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***Paraphaeosphaeria schoenoplecti* sp. nov. from senescent culms of *Schoenoplectus litoralis* in Hong Kong**

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*Paraphaeosphaeria schoenoplecti* sp. nov. is described and illustrated, based on collections of senescent *Schoenoplectus litoralis* from Hong Kong. Ascospores are 3-celled, with the central cell markedly shorter than the two end cells. The ascospores are comparatively longer than those of all other species in the genus with 3-celled ascospores and these are surrounded by a wide spreading mucilaginous sheath. *Paraphaeosphaeria schoenoplecti* is compared with *P. concentrica*, *P. michotii*, and *P. microspora*, which also consistently possess 3-celled ascospores.

**Key words:** Ascomycotina, cyperaceous fungi, intertidal fungi, *Phaeosphaeriaceae*, systematics.

**Introduction**

*Paraphaeosphaeria* was introduced by Eriksson (1967) as a segregate from *Leptosphaeria* Ces. and De Not. (1863). Ascomata of *Paraphaeosphaeria* are generally scattered, immersed and subepidermal. They may be globose, depressed globose, or laterally compressed. Asci are bitunicate, and are mostly cylindrical to clavate, and with a short pedicel. Ascospores vary in septation from 2-9, with the first septum always forming below the middle, resulting in a slightly enlarged central cell. Ascospores are yellowish to brown, and are generally surrounded by a mucilaginous sheath.

*Paraphaeosphaeria* differs from *Leptosphaeria* species because the first-formed septum of the ascospores is submedian and the anamorphs are *Coniothyrium* species (Sivanesan, 1984). Shearer *et al.* (1993) also noticed that the ascomata in the genus have a characteristic broad hymenial layer, and the peridium comprises large pseudoparenchymous cells.

When introducing *Paraphaeosphaeria*, Eriksson (1967) described four species with oblong-cylindric ascospores (i.e. *P. castagnei*, *P. michotii*, *P. obtusispora*, and *P. rusci*). Hedjaroude (1969) and Ahmad (1978) expanded the genus to include *P. capparidicola* Mundk. and Ahmad and *P. vectis* (Berk. and Broome.) Hedjaroude. Shoemaker and Babcock (1984) monographed and re-

described the Canadian species. Eriksson (1992) transferred *Pleospora cylindrospora* to *Paraphaeosphaeria cylindrospora*, while Shearer *et al.* (1993) transferred *Leptosphaeria trimerioides* to *P. cylindrospora*. Ramaley (1997) introduced *P. agavensis* and *P. nolinae* with 5-septate ascospores based on collections from *Agave*, *Dasyllirion*, and *Nolina*, and Kohlmeyer *et al.* (1996; 1999) introduced *P. pilleata* and *P. apicicola* based on collections on *Juncus roemerianus*. Nineteen species are presently known in the genus and a further new species is described in this paper (Table 1).

In a survey of the saprobic fungi on *Schoenoplectus litoralis* in a freshwater marsh (Gei Wai number 9, Mai Po Marshes) in Hong Kong, a new *Paraphaeosphaeria* was identified. In this species ascospores are 3-celled, with the central cell markedly shorter than the two end cells, and are consistently surrounded by a wide-spreading mucilaginous sheath. It was found associated with dead standing culms in the region 10 cm below the water level to 10 cm above, and can be regarded as a freshwater species. *Paraphaeosphaeria schoenoplecti* sp. nov. is illustrated with light micrographs (Figs. 1-9) and is compared with *P. concentrica*, *P. michotii*, and *P. microspora* with consistent 3-celled ascospores (Figs. 10-13). A synopsis of *Paraphaeosphaeria* species (Table 1) is provided and summarizes the major characters exhibited by species in this genus.

## Taxonomy

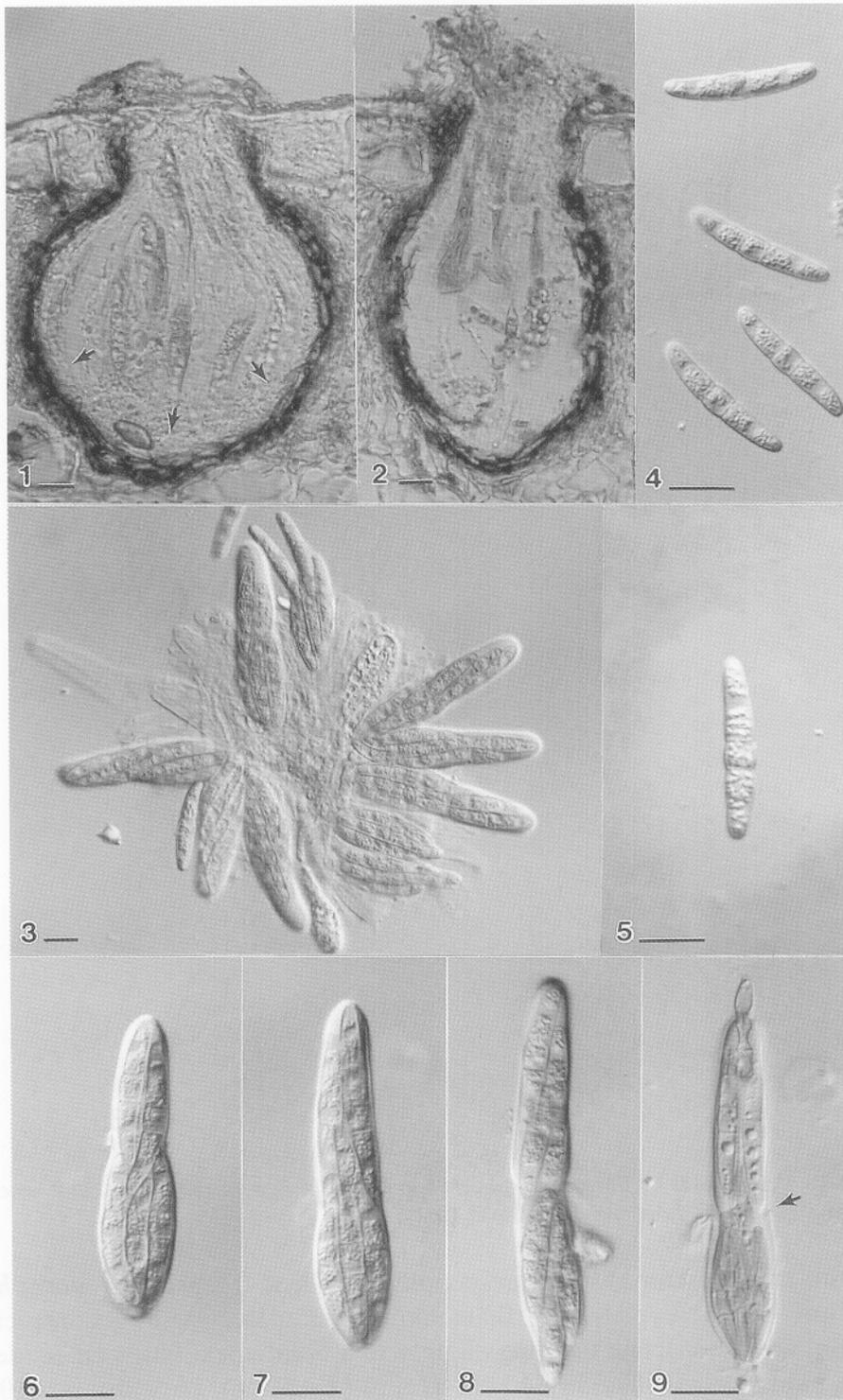
### *Paraphaeosphaeria schoenoplecti* M.K.M. Wong, Goh and K.D. Hyde, sp. nov. (Figs. 1-9)

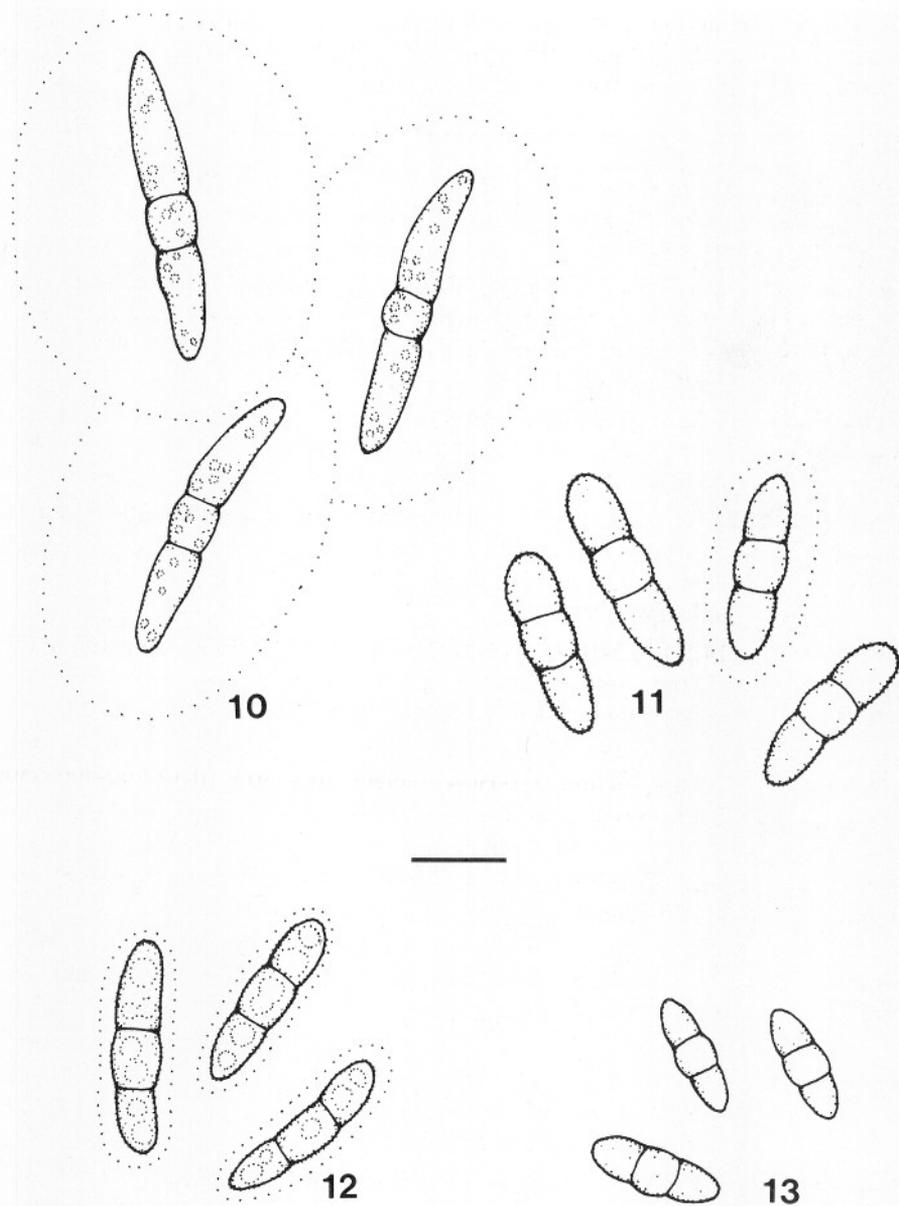
*Etymology*: *schoenoplecti*, referring to the host

*Ascomata* 76-120  $\mu\text{m}$  alta, 110-130  $\mu\text{m}$  in diametro, immersa, subglobosa, ostiolata. *Ostiolum* 40-60  $\mu\text{m}$  altum, 30-34  $\mu\text{m}$  latum, centrale, cylindricum, non-periphysatum. *Asci* 50-64  $\times$  14-16  $\mu\text{m}$ , 8-spore, clavati, apedicellati, bitunicati, fissitunicati, apparato apicali non praediti. *Ascosporeae* 27-31  $\times$  3.8-4  $\mu\text{m}$ , 2-3-seriatae, rectae vel subcurvatae fusiformes, flavidobrunneae, ad septa constrictae, guttulatae, laeves, cum tunico mucilaginosa praeditae.

*Ascomata* 76-120  $\mu\text{m}$  high, 100-130  $\mu\text{m}$  diam., immersed in the palisade mesophyll of the host, globose to subglobose, ostiolate, with a short cylindrical ostiole. *Peridium* 10-12  $\mu\text{m}$  thick, of uniform width throughout, comprising 3-4 layers of brown, slightly compressed pseudoparenchymatous cells (Figs. 1-2). *Ostiole* 40-60  $\mu\text{m}$  high and 30-34  $\mu\text{m}$  wide, central, cylindrical, consistent with

**Figs. 1-9.** *Paraphaeosphaeria schoenoplecti* (from holotype). **1, 2.** Vertical sections through ascomata. Note the asci developed from a broad hymenial layer in Fig. 1 (arrowed). **3.** A cluster of asci. **4, 5.** Ascospores. Note the mucilaginous sheath in Fig. 5 (in Indian Ink). **6-9.** Asci, which are apedicellate and slightly constricted at the middle. Note fissitunicate dehiscence in Fig. 9 (arrowed). Bars = 10  $\mu\text{m}$ .





**Figs. 10-13.** Ascospores of *Paraphaeosphaeria* species. **10.** *P. schoenoplecti*. **11.** *P. michotii*. **12.** *P. concentrica*. **13.** *P. microspora*. Bar = 10  $\mu\text{m}$ .

the width at the ascoma wall, non-periphysate (Figs. 1-2). *Pseudoparaphyses* 2-2.5  $\mu\text{m}$  wide, hypha-like, filamentous, guttulate, with inconspicuous septation, not constricted, tapering slightly to a blunt apex, bases embedded in mucilaginous matrix. *Asci* 50-64  $\times$  14-16  $\mu\text{m}$  ( $\bar{x}$  = 57.8  $\times$  15.5  $\mu\text{m}$ ; n = 10), 8-

**Table 1.** Synopsis of accepted species in *Paraphaeosphaeria* (Ahmad, 1978; Barr, 1992; Hedjaroude, 1969; Huhndorf, 1992; Kohlmeyer *et al.*, 1996, 1999; Ramaley, 1997; Sivanesan, 1984; Shearer *et al.*, 1993; Shoemaker and Babcock, 1984).

Species	Ascospores	Asci	Ascomata
<i>P. agavensis</i> A.W. Ramaley	29-37 × 9-11 µm, 5-septate, cylindrical, yellowish-brown, finely punctate	128-180 × 17.5-21.5 µm	250-500 µm wide and 250-500 µm high
<i>P. apicicola</i> Kohlm., Volk.-Kohlm. and O.E. Erikss.	19.5-25.5 × 5.5-7 µm, (3-)4-5(-6)-septate, cylindrical to elongate ellipsoidal or fusiform, light brown, smooth-walled	80-105 × 12.5-15 µm, with a small ocular chamber	225-400 µm wide and 200-400 µm high
<i>P. capparidicola</i> Mundk. and Ahmad	19-30 × 6-8.5 µm, 4-6-septate, curved, oblong with obtuse ends, yellowish-brown	90-115 × 14-17 µm	180-250 µm diam.
<i>P. castagnei</i> (Durieu and Montagne) O.E. Erikss.	24-45 × 6-8 µm, (7-)9(-11)-septate, cylindrical, reddish-brown, with a large oval guttule per cell, smooth-walled, with sheath	120-140 × 16-19 µm	300-500 µm wide and 200-250 µm high
<i>P. concentrica</i> (Ellis and Everh.) Huhndorf	(14.5-) 16.5-18.7 × (3.6-) 4.3-5.7 (-6.5) µm, 2-septate, cylindrical, brown, with rounded end cells	(43-) 54-66 × 10.8-12.2 µm, with apical chamber	90-100 µm wide and 100-125 µm high
<i>P. conglomerata</i> Barr	20-25 × 7-8 µm, (1-2-)3(-4)-septate, oblong, yellowish-brown, finely verruculose, with a gelatinous coat	100-130 × 10-12 µm	200-400 (-500) µm diam.
<i>P. cylindrospora</i> (Wehm.) O.E. Erikss.	18-21 × 5.5-7 µm, 5-6 septa, ends broadly rounded, yellowish-brown	85-110 × 12.5-14 µm	200-250 µm diam.
<i>P. filamentosa</i> (Ellis and Everh.) Barr	12-14 × 4-5 µm, (1-2-)3-septate, oblong, yellowish-brown, verruculose	55-70 × 8-10 µm, oblong	200-220 µm diam.
<i>P. glauco-punctata</i> Grev.	19-24 × 4-5 µm, 4-septate, cylindrical, yellowish-brown, coarsely echinulate, with a sheath	70-85 × 14-16 µm	200-300 µm wide and 150-250 µm high
<i>P. maximiliani</i> (Ellis and Everh.) Barr	15.5-22.5 × (3.5-) 6.5-8 µm, 2(3-4)-septate, oblong, yellowish to yellowish-brown, smooth-walled	60-67 × 12-15 µm	350-315 µm wide and 130 µm high
<i>P. michotii</i> (Westen.) O.E. Erikss.	(12-) 16-24 × 4-5 (-6) µm, 2-septate, cylindrical, yellowish brown, with small guttules, echinulate	60-80 × 12-18 µm	200-250 µm wide and 150-190 µm high

Table 1. (continued).

Species	Ascospores	Asci	Ascomata
<i>P. microspora</i> Ellis and Everh.	(9-) 12-16 × 3.5-4.5 µm, 2-septate, narrowly fusiform, yellowish-brown, no guttule, smooth, without sheath	55-60 (70) × 5-7 µm	150-200 µm wide and 120-140 µm high
<i>P. nolinae</i> A.W. Ramaley	22.5-34.5 × 8-9.5 µm, 5-septate, cylindrical, yellowish-brown, finely punctate	136-168 × 13.5-16 (-17.5) µm	200-325 µm wide and 200-375 µm high
<i>P. obtusispora</i> (Speg.) Hedjar.	(15-) 17-24 × 4.5-6.5 µm, 5-septate, cylindrical, yellowish-brown, guttulate, echinulate, with sheath	90-110 × 11-13 µm	250-350 µm wide and 200-250 µm high
<i>P. pilleata</i> (Kohlm., Volk. and O.E. Erikss.)	15.5-23.5 × 4.5-6 µm, 2(-3)-septate, cylindrical to elongate ellipsoidal, olive brown, verruculose, surrounded by a sheath with an umbilicus at the top	60-80 × 10-12 µm	150-350 µm wide 120-300 µm high
<i>P. quadriseptata</i> Barr	16-19.5 × 5-7 µm, 4-septate, oblong, with rounded end cells, dark reddish-brown, verruculose, with a narrow gelatinous coat	76-110 × 11-14 µm, oblong	220-330 µm diam.
<i>P. schoenoplecti</i> sp. nov.	27-31 × 3.8-4 µm, 2-septate, long fusiform, yellowish-brown, with tiny guttules, with a large sheath	50-64 × 14-16 µm, apedicellate	100-130 µm wide and 76-120 µm high
<i>P. trimerioides</i> (Rehm) Shearer, Huhndorf and Crane	13-15 × 5.8-8 µm, (1-)2(-3)-septate, fusiform with acute to rounded end cells, pale brown with dense deposits of golden-brown pigment at septa, without sheath	57.2-83.3 × 5.8-8 µm	213-289 µm wide and 127-156 µm high
<i>P. vectis</i> (Berk. and Broome) Hedjar.	20-27 × 6-7 µm, 4-septate, cylindrical, yellowish-brown, finely echinulate, with guttules, with sheath	80-90 × 12-15 µm	170-200 µm wide and 130-150 µm high

spored, clavate, slightly constricted in the middle, apedicellate, fissitunicate, tapering to a rounded apex, lacking any apical apparatus (Figs. 6-9). *Ascospores* 27-31 × 3.8-4 µm ( $\bar{x}$  = 29.3 × 4.0 µm; n = 10), 2-3-seriate, straight to slightly curved, fusiform, yellowish-brown, 2-septate, constriction at the septa, with numerous tiny guttules, smooth-walled, surrounded by a wide spreading mucilaginous sheath; central cell slightly swollen, isodiametric; end cells longer than central cell with length ratio *ca.* 2:1:2, rounded to slightly tapering towards the ends, longer than width (Figs. 4-5).

*Material examined:* HONG KONG, New Territories, Mai Po Marshes, Gei Wai number nine, (22°29'N, 114°02'E), on standing senescent culms (10 cm below water level to 10 cm

above water level) on *Schoenoplectus litoralis*, 17 June 1997, M.K.M. Wong [HKU(M) 12505, HOLOTYPE]; *ibid*, 1 Sep. 1999 [HKU(M)12508, HKU(M)12509, HKU(M)12510, HKU(M)12511, HKU(M)12512].

### Discussion

*Paraphaeosphaeria schoenoplecti* is similar to *P. concentrica*, *P. michotii*, and *P. microspora*, which consistently have two-septate ascospores (Figs. 10-13). The ascospores of these three species, however, are markedly shorter, and in two species, the walls are echinulate (Barr, 1992; Hedjaroude, 1969; Shoemaker and Babcock, 1984). In *P. schoenoplecti*, the ascospores have two end cells are distinctly longer and are approximately two times longer than the central cells. Asci of *P. schoenoplecti* are apedicellate, whereas those of other species have a short pedicel.

*Paraphaeosphaeria* species are commonly found on monocotyledonous plants (Huhndorf, 1992). *Paraphaeosphaeria apicicola* is recorded from *Juncus roemerianus* (Kohlmeyer *et al.*, 1999). *Paraphaeosphaeria michotii* is recorded on *Saccharum officinarum* and a variety of other grasses, and is widespread and causes leaf spot of sugar cane (Sivanesan, 1984). *Paraphaeosphaeria schoenoplecti* is however the only species found on sedge (*Cyperaceae*). Both *P. apicicola* and *P. michotii* appear to occur on leaves, whereas *P. schoenoplecti* is found on culms.

### Key to *Paraphaeosphaeria* species

1. Ascospores (1-)2(-3)-septate ..... 2
1. Ascospores always with more than 2 septa ..... 8
2. Ascospores smooth-walled ..... 3
2. Ascospores rough-walled ..... 6
3. Ascospores usually wider than 6  $\mu\text{m}$  ..... 4
3. Ascospores usually narrower than 6  $\mu\text{m}$  ..... 5
4. Ascospores 15.5-22.5  $\times$  (3.5-)6.5-8  $\mu\text{m}$ , 2(-4)-septate, oblong ..... *P. maximiliani*
4. Ascospores shorter than 13-15  $\times$  5.8-8  $\mu\text{m}$ , (1-)2(-3)-septate, fusiform ..... *P. trimerioides*
5. Ascospores 27-31  $\times$  3.8-4  $\mu\text{m}$ , with a large mucilaginous sheath ..... *P. schoenoplecti*
5. Ascospores (9-)12-16  $\times$  3.5-4.5  $\mu\text{m}$ , without a sheath ..... *P. microspora*
6. Ascospores consistently 2-septate ..... 7
6. Ascospores usually 2-septate, rarely 3-septate, 15.5-23.5  $\times$  4.5-6  $\mu\text{m}$ , surrounded by a sheath with an umbilicus at the top ..... *P. pilleata*
7. Ascospores (14.5-)16.5-18.7  $\times$  (3.6-)4.3-5.7(-6.5)  $\mu\text{m}$ , usually with a thin sheath; on dicotyledonous hosts ..... *P. concentrica*

7. Ascospores (12-)16-24 × 4-5(-6) μm, with a sheath only when young, with small guttules; exclusively on monocotyledonous hosts ..... *P. michoti*
8. Ascospores smooth-walled ..... 9
8. Ascospores rough-walled ..... 12
9. Ascospores 3-6-septate ..... 10
9. Ascospores 25-45 × 6-8 μm, 9-10-septate ..... *P. castagnei*
10. Ascospores 19-30 × 6-8.5 μm, 4-6-septate, curved, oblong with obtuse ends .....  
..... *P. capparidicola*
10. Ascospores shorter than 24 μm ..... 11
11. Ascospores 18-21 × 5.5-7 μm, 5-6-septate, cylindrical with broadly rounded ends .....  
..... *P. cylindrospora*
11. Ascospores 19.5-25.5 × 5.5-7 μm, (3-)4-5(-6)-septate, cylindrical to longate ellipsoidal or fusiform ..... *P. apicicola*
12. Ascospores longer than 20 μm ..... 13
12. Ascospores shorter than 20 μm ..... 18
13. Ascospores wider than 8 μm ..... 14
13. Ascospores narrower than 8 μm ..... 15
14. Ascospores 22.4-34.4 × 8-9.6 μm; with *Phaeostagonospora* anamorph; *Nolina erumpens* .  
..... *P. nolinae*
14. Ascospores 28.8-36.8 × 8.8-11.2 μm; with *Microsphaeropsis*; on *Agave navardiana* .....  
..... *P. agavensis*
15. Ascospores (15-)17-24 × 4.5-6.5 μm, 5-septate, cylindrical, guttulate ..... *P. obtusispora*
15. Ascospores with less than 5 septa ..... 16
16. Ascospores 20-25 × 7-8 μm, (1-)3(-4)-septate, oblong ..... *P. conglomerata*
16. Ascospores narrower than 7 μm ..... 17
17. Ascospores 20-24 × 4-5 μm, dark-reddish-brown, coarsely echinulate .....  
..... *P. glauco-punctata*
17. Ascospores 20-27 × 6-7 μm, yellowish-brown, finely echinulate ..... *P. vectis*
18. Ascospores 16-19.5 × 5-7 μm, 4-septate ..... *P. quadriseptata*
18. Ascospores 12-14 × 4-5 μm, (1-)3-septate ..... *P. filamentosa*

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