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Coniochaeta ershadii, a new species from Iran, and a key to well-documented *Coniochaeta* species

by

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With 1 figure

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Abstract: A new species of *Coniochaeta* from dead pistachio twigs, *C. ershadii,* is described from Varamin district, Tehran Province. *C. ershadii* differs from the similar *C. gamsii* by possessing smaller ascocarps covered with setae, a peridium with an irregular texture, longer and narrower asci, shorter ascospores, and by producing numerous crystals when cultivated on Leonian agar and other media. It is particularly distinguished by its ascospores with protruding ends up to 1.7-2.5 µm long. The conidiophores of the nodulisporium-like anamorph of *C. ershadii* produce 2-3 conidiogenous loci and cylindrical blastoconidia with attenuated bases. A dichotomous key for identification of 54 sufficiently documented *Coniochaeta* species is provided.

Key words: Ascomycetes, *Coniochaeta*, pistachio, taxonomy.

Introduction

Coniochaeta (Sacc.) Cooke was originally introduced by Saccardo (1882) as a subgenus of *Rosellinia* De Not. for species with hairy perithecia. Cooke (1887) raised it to genus level. The genus was lectotypified with *C. ligniaria* (Grev.) Massee (Clements & Shear 1931, von Arx & Müller 1954). Malloch & Cain (1971) established the family Coniochaetaceae to include *Coniochaeta* and *Coniochaetidium*. *Coniochaeta* differs from the xylariaceous genus *Rosellinia* by the absence of an amyloid apical apparatus in the asci. In the recent literature the family Coniochaetaceae

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is placed under Sordariales (Lee & Hanlin 1999, Kirk et al. 2001). The Coniochaetaceae differ from the Sordariaceae in having ascospores with longitudinal germ slits. The species of *Coniochaeta* have dark brown to black ascocarps with a peridium that may or may not be setose. They have ellipsoidal to fusoid or nearly globose ascospores with a germ slit extending over the narrow side (Mahoney & LaFavre 1981, Hanlin 1990). Associated anamorphs belong to the phialidic genus *Lecythophora* Nannf. (Weber 2002, Weber et al. 2002) or are polyblastic and nodulisporium-like (Hawksworth 1978, Asgari & Zare 2006).

Coniochaeta species are known to produce antibacterial and antifungal metabolites. Coniosetin and coniochaetone-a and -b, compounds with considerable antibacterial and antifungal activity, have been obtained from *Coniochaeta* spp. Specifically, coniosetin is produced by *C. ellipsoidea* (Segeth et al. 2003), while the coniochaetones are obtained from *C. saccardoi* (Wang et al. 1995). *C. tetraspora* has been studied in an attempt to elucidate the mechanism of programmed ascospore death in homothallic ascomycetes (Raju & Perkins 2000). Raju & Perkins (2000) showed that *C. tetraspora* is homothallic and ascospore death, disintegration of two pairs of ascospores in each mature ascus, is nonrandom. They showed that one of the two haploid nuclei entering each functional zygote must carry the altered element a specific chromosome locus, which is segregated into two of the four meiotic products and is eliminated when ascospores that contain it disintegrate.

During an investigation on the mycoflora of pistachio tree (*Pistacia vera* L.) mycoflora in Iran (2004-06), an isolate of *Coniochaeta* with distinctive characteristics was obtained. *Coniochaeta gamsii* and *C. velutinosa*, are the only *Coniochaeta* species known from Iran. They were isolated from barley leaves (Asgari & Zare 2006).

Mahoney & LaFavre (1981) gave a list of *Coniochaeta* species on different substrata and a synopsis of ascospore characters. Hawksworth & Yip (1981) provided a key to 11 species known in culture. Checa et al. (1988) and Romero et al. (1999), respectively, provided keys to Spanish and Argentinian *Coniochaeta* species. Based on these and other recent publications, we present an identification key to well-documented *Coniochaeta* species. This key is clearly not a substitute for a necessary critical revision of all described species of this large and highly diversified genus.

Material and methods

The isolate of *C. ershadii* was obtained from pistachio (*Pistacia vera* L.) twigs by placing unsterilized pieces of twigs on PDA (potato-dextrose agar, Merck) containing antibiotics. Colony morphology and microscopic features of the teleomorph were recorded for colonies grown on Leonian´s agar (Gams et al. 1998) at 24°C in the dark. The anamorph was studied using single-ascospore cultures on PCA (potato-carrot agar) incubated at 24°C. Microscopic measurements were taken from material mounted in water. Ascocarps were hand-sectioned using a razor blade. Photographs were taken using an Olympus digital camera (C-4000), a BH2 Olympus microscope and a Zeiss (STEMI SV8) stereo microscope. Mean averages and standard deviations were calculated for 20 measurements of asci and ascospores and 10 measurements of ascocarps. BioloMICS software was used for the calculations (provided by Dr V.Robert, BioAware, S.A., 2003, Version 1.0.2).

Results and discussion

Coniochaeta ershadii Zare, Asgari & W.Gams, sp. nov., MycoBank 500785. Fig.1

Etymology: We name this species after our friend Djafar Ershad, Tehran, in recognition of his contributions to Iranian mycology.

Coloniae primum albidae, deinde fuscescentes. Mycelium aerium parcum, hyphis 2.3-2.7 µm latis; crystalla octahedrica copiosa; chlamydosporae nullae. Perithecia post 4-6 hebdomadas maturantia, superficialia, atra, globosa vel subglobosa, 200-500 µm diam., ventro globoso collum breve portante; setis fuscis, crassitunicatis, hebetibus, levibus, 44-46 µm longis obtecta; peridium irregulariter pseudoparenchymaticum, fuscum, cellulis 6-12 µm; paraphyses numerosae, filiformes, septatae, simplices, hyalinae, 8-9.5 µm latae, sursum ad 2.5-4 µm attenuatae, acutatae, ascos superantes; asci cylindrici, 8-spori, breviter stipitati, 110-150 × 10.5-12 µm; ascosporae oblique uniseriatae, cito brunnescentes, leves, ellipsoideo-fusoideae, haud applanatae, uno vel ambobus polis ad 2.5 µm protrudentibus, 16-18 × 9.5-10.5 µm, guttulam magnam continentes, fissura germinationis secundum longitudinem extensa; ascosporae in massa globosa per ostiolum exeuntes. Anamorphe *Nodulisporii* similis; cellulae conidiogenae 4-24 µm longae, e 2-3 denticulis conidia singula cylindrica 8-11 × 2-3 µm proferentes.

Colonies reaching 90 mm diam in 9 days on Leonian agar, at first white, then becoming dark brown, reverse uncoloured; mycelium with low aerial growth, composed of hyaline, smooth-walled, septate, often anastomosing, 2.3-2.7 µm wide hyphae; numerous octahedral crystals present in the culture (Fig. 1 r, s); chlamydospores absent. Ascocarp initials arising as interwoven hyphae, soon becoming contorted. Perithecia produced abundantly in the second week, maturing in 4-6 weeks, solitary or aggregated, superficial, black, globose to subglobose, 200-500 µm diam, with a nearly globose venter and a very short neck (Fig. 1 a); covered with dark stiff setae that are thick-walled and blunt-ended, with smooth or rough surface, simple or distinctly branched, mostly swollen near the base, measuring 44-46 × 4.2-4.6 µm (Fig. 1 d, e); peridium irregularly pseudoparenchymatous, dark brown, with cells 6-12 µm (Fig. 1 b, c); paraphyses numerous, filiform, septate, simple, hyaline, 8-9.5 µm wide at the base, tapering to 2.5-4 µm near the apex, with a pointed tip, mostly longer than the asci; asci cylindrical, 8-spored, with non-amyloid undifferentiated apex, with a short stout stipe, measuring 110-150 × 10.5-12 µm (Fig. 1 f-h); ascospores obliquely uniseriate, hyaline at first but soon turning pale green to greenish brown and finally dark brown or black, smooth, without a sheath, ellipsoid-fusoid, mostly with rotational symmetry (Fig. 1 i, j), measuring 16-18 × 9.5-10.5 µm, with a distinctive protrusion at one or both ends reaching up to 1.7-2.5 µm (Fig. 1 j), containing a large guttule when mounted in water (Fig. 1 i); germ slits straight, extending over the whole length of the ascospores (Fig. 1 h); ascospores exuded as a large globose mass at the mouth of the ostiole (Fig. 1 a).

Anamorph: Conidiogenous cells, produced predominantly on hyphal coils and also on aerial hyphae, simple, hyaline, variable in length, measuring 4-24 × 2-2.3 µm, monoblastic or polyblastic, usually producing 2-3 conidiogenous denticles bearing single blastoconidia (Fig. 1 k-q); phialides absent; conidia rarely formed on aerial hyphae, remaining attached to the conidiogenous locus for a long time, smooth, subhyaline, oblong, regularly cylindrical, sometimes slightly constricted in the middle, with rounded apex and distinctly attenuated base (0.5-1.2 µm long), with truncated basal scar (Fig. 1 t, u), measuring 8-11 × 2-3 µm.

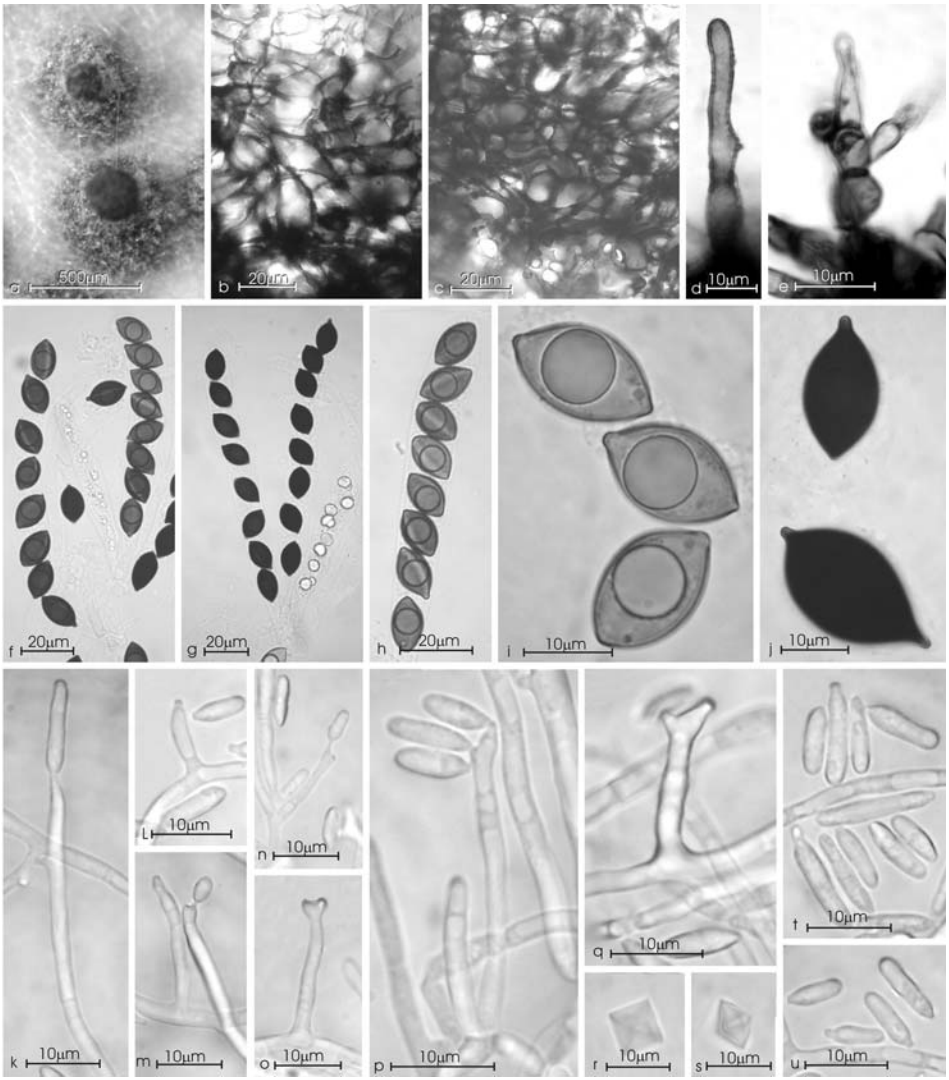

Fig. 1. *Coniochaeta ershadii* and its nodulisporium-like anamorph. a-j. Teleomorph. a. Ascocarps viewed from above exuding ascospore masses; b, c. peridium of irregular structure; d, e. setae; f-h. asci; i-j. ascospores. k-u. Anamorph. k-q. Conidiogenous cells; r, s. crystals; t, u. conidia.

HOLOTYPE: IRAN 1841 F (ex-type strain IRAN 972 C = CBS 119785), isolated by M.Mirabolfathy from dead twigs of *Pistacia vera*, from Varamin, Tehran Province, Iran.

Coniochaeta ershadii is very similar to *C. gamsii* Asgari & Zare in colony morphology, shape of ascocarps, asci, ascospores and paraphyses. The most striking features shared by both species are the protruding ends in the ascospores and the nodulisporium-like anamorph. *C. gamsii* has much larger ascocarps (500-800 µm diam.) than *C. ershadii*, the ascocarps lack setae and have a regularly textured

peridium, relatively shorter and wider asci (110-130 × 12-14 µm), and longer ascospores (16-19 × 6-11 µm). Ascocarps in *C. ershadii* need more time to mature than those of *C. gamsii* (4-6 vs. 3-4 weeks). Crystals were not produced by *C. gamsii* but they were abundant in *C. ershadii* when it was grown on Leonian´s agar (see also Asgari & Zare 2006).

The nodulisporium-like anamorph of *C. gamsii* differs slightly from that of *C. ershadii*. Conidia in *C. gamsii* are not as markedly attenuated at the base, and are mostly aggregated in clusters at the tip of the conidiogenous cells (see Asgari & Zare 2006), while the conidiogenous cells in *C. ershadii* proliferate laterally once or twice.

In spite of intense searching, only a single isolate of this species could be obtained.

Key to well-documented *Coniochaeta* species

1. Asci multispored..... 2
1. Asci 4-8-spored..... 6

2. Asci with 128 or fewer spores..... 3
2. Asci with more than 128 spores..... 5

3. Ascospores discoid with germ slit around the circumference, 13-16.5 × 9.5-13.5 × 5.5-9 µm; asci with 64 spores..... *C. polymegasperma*
3. Ascospores narrowly elliptical in side view..... 4

4. Ascospores broadly elliptical to subcircular in face view, 8 × 6-8 µm; asci with 32 spores..... *C. philocoproides*
4. Ascospores broadly elliptical to circular or ovate in face view, 6-9 × 5-9 × 4-7 µm; asci with 64-128 spores..... *C. hansenii*

5. Asci with 512 spores; ascospores circular to broadly ovate in face view, elliptical in side view, 7-8 × 6-8 × 4-4.5 µm..... *C. polysperma*
5. Asci with 1000 or more spores; ascospores circular in face view, elliptical in side view, 5-7 × 3-6 µm..... *C. multispora*

6. Asci 4-spored..... 7
6. Asci 8-spored..... 9

7. Ascospores broadly elliptical in face view, 10-16 × 6-10 × 5-7 µm..... *C. tetraspora*
7. Ascospores mostly longer than 15 µm..... 8

8. Ascospores ellipsoidal, with slightly apiculate ends, 15-20 × 12-15 × 9-11 µm; anamorph nodulisporium-like..... *C. nodulisporioides*
8. Ascospores fusiform, 17-20 × 9-11 µm; anamorph unknown..... *C. magniquadrispora*

9. Arrangement of ascospores in asci biseriate..... 10
9. Arrangement of ascospores in asci uniseriate..... 15

10. Ascospores equilateral..... 11
10. Ascospores inequilateral..... 14

11. Ascospores mostly narrower than 4 µm; anamorph *Lecythophora*..... 12
11. Ascospores mostly wider than 4 µm; anamorph *Lecythophora* or absent..... 13

12. Ascospores narrowly ellipsoidal with a longitudinal germ slit extending to the tips of the ascospores, 9-11 × 3-5 × 3-4 µm..... *C. nepalica*
12. Ascospores narrowly ellipsoidal, slightly attenuated at the apices, with a raised longitudinal germ slit not extending to the tips of the ascospores, (11.5-)12-13.5(-14.5) × (3-)3.5-4 µm..... *C. angustispora*

13. Ascospores fusiform and cymbiform (boat-shaped), 14-17 × 4.5-5.5 × 4-4.5 µm; anamorph *Lecythophora*..... *C. cymbiformispora*
13. Ascospores flying-saucer-shaped and cruciform in polar view, 11-13 × 7-8.5 × 5.5-6.5 µm; anamorph unknown..... *C. cruciata*

14. Ascospores ellipsoidal, convex on one side, almost flat on the other side, apiculate at one or both ends, 10-12 × 6-7.5 × 6-8 µm..... *C. arxii*
14. Ascospores reniform, convex on one side, flat on the other side, (8.9-)11-13.3 × 6.7-8.9(-10) µm ..... *C. renispora*

15. Peridium areolate, reddish; ascospores ellipsoidal with rounded ends, 10-13 × 6-7 × 5-6 µm ..... *C. areolatirubra*
15. Peridium not areolate..... 16

16. Peridium red; ascomata covered with 60 µm long pointed setae; ascospores oblong, 16-19(-21) × 11-12 µm..... *C. sanguinolenta*
16. Peridium not red, with isodiametric or angular cells..... 17

17. Ascospores flying-saucer-shaped, broadly elliptical in face view, limoniform in side view and cruciform in end view, 16-18 × 9-12 × 7-9 µm; ascomata covered with a loosely appressed layer of flexuous hairs; anamorph *Lecythophora*..... *C. extramundana*
17. Ascospores ellipsoidal in face view, lenticular in side view, 10-14 × 7.5-9 × 5-6 µm; ascomata covered with mace-like and capitate setae; anamorph *Lecythophora*..... *C. rhopalochaeta*
17. Ascospores narrowly ellipsoidal, fusiform or subfusiform..... 18

18. Peridium cephalothecoid; anamorph *Lecythophora*..... 19
18. Peridium pseudoparenchymatous; anamorph *Lecythophora* or deviating..... 20

19. Ascomata covered with pointed setae; ascospores ovoid to almond-shaped or pyriform, 8-13 × 5-7.5 × 4-5 µm..... *C. cephalothecoides*
19. Ascomata covered with blunt setae; ascospores ellipsoidal to fusiform, with apiculate ends, (13-)14-16(-17.5) × 3.5-5 µm..... *C. dumosa*

20. Peridial cells of irregular shape..... 21
20. Peridial cells of regular shape..... 23

21. Ascospores ellipsoidal-fusoid, with rotational symmetry, measuring 16-18 × 9.5-10.5 µm, with a distinct protrusion at one or both ends reaching 1.7-2.5 µm in length; ascomata covered with blunt setae; anamorph nodulisporium-like..... *C. ershadii*
21. Ascospores inequilateral ellipsoidal..... 22

22. Ascomata covered with hyaline or yellowish brown hyphae; ascospores measuring 10-12 × 6-7 × 5.5-6.5 µm, with apiculate ends; anamorph paecilomyces-like..... *C. cypraeispora*
22. Ascomata covered with loose hairs or almost glabrous; ascospores measuring 7-10 × 4.5-6 × 4.5-5.5 µm; anamorph nodulisporium-like..... *C. emodensis*

23. Ascospores flattened ellipsoidal to fusoid..... 24
23. Ascospores ellipsoidal, ovoid or fusiform, with rotational symmetry..... 39

24. Inner peridial cells and subhymenium turning green in alkaline solutions; ascospores subfusiform in side view, 12-15 × 8-10 × 5-8 µm; anamorph unknown..... *C. alkalivirens*
24. Subhymenium not turning green in alkaline solutions..... 25

25. Ascospores lenticular or mill-stone shaped..... 26
25. Ascospores ovoid, fusoid or ellipsoidal..... 27

26. Ascospores lenticular, 11-12 × 5-7 × 3-4 µm; ascomata glabrous; anamorph unknown..... ..... *C. phalacrocarpa*
26. Ascospores mill-stone shaped, broadly elliptical in face view, narrowly elliptical in side view, 10-14 × 9-13 × 6-8 µm; ascomata densely covered with setae with a broad base and pointed apex; anamorph *Lecythophora*..... *C. malacotricha*

27. Ascospores ovoid, one end round, the other end apiculate, 17-23 × 8-10 × 6-8 µm..... *C. ovata*
27. Ascospores not ovoid..... 28

28. Ascospores fusiform..... 29
28. Ascospores ellipsoidal..... 30

29. Ascomata apically covered with brown, rigid setae; ascospores fusiform-ellipsoidal, 12-14 × 4-4.5 × 3.5-4 µm; anamorph *Lecythophora*..... *C. perangusta*
29. Ascomata entirely covered with blackish-brown, pointed setae; ascospores fusoid, 9-13 × 5-6 × 3-4 µm; anamorph unknown..... *C. arctespora*

30. Ascospores often flat on one side, subapiculate at both ends, 18-23 × 9-13 × 5-8 µm; anamorph unknown..... *C. ellipsoidea*
30. Ascospores not so..... 31

31. Ascospores mostly narrower than 11 µm..... 32
31. Ascospores mostly wider than 11 µm..... 37

32. Ascospores broadly elliptical to circular in face view, narrowly elliptical in side view; anamorph *Lecythophora* or phialophora-like..... 33
32. Ascospores broadly ovoid-ellipsoidal or narrowly ellipsoidal in face view; anamorph unknown... 36

33. Ascospores mostly longer than 10 µm..... 34
33. Ascospores mostly shorter than 10 µm..... 35

34. Ascospores measuring 10-12.5 × 7.5-11.5 × 6-7 µm; anamorph *Lecythophora*..... *C. velutinosa*
34. Ascospores measuring 11-14 × 8-12 × 6-8 µm; anamorph unknown..... *C. vagans*

35. Ascospores sometimes slightly oval, with 1-2 guttules, measuring 6-10 × 4-7 × 3-5 µm; anamorph *Lecythophora*..... *C. velutina*
35. Ascospores non-guttulate, measuring 7-10 × 5-9 × 4-8 µm; anamorph phialophora-like..... ..... *C. leucoplaca*

36. Ascospores broadly ovoid-ellipsoidal, slightly irregular, 8-13 × 6-9 × 5-6 µm; ascomata apically covered with scanty, undulate, blunt setae..... *C. subcorticalis*
36. Ascospores ellipsoidal to narrowly ellipsoidal, 14-20 × 6-9 × 5-6 µm; ascomata entirely covered with sparse setae that are swollen at the base and rounded at the apex..... *C. saccardoi*

37. Ascomata covered with rigid, straight setae; ascospores circular to broadly elliptical in face view, 16-23 × 10-19 × 8-15 µm; anamorph unknown..... *C. scatigena*
37. Ascospores mostly less than 8 µm in end view..... 38

38. Ascomata covered with short, blunt hairs; ascospores broadly ellipsoidal to subglobose, 9-15 × 9-14 × 7-8 µm; anamorph *Lecythophora decumbens*..... *C. pulveracea*
38. Ascomata covered with rigid, pointed setae, ascospores broadly elliptical to subcircular or slightly ovate in face view, 9-20 × 8-15 × 4-8 µm; anamorph *Lecythophora mutabilis*..... *C. ligniaria*

39. Ascospores ellipsoid-fusoid, 16-19 × 6-11 µm, with protrusion at both ends and a distinct large guttule; anamorph nodulisporium-like..... *C. gamsii* (see also 21)
39. Ascospores without protruding ends; anamorph not nodulisporium-like..... 40

40. Ascospores with (sub-)apiculate ends..... 41
40. Ascospores with rounded ends..... 43

41. Ascospores broadly ellipsoidal, slightly apiculate at one end, 7-10 × 3-5 µm; anamorph unknown ..... *C. microspora*
41. Ascospores mostly wider than 5 µm..... 42

42. Ascospores ellipsoidal with subapiculate ends, 15-19 × 7.5-10 µm; anamorph unknown... *C. caffra*
42. Ascospores ellipsoidal-fusoidal, apiculate at both ends, 12-17 × 6-8 µm; anamorph phialophora-like..... *C. elaeidicola*

43. Ascospores ovoid, globose or subglobose..... 44
43. Ascospores ellipsoidal or fusoid..... 46

44. Ascospores globose, rarely broadly ellipsoidal or ovoid, 11-16 µm diam. (rarely 19 × 10-15 µm) ..... *C. albidomucosa*
44. Ascospores not globose..... 45

45. Ascospores ovoid with obtuse ends, 7-9 × 4-6 µm..... *C. williamsii*
45. Ascospores slightly flattened, broadly ovoid or ellipsoid, often subglobose, 4-8 × 4-7 µm..... ..... *C. sordaria*

46. Ascospores inequilateral ellipsoidal, flattened on one side, 10-15 × 6-8 µm..... *C. sarothamni*
46. Ascospores equilateral ellipsoidal..... 47

47. Ascospores mostly longer than 15 µm..... 48
47. Ascospores mostly shorter than 15 µm..... 50

48. Ascomata covered with sinuous, pointed or blunt setae; ascospores broadly ellipsoidal, slightly fusoid, 16-20 × 8-9 µm..... *C. niesslii*
48. Ascomata covered with rigid, acute setae..... 49

49. Asci uniseriate to sub-biseriate; ascospores ellipsoidal without gelatinuous sheath, 17-19 × 5-7 µm ..... *C. gymnosporae*
49. Asci uniseriate; ascospores ellipsoidal or fusoid with gelatinous sheath, 20-26 × 7-10 µm..... ..... *C. caryotae*

50. Ascospores ellipsoidal, very broadly rounded at the ends, 4-6 × 3-4 µm..... *C. kellermanii*
50. Ascospores ellipsoidal, mostly wider than 5 µm..... 51

51. Ascomata covered with dark brown, acute setae; ascospores with gelatinous sheath, 11-13 × 6-8 µm..... *C. tilakii*
51. Ascomata nearly glabrous; ascospores without gelatinous sheath..... 52

52. Ascospores ellipsoidal to subglobose, 10-12 × 6-8 µm..... *C. ambigua*
52. Ascospores broadly ellipsoidal, 9-12 × 5-8 µm..... *C. myricariae*

List of *Coniochaeta* species mentioned in the key and some synonyms

C. albidomucosa Petr., Sydowia **6**: 352 (1952) (wood).

C. alkalivirens Checa & G.Moreno, Crypt. Mycol. **9**: 3 (1988) (wood).

C. ambigua (Sacc.) Popushoi, Mikoflora plodovykh derevyaev SSSR [Mycoflora of fruit trees of the U.S.S.R.] (Moscow): 90 (1971) (wood).

≡ *Rosellinia ambigua* Sacc., Fungi Ven. Ser. II in N. Giorn. Bot. Ital. **7**: 323 (299-329) (1875), and Fungi ital. T. 584. (1882).

= *C. niesslii fide* von Arx & Müller (1954), see below.

C. angustispora D.Hawksw. & H.Y.Yip, Aust. J. Bot. **29**: 378 (1981) (soil).

C. arctespora (Cooke & Ellis) M.E.Barr, Mycotaxon **46**: 49 (1993) (plant material, Ericaceae).

≡ *Sphaeria arctespora* Cooke & Ellis, Grevillea **5**: 93 (1877).

= *Sphaeria xylariispora* Cooke & Ellis, Grevillea **6**: 94 (1878) [as '*xylariaespora*'].

≡ *Rosellinia xylariispora* (Cooke & Ellis) Sacc., Syll. Fung. **1** : 727 (1882) (morphological details by D.L.Hawksworth, pers. comm.).

≡ *Coniochaeta xylariispora* (Cooke & Ellis) Cooke, Grevillea **16**: 16 (1887) [as '*xylarispora*'].

C. areolatirubra Checa, Barrasa & G. Moreno, Crypt. Mycol. **9**: 6 (1988) (plant material).

C. arxii Udagawa & Takada, Stud. Mycol. **31**: 189 (1989) (soil).

C. caffra Matsush., Matsush. Mycol. Mem. **9**: 6 (1996) [as '*caffera*'] (soil).

C. caryotae R.Rao, Sydowia **24**: 322 (1970) (wood).

C. cephalothecoides Kamiya, Uchiy. & Udagawa, Mycoscience **36**: 377 (1995) (soil).

C. cruciata Fort & Guarro, Crypt. Mycol. **9**: 10 (1988) (leaf litter).

C. cymbiformispora T.Yokoy. & Tad. Ito, Trans. Mycol. Soc. Japan **29** (1988): 319 (1989) (soil).

C. cypraeispora Van der Linde, Mycol. Res. **95**: 510 (1991) (Gramineae) [as '*cypraeaspora*'] (Gramineae).

C. dumosa Kamiya, Uchiy. & Udagawa, Mycoscience **36**: 380 (1995) (soil).

C. elaeidicola (Henn.) C. Moreau & M. Moreau, Rev. Mycol. **14**, Suppl. Col. 2: 60 (1949) (wood).

≡ *Rosellinia elaeidicola* Henn., Engler's Bot. Jahrb. **22**: 77 (1895) [as '*elaeicola*'].

C. ellipsoidea Udagawa, in Udagawa & Takada, Trans. Mycol. Soc. Japan **8**: 51 (1967) (soil).

C. emodensis Udagawa & Y.Horie, Rep. Cryptog. Study Nepal: 100 (1982) (soil).

C. ershadii Zare, Asgari & W.Gams, this paper.

C. extramundana Mahoney & La Favre, Mycologia **73**: 931 (1981) (soil).

C. gamsii Asgari & Zare, Nova Hedwigia **82**: 228 (2006) (Gramineae).

C. gymnosporae S.B.Kale & S.V.S.Kale, Indian Phytopathol. **25**: 294 (1972) (wood).

C. hansenii (Oudem.) Cain, Univ. Toronto Stud., Biol. Ser. **38**: 63 (1934) (dung).

≡ *Sordaria hansenii* Oudem., Hedwigia **21**: 123 (1882).

≡ *Philocopra hansenii* (Oudem.) Oudem., Hedwigia **21**: 160 (1882).

C. kellermanii (Ellis & Everh.) Munk, Dansk Bot. Ark. **15**(2): 54 (1953) (dung) [as '*kellermanni*'], possibly synonymous with *C. velutina*.

≡ *Rosellinia kellermanii* Ellis & Everh., Proc. Acad. Nat. Sci., Philad.: 227 (1890).

?= *C. velutina fide* Taylor (1970).

C. leucoplaca (Berk. & Ravenel) Cain, Univ. Toronto Stud., Biol. Ser. **38**: 61 (1934) (dung).

≡ *Sphaeria leucoplaca* Berk. & Ravenel, North Am. Fungi no. 913 (1876).

= *Sordaria microspora* Plowr., Brit. Fungi, Grevillea **6** [1877-78]: 28 (1878).

= *C. velutina* (Fuckel) Munk *fide* Checa et al. (1988) (q.v.).

C. ligniaria (Grev.) Massee, Grevillea **16**: 37 (1887) (dung and wood).

≡ *Sphaeria ligniaria* Grev., Scot. Crypt. Fl. **1**: 82 (1824).

≡ *Rosellinia ligniaria* (Grev.) Nitschke, in Fuckel, Jb. Nassau. Ver. Naturk. **23-24**: 150 (1870).

≡ *Helminthosphaeria ligniaria* (Grev.) Kirschst., Trans. Brit. Mycol. Soc. **18**: 305 (1934).

= *C. discospora* (Auersw. ex Niessl) Cain, Univ. Toronto Stud. **37**: 62 (1934) *fide* Hawksworth & Yip (1980), Checa et al. (1988), but see below under *C. vagans.*

C. magniquadrispora Matsush., Matsush. Mycol. Mem. **9**: 7 (1996) (soil).

C. malacotricha (Auersw. ex Niessl) Traverso, Fl. Ital. Crypt. **1**: 473 (1907) (wood).

≡ *Rosellinia malacotricha* Auersw. ex Niessl, Verhandl. Naturforsch. Vereines Brünn **10**: 186 (1872).

≡ *Helminthosphaeria malacotricha* (Auersw. ex Niessl) Kirschst., Trans. Brit. Mycol. Soc. **18**: 305 (1934).

C. microspora S.M.Reddy & Bilgrami, Curr. Sci. **38**: 48 (1969) (wood).

C. multispora Cain, Univ. Toronto Stud. Biol. Ser. **38**: 64 (1934) (dung).

C. myricariae (Fuckel) Arx & E. Müll., Beitr. Kryptogamenfl. Schweiz **11**(1)**:** 307 (1954) (wood).

≡ *Sphaeria myricariae* Fuckel, Jb. Nassau. Ver. Naturk. **27-28**: 32 (1873).

≡ *Rosellinia myricariae* (Fuckel) Sacc., Syll. Fung. **1**: 272 (1882).

C. nepalica Minoura, Morinaga & T. Muroi, Trans. Mycol. Soc. Japan **18**: 123 (1977) (soil).

C. niesslii (Auersw.) Arx & E. Müll., Beitr. Kryptogamenfl. Schweiz **11**(1): 306 (1954) (wood).

≡ *Rosellinia niesslii* Auersw., in Niessl Beitr. Kenntn. Pilze: 35 (1871).

≡ *Sphaerodermella niesslii* (Auersw.) Höhn., Sitz.ber. K. Akad. Wiss. Wien, Math.-naturw. Kl., 1. Abt., **116**: 105 (1907).

≡ *Helminthosphaeria niesslii* (Auersw.) Kirschst., Trans. Brit. Mycol. Soc. **18**: 305 (1934).

C. nodulisporioides D.Hawksw., Norw. J. Bot. **25**: 15 (1978) (soil).

C. ovata Matsush., Microfungi of the Solomon Islands and Papua-New Guinea (Osaka): 72 (1971) (soil).

C. perangusta Udagawa & Y.Sugiy., Rep. Cryptog. Study Nepal: 20 (1982) (soil).

C. phalacrocarpa G.C.Carroll & Munk, Mycologia **56**: 78 (1964) (wood).

C. philocoproides (Griffiths) Cain, Univ. Toronto Stud., Biol. Ser. **38**: 65 (1934) (dung).

≡ *Sordaria philocoproides* Griffiths, Mem. Torrey Bot. Club: 54 (1901).

C. polymegasperma M.J.Richardson, Mycol. Res. **102**: 1038 (1998) (hare dung).

C. polysperma Furuya & Udagawa, Trans. Mycol. Soc. Japan **17**: 251 (1976) (dung).

C. pulveracea (Ehrh.) Munk, Dansk Bot. Ark. **12**(11): 9 (1948) (wood).

≡ *Sphaeria pulveracea* Ehrh. in Persoon, Syn. Meth. Fung.: 83 (1801).

≡ *Rosellinia pulveracea* (Ehrh.) Fuckel, Jb. Nassau. Ver. Naturk. **23-24**: 149 (1870).

≡ *Coniomela pulveracea* (Ehrh.) Kirschst., Trans. Brit. Mycol. Soc. **18**: 306 (1934).

= *C. sarothamni* (J.Schroet.) Arx & E.Müll. *fide* Checa et al. (1988), but see below.

C. renispora J.L.Crane & Shearer, Mycotaxon **54**: 107 (1995) (wood).

C. rhopalochaeta A.I.Romero & Carmarán, Mycol. Res. **103**: 689 (1999) (wood).

C. saccardoi (Marchal) Cain, Univ. Toronto Stud., Biol. Ser. **38**: 65 (1934) (dung).

≡ *Hypocopra saccardoi* Marchal, Fungi coproph.: 23 (1885).

C. sanguinolenta (Wallr.) Checa, Barrasa & Moreno, Cryptog. Mycol. **9**: 8 (1988) (wood).

≡ *Sphaeria sanguinolenta* Wallr., Fl. Crypt. Germ. **2**: 801 (1833).

≡ *Rosellinia sanguinolenta* (Wallr.) Sacc., Syll. Fung. **1**: 272 (1882)

C. sarothamni (J.Schröt.) Arx & E.Müll., Beitr. Kryptogamenfl. Schweiz **11**(1): 303 (1954) (plant material).

≡ *Rosellinia sarothamni* J.Schröt., Krypt. Fl. Schlesiens **3**: 302 (1897).

C. scatigena (Berk. & Broome) Cain, Univ. Toronto Stud., Biol. Ser. **38**: 62 (1934) (dung, plant material).

≡ *Sphaeria scatigena* Berk. & Broome, Ann. Mag. Nat. Hist, Ser. 3, **7**: 452 (Not. Brit. Fungi no. 972) (1861).

≡ *Hypocopra scatigena* (Berk. & Broome) Sacc., Syll. Fung. (Abellini) **1**: 243 (1882).

= *Sordaria platyspora* W.Phillips & Plowr., Brit. Fungi, Grevillea **6** [1877-78]: 28 (1878).

≡ *Hypocopra platyspora* (W.Phillips & Plowr.) Sacc., Syll. Fung. (Abellini) **1**: 241 (1882).

C. sordaria (Fr.) Trav. in Ferraris, Fl. Ital. Crypt., Fungi, Pyrenomycetes: 472 (1906) (wood). To be compared with *C. velutina*.

≡ *Sphaeria sordaria* Fr., Syst. Mycol. **2**: 458 (1823).

≡ *Rosellinia sordaria* (Fr.) Rehm, Ascom. no. 192 (1873).

C. subcorticalis (Fuckel) Cooke, Grevillea **16**: 16 (1876) (bark, soil, dung).

≡ *Rosellinia subcorticalis* Fuckel, Jb. Nassau. Ver. Naturk. **23-24**: 150 (1870).

C. tetraspora Cain, Canad. J. Bot. **39**: 1231 (1961) (soil, dung).

C. tilakii S.B.Kale, Sydowia **21**: 123-124 (1967) (wood of *Phoenix*).

C. vagans (Carestia & De Not.) Lundq., Publ. Herb. Univ. Uppsala **8**: 9 (1981) (dung).

≡ *Sordaria vagans* Carestia & De Not. in De Not., Comment. Soc. Crittog. Ital. **2**: 479 (1867).

≡ *Hypocopra vagans* (Carestia & De Not.) Sacc., Syll. Fung. **1**: 241 (1882).

= *C. discospora* (Auersw. ex Niessl) Cain, Univ. Toronto Stud. **37**: 62 (1934).

≡ *Sordaria discospora* Auersw. ex Niessl, Verh. Nat. Ver. Brünn **10**: 1982 (1872).

≡ *Hypocopra discospora* (Auersw. ex Niessl) Fuckel, Jb. Nassau. Ver. Naturk. **27-28**: 43 (1873).

C. velutina (Fuckel) Cooke, Grevillea **16**: 16 (1887) (dung, wood, *Stereum*).

≡ *Rosellinia velutina* Fuckel, Jb. Nassau. Ver. Naturk. **23-24**: 49 (1870).

≡ *Helminthosphaeria velutina* (Fuckel) Kirschst., Trans. Brit. Mycol. Soc. **18**: 305 (1934).

C. velutinosa Asgari & Zare, Nova Hedwigia **82**: 232 (2006) (Gramineae).

C. williamsii Hansf., Proc. Linn. Soc. N.S.W. **79**: 115 (1954) [as '*williamsi*'] (wood).

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References

ARX, J.A. von & E. MÜLLER (1954): Die Gattungen der amerosporen Pyrenomyceten. - Beitr. Kryptogamenfl. Schweiz **11**(1): 302-308.

ASGARI, B. & R. ZARE (2006): Two new *Coniochaeta* species from Iran. - Nova Hedwigia **82**: 227-236.

CHECA, J., J.M. BARRASA, G. MORENO, F. FORT & J. GUARRO (1988): The genus *Coniochaeta* (Sacc.) Cooke (Coniochaetaceae, Ascomycotina) in Spain. - Cryptog. Mycol. **9**: 1-34.

CLEMENTS, F.E. & C.L. SHEAR (1931): The genera of fungi. - H.W. Wilson, New York.

COOKE, M. (1887): Synopsis Pyrenomycetum. - Grevillea **16**: 16-19.

GAMS, W., E.S. HOEKSTRA & A. APTROOT, eds. (1998): CBS Course of Mycology. - CBS, Baarn, the Netherlands.

HANLIN, R.T. (1990): Illustrated Genera of Ascomycetes. - APS Press, St. Paul, Minnesota, USA.

HAWKSWORTH, D.L. (1978): A new species of *Coniochaeta* with an interesting conidial state. - Norw. J. Bot. **25**: 15-18.

HAWKSWORTH, D.L. & H.Y. YIP (1981): *Coniochaeta angustispora* sp. nov. from roots in Australia, with a key to the species known in culture. - Aust. J. Bot. **29**: 377-384.

KIRK, P.M., P.F. CANNON & J.C. DAVID (2001): Ainsworth & Bisby's Dictionary of the fungi (9th ed.). - CAB International, Wallingford.

LEE, S. & R.T. HANLIN (1999): Phylogenetic relationships of *Chaetomium* and similar genera based on ribosomal DNA sequences. - Mycologia **91**: 434-442.

MAHONEY, D.P. & J.S. LAFAVRE (1981): *Coniochaeta extramundana*, with a synopsis of other *Coniochaeta* species. - Mycologia **73**: 931-952.

MALLOCH, D. & R.F. CAIN (1971): New cleistothecial Sordariaceae and a new family Coniochaetaceae. - Canad. J. Bot. **49**: 869-880.

MUNK, A. (1957). Danish Pyrenomycetes. - Dansk Bot. Ark. **17**(1): 1-491.

RAJU, N.B. & D.D. PERKINS (2000): Programmed ascospore death in the homothallic ascomycete *Coniochaeta tetraspora*. - Fungal Genet. Biol. **30**: 213-221.

ROMERO, A.I., C.C. CARMARAN & L.E. LORENZO (1999): A new species of *Coniochaeta* with a key to the species known in Argentina. - Mycol. Res. **103**: 689-695.

SACCARDO, P.A. (1882): Sylloge Fungorum omnium hucusque cognitorum. Vol. I. - Padova.

SEGETH, M.P., A. BONNEFOY, M. BRONSTRUP, M. KNAUF, D. SCHUMMER, L. TOTI, L. VERTESY, M.C. WETZEL-RAYNAL, J. WINK & G. SEIBERT (2003): Coniosetin, a novel tetramic acid antibiotic from *Coniochaeta ellipsoidea*. - J. Antibiotics **56**: 144-122.

TAYLOR, L.D. (1970): *Coniochaeta velutina* and its synonyms. - Canad. J. Bot. **48**: 81-83.

WANG, H.J., J.B. GLOER, J.A. SCOTT & D. MALLOCH (1995): Coniochaetone-a and coniochaetone-b - new antifungal benzopyranones from the coprophilous fungus *Coniochaeta saccardoi*. - Tetrahedron Letters **36**: 5847-5850.

WEBER, E. (2002): The *Lecythophora-Coniochaeta* complex. I. Morphological studies on *Lecythophora* species isolated from *Picea abies*. - Nova Hedwigia **74**: 159-185.

WEBER, E., C. GÖRKE & D. BEGEROW (2002): The *Lecythophora-Coniochaeta* complex. II. Molecular studies based on sequences of the large subunit of ribosomal DNA. - Nova Hedwigia **74**: 187-200.

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Addendum

After completion of this study, we received a very relevant publication by D. García, A.M. Stchigel, J. Cano, M. Calduch, D.L. Hawksworth & J. Guarro (2006): Molecular phylogeny of Coniochaetales. – Mycol. Res. 110: 1271-1289.

The authors transfer *Coniochaeta gamsii* to a new genus, *Coniolariella*, a member of the Xylariales. They are using the names *Coniolaria murandii* and *Coniolariella gamsii* somewhat inconsistently but decide that they are synonymous. At that time *Coniochaeta ershadii* was not yet published. Now we see that the synonymy of *C. murandii* with *C. ershadii* is more likely than that with *C. gamsii.* Although we do not yet have molecular evidence, we assume that both these species are congeneric. The apiculate ascospores may be an additional characteristic feature of the genus. García et al. are expanding the generic concept of *Coniochaeta* considerably, including also species with cleistothecia and others with pitted ascospores. Our key will, however, only be helpful for identifying species with ostiolate perithecia and smooth ascospores. We regret that, in spite of our request to obtain a copy of this forthcoming paper, the authors were not prepared to inform us in time about their intentions.