

## The genera *Podospora* and *Schizothecium* from Mainland China

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**Abstract** – Approximately 400 dung samples were collected from Mainland China during the past two years and examined for coprophilous fungi. Fourteen are new records of *Podospora* and *Schizothecium* for Mainland China and the taxa are described and illustrated in this paper. A key to these species from Mainland China is also provided.

**Coprophilous fungi / Mainland China / *Podospora* / *Schizothecium* / Sordariales**

### INTRODUCTION

Coprophilous fungi have attracted attention of a relatively large number of mycologists (Bell & Mahoney, 1995). The genera *Podospora* and *Schizothecium* are the most frequently collected genera of coprophilous fungi (Bell, 1983; 2005). However, they have not been studied in Mainland China. Tai (1979) recorded two species: *Podospora coprophila* and *P. strobiliformis* from China, but these species have been referred to *Cercophora* (Lundqvist, 1972). There has been taxonomic confusion regarding the relationship between *Podospora* and *Schizothecium* (Lundqvist, 1972). However, based on multi-gene sequences and morphology, Cai *et al.* (2005) have clarified their phylogenetic relationships, in which *Schizothecium* species are found to be monophyletic.

Four *Schizothecium* species and ten *Podospora* species were found in Mainland China in this study. A key to these Chinese species is provided. Illustrations and descriptions of the species are given. The morphological variations between our specimens and type specimens were noted. Dry specimens are deposited in Laboratory for Conservation and Utilization of Bio-resources, Yunnan University (YNU).

### MATERIALS AND METHODS

Samples were collected mostly in Yunnan Province, China. The dung samples were placed in sealed plastic bags and returned to the laboratory. All the samples were incubated in moist chambers (Lundqvist, 1972). The samples were

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examined every 4 days until almost no further fruiting bodies were observed. The fruiting bodies were picked off from the substrate and mounted in water. All the descriptions, measurement and photographs are from water mounts. To observe the gelatinous caudae clearly, Indian ink was used.

## TAXONOMY

*Podospora* Ces. and *Schizothecium* Corda are in the family Lasiosphaeriaceae (Lundqvist, 1972). *Podospora* Ces. was established by Cesati (1856) for *P. fimicola* Ces. but he misinterpreted *Schizothecium fimicola* Corda as *Podospora fimicola* Ces. and introduced considerable confusion (Lundqvist, 1972). Lundqvist (1972) divided the two genera and stated that *Schizothecium* was characterized by and distinguished from *Podospora* principally by the swollen agglutinated hairs or prominent protruding peridial cells, lack of interascal filiform paraphyses, early spore septation, and long persistent, plasma-filled pedicels. Although most mycologists have not accepted *Schizothecium* as a genus (Krug & Khan, 1988; Bell & Mahoney, 1995; Wang, 2000), Cai *et al.* (2005) reevaluated the genus *Schizothecium* using molecular data and found that *Schizothecium* species constitute a natural grouping and merit generic rank.

1. *Schizothecium aloides* (Fuckel) N. Lundq., Symb. Bot. Upsal. 20: 253. 1972. (Fig. 1a-h, Fig. 12a)

≡ *Podospora aloides* (Fuckel) Mirza and Cain, Can. J. Bot. 47: 2004. 1969.

For more synonyms see Mirza and Cain, (1969).

Perithecia pyriform, semi-immersed, scattered, semitransparent, 850-1050 × 550-600 μm, upper part with long, brown fascicles of agglutinated hairs, 240-330 μm long, ca. 50 μm wide at the base; neck cylindrical, dark, small. Peridium semitransparent, consisting of swollen, globose cells. Paraphyses swollen, surrounding the asci. Asci 8-spored, broad-clavate, ca. 320 × 100 μm, swelling in water, apical apparatus not observed, stipe more than half the length of ascus. Ascospores biseriata, ellipsoidal, dark brown, 31-33 × 14-16 μm; pedicel slender, hyaline, 10-12 × 2.4 μm; caudae not observed; germ pores not distinct.

**Specimens examined:** China, Yunnan Province, Dahuadian Farm, on cattle dung, Nov. 21, 2004, D.M. Hu (YMF6.00009).

**Notes:** *Schizothecium aloides* was commonly observed in this study and could easily be recognized under the dissecting microscope by its long agglutinated hairs, which are typical of *Schizothecium* species. The ascospores of this species in this study were narrower than the ascospores of the description provided by Cain (1969), caudae were absent and an ascal apical ring was not prominent. The differences did not provide enough evidence for us to set up this record as a new species.

2. *Schizothecium curvuloides* (Cain) L. Cai, Fungal Diversity, 19: 1-21. 2005. (Fig. 2a-i, Fig. 12b)

≡ *Podospora curvuloides* Cain, Can. J. Bot. 40: 453. 1962.

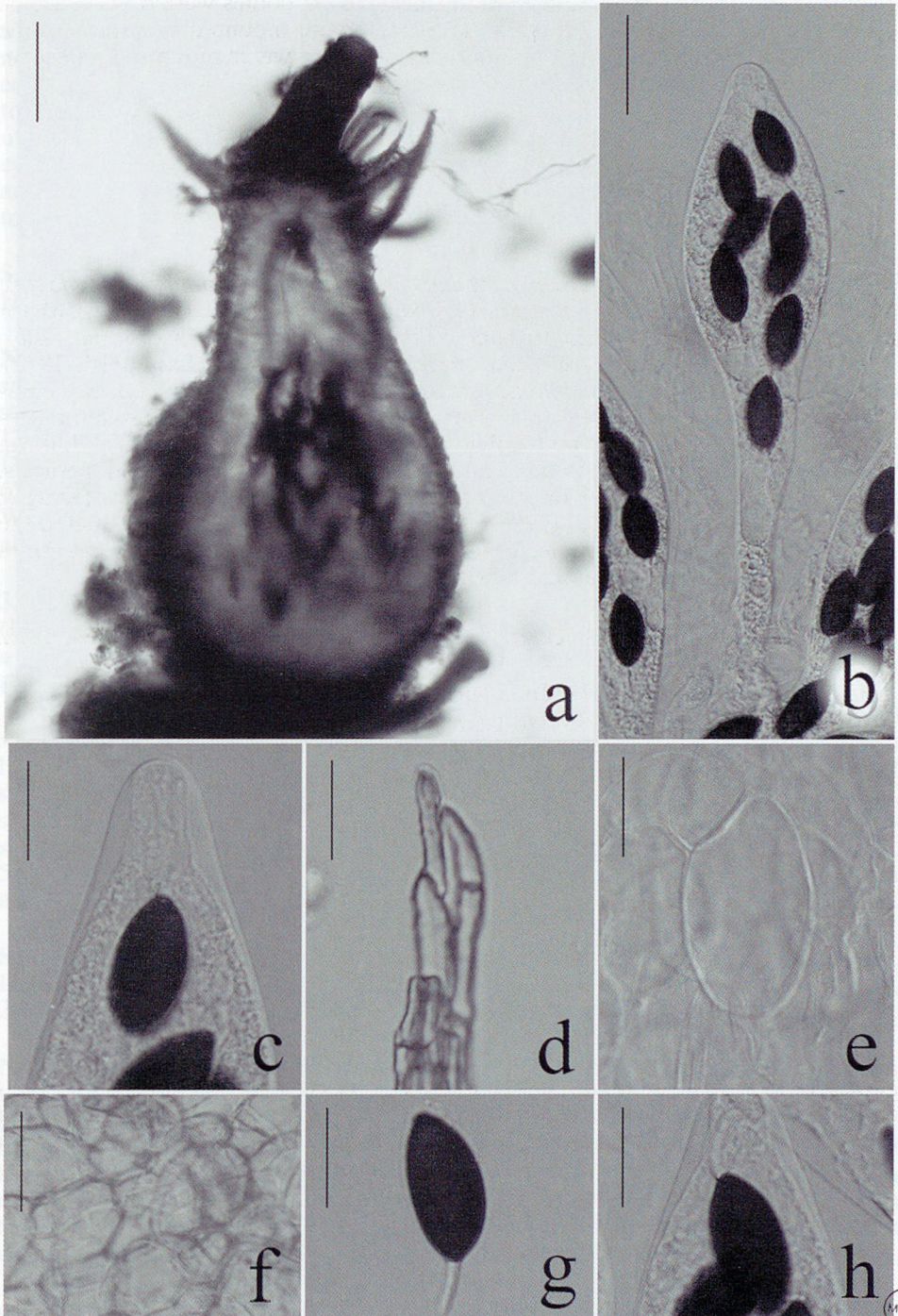


Fig. 1. *Schizothecium aloides*. a: Perithecium. b: Ascus. c: The upper part of the ascus. d: Agglutinated perithecial hairs. e: Cells of paraphyses. f: Cells of peridium. g: Ascospore. h: Ascospores in the ascus. Scale bars: a = 200  $\mu$ m, b = 40  $\mu$ m, c-h = 20  $\mu$ m.

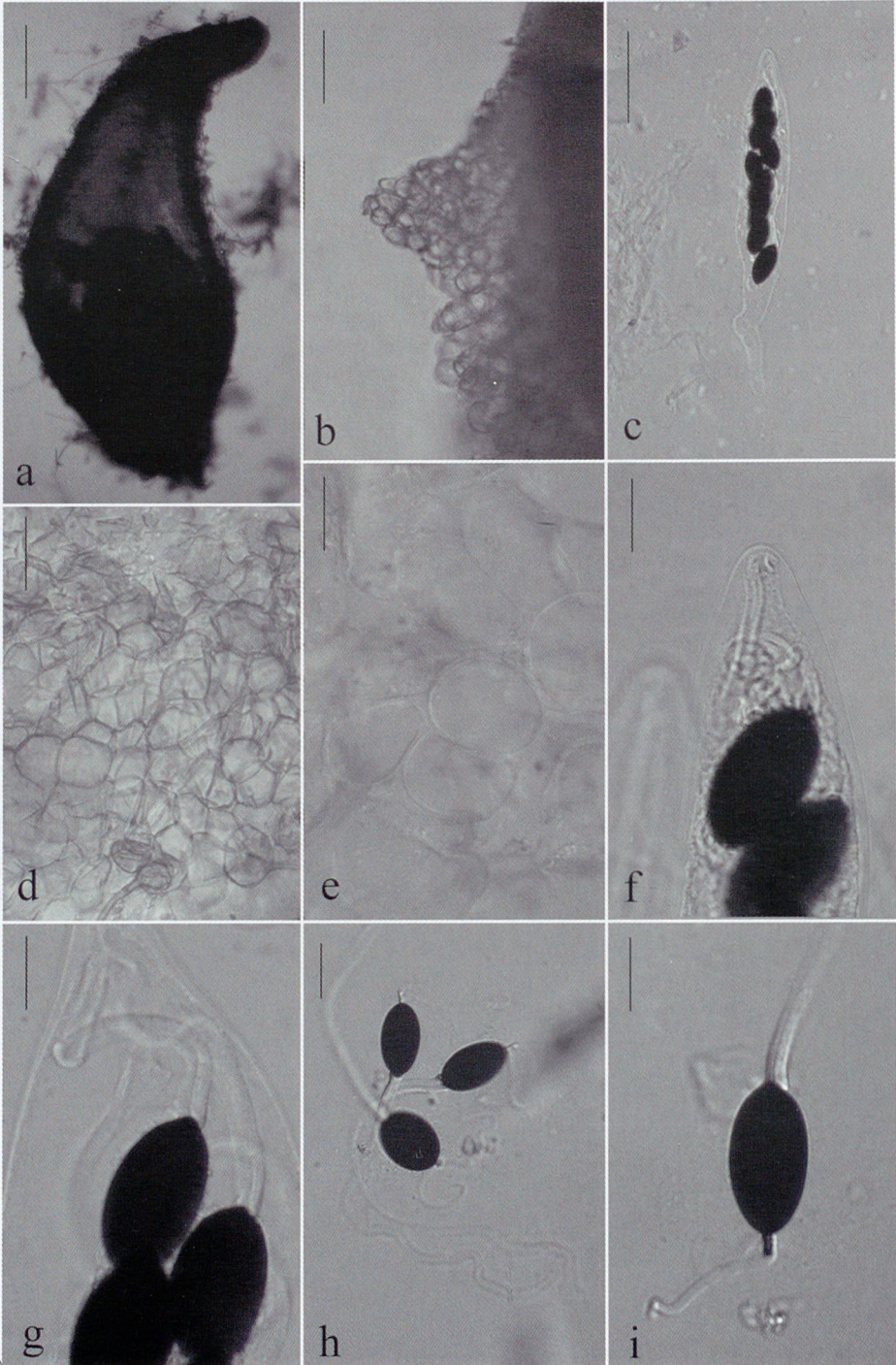


Fig. 2. *Schizothecium curvuloides*. a: Perithecium. b: Swollen perithecial hairs. c: Ascus. d: Peridial cells. e: Paraphyses cells. f: The upper part of the ascus. g-i: Ascospores. Scale bars: a = 200  $\mu$ m, b = 20  $\mu$ m, c = 100  $\mu$ m, d-g = 20  $\mu$ m, h = 30  $\mu$ m, i = 20  $\mu$ m.

Perithecia narrow pyriform, semi-immersed, scattered, dark brown, with a few short small clusters of agglutinated, swollen hairs around the base of the neck. Peridium membranaceous consisting of swollen, globose cells. Paraphyses consisting of swollen globose cells, surrounding the asci. Asci 8-spored, cylindrical to clavate, ca.  $350 \times 50 \mu\text{m}$ ; stipe short; apical ring not distinct. Ascospores uniseriate broad ellipsoidal, dark brown,  $40\text{--}46 \times 20\text{--}27 \mu\text{m}$ ; pedicel slender, cylindrical; upper cauda symmetrical, grooved on one side, cylindrical, elongate and swollen in water; lower cauda at the distal end of the pedicel, and usually split to two narrower caudae; germ pores apical, ca.  $2 \mu\text{m}$  in diam.

**Specimens examined:** China, Yunnan Province, Dahuadian farm, on cattle dung: HDN69, HDN68, HDN65, Nov. 15, 2004, D.M. Hu (YMF6.00010).

**Notes:** *Schizothecium curvuloides* was transferred to *Schizothecium* from *Podospora* by Cai *et al.* (2005) based on molecular data. The species recorded in this study had larger ascospores ( $40\text{--}46 \times 20\text{--}27 \mu\text{m}$ ) than the description ( $31\text{--}41 \times 17\text{--}20 \mu\text{m}$ ) provided by Cain (1969). We found two lower caudae in some species. Despite the spores of our collection being larger than the description provided by Cain (1969), other ascosporic and ascomatal morphologies are essentially similar. We therefore, identified this collection as *Schizothecium curvuloides* and regard above spore size difference as strain-level variation.

3. *Schizothecium dakotense* (Griff.) N. Lundq., Symb. Bot. Upsal. 20: 254. 1972. (Fig. 3a-g, Fig. 12c)

≡ *Podospora dakotensis* (Griff.) Mirza & Cain, Can. J. Bot. 47: 2016. 1969.

For more synonyms see Mirza and Cain, (1969).

Perithecia broad pyriform, scattered, immersed, semitransparent,  $480\text{--}800 \times 250\text{--}300 \mu\text{m}$ , upper part covered with tufts of short, brown, agglutinated, swollen hairs; neck short cylindrical, dark. Peridium membranaceous, consisting of swollen, angular cells. Paraphyses not observed. Asci 32-spored, broad clavate, swelling in water, ca.  $180 \times 40 \mu\text{m}$ , apical ring not distinct. Ascospores multi-seriate, ellipsoidal, dark brown,  $20\text{--}24 \times 12\text{--}13 \mu\text{m}$ ; pedicel cylindrical, slender, ca.  $5 \times 1.5 \mu\text{m}$ ; upper cauda long, eccentrically attached, evanescent; a similar cauda attached at the distal end of the pedicel; germ pores apical, ca.  $1.5 \mu\text{m}$  in diameter.

**Specimens examined:** China, Yunnan Province, Zhongdian, on cattle dung, Dec. 5, 2004, H.Y. Su (YMF6.00011). Dahuadian farm, on cattle dung, Jun. 13, 2004, D.M. Hu (YMF6.00012).

**Notes:** The perithecia of *Schizothecium dakotense* vary greatly. Figure 3a shows a typical perithecium, but we often found some atypical perithecia which were larger and darker at the upper part, the peridial cells were smaller and more brittle than the typical ones. The lower cauda of *S. dakotense* have been described as attached at the distal end of the pedicel (Mirza & Cain 1969). However, a detailed examination on our samples showed that the lower cauda of this species actually surrounds the pedicel (Fig. 3e-g). This species is very common on samples collected from Zhongdian, Yunnan Province, China.

4. *Schizothecium miniglutinans* (J.H. Mirza & Cain) N. Lundq., Symb. Bot. Upsal. 20: 254. 1972. (Fig. 4a-e, Fig. 12d)

≡ *Podospora miniglutinans* J.H. Mirza and Cain, Can. J. Bot. 47: 2030. 1969.

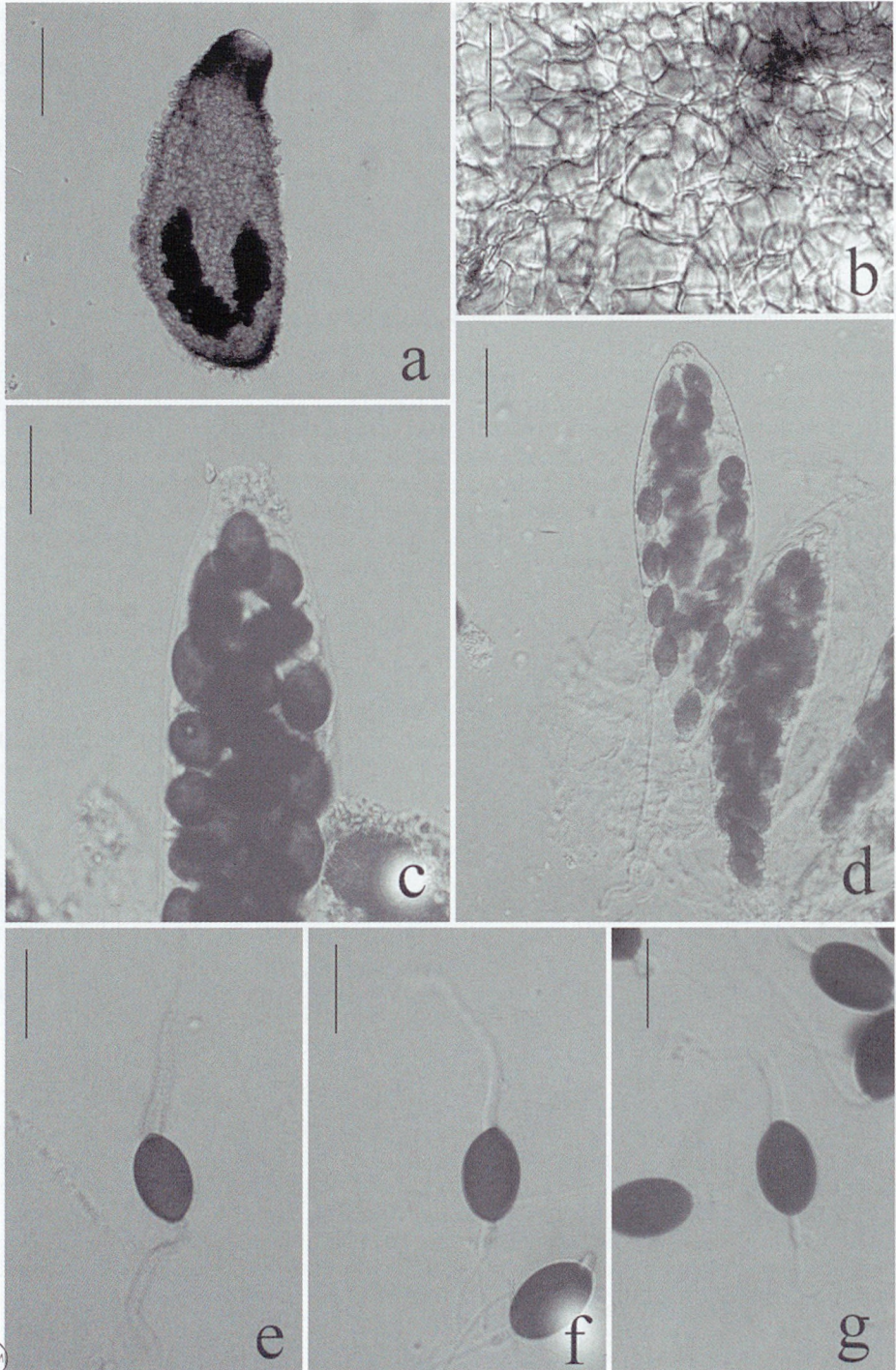


Fig. 3. *Schizothecium dakotense*. a: Perithecium. b: Peridium cells. c: The upper part of the ascus. d: Asci. e-g: Ascospores. Scale bars: a = 200  $\mu$ m, b-c = 20  $\mu$ m, d = 40  $\mu$ m, e-g = 20  $\mu$ m.

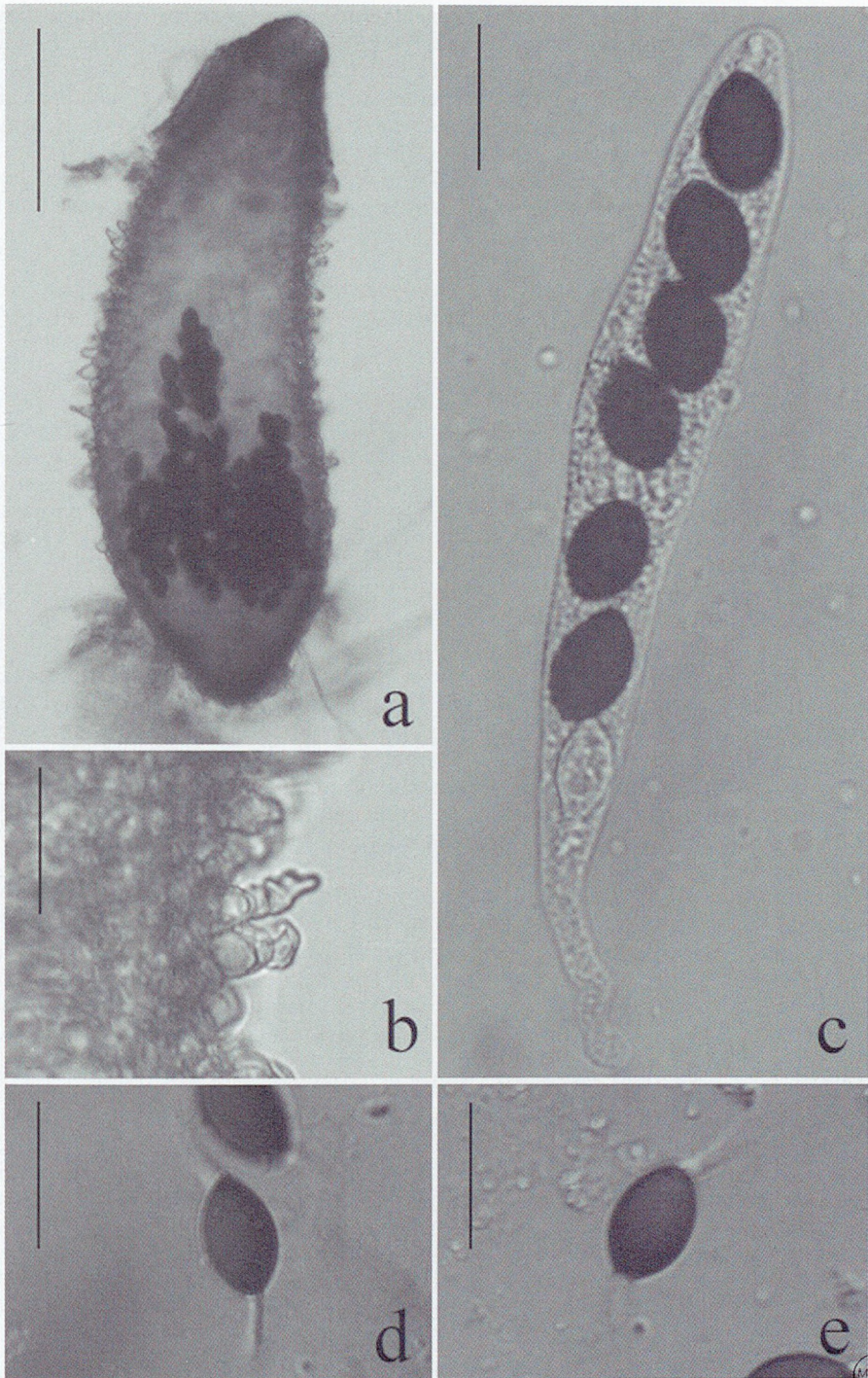


Fig. 4. *Schizothecium minigtinnans*. a: Perithecium. b: Perithecial hairs. c: Ascus. d-e: Ascospores. Scale bars: a = 100  $\mu$ m, b-e = 20  $\mu$ m.

Perithecia pyriform to conical, scattered, semi-immersed or superficial, olivaceous-brown, semitransparent,  $230\text{--}350 \times 100\text{--}130 \mu\text{m}$ ; neck papilliform, dark; the upper part of the venter covered with short, agglutinated hairs consisting of swollen cells. Peridium membranaceous, consisting of swollen, globose cells. Paraphyses not observed. Asci 8-spored, cylindrical, ca.  $156 \times 25 \mu\text{m}$ ; stipe short; apical ring not distinct. Ascospores uniseriate, ellipsoidal, dark brown,  $14\text{--}21 \times 9\text{--}13 \mu\text{m}$ ; pedicel slender, cylindrical,  $5\text{--}7.2 \times 1.4\text{--}2.4 \mu\text{m}$ ; caudae lash-like, evanescent; upper cauda attached at the top of the spore; lower cauda attached at the distal end of the pedicel; germ pores not distinct.

**Specimens examined:** China, Yunnan Province, Dahuadian, on cattle dung, Nov. 15, 2004, D.M. Hu (YMF6.00013); Zhongdian, on cattle dung, Dec. 12, 2004, H.Y. Su (YMF6.00014).

**Notes:** Cain (1969) described *Schizothecium miniglutinans* as a new species because of its small ascospores ( $20\text{--}24 \times 12\text{--}17 \mu\text{m}$ ). The ascospores recorded in this study were even smaller ( $14\text{--}21 \times 9\text{--}13 \mu\text{m}$ ). This species is similar to *S. dakotense*, but they can be distinguished by their different number of ascospores in the asci (8-spored in *S. miniglutinans* vs. 32-spored in *S. dakotense*). *Schizothecium miniglutinans* was commonly collected in this study.

5. *Podospora anserina* (Ces. in Rabenh.) Niessl, Hedwigia, 22: 156. 1883. (Fig. 5a-i, Fig. 12e)

For synonyms see Mirza and Cain, (1969).

Perithecia pyriform to subglobose, scattered, semi-immersed to superficial, dark brown to black,  $390\text{--}550 \times 300\text{--}330 \mu\text{m}$ ; neck short conical to cylindrical; with a few tufts of straight, brown, nonseptate hairs at the base of the neck aggregated at one side, and a few long, flexuous, septate, brown hairs covering the venter. Peridium membranaceous, consisting of small, angular cells. Paraphyses transparent, septate, with swollen cells. Asci cylindrical, 4-spored, ca.  $160\text{--}252 \times 21\text{--}26 \mu\text{m}$ , with a long stipe, apical ring not distinct. Ascospores transparent when young and becoming dark brown when mature, ellipsoidal, uniseriate,  $26\text{--}30 \times 16\text{--}17 \mu\text{m}$ , pedicel cylindrical, constant in water, ca.  $27 \times 5 \mu\text{m}$ ; caudae lash-like, evanescent, upper cauda eccentrically attached to the spore apex, two caudae attached to the pedicel, one at the base another at the distal end; germ pore apical.

**Specimens examined:** China, Yunnan Province, Kunming Zoo, on antelope dung, Mar. 11, 2004, D.M. Hu (YMF6.00001). Zhongdian, on cattle dung, Dec. 5, 2004, D.M. Hu.

**Notes:** *Podospora anserina* was a common species in this study. The ascospores from our collection are smaller than the ascospores of description provided by Cain (1969) ( $26\text{--}30 \times 16\text{--}17 \mu\text{m}$  vs.  $34\text{--}40 \times 18\text{--}20 \mu\text{m}$ ). Cain (1969) described this species as having "two small, very evanescent secondary appendages (= caudae) attached to primary appendage (= pedicel) near the base". Bell (1983) illustrated this species with only one lower lash-like cauda attached at the distal end of the pedicel. However, we found two lower caudae, one attached at the pedicel near the base and another attached at the distal end of the pedicel (fig. 5g-h).

6. *Podospora araneosa* (Cain) Cain, Can. J. Bot. 40: 459. 1962. (Fig. 12f)

Perithecia pyriform, superficial, scattered,  $530\text{--}700 \times 450\text{--}570 \mu\text{m}$ , densely covered with long, flexuous, slender, grayish-brown, septate hairs; neck stout,



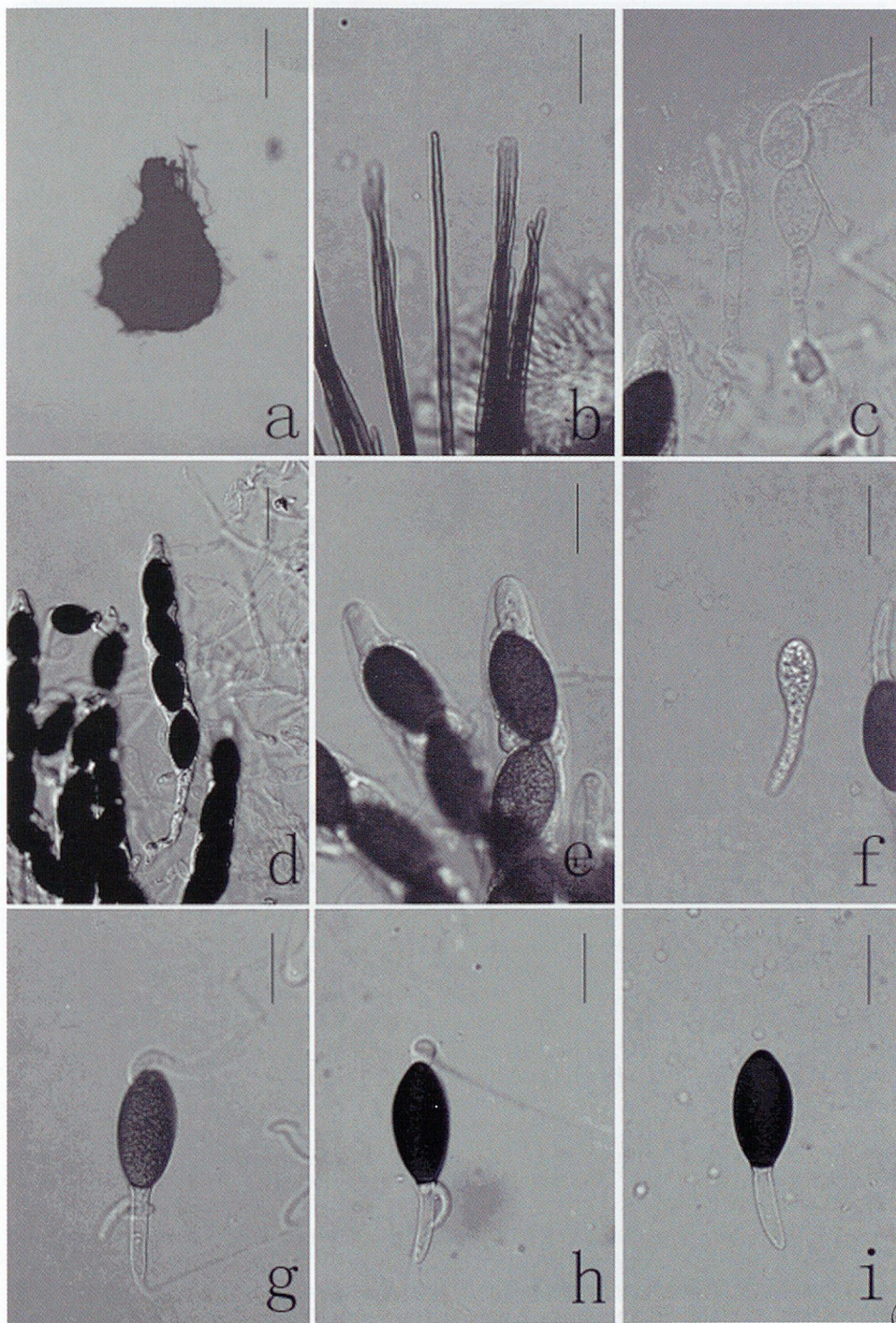


Fig. 5. *Podospora anserina*. a: Perithecium. b: Perithecial hairs. c: Paraphyses. d: Asci. e: The upper part of the asci. f: Immature ascospore. g-i: Ascospores. Scale bars: a = 200  $\mu$ m, b-c = 20  $\mu$ m, d = 40  $\mu$ m, e-i = 20  $\mu$ m.

papilliform, covered with short, straight, brown, sparsely septate hairs, hyaline at the apex, about 154  $\mu\text{m}$  long, 3.6  $\mu\text{m}$  wide. Paraphyses not observed clearly. Asci 256-spored, clavate, ca. 280  $\times$  60  $\mu\text{m}$ , apical ring not distinct. Ascospores multi-seriate, dark brown, ellipsoidal, 10-14  $\times$  7-8  $\mu\text{m}$ ; pedicel cylindrical, ca. 6.5-8  $\times$  2  $\mu\text{m}$ ; with a single, lash-like cauda at the apex of the spore and a similar cauda at the distal end of the pedicel; germ pore slightly eccentric, ca. 1  $\mu\text{m}$  in diameter.

**Specimens examined:** China, Yunnan Province, Kunming Zoo, on giraffe dung, Mar. 16, 2004, D.M. Hu (YMF6.00016).

**Notes:** Our collection agrees well with the description provided by Cain (1969).

7. *Podospora argentinensis* (Speg.) Mirza, J. H. and Cain, R. F., Can. J. Bot. 47: 2008. 1969. (Fig. 12g)

For synonyms see Mirza and Cain, (1969).

Perithecia globose to pyriform, scattered, semi-immersed to immersed, dark brown, 445-600  $\times$  225-500  $\mu\text{m}$ , upper part of the perithecia with black tubercles; neck papilliform to short cylindrical, completely covered with black papillae; peridium membranaceous, cellular structure clearly visible. Paraphyses filiform above, ventricose below, evanescent. Asci 8-spored, clavate, ca. 180-200  $\times$  30-40  $\mu\text{m}$ , narrowly rounded at the apex; apical apparatus not distinct; stipe moderately long. Ascospores biseriate, ellipsoidal, 30-32  $\times$  16-17  $\mu\text{m}$ ; pedicel cylindrical, 30-32  $\times$  5-10  $\mu\text{m}$ ; upper cauda lyre-shaped attached at the apex of spore; several caudae surrounding the pedicel at the base; germ pore eccentric.

**Specimen examined:** China, Yunnan Province, Dahuadian farm, on cattle dung, Nov. 15, 2004, D.M. Hu (YMF6.00017).

**Notes:** Our collection agrees well with the description provided by Cain (1969).

8. *Podospora communis* (Speg.) Niessl, Hedwigia, 22: 156. 1883. (Fig. 6a-i, Fig. 12h)  
For synonyms see Mirza and Cain, (1969).

Perithecia globose, scattered, semi-immersed, brown, semitransparent, 480-600  $\times$  440-450  $\mu\text{m}$ ; neck dark, smooth, papilliform, 110-150  $\times$  100-110  $\mu\text{m}$ ; venter covered with a few long, flexuous, brown, septate, ca. 2  $\mu\text{m}$  wide hairs. Peridium thin, membranaceous, consisting of small angular cells. Paraphyses transparent, septate, cylindrical, swollen at the lower part. Asci 8-spored, clavate, ca. 216-228  $\times$  48-58  $\mu\text{m}$ , swelling considerably in water, apical ring not distinct. Ascospores dark brown, biseriate, ellipsoidal, 28-35  $\times$  15-22  $\mu\text{m}$ ; pedicel cylindrical, constant in water, 29-44  $\times$  5-6  $\mu\text{m}$ ; four similar caudae near apex of spores and four similar caudae at the distal end of the pedicel; germ pore apical, ca. 2  $\mu\text{m}$  in diam.

**Specimen examined:** China, Yunnan Province, Dahuadian farm, on cattle dung: HDN32, HDN33, HDN7, HDN40, Nov. 15, 2004, D.M. Hu (YMF6.00002).

**Notes:** *Podospora communis* is characterized by four upper ascospore caudae and four lower caudae. There are five species that have similar ascospore morphologies such as *Podospora communis*, *P. austrohemisphaerica* Lundq., *P. deropodalis* Khan & Cain, *P. spinulosa* Khan & Cain and *P. multispora* Khan & Cain. The perithecia of *P. austrohemisphaerica* differ in being covered by rigid hairs on the neck. The ascospores of *P. deropodalis* and *P. spinulosa* have less than four

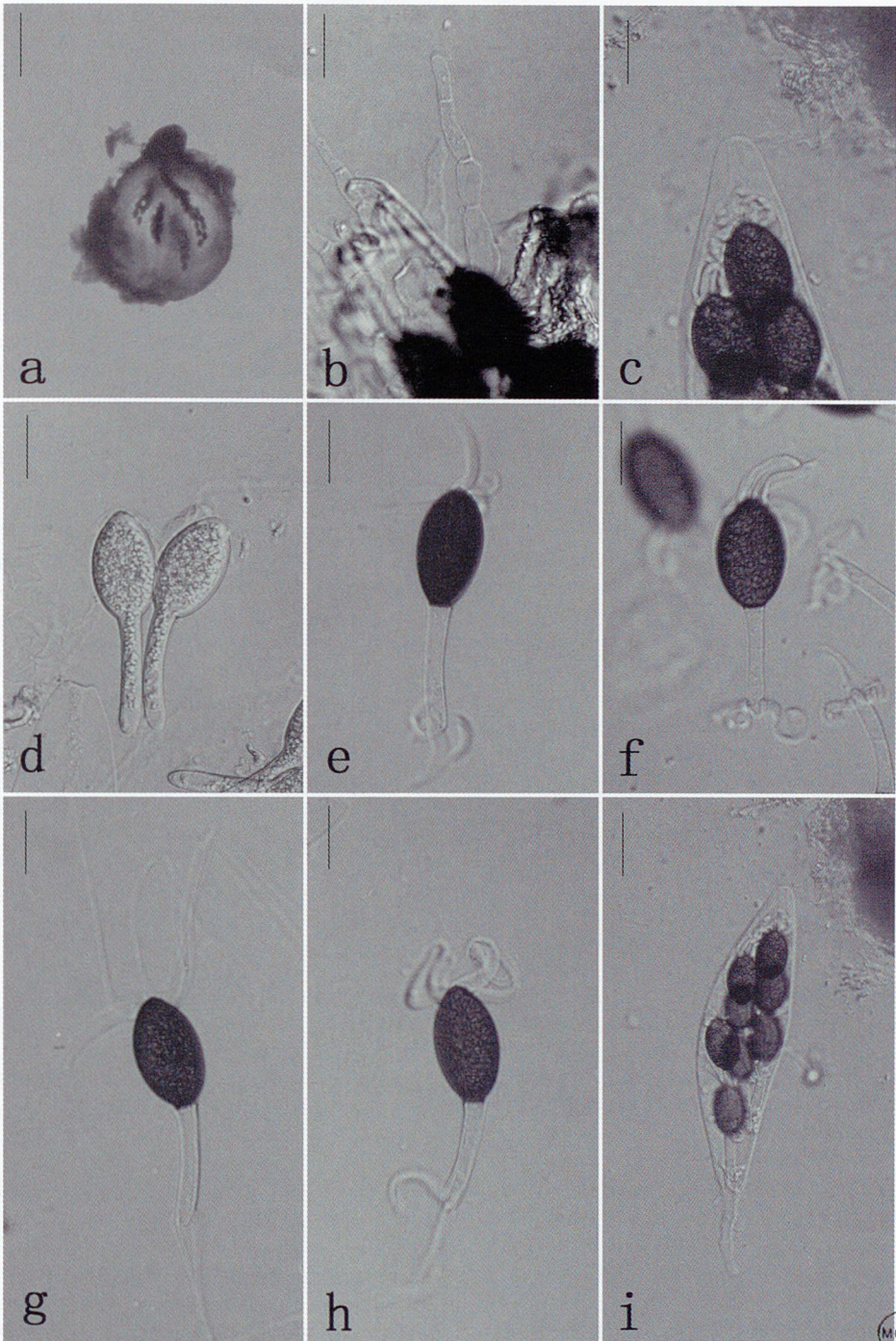


Fig. 6. *Podospora communis*. a: Perithecium. b: Paraphyses. c: Upper part of the ascus. d-e: Ascospores. f: Ascus. g: Young ascospores. h-i: Ascospores. Scale bars: a = 200 µm, b-e = 20 µm, f = 40 µm, g-i = 20 µm.

lower caudae. The asci of *P. multisporea* contain multispores. Our collections differ from the description provided by Cain (1969) in two aspects: the necks that are smaller and papilliform as compared to long cylindrical in the description; and the pedicels that are longer than the description (29-44  $\mu\text{m}$  vs. 25-35  $\mu\text{m}$ ).

9. *Podospora decipiens* (Winter) Niessl, Hedwigia, 22: 156. 1883. (Fig. 7a-i, Fig. 12i)  
For synonyms see Mirza and Cain, (1969).

Perithecia pyriform, scattered, semi-immersed, brown, semitransparent, ca. 500  $\times$  320  $\mu\text{m}$ ; neck dark, cylindrical, with short, tubular, dark hairs at the base. Peridium thin, membranaceous, consisting of angular cells. Paraphyses surrounding the asci, consisting of cylindrical, swollen cells. Asci clavate, 8-spored, ca. 190  $\times$  60  $\mu\text{m}$ , apical ring not distinct. Ascospores biseriate, dark brown, ellipsoidal, 39-40  $\times$  20-22  $\mu\text{m}$ ; pedicel cylindrical, 55-57  $\times$  8-9  $\mu\text{m}$ ; caudae evanescent, a lyre-shaped tuft of caudae attached at the apex of spore; several lower caudae attached at the base of pedicel; germ pore apical, ca. 1.5  $\mu\text{m}$  in diam.

**Specimens examined:** China, Yunnan Province, Dahuadian farm, on cattle dung: D4, D9, D2, D12, Jun. 13, 2004, D.M. Hu (YMF6.00003).

**Notes:** *Podospora decipiens* is similar to *P. argentinensis* and *P. pleiospora*. However, the asci of *P. pleiospora* contained 32 ascospores. *Podospora argentinensis* can be differentiated from *P. decipiens* by the size of the ascospores (30-32  $\times$  16-17  $\mu\text{m}$  in *P. argentinensis* vs. 39-40  $\times$  20-22  $\mu\text{m}$  in *P. decipiens*).

10. *Podospora fimiseda* (Ces. & De Not.) Niessl, Hedwigia 22: 156. 1883. (Fig. 8a-f, Fig. 12j)

For synonyms see Mirza and Cain (1969).

Perithecia pyriform, semi-immersed, scattered or loosely aggregated, dark brown to black, 1000-1100  $\times$  600-650  $\mu\text{m}$ ; Neck cylindrical; the upper part of the venter and the neck covered with short, straight, septate, brown, hyaline-tipped, hairs; peridium coriaceous, consisting of small angular cells. Paraphyses filiform, septate. Asci cylindrical to clavate, 8-spored, ca. 372-470  $\times$  50-61  $\mu\text{m}$ , apical ring distinct. Ascospores biseriate, dark brown, oblong-ellipsoidal, 50-58  $\times$  27-33  $\mu\text{m}$ ; pedicel pestle-shaped, 34-45  $\times$  6.8-7.2  $\mu\text{m}$ ; upper cauda eccentric, lower cauda attached at the distal end of pedicel.

**Specimens examined:** China, Yunnan Province, Dahuadian farm, on cattle dung, Nov. 15, 2004, D.M. Hu (YMF6.00004); Yiliang, Apr. 11, 2005, D.M. Hu (YL35).

**Notes:** *Podospora fimiseda* is characterized by its rigid hairs, large ascospores and large caudae (Fig. 8e). Our collection agrees well with the description provided by Cain (1969).

11. *Podospora intestinacea* N. Lundq., Symb. Bot. Upsal. 20: 163. 1972. (Fig. 9a-i, Fig. 12k)

Perithecia pyriform, scattered, semi-immersed, dark brown, 790-810  $\times$  430-500  $\mu\text{m}$ ; neck cylindrical, black, smooth, ca. 220-150  $\mu\text{m}$ ; the immersed part covered by a few brown, long, septate hairs, about 2  $\mu\text{m}$  in diameter. Paraphyses swollen, evanescent, surrounding the asci. Asci 8-spored, cylindrical or broad clavate, ca. 268  $\times$  52.8  $\mu\text{m}$ , swelling in water, long stalked (ca. 96  $\mu\text{m}$  long). Ascospores biseriate, narrow ellipsoidal, transparent to yellow or green when young, dark brown at maturity, 46.8-67.2  $\times$  21.6-26.4  $\mu\text{m}$ ; pedicel cylindrical,

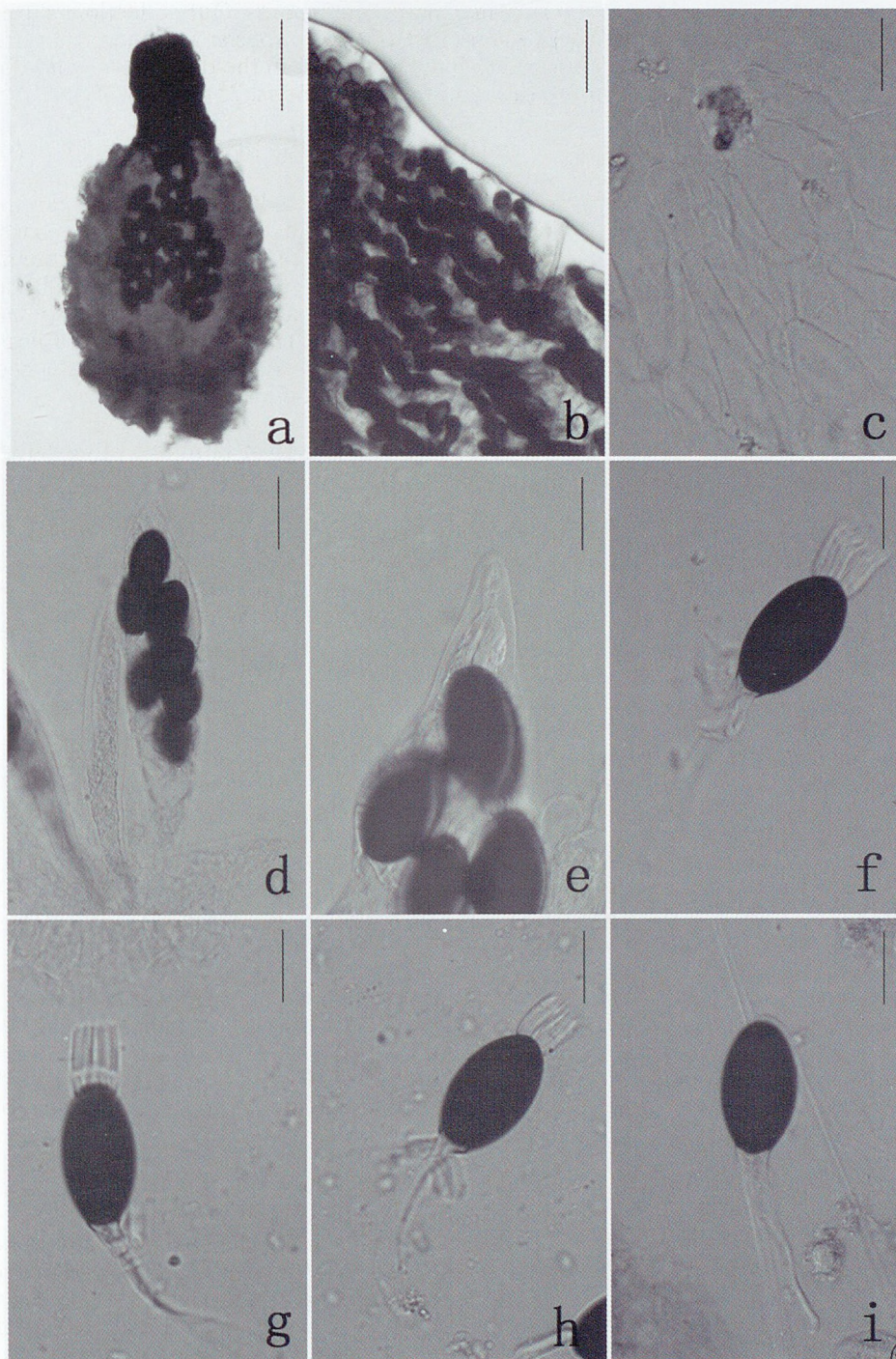


Fig. 7. *Podospora decipiens*. a: Perithecium. b. Perithecial hairs. c: Paraphyses. d: Ascus. e: The upper part of the ascus. f-i: Ascospores. Scale bars: a = 100  $\mu$ m, b and c = 20  $\mu$ m, d = 40  $\mu$ m, e-i = 20  $\mu$ m.

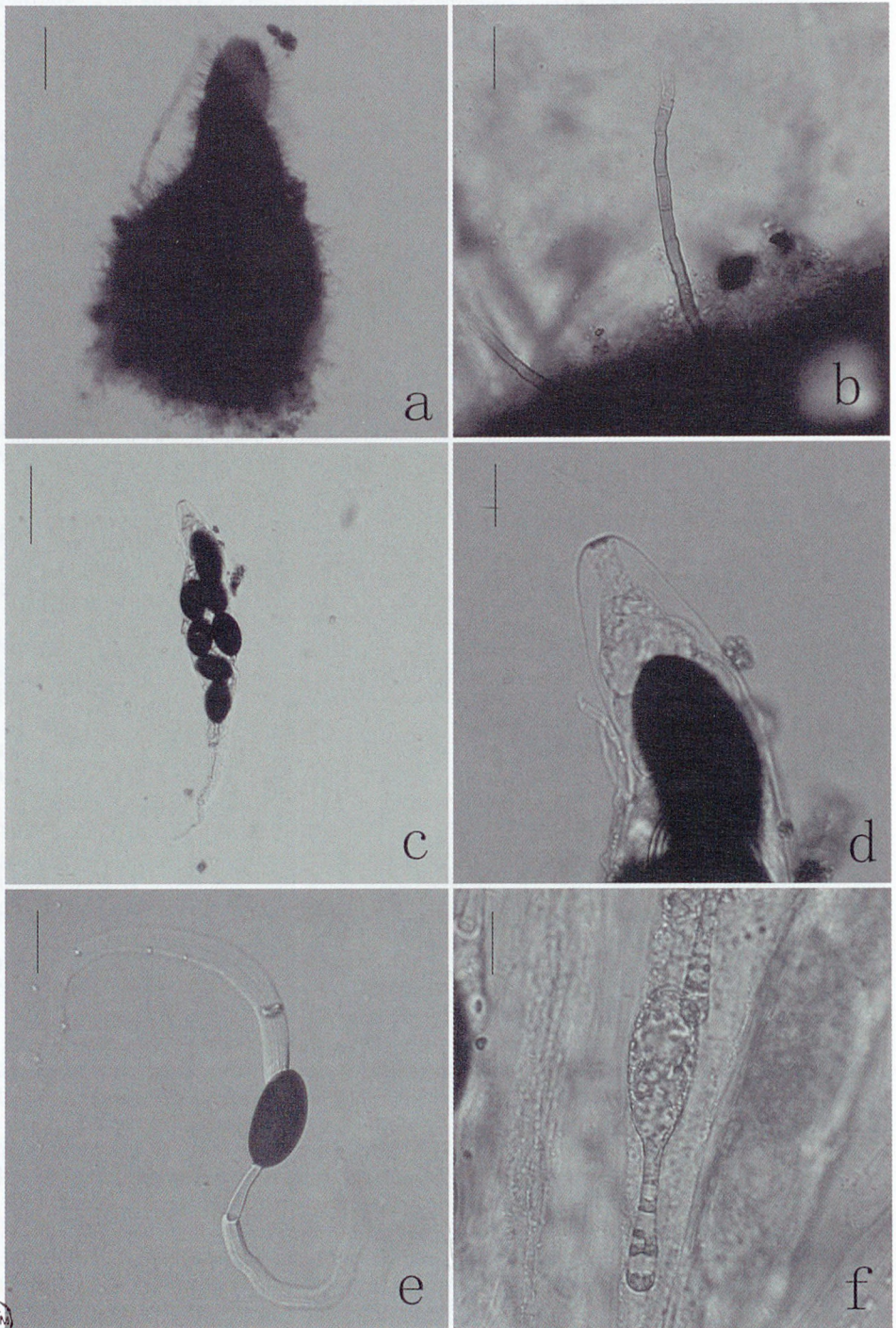


Fig. 8. *Podospora fimiseda*. a: Perithecium. b: Perithecial hairs. c: Ascus. d: The upper part of the ascus. e: Ascospore. f: Young ascospore. Scale bars: a = 200  $\mu$ m, b = 20  $\mu$ m, c = 100  $\mu$ m, d-f = 20  $\mu$ m.

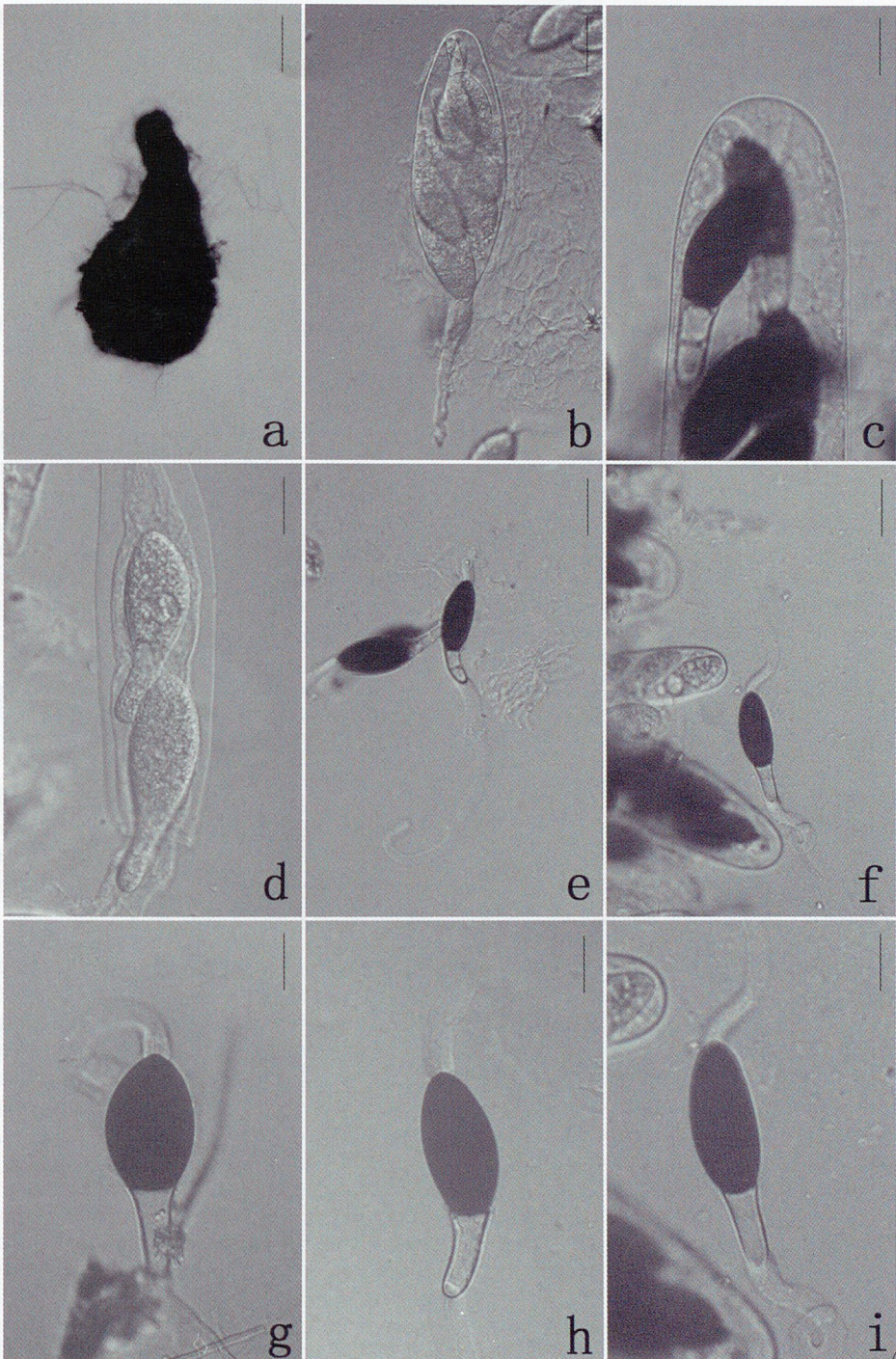


Fig. 9. *Podospora intestinacea*. a: Perithecium. b: Young ascus. c: Upper part of an ascus. d: Young ascospores. e-i: Ascospores. Scale bars: a=200  $\mu$ m, b=40  $\mu$ m, c and d=20  $\mu$ m, e-f=40  $\mu$ m, g-i=20  $\mu$ m.

seldom septate,  $21.6\text{-}32.8 \times 4.4\text{-}9.6 \mu\text{m}$ ; whip-like, extensible caudae, one at the top of the dark cell, the other at the bottom of the pedicel.

**Specimens examined:** China, Yunnan Province, Dahuadian, on cattle dung, Jun. 13, 2004, D.M. Hu (YMF6.00005).

**Notes:** *Podospora intestinacea* was first described and illustrated by Lundqvist (1972). The characters of our fungus generally agree with the description provided by Cain (1969) except our collection lack hairs surrounding the neck and the basal cauda attached at the distal end of the pedicel rather than surrounding the pedicel.

12. *Podospora pleiospora* (Winter) Niessl, Hedwigia, 22: 156. 1883. (Fig. 10a-i, Fig. 12l)

For synonyms see Mirza and Cain, (1969).

Perithecia pyriform, scattered, semi-immersed, olivaceous-brown, semitransparent,  $400\text{-}620 \times 300\text{-}480 \mu\text{m}$ ; neck dark, papilliform to cylindrical,  $130\text{-}150 \times 100\text{-}130 \mu\text{m}$ , covered with dark brown tubular hairs at the base; peridium membranaceous, consisting of small, angular cells. Paraphyses surrounding the asci, consisting of swollen cylindrical cells. Asci with 32 ascospores, broad-clavate, ca.  $300 \times 70 \mu\text{m}$ , apical ring not distinct. Ascospores multi-seriate, dark brown, ellipsoidal,  $31\text{-}36 \times 18\text{-}20 \mu\text{m}$ ; pedicel cylindrical,  $34\text{-}43 \times 5\text{-}8.5 \mu\text{m}$ ; upper cauda layered, constant in water, attached at the apex of the ascospore; several lower caudae surrounding the pedicel at the base.

**Specimens examined:** China, Yunnan Province, Dahuadian farm, on cattle dung, Nov. 15, 2004, D.M. Hu (YMF6.00006); Zhongdian, on cattle dung, Dec. 5, 2004, D.M. Hu; Yiling, on cattle dung, Apr. 11, 2005, D.M. Hu.

**Notes:** The asci of *Podospora pleiospora* are generally 32-spored, occasionally 16-spored or 64-spored (Cain, 1969). We only observed the 32-spored asci in this study. *Podospora pleiospora* is similar to *P. decipiens* and *P. argentinensis*. *Podospora pleiospora* differs from *P. decipiens* and *P. argentinensis* in having 32-spored asci.

13. *Podospora pyriformis* (Bayer) Cain, Can. J. Bot. 40: 460. 1962. (Fig. 11a-g, Fig. 12m)

Perithecia subglobose to pyriform, scattered, semi-immersed, olivaceous brown,  $820\text{-}1171 \times 620\text{-}750 \mu\text{m}$ ; neck dark, papilliform to cylindrical,  $250\text{-}340 \times 160\text{-}200 \mu\text{m}$ , with several long flexuous, septate, hyaline hairs at the base. Peridium membranaceous, consisting of angular cells. Paraphyses surrounding the asci, consisting of swollen cells. Asci 8-spored, clavate, ca.  $420 \times 50 \mu\text{m}$ , swelling considerably in water; apical ring not distinct. Ascospores biseriate, dark brown, broadly ellipsoidal,  $28.8\text{-}38.4 \times 19.6\text{-}24 \mu\text{m}$ ; pedicel cylindrical, longer than the ascospores,  $28.8\text{-}48 \times 7.2\text{-}14.4 \mu\text{m}$ ; caudae lash-like, longitudinally striate, upper cauda eccentrically attached to apex of spore; lower one attached at the distal of the pedicel; germ pore apical, ca.  $2 \mu\text{m}$  in diameter.

**Specimens examined:** China, Yunnan Province, Dahuadian farm, on cattle dung: HDN12, HDN38, HDN30, HDN31, Nov. 13, 2004, D.M. Hu (YMF6.00007). Zhongdian, on cattle dung: ZDN76, ZDN32, ZDN61, Dec. 5, 2004, H.Y. Su (YMF6.00008).



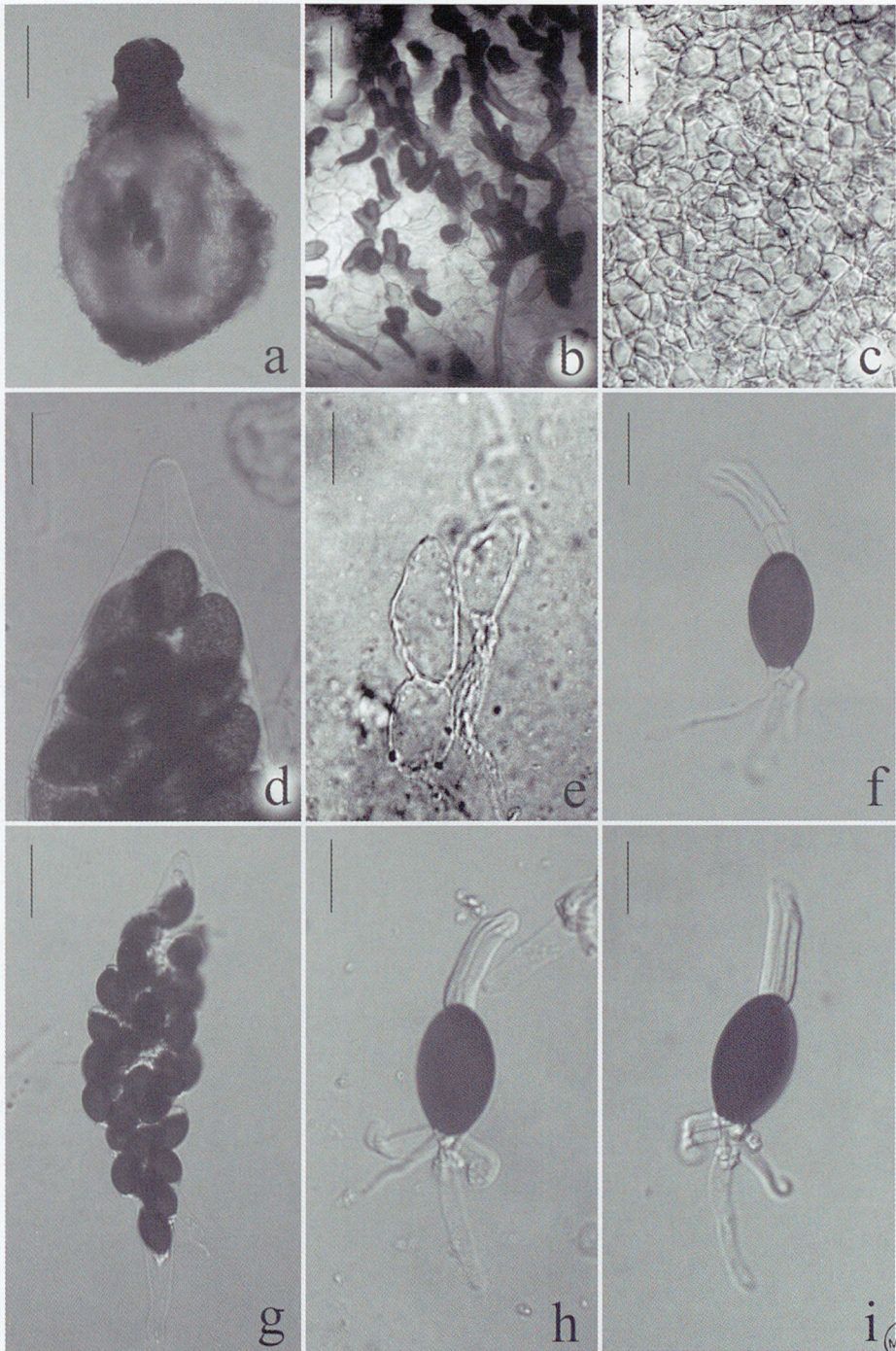


Fig. 10. *Podospora pleiospora*. a: Perithecium. b: Perithecial hairs. c: Peridial cells. d: The upper part of an ascus. e: Paraphyses. f: Ascospores. g: Ascus. h-i: Ascospores. Scale bars: a = 200  $\mu$ m, b-f = 20  $\mu$ m, g = 40  $\mu$ m, h-i = 20  $\mu$ m.

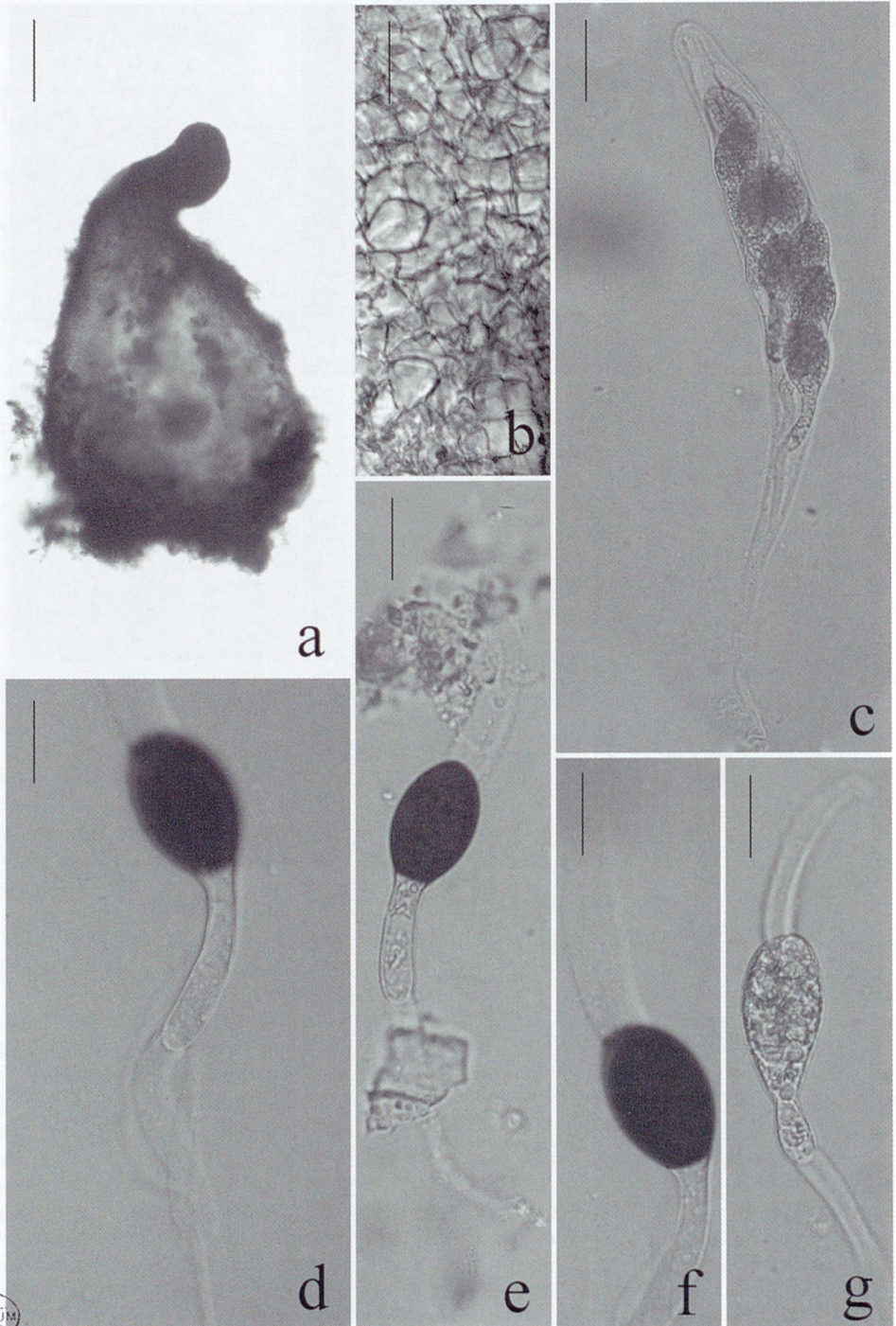


Fig. 11. *Podospora pyriformis*. a: Perithecium. b: Peridial cells. c: Young ascus. d-f: Ascospores. g: Young ascospore. Scale bars: a = 200  $\mu$ m, b = 20  $\mu$ m, c = 40  $\mu$ m, d-g = 20  $\mu$ m.

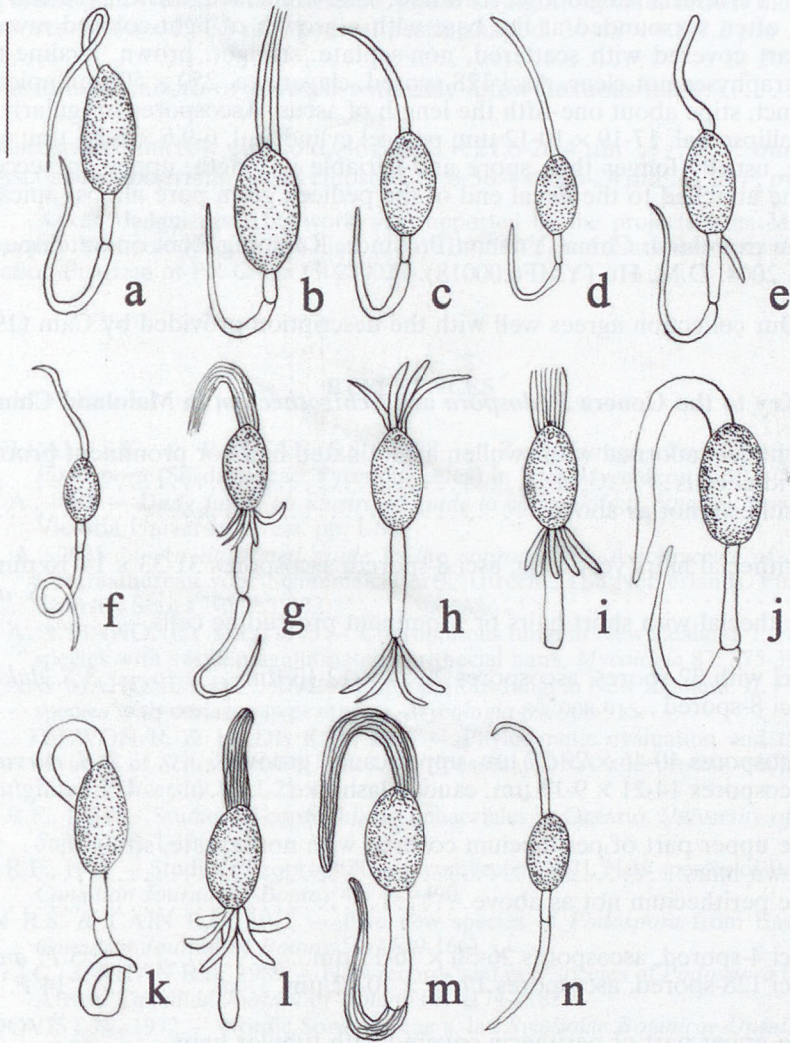


Fig. 12. Ascospores of species of *Schizothecium* and *Podospora*. a: *Schizothecium aloides*. b: *Schizothecium curvuloides*. c: *Schizothecium dakotense*. d: *Schizothecium miniglutinans*. e: *Podospora anserina*. f: *Podospora araneosa*. g: *Podospora argentinensis*. h: *Podospora communis*. i: *Podospora decipiens*. j: *Podospora fimiseda*. k: *Podospora intestinacea*. l: *Podospora pleiospora*. m: *Podospora pyriformis*. n: *Podospora setosa*. Scale bars = 40  $\mu$ m.

**Notes:** This collection differs from the type in two aspects. Firstly, the perithecia are covered with sparse flexuous, septate, brown hairs, but in the description provided by Cain (1969), they were reported as glabrous. Secondly, the ascospores of our collection are smaller ( $28.8\text{-}38.4 \times 19.6\text{-}24 \mu\text{m}$  vs.  $37\text{-}48 \times 22\text{-}29 \mu\text{m}$ ).

14. *Podospora setosa* (Winter) Niessl, Hedwigia, 22: 156. 1883. (Fig. 12n)  
For synonyms see Mirza and Cain, (1969).

Perithecia subglobose, scattered, semi-immersed, brown,  $450-620 \times 350-400 \mu\text{m}$ , often surrounded at the base with a growth of light-colored mycelium, upper part covered with scattered, non-septate, straight, brown, hyaline-tipped hairs. Paraphyses not clear. Asci 128-spored, clavate ca.  $250 \times 50 \mu\text{m}$ ; apical ring not distinct, stipe about one-fifth the length of ascus. Ascospores irregularly multi seriate, ellipsoidal,  $17-19 \times 10-12 \mu\text{m}$ ; pedicel cylindrical,  $6-9.6 \times 2-2.5 \mu\text{m}$ ; caudae lash-like, usually longer than spore and variable in length, upper one eccentric, lower one attached to the distal end of the pedicel; germ pore almost apical.

**Specimen examined:** China, Yunnan Province, Kunming Zoo, on antelope dung, Mar. 16, 2004, D.M. Hu (YMF6.00018).

**Notes:** Our collection agrees well with the description provided by Cain (1969).

### A Key to the Genera *Podospora* and *Schizothecium* in Mainland China

1. Perithecia adorned with swollen agglutinated hairs or prominent protruding peridial cells . . . . . 2
1. Perithecia not as above . . . . . 5
2. Perithecial hairs very long, asci 8-spored, ascospores  $31-33 \times 14-16 \mu\text{m}$  . . . . . *S. aloides* 3
2. Perithecial with short hairs or prominent protruding cells. . . . . 3
3. Asci with 32 spores, ascospores  $20-24 \times 12-13 \mu\text{m}$ . . . . . 3 *S. dakotense*
3. Asci 8-spored . . . . . 4
4. Ascospores  $40-46 \times 20-27 \mu\text{m}$ , upper cauda groove. . . . . 2 *S. curvuloides*
4. Ascospores  $14-21 \times 9-13 \mu\text{m}$ , caudae lash-like . . . . . 4 *S. miniglutinans*
5. The upper part of perithecium covered with nonseptate, straight, . . . . . brown hairs . . . . . 6
5. The perithecium not as above. . . . . 7
6. Asci 4-spored, ascospores  $26-30 \times 16-17 \mu\text{m}$ . . . . . 5 *P. anserina*
6. Asci 128-spored, ascospores  $17-19 \times 10-12 \mu\text{m}$ . . . . . 14 *P. setosa*
7. The upper part of perithecia covered with tubular hairs . . . . . 8
7. The perithecia not as above . . . . . 10
8. Asci with 32 spores, ascospores  $31-36 \times 18-20 \mu\text{m}$ . . . . . 12 *P. pleiospora*
8. Asci 8-spored . . . . . 9
9. Ascospores  $30-32 \times 16-17 \mu\text{m}$  . . . . . 7 *P. argentinensis*
9. Ascospores  $39-40 \times 20-22 \mu\text{m}$  . . . . . 9 *P. dicepiens*
10. Asci 8-spored . . . . . 11
10. Asci 256-spored, ascospores  $10-14 \times 7 \mu\text{m}$  . . . . . 6 *P. araneosa*
11. Ascospores with four upper gelatinous appendages and four lower gelatinous appendages,  $28-35 \times 15-22 \mu\text{m}$  . . . . . 8 *P. communis*
11. Ascospores with only two gelatinous appendages . . . . . 12

12. Perithecia covered with scattered, short, straight, septate, brown hairs, ascospores  $50\text{-}58 \times 27\text{-}33 \mu\text{m}$ , pedicel pestle-shaped,  $34\text{-}45 \times 6.8\text{-}7.2 \mu\text{m}$  ..... 10 *P. fimiseda*
12. Perithecia smooth or covered with only a few flexuous hairs.....13
13. Ascospores narrow ellipsoid,  $46.8\text{-}67.2 \times 21.6\text{-}26.4 \mu\text{m}$  ....11 *P. intestinacea*
13. Ascospores biseriate, broad ellipsoid,  $28.8\text{-}38.4 \times 19.6\text{-}24 \mu\text{m}$  ... 13 *P. pyriformis*

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