

# Reappraisal and neotypification of *Phyllachora feijoa*

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**Abstract:** *Acca sellowiana* (Myrtaceae), feijoa (in Brazil, goiaba da serra), is a native southern South America tree that produces edible fruits which, although only occasionally cultivated in South America, became a significant fruit crop in New Zealand. Recently, during surveys for fungal pathogens of feijoa in southern Brazil, several plants were found bearing tar-spot symptoms caused by a species of *Phyllachora*. A literature search enabled us to identify the fungus as *Phyllachora feijoa*, a little-known species originally described in the 19<sup>th</sup> century by H. Rehm and later transferred to the genus *Catacauma*. The name *Catacauma feijoa*, although now regarded as a later synonym of *P. feijoa* is still mistakenly in use (as, for instance, in the Brazilian list of fungi on plants). The type specimen was most probably deposited in the Botanisches Garten und Museum Berlin-Dahlem (B) and lost or destroyed during World War II, and could not be located. The recent recollection of abundant material of this fungus in the vicinity of Pelotas (Rio Grande do Sul, Brazil) allowed its re-examination and neotypification. *Phyllachora feijoa* is also illustrated here for the first time.

## Key words:

*Ascomycota*  
Brazil  
fruit crop  
*Myrtaceae*  
Neotropics  
nomenclature  
*Phyllachoraceae*

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## INTRODUCTION

The plant family *Myrtaceae* includes approximately 150 genera with over 5 500 species (Heywood *et al.* 2007), amongst which are some important forestry species (e.g. *Eucalyptus* spp.) and several fruit crops such as guava (*Psidium guajava*). Some, such as *Acca sellowiana* (common name feijoa; in Brazil, goiabeira da serra) are only minor fruit crops. *Acca sellowiana* is a shrub or small tree native to southern South America (southern Argentina, Brazil, Paraguay, and Uruguay) and, although only occasionally cultivated in South America, it has become more significant as a fruit crop in New Zealand (Al-Harthy 2010). There are few published records of fungal pathogens associated with feijoa (Farr & Rossman 2011, Mendes & Urben 2011). However, during a recent search for pathogens of feijoa in the southern Brazilian state of Rio Grande do Sul, individuals of *A. sellowiana* in rural areas in the vicinity of Pelotas had foliage with intense tar-spot symptoms. Such symptoms were typical of those caused by fungi belonging to the genus *Phyllachora*. Examination of specimens collected and a literature and herbarium search were performed in order to clarify the identity of the fungus on feijoa, and the results of these investigations are presented here.

## MATERIAL AND METHODS

Samples of diseased foliage of *Acca sellowiana* were collected in two localities. These were dried in a plant press and taken

to the laboratory for further examination. Representative specimens were deposited in the local herbarium (Herbarium Universidade Federal de Viçosa, VIC). Examination of selected leaves bearing tar-spot symptoms with the help of an Olympus SXZ7 stereoscopic microscope revealed that fungal structures were immersed in the leaf tissue and sections were prepared and mounted in lactophenol and lactofucsin for further examination. Additionally, sections were also prepared with a freezing microtome (Cryostat Microm<sup>®</sup> HM 520). Observations, photographs, and line drawings were prepared with a light microscope Olympus BX51, fitted with a digital camera (Olympus E-volt 330) and a drawing tube.

## TAXONOMY

***Phyllachora feijoa*** Rehm, *Hedwigia* **36**: 370 (1897).  
*Synonym:* *Catacauma feijoa* (Rehm) Theiss & Syd.,  
*Ann. Mycol.* **13**: 397 (1915).  
(Fig. 1)

*Type:* **Brazil:** *Rio Grande do Sul:* Pelotas, Chácara da Brigada, Cerro da Buena, on leaves of *Acca sellowiana* (*Myrtaceae*), 18 Aug. 2010, R. W. Barreto (VIC 31476 – **neotype designated here**; B 70 0015054 – isoneotype).

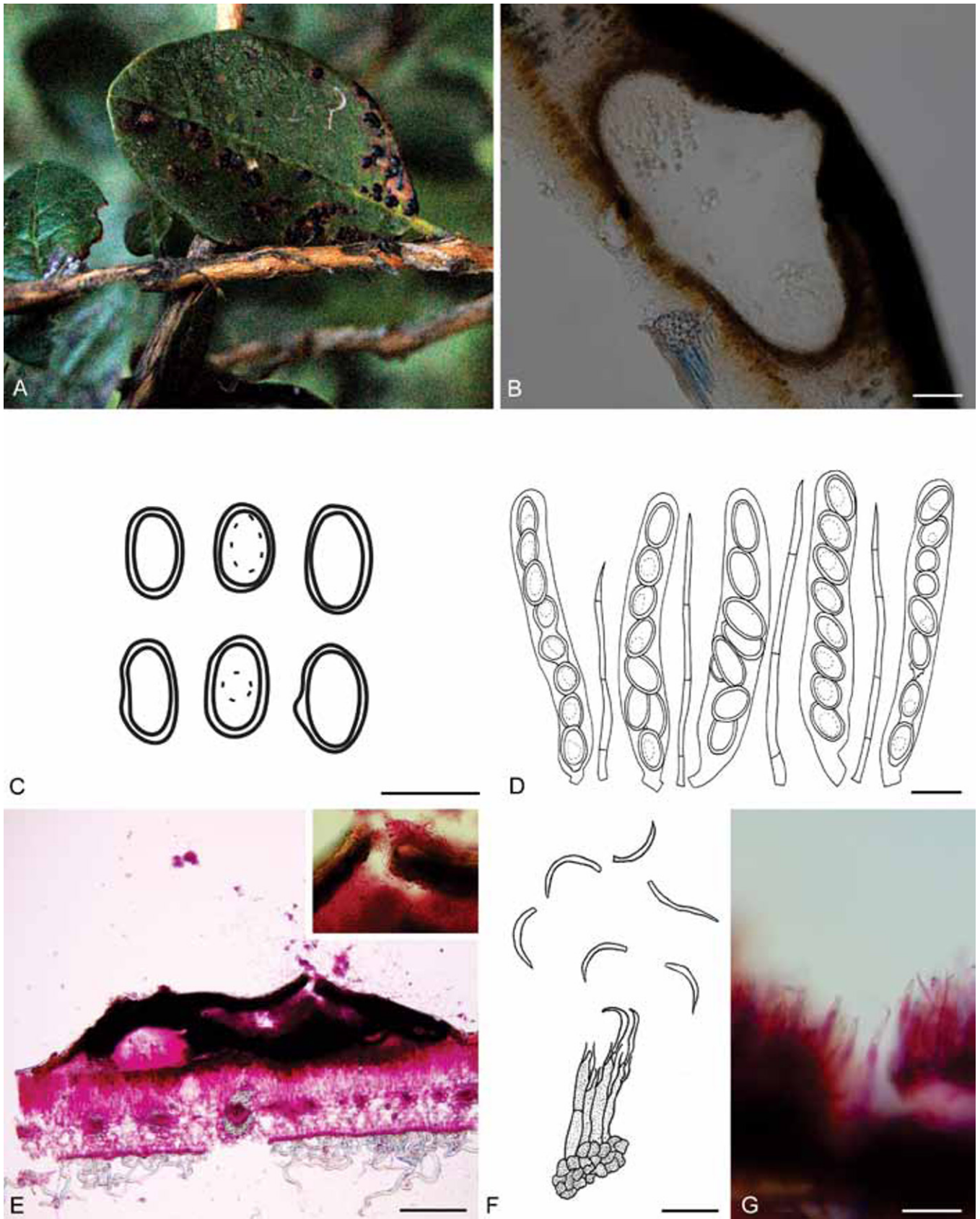
*Other specimen examined:* **Brazil:** *Rio Grande do Sul:* Pelotas, Capão do Leão, on leaves of *Acca sellowiana* (*Myrtaceae*), 18 Aug. 2010, R. W. Barreto (VIC 31766).

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**Fig. 1.** *Phyllachora feijoae* (VIC 31766). **A.** Tar-spots on leaves of *Acca sellowiana*. **B.** Perithecium and clypeus. **C.** Ascospores. **D.** Paraphyses and asci with ascospores. **E.** Ascomata (left) and conidioma (right) and close up part of the conidioma. **F–G.** Conidiogenous cell and conidia. Bars: B = 80  $\mu\text{m}$ , C = 20  $\mu\text{m}$ , D = 20  $\mu\text{m}$ , E = 275  $\mu\text{m}$ , F–G = 10  $\mu\text{m}$ .

*Lesions* on living leaves, adaxially on all leaves at various developmental stages, initially punctiform, becoming irregular tar-spots, raised, with age surrounded by yellowish to reddish peripheral necrotic haloes, widely distributed and leading to foliage distortions, 0.2–0.3 × 2.1–3.0 mm diam, indistinct abaxially. *Internal mycelium* intra- and intercellular, hyphae 2.0–3.0 µm diam, branched, septate, hyaline to pale brown. *External mycelium* absent. *Stromata* adaxial, clypeate, shield-like, merged with the upper wall of the ascoma. *Conidia* formed within stromata externally indistinguishable from teleomorph stomata; flattened, lenticular to irregular (in section), epigenous, subepidermal, single or in combination with ascomata, sometimes very broad occupying nearly the whole breadth of the stroma, 615–1729 × 100–184 µm walls of dark brown *textura angularis*, 38.5–69 µm thick, smooth; *conidiogenous cells* subcylindrical, straight, 15–25(–40) × 2–3 µm, 0–1-septate, pale brown; *conidia* mucilaginous, enteroblastic, acicular, curved, lunate or sigmoid, 13–19 × 1.5 µm, aseptate, thin-walled, hyaline, smooth. *Ascomata* perithecial, epigenous, immersed, solitary, spherical to subspherical, somewhat to strongly depressed, short papillate, 41–218 µm diam, inconspicuously ostiolate, composed of thin-walled brown *textura angularis*, walls 6.5–44 µm, 7–11 cells thick, outer layers dark brown, inner layers pale brown to subhyaline. *Interascal tissue* of paraphyses, 2.5–3 µm diam, longer than the asci, filiform, septate, hyaline, thin-walled, constricted at the septae; periphyses well-developed, filiform, hyaline, thin-walled. *Asci* unitunicate, cylindrical to clavate, short-stalked, 70.5–104 × 13–27 µm, apex broadly rounded to nearly flat, thin-walled, 8-spored. *Ascospores* at first uniseriate but sometimes partially biseriate, 15.5–22 × 8–14 µm, ellipsoidal to cylindrical-ellipsoidal, rounded at the ends, walls 2–3 µm thick, aseptate, hyaline, smooth, without a mucous sheath or appendages.

*Notes:* Very little information is available on *Phyllachora feijoae*. Only a very brief description is given in the original publication of Rehm (1897). Later, Theissen & Sydow (1915) prepared a more complete description of the fungus when combining it into *Catacauma*. This is, nevertheless, somewhat incomplete and no illustrations were provided. Furthermore, the description was apparently based on Rehm's material collected in "Serra Geral, Minas Gerais – Brazil". The last publication dealing with this fungus was that of Jimenez & Hanlin (1992), where names of fungi described in *Catacauma* were listed. Although the authors acknowledged that after Petrak's (1924) work it became widely accepted that the distinction of *Catacauma* from *Phyllachora* was artificial, they prudently did not propose that names in *Catacauma* should be immediately rejected or recombined into *Phyllachora* without a careful re-examination of types. Since that publication, mycologists have shown little interest in the names of fungi referred to *Catacauma*, but some earlier fungal names in *Phyllachora* have been reinstated. That is the case of the name *C. feijoae*, presently listed in MycoBank and *Index Fungorum* as a later synonym of *P. feijoae*. Nevertheless, this name is still being used in other instances (e.g. the Brazilian list of fungi on plants; Mendes & Urben 2011).

An expanded description based on the material recently collected in Brazil is provided above. This is also the first time illustrations of *P. feijoae* have been published. The original material of the species studied by Rehm would almost certainly have been deposited in the collections of the Botanisches Garten und Museum Berlin-Dahlem (B), but if so it appears to have been lost or destroyed during World War II as it could not now be found (H.J.M. Sipman, pers. comm.). We therefore designate one of the recent collections as a neotype to fix the application of the name.

## DISCUSSION

The fungus on *Acca sellowiana* exhibits all the typical features, both in terms of symptoms produced on the host and in its morphology, to members of the genus *Phyllachora* (*Phyllachoraceae*, *Phyllachorales*). *Phyllachora* is a large genus including approx. 1000 named species (Kirk *et al.* 2008). All species of *Phyllachora* are biotrophic plant pathogens, causing tar-spots on members of numerous plant families, but are particularly common on *Fabaceae* (Cannon 1991) and *Poaceae* (Parbery 1971). Besides the presence of a well-developed, dark brown to black clypeus, other features such as the formation of the perithecia within the plant tissues, and hyaline, thin-walled, smooth and aseptate ascospores, are typical for the genus (Cannon 1991). Around 70 species of *Phyllachora* have been described on members of *Myrtaceae* worldwide (Farr & Rossman 2011), with 21 species recorded on this host-family in Brazil (Mendes & Urben 2011). Species of *Phyllachora* associated with *Myrtaceae* have never been monographed.

Some of the older records of *Phyllachora* on *Myrtaceae* were later recognized as mistakenly placed in that genus. Some were found to belong to other genera, - such as *P. pululahuensis* (now regarded as a synonym of *Vestegrenia multipunctata*; von Arx & Müller 1954), and *P. eucalypti* (now recognized as a synonym of *Clypeophysalospora latitans*; Crous *et al.* 1990). Other species were recombined into genera such as *P. peribebuyensis* which is now treated as *Coccodiella peribebuyensis* (Katamoto 1968). Several names in *Phyllachora* that are listed on members of *Myrtaceae* were found to be later synonyms of already known species names: *P. conspurcata* (syn. *P. tropicalis*; Saccardo 1883), *P. phylloplaca* (syn. *P. ipirangae*; Theissen & Sydow 1915b), *P. pseudostromatica* (syn. *P. melaleuca*; Sydow & Sydow 1904), and *P. semillunata* (syn. *P. selenospora*; Petrak & Ciferri 1930). Additionally, *P. langdonii* is now treated as a subspecies of *P. callistemonis*, *P. callistemonis* subsp. *langdonii* (Pearce & Hyde 1994).

In the case of species of *Phyllachora* recorded from Brazil, an issue to be taken into consideration is that numerous species names are included in Mendes *et al.* (1998), and have also been kept in the database of fungi on plants in Brazil (Mendes & Urben 2011) but quoted as being "in press". These names, for which Medeiros & Dianese are given as authors, have never been validly published and include the following



Table 1. Data on *Phyllachora* spp. described on hosts belonging to *Myrtaceae*.

Species	Asci (µm)	Ascospores (µm)	Host plants	References
<i>P. ambigua</i>	50–60 x 8–12	9–11 x 6	<i>Syzygium cumini</i> (syn. <i>Eugenia jambolana</i> )	Theissen & Sydow (1915b)
<i>P. angustispora</i>	80–90 x 12–14	30 x 8–9	<i>Eugenia</i> sp.	Saccardo (1916)
<i>P. bella</i>	60–70 x 5–7	7.5–9 x 3–4	<i>Syzygium australe</i> (syn. <i>E. australis</i> )	Sydow (1937)
<i>P. biareolata</i>	90–95 x 6–9	12 x 5	<i>Eugenia rhombea</i>	Saccardo (1891)
<i>P. biguttulata</i>	50–65 x 8–10	10–12 x 5–5.5	<i>Campomanesia rhombea</i>	Saccardo (1913)
<i>P. brenesii</i>	70–80 x 10–15	12–17 x 8–10	<i>Eugenia guayaquilensis</i>	Sydow & Petrak (1929)
<i>P. callistemonis</i>	115–210 x 12.5–16	18–27.5 x 7.5–10	<i>Callistemon pallidus</i>	Pearce & Hyde (1994)
<i>P. callistemonis</i> subsp. <i>Langdonii</i>	100–154 x 12–20	18–25 x 6–9	<i>Callistemon</i> sp.	Pearce & Hyde (1994)
<i>P. callistemonis</i> subsp. <i>Similis</i>	117–173 x 18–27.5	18–29 x 7.5–12.5	<i>Callistemon viminalis</i>	Pearce & Hyde (1994)
<i>P. capensis</i>	100–120 x 13–14	60–70 x 5–6	<i>Eugenia zuluensis</i>	Doidge (1942)
<i>P. cayennensis</i>	68–75 x 12–14	20–24 x 7–8	<i>Psidium</i> sp.	Theissen & Sydow (1915b)
<i>P. clavata</i>	110–140 x 15–18	39–45 x 3–6	<i>Myrcia</i> sp.	Garces Orejuela (1944)
<i>P. curvulispora</i>	60–80 x 10–20	17–20 x 5–7	<i>Myrtaceae</i> sp.	Saccardo (1925–1928)
<i>P. distinguenda</i>	60–70 x 18	18–20 x 4.5	<i>Myrtaceae</i> sp.	Saccardo (1899)
<i>P. egenula</i>	70–85 x 7–8	10–13 x 5–6	<i>Leptospermum lanigerum</i>	Sydow (1938)
<i>P. emarginata</i>	80–130 x 18–28	16–20 x 10–12	<i>Eugenia</i> sp.	Petrak (1948)
<i>P. eugeniae</i>	60–75 x 7–9	8–10 x 4–4.5	<i>Eugenia rhombea</i>	Chardón (1927)
<i>P. feijoa</i>	60 x 25	18 x 10	<i>Acca sellowiana</i>	Rehm (1915)
<i>P. gentilis</i>	120 x 4–12	18–20 x 8–9	<i>Eugenia</i> sp.	Saccardo (1895)
<i>P. goyazensis</i>	70–90 x 17–18	12–14 x 8–12	<i>Myrtaceae</i> sp.	Hennings (1895)
<i>P. guavira</i>	100–110 x 6–8	12 x 5	<i>Psidium</i> sp.	Theissen & Sydow (1915b)
<i>P. ipirangae</i>	30–90 x 10–12	15–16 x 8	<i>Eugenia</i> sp.	Theissen & Sydow (1915b)
<i>P. lindmanii</i>	80–90 x 13–16	16–24 x 13–16	<i>Myrtaceae</i> sp.	Theissen & Sydow (1915a)
<i>P. maculata</i> *		22–25	<i>Eucalyptus</i> sp.	Cooke (1891)
<i>P. manuka</i>		10.5–13 x 6.5–8	<i>Leptospermum scoparium</i>	Johnston & Cannon (2004)
<i>P. melaleuca</i>	66–84 x 8–11		<i>Melaleuca spinosa</i>	Theissen & Sydow (1915a)
<i>P. myrciae</i> *			<i>Eugenia bimarginata</i>	Saccardo (1883)
<i>P. myrciae-rostratae</i>	100–120 x 6–8	14–17 x 5–6	<i>Myrcia splendens</i> (syn. <i>M. rostrata</i> )	Viégas (1944)
<i>P. muelleri</i>	95–120 x 13–15	28–32 x 6–7	<i>Eugenia dodonaeifolia</i>	Chardón <i>et al.</i> (1940)
<i>P. myrrhinii</i>	50–72 x 12–16	14–16 x 5	<i>Myrrhinium atropurpureum</i> var. <i>octandrum</i>	Theissen & Sydow (1915a)
<i>P. nigerrimum</i>	100–130 x 9	10–16 x 5	<i>Campomanesea adamantium</i> (syn. <i>C. caerulea</i> )	Viégas (1944)
<i>P. opaca</i>	80–85 x 6–8	10 x 4–4.5	<i>Myrtaceae</i> sp.	Berlese & Voglino (1886)
<i>P. peglerae</i>	120–140 x 17–20	20–23 x 12–13	<i>Eugenia capensis</i>	Doidge (1942)
<i>P. pettimenginii</i>	85–105 x 14–18	2–8–32 x 8.5–11	<i>Myrtaceae</i> sp.	Maire (1908)
<i>P. rhytismoides</i>		14–19.5 x 12–15.5	<i>Melaleuca cajuputi</i>	Cannon (1991)
<i>P. rickiana</i>	68–78 x 14–15	10–13 x 6	<i>Myrtaceae</i> sp.	Theissen (1918)
<i>P. rimulosa</i>	85–100 x 10	14 x 8	<i>Eugenia</i> sp.	Saccardo (1925–1928)
<i>P. samanensis</i>	70–83 x 13–16.5	32–40 x 6–7.5	<i>Eugenia</i> sp.	Petrak & Ciferri (1932)
<i>P. shivasii</i>	136–225 x 10–15	15–22 x 6–8.5	<i>Melaleuca viridiflora</i>	Pearce & Hyde (1995)
<i>P. subcircinans</i>	80–90 x 10–16	14–16 x 8–10	<i>Psidium grandifolium</i>	Viégas (1944)
<i>P. subopaca</i>	75 x 10–15	12–14 x 7	<i>Myrtaceae</i> sp.	Saccardo (1899)
<i>P. tachirensis</i>	109–166 x 9.5–12	13–17 x 7–8	<i>Eugenia</i> sp.	Chardón & Toro (1934)
<i>P. tropicalis</i>	70–75 x 10–14	15–18 x 7–8	<i>Psidium grandifolium</i>	Saccardo (1883)
<i>P. truncatispora</i>	70–90 x 16–24	22–26 x 7–8	<i>Myrtaceae</i> sp.	Viégas (1944)
<i>P. urbaniana</i>	70–90 x 16–18	14–15 x 6–8	<i>Myrtaceae</i> sp.	Saccardo (1899)
<i>P. verrucosa</i>	78–105 x 15–19	14–20 x 9–13	<i>Melaleuca leucadendra</i>	Arx & Müller (1954)

Table 1. (Continued).

Species	Asci (µm)	Ascospores (µm)	Host plants	References
<i>P. whetzelii</i>	87–109 x 8–10.5	11.5–13 x 3–4	<i>Eugenia</i> sp.	Chardón (1921)
<i>P. woodiana</i>	80–100 x 6–7.5	12.5–15.0 x 5–6	<i>Eugenia capensis</i>	Doidge (1942)

species designations associated with members of *Myrtaceae*: *P. eugenii-complicatae*, *P. eugenii-punctifolia*, *P. myrciae-decrescentis*, *P. myrciae-guianensis*, *P. myrciae-multiflorae*, *P. myrciae-multiflorae*, *P. myrciae-pallescens*, *P. myrciae-tematae*, *P. myrciae-tortae*, and *P. pampulhae*. Although all these designations are not validly published, most may well represent good taxonomic species which are still awaiting formal description. Most were collected in the Brazilian cerrado, an area rich in endemic organisms of all kinds.

A study of the 48 published descriptions of taxa (including three varieties) of *Phyllachora* described from hosts belonging to *Myrtaceae*, is summarized in Table 1. This shows that there are three species of *Phyllachora* with close morphological similarity to *P. feijoa* on *A. sellowiana*: *P. brenesii*, *P. emarginata*, and *P. subcircinans*. Each of those species was found to have morphological differences from *P. feijoa*. *Phyllachora brenesii* has perithecia with narrower walls (5 µm thick), and asci which are also narrower (10–15 µm wide). *Phyllachora emarginata* has thinner ascospore walls (2 µm). And *P. subcircinans* has much wider perithecia (250–500 µm diam). Additionally, *P. feijoa* can be recognized as distinct from the other species known on *Myrtaceae* (Table 1) by a combination of morphometric features; differences in perithecial diameter, ascus width, and the absence of a mucilaginous sheath on the ascospores. Although no comparison of the morphology of *P. feijoa* with other species on *Myrtaceae* was attempted in previous publications, our results indicate that this species is distinct from other *Phyllachora* species on this host-family, and so deserves recognition as a separate species. No significant discrepancies were found between the morphology of the neotype and the description provided in Theissen & Sydow (1915).

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