
Several rare entopathogenic fungi from the Western Sichuan mountains

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Two new species of *Cordyceps* and a new species of *Paecilomyces* were collected from Dujiangyan Forest Park, Huanglong Nature Reserve and Xilin Jokul respectively. These new species are *C. sichuanensis* which parasitizes the adults of Pentatomidae (Hemiptera), *C. dayiensis* which has a very thin ascus cap and *Paecilomyces rariramus* with synnemata consisting of a few branchlets and subglobose conidia.

Key words: China, *Cordyceps dayiensis*, *Cordyceps sichuanensis*, new species, *Paecilomyces rariramus*.

Introduction

Species of the genus *Cordyceps* in the Western Sichuan mountains are diverse comprising common species such as *C. militaris* (Vuill.) Fr., *C. sobolifera* Berk. and *C. sinensis* (Berk.) Sacc. and also rare taxa (Table 1). In this paper we introduce two new species of *Cordyceps* and a new species of *Paecilomyces* from this area.

Taxonomy

***Cordyceps sichuanensis* Z.Q. Liang & B. Wang, sp. nov.** (Figs. 1, 4-6)

Etymology: Latin *sichuanensis*, referring here to Sichuan, the locality of this interesting fungus.

Stromata singularia, supra bifurcata ex abdomine hospitis oriunda. *Stipes* cylindricus, cinnabarinus, 100 mm longus, 2-3 mm crassus, prope basin denigratus. *Pars fertilis* terminalia, cinnabarinus, ovoidea vel ellipsoidea, 10-18 × 7-8 mm, minutissime mammillata, ostioliis humilibus. *Perithecia* immersa ovata aut pyriformia, 465-750 × 255-450 μm. Peridio mycelio.

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Table 1. Some reported species of *Cordyceps* from Western Sichuan mountains.

Name	Origin	Reference
<i>C. agriota</i>	Wawu Mountain	Liu <i>et al.</i> , 2001b
<i>C. aspera</i>	Songpan	Zang and Kinjo, 1998
<i>C. atrovirens</i>	Emei Mountain	Liu <i>et al.</i> , 1997
<i>C. brittlebankisoides</i>	Wawu Mountain	Liu <i>et al.</i> , 2001b
<i>C. emeishanensis</i>	Emei Mountain	Liu <i>et al.</i> , 1997
<i>C. kangdingensis</i>	Kangding	Zang and Kinjo, 1998
<i>C. liangshanensis</i>	Liangshan Mountain	Zang <i>et al.</i> , 1982
<i>C. longdongensis</i>	Emei Mountain	Liu <i>et al.</i> , 1997
<i>C. militaris</i>	Wawu Mountain	Liu <i>et al.</i> , 2001b
<i>C. militaris</i> var. <i>sphaerocephala</i>	Emei Mountain	Liu <i>et al.</i> , 1997
<i>C. multiaxoalis</i>	Kangding	Zang and Kinjo, 1998
<i>C. nutans</i>	Wawu Mountain	Liu <i>et al.</i> , 2001b
<i>C. petchii</i>	Rue Er Gai	Zang and Kinjo, 1998
<i>C. sinensis</i>	Miyalo, Li county	Liang <i>et al.</i> , 1995
<i>C. sobolifera</i>	Dujiangyan	Liu <i>et al.</i> , 2001a
<i>C. sphecocephala</i>	Wawu Mountain	Liu <i>et al.</i> , 2001b
<i>C. tricentrii</i>	Wawu Mountain	Liu <i>et al.</i> , 2001b

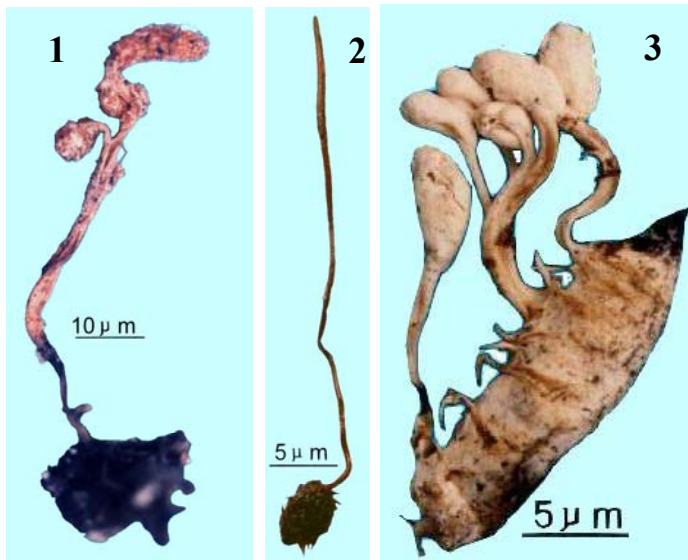
Asci cylindricis, 120-300 × 3-4.2 µm, capitibus 3-3.6 µm diam. *Ascosporis* filiformibus, multiseptatis. *Articulis* oblongis, 2.4-3.6 × 1-1.5 µm.

Stroma single, ramified at upper portion, arising from the abdomen of host insect. *Stipe* cylindric, salmon pink, 100 mm long and 2-3 mm wide, black near basal portion. *Fertile part* terminal, elliposoidal, 10-18 × 7-8 mm, with mastoid ostiole opening to the outside. *Perithecia* immersed, ovate or pyriform, 465-750 × 255-450 µm, in a tissue consisting of interwoven hyphae. *Asci* cylindric, 120-300 × 3-4.2 µm, with compressed globose cap of ascus, 2 µm high and 3-3.6 µm wide. *Ascospores* multiseptate, finally breaking into cylindric 1-celled fragments, 2.4-3.6 × 1-1.5 µm.

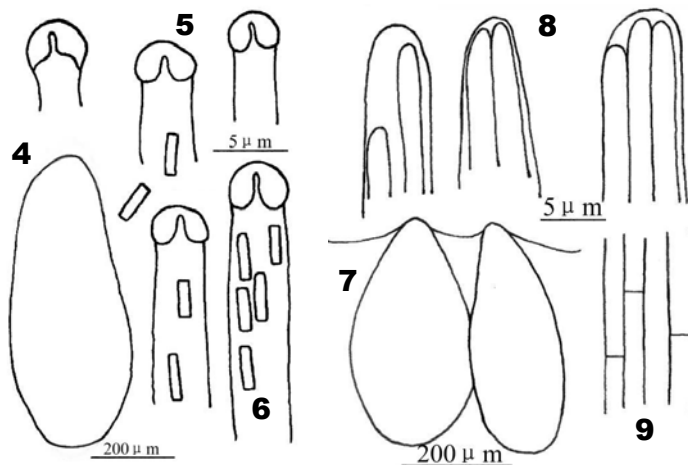
Habitat: Adult of Pentatomidae, Hemiptera.

Material examined: CHINA, Sichuan Province, Dujiangyan City, Longchi Forest Park, altitude 1600 m, October 1996, B. Wang (LFRGU-SAAS112, **holotype designated here**).

Notes: *Cordyceps pentatomi* Koval, *C. nutans* Pat. and *C. lutea* Moureau have been reported as parasitizing the adults of Hemiptera (Moureau, 1949; Kobayasi and Shimizu, 1978, 1983). *Cordyceps nutans* Pat. and *C. lutea* Moureau differ from *Cordyceps sichuanensis* in having obliquely immersed perithecia more than 1000 µm diam. *Cordyceps sichuanensis* is also similar to *Cordyceps pentatomi* Koval in the size of its perithecia and secondary ascospores, but the latter is clearly different in the fertile part which has lateral cushions and a sterile apical appendage.



Figs. 1-3. New species. 1. *Cordyceps sichuanensis*. 2. *C. dayiensis*. 3. *Paecilomyces rariramus*.



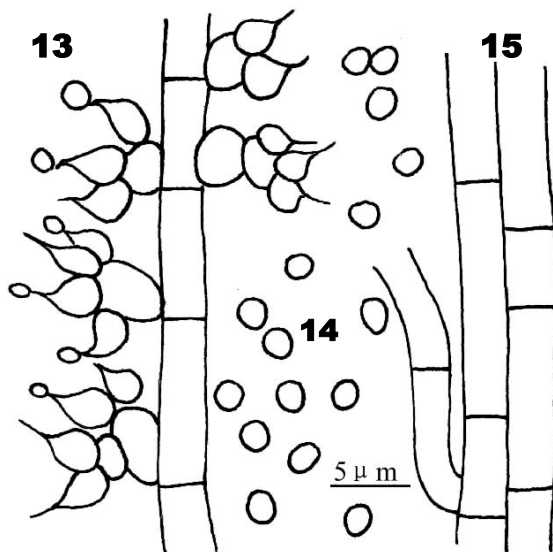
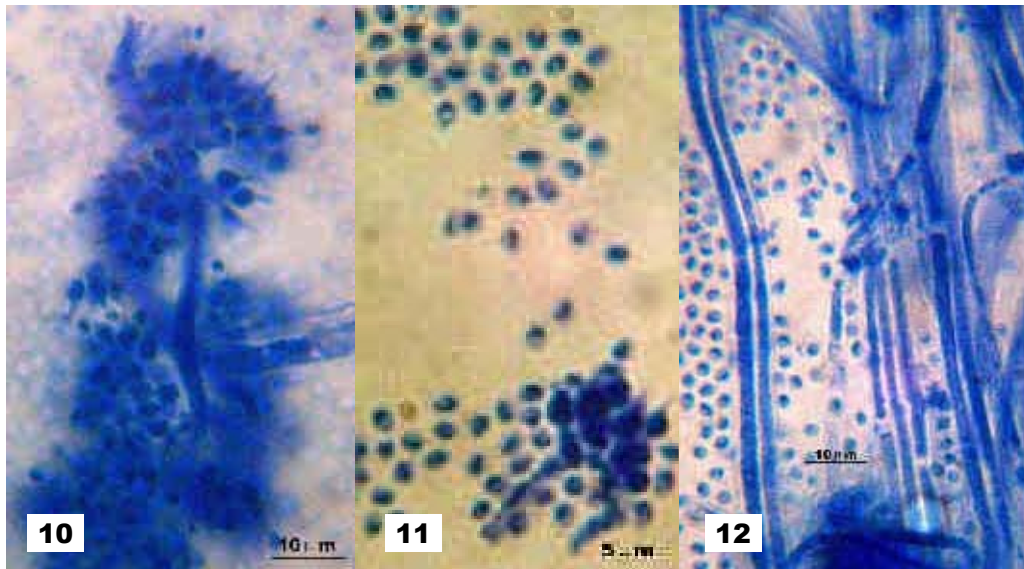
Figs. 4-6. *Cordyceps sichuanensis*. 4. Perithecia. 5. Upper portion of asci. 6. Secondary ascospores. **Figs. 7-9.** *Cordyceps dayiensis*. 7. Perithecia. 8. Upper portion of asci. 9. Ascospores.

***Cordyceps dayiensis* Z.Q. Liang, sp. nov.**

(Figs. 2, 7-9).

Stromata singularia, filiformia, simplicia, brunneola, 140 mm longa, 2 mm crassa. *Pars fertilis* cylindrica, ca. 37 mm longa, 2 mm crassa, sine appendiculis. *Perithecia* immersa, ovata longa aut pyriformia, 430-480 × 210-270 μm. *Asci* 225-345 × 6-7.5 μm, capitibus non nisi 1.5 μm alto. *Ascospores* immaturae, sed multiseptatae, utrinque attenuatae, 300 × 1-1.8 μm, cellulis intervalli (4.2-)7.2-12.8 μm longis.

Stroma single, filiform, simple, 140 mm long, 2 mm thick, brownish. *Fertile part* cylindric, 37 × 2 mm, without sterile apical appendage. *Perithecia* immersed, narrowly ovoid, 430-480 × 210-270 μm. *Asci* slender cylindric, 225-345 × 6-7.5 μm, with very thin cap of ascus, 1-1.5 μm high and 3 μm wide. *Ascospores* filiform, multiseptate, not breaking into segments, pointed at



Figs. 10-15. *Paecilomyces rariramus*. **10, 13.** Conidiophore and phialides. **11, 14.** Conidia. **12, 15.** Hyphae.

both ends, 300 μm long and 1-1.8 μm wide, septate cells (4.2-)-7.2-12.8 μm long.

Ex larva Lepidopteri

Material examined: CHINA, Sichuan Province, Dayi City, Xileng Jpkul, July 1997, Z.Q. Liang & B. Wang (LFRGU97-715, **holotype designated here**).

Notes: Petch (1924), Mains (1958) and Kobayasi and Shimizu (1983) reported that there were three species in the genus *Cordyceps*, *Cordyceps blattae* Petch, *Cordyceps peltata* Wakef. and *Cordyceps sheeringii* Masee which had a very thin or lacked an ascus cap. These species differ from *C. dayiensis* in the shape and size of their stromata and fertile part, also in host and the width of secondary ascospores (see Table 2).

Table 2. Comparison of species of *Cordyceps* without thickened caps to the ascus.

Name	Stroma	Fertile part	Ascospore	Host
<i>C. blattae</i>	Single, clavate, 10 × 1 mm	Clavate	3.5 µm wide	Cockroach
<i>C. peltata</i>	Single, capitate, 1.5 × 5 mm	Discal	3-4 µm wide	Weevil
<i>C. sherringii</i>	Caespitose, capitate, 10 × 2 mm	Globose		Ant
<i>C. dayiensis</i>	Single, cylindric, 140 × 2 mm	Cylidric	1-1.8 µm wide	Caterpillar

***Paecilomyces rariramus* Z.Q. Liang & B. Wang, sp. nov.** (Figs. 3, 10-12)

Hospes a mycelio tenui, pallido flavo, obtectus. *Synnemata* erecta, alba ad flavida, capitata, aliquot; ramosa, ellipsoidea, pulverea compacta in parte superiore, 3-7 × 2-3 mm. *Stipes* 10 mm longus, 1-2 mm crassus. Mycelia raro ramose, 1.5-3 µm crassa. *Phialides* 4.5-5 × 2-2.5 µm, e basi inflata globosa in collum 0.4 µm crassum angustatae. *Conidia* globosa vel ellipsoidea, hyalina, levia, 1-1.5 × (1.2-)1.5-1.8 µm.

Pupae of host insect covering yellowish mycelia. *Synnemata* white to pale yellow, capitate, several; ramified at upper part, ellipsoidal, compact farinose, 3-7 × 2-3 mm. *Stipe* 10 mm long and 1-2 mm thick. *Hyphae* of conidiogenous structure 1.5-3 µm thick, few ramifications. *Phialides* 4.5-5 × 2-2.5 µm, globose or subglobose at basal portion, inflated, tapering up into a thin neck, 1.5-1.8 µm long and 0.4 µm wide. *Conidia* subglobose, hyaline, smooth-walled, 1-1.5 × (1.2-)1.5-1.8 µm.

Ex pupis lepidopterarum

Material examined: CHINA, Sichuan Province, Wolong Nature Reserve, altitude 1600 m, September 1996, B. Wang (LFRGU-SAAS042, **holotype designated here**).

Notes: The latin '*rariramus*' refers here having lesser ramification in the conidiogenous structure of this interesting fungus. Moreover, as the synnemata have a compact farinose head and subglobose conidia this leads us to believe that *Paecilomyces rariramus* differs from other related taxa in the genus *Paecilomyces* (Samson, 1974; Samson and Evans, 1977; Dunn, 1983; Liang *et al.*, 1993).

Acknowledgements

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