995). Asci are  $95\text{--}137 \times 12.5\text{--}20 \mu\text{m}$  and ascospores are  $27.5\text{--}40 \times 5\text{--}7.5 \mu\text{m}$ . This is a common taxon associated with leaf spots of *Cocos nucifera* in Australia (Hyde & Fröhlich, 1995).

5. ***Mycosphaerella serrulata*** (Ellis & Everh.) Diehl in Weiss, Plant Disease Reporter 26, 296. 1942. – Figs. 12–16.

≡ *Sphaerella serrulata* Ellis & Everh., Journal of Mycology 3, 45. 1887.

≡ *Laestadia serrulata* (Ellis & Everh.) Sacc., Sylloge Fungorum 9, 586. 1891.

Ascomata appearing as minute black dots on dead palm stems (Fig. 12); in section immersed, spherical,  $100\text{--}135 \mu\text{m}$  wide,  $62\text{--}70 \mu\text{m}$  high, with a central, periphysate ostiole (Fig. 13). – Peridium up to  $15 \mu\text{m}$  thick composed of several layers of compressed brown walled cells (Fig. 13). – Pseudoparaphyses absent. – Asci  $33\text{--}40 \times 6\text{--}7.5 \mu\text{m}$ , 8-spored, obclavate, pedicellate and bitunicate (Figs. 14, 15). – Ascospores  $8\text{--}10 \times 2.5 \mu\text{m}$ , cylindrical, hyaline, 2–3-seriate, not constricted at the septum (Fig. 16).

Known palm hosts. – *Acrocomia*, *Cocos*, *Maximiliana*, *Sabal*.

Known distribution. – Brazil, Indonesia (East Timor), Jamaica, Tahiti, U.S.A. (Florida), Venezuela.

Type. – U.S.A., Florida, on dead petioles and leaves of *Sabal serrulata*, Jan. 1887, W. W. Calkins (NY, holotype of *Sphaerella serrulata*).

*Mycosphaerella serrulata* has the smallest ascospores of any *Mycosphaerella* species known from palms. *Sphaerella gastonis* is reported to have asci which are  $40 \times 10 \mu\text{m}$  and ascospores which are  $7\text{--}8 \times 2\text{--}3 \mu\text{m}$  (Corlett, 1991), while in *Sphaerella zonata* asci are  $22\text{--}25 \times 6 \mu\text{m}$ , and ascospores are  $7\text{--}9 \times 2.5 \mu\text{m}$  (Corlett, 1991). Asci in *Mycosphaerella acrocomiicola* are reported to be  $13.5\text{--}50 \times 5\text{--}7 \mu\text{m}$  and ascospores  $7\text{--}10 \times 2\text{--}3.5 \mu\text{m}$  (Batista, 1954). Sydow (1930) reports



Figs. 12–16. – *Mycosphaerella serrulata* (from holotype). – 12. Appearance of ascomata on host surface. – 13. Vertical section through ascomata. – 14, 15. Asci. – 16. Ascospore. – Scale bars: 12 = 1 mm, 13 = 100  $\mu$ m, 14–16 = 10  $\mu$ m.

asci in *Mycosphaerella advena* to be  $32\text{--}40 \times 7\text{--}9 \mu\text{m}$  and ascospores to be  $7\text{--}10 \times 2.5\text{--}3 \mu\text{m}$ . These species with small ascospores may be conspecific.

6. *Mycosphaerella tassiana* (De Not.) Johan., Öfvers. Förh. Kongl. Svenska Vetensk. – Akad. 41, 167. 1884.

= *Sphaerella washingtoniae* Rehm, Annales Mycologici 9, 364. 1911.

= *Mycosphaerella washingtoniae* (Rehm) Trotter, Sylloge Fungorum 24, 881. 1928.

For other synonyms see Arx (1949).

Known palm host. – *Washingtonia*.

Known distribution. – U.S.A. (California).

Type. – U.S.A.: California, Los Angeles, Claremont, on *Washingtonia brachypoda*, C. F. Baker & Metz 5388 (S, holotype).

This species forms brown leaf spots on *Washingtonia brachypoda*. Asci are 57–65 × 17–20 µm and ascospores are 15–19 × 5–6 µm (Rehm, 1911). *M. washingtoniae* is considered a synonym of *M. tassiana* by Arx (1949).

### Excluded, misplaced or poorly known species

***Mycosphaerella advena*** Syd., Annales Mycologici 28, 82. 1930.

Type. – VENEZUELA, Puerto la Cruz, on living leaves of palm (*Maziliania*), 25 Dec. 1927, H. Sydow 174b (type not seen).

We have been unable to locate type material of this species, which may be synonymous with *Mycosphaerella serrulata*.

***Mycosphaerella acrocomiicola*** Bat., Anais da Reuniao Anual da Sociedade Botânica do Brasil 5, 116. 1954.

Type. – BRAZIL, Recife, Afogados, on living leaves of *Acrocomia intumescens* Drude, 20 May 1953, A. Tenorio 4505 (URM, holotype, not seen).

We have been unable to obtain type material of this species, which may be synonymous with *Mycosphaerella serrulata*.

***Mycosphaerella braheae*** Siemaszko, Acta Soc. Bot. Polon. 1, 1. 1923.

Type. – RUSSIA, Georgia, Adzaria, Batum, on leaves of *Brahea edulis*, Sep. 1917, G. Woronow (type, not seen).

We have been unable to obtain type material of this species, which may be synonymous with *Mycosphaerella cocoecis*.

***Frondispora bicalcarata*** (Ces.) K. D. Hyde, Sydowia 45, 208. 1993.

≡ *Sphaerella bicalcarata* Ces., Hedwigia 11, 181. 1872.

≡ *Diaporthe bicalcarata* (Ces.) Niessl, Verhandlungen Naturforschender Verein in Bruenn 14, 169. 1876.

≡ *Ceriospora bicalcarata* (Ces.) Sacc., Sylloge Fungorum 2, 186. 1883.

≡ *Ceriosporella bicalcarata* (Ces.) Berlese, Icones Fungorum 1, 121. 1894.



***Laestadia cocophila*** (Cooke) Sacc., Sylloge Fungorum 1, 431. 1882.

= *Sphaerella cocophila* Cooke, Grevillea 5, 102. 1877.

Material examined. – GUIANA, Demerara, on leaves of *Cocos nucifera*, 1885 (K, holotype of *Sphaerella cocophila*).

Material examined by Hyde (1995) is immature.

***Oxydothis elaeidis*** (Beeli) Sivan., Transactions of the British Mycological Society 54, 496. 1970.

= *Sphaerella elaeidis* Beeli, Revue de Zoologie Africaine II(2), Supplement Botanique B10. 1923.

= *Mycosphaerella elaeidis* (Beeli) Hendr., Publications Institut National pour l'Étude Agronomique du Congo Belge. Serie Scientifique 35, 7. 1948.

***Sphaerella gastonis*** Sacc., Revue Mycologie 7, 58. 1885.

= *Mycosphaerella gastonis* (Sacc.) Lindau in Engler & Prantl, Natürliche Pflanzenf. 1, 426. 1897.

= *Mycosphaerella gastonis* (Sacc.) M. Barros & Garcia de Orta Estudios Agronomicos 1, 32 & 34. 1973, a superfluous synonym.

Type. – TAHITI, on leaves of *Cocos nucifera*, G. Brunaud (type of *Sphaerella gastonis*, not seen).

We have been unable to locate the type of this species. It may be an earlier name for *Mycosphaerella serrulata*.

***Oxydothis sabalensis*** (Cooke) Petr., Sydowia 6, 403. 1952.

= *Sphaerella incisa* Ellis & G. Martin, Journal of Mycology 1, 99. 1885.

Type. – U.S.A., Florida, Green Cove Springs, on dead petioles of *Sabal serrulata*, Winter of 1885, G. Martin (not at NY).

This species does not appear to have been studied since its introduction by Ellis & Martin (1885) and we have been unable to locate type material. Ascomata are reported as being depressed-globose and forming under a blackened region, asci are 100–120 × 8–10 µm, and ascospores are 40–50 × 3–4 µm, fusiform, and attenuated to a bristle-like point at each end (Ellis & Martin, 1885). This is probably a species of *Oxydothis* Penz. & Sacc., and is likely to be a synonym of *Oxydothis sabalensis* (Cooke) Petr.

***Sphaerella sabilidis*** Sousa da Câmara [as *sabalidis*], Boletim de Agricultura 2, 20. 1936.

= *Mycosphaerella sabalis* (Sousa da Câmara) Cash [as *sabalidis*], Sylloge Fungorum 26, 351. 1972.

Type. – PORTUGAL, Olisipponis Polytechnic, Botanical Gardens, on bark of branch of *Sabal palmetto*, Mar. 1934, S. Teixeira (type of *Sphaerella sabilidis*, not seen).

We have been unable to locate type material of this species, which may be synonymous with *Mycosphaerella cocoës*.

***Sphaerella sabaligena*** Ellis & Everh., Journal of Mycology 2, 101. 1886.

Material examined. – U.S.A., Louisiana, Pointe a la Hache, on dead tips of leaves of *Sabal palmetto*, Apr 1886, Langlois 426 (NY, holotype).

This species has brown fusiform 3-septate ascospores and is not a *Mycosphaerella*. It may be a *Phaeosphaeria* I. Miyake.

***Sphaerella zonata*** Ellis & Everh., J. Inst. Jamaica 1, 285. 1893.

Type. – JAMAICA, near Montego Bay, Catherine Hall Estate, on coconut palm, F. A. Sinclair 69 (type not seen).

We have been unable to locate type material of this species, which may be synonymous with *Mycosphaerella serrulata*.

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