

Rust Fungi of *Phragmidium* (Uredinales) from Yunnan Province, China, Collected in 1998*

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Abstract Four species of rust fungi belonging to the genus *Phragmidium* of Phragmidiaceae (Uredinales) are reported based on the specimens collected during Botanical Expedition to Yunnan, China in 1998. All species were newly recorded from Yunnan, China. *Rubus foliolosus* is a new host plant for *Phragmidium barclayi*.

Key words: China, *Phragmidium*, *Rosa*, *Rubus*, rust fungi, Uredinales, Yunnan.

Introduction

The genus *Phragmidium* (Uredinales) is a important group of plant parasitic fungi on Rosaceae. About 30 species of *Phragmidium* has been reported from China (Tai, 1947; Cummins, 1950; Cummins and Ling, 1950; Wang, 1951; Tai, 1979; Wei, 1988; Zhuang and Wei, 1994). Among them only 11 species have been known to distribute in Yunnan, China (Tai, 1979; Wei, 1988; Zang *et al.*, 1996). However, more species are expected to be found in this area because plant species of Rosaceae are very rich and diverse. Therefore, more extensive field survey and collections are required for better understanding of this genus of rust fungi.

We report here 4 species of *Phragmidium* based on the specimens collected during Botanical Expedition carried out mainly in Zhantong and Nujiang Districts, Yunnan Province, China in 1998. All species reported here, *P. assamense*, *P. barclayi*, *P. cinnamomeum* and *P. himalense* were newly recorded from Yunnan Province. New host

plants were also reported in *Phragmidium barclayi*.

Material and Methods

The collected materials were kept as dry specimens. Morphological characteristics of specimens were examined under light (LM) and scanning electron microscopy (SEM). The spores scrapped from specimens or hand sections of sori were mounted in a drop of lactophenol solution on glass slides for LM observations. The size of spores were measured with Leica Q-Win Image Analyzer attached to LM. For SEM observations, spores were dusted on double adhesive tape mounted on a specimen holder and coated with platinum-palladium with Hitachi E-1030 Ion Sputter. The spore surface structure of the specimens was observed with a Hitachi S-4200 SEM.

All the specimens cited in this paper were deposited in the following herbaria: the Mycological Herbarium of the Institute of Agriculture and Forestry, University of Tsukuba, Japan (TSH), the Mycological Herbarium, Department of Botany, National Science Museum, Tokyo, Japan (TNS), the Cryptogamic Herbarium, Kunming Institute of Botany, Kunming, China (HKAS),

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and the Mycological Herbarium, the Institute of Microbiology, Academia Sinica, Beijing, China (HMAS).

Enumeration of species

1. *Phragmidium assamense* Syd., Ann. Mycol. 10: 264, 1912. (Fig. 1)

Spermogonia and aecia not observed. Uredinia hypophyllous, aggregates or sparsely distributed, orange to light brown, paraphysate. Urediniospores globose, subglobose, subclavate, 16.1–(19.2)–22.0×14.0–(16.3)–18.5 μm ; walls colorless, uniformly echinulate, 1.1–(1.3)–1.5 μm thick; germ pores obscure. Paraphyses clavate, subclavate, curved, 40.3–(49.9)–77.4×11.8–(16.1)–23.1 μm ; walls colorless, smooth, 1.1–(1.7)–2.6 μm thick. Telia hypophyllous, light to dark brown, sparsely distributed. Teliospores cylindrical, ellipsoid, fusiform or subclavate, mostly 5 or 6-celled, 59.7–(69.2)–79.8×29.2–(31.7)–37.5 μm ; walls brown, warty, 1.3–(2.6)–3.9 μm thick; germ pores 2 to 3 per cell, distributed closely to equatorial parts; apiculus lacking, but colorless part sometime present at the apex. Teliospore pedicels cylindrical, colorless, smooth, 43.6–(53.3)–75.4×12.2–(13.5)–15.7 μm ; hygroscopic parts, colorless, rugose.

Specimen examined: on *Rubus flosculosus* Focke, N25°59'429"; E98°39'750"; Alt. 2335 m, Xia Pian Ma, Pian Ma, Lu Sui Co., Nujiang District, Yunnan Province, China, Sept. 29, 1998, M. Kakishima, CH-129 (TSH-R1979, TNS-F-108072, HKAS, HMAS).

Host plants and distribution: *Rubus coreanus* Miq., Shaanxi, China (Wei, 1988); *R. flosculosus* Focke, Sichuan, China (Wei, 1988), Yunnan, China (Present study); *Rubus* sp., Xizang, China (Wei, 1988).

This rust fungus has been reported in southern area of China (Wei, 1988), but not in Yunnan before.

2. *Phragmidium barclayi* Dietel, Hedwigia 29: 264, 1890. (Fig. 2)

Uredinia hypophyllous, scattered, small, or-

ange, paraphysate. Urediniospores globose, subglobose, obovoid, broadly ellipsoid, 17.4–(19.4)–26.4×15.5–(17.1)–19.6 μm ; walls colorless, uniformly echinulate, 1.1–(1.3)–1.5 μm thick; germ pores obscure. Paraphyses clavate, subclavate, curved, 40.3–(49.9)–77.4×11.8–(16.1)–23.1 μm ; walls smooth, 1.1–(1.7)–2.6 μm thick. Teliospores cylindrical, 5 to 8 celled, mostly 6, 61.5–(79.3)–100.3×28.3–(31.2)–34.4 μm ; walls orange to light brown, sparsely verrucose, 1.3–(2.3)–3.5 μm thick; apiculus lacking. Teliospore pedicels cylindrical, colorless, 53.6–(77.9)–117.7×10.0–(13.2)–15.3 μm ; hygroscopic parts, colorless, rugose, 28.3–(46.6)–63.2×10.9–(13.2)–15.3 μm .

Specimen examined: on *Rubus foliolosus* D. Don., N25°56'999"; E98°43'995"; Alt. 2175 m, Lu Sui-Pian Ma, Lu Sui Co., Nujiang District, Yunnan Province, China, Sept. 28, 1998, M. Kakishima, CH-89 (TSH-R1980, TNS-F-108073, HKAS, HMAS).

Host plants and distribution: *Rubus austro-tibetans* Yu et Lu, Nyalam, China (Zhuang and Wei, 1994); *R. laciocarpus* Sm., Pakistan (Ahmad, 1956), Nepal (Durrieu, 1977); *R. aff. hoffmeisterianus* Kunth et Bouche, Pakistan (Ono, 1992); *R. foliolosus* D. Don. Yunnan, China (Present study).

This species is morphologically similar to *P. quinqueloculare* Barclay on *R. foliolosus* (Durrieu, 1977, 1980; Ono, 1992; Ono *et al.*, 1995). However, this species differs from *P. quinqueloculare* in number of cells in teliospores. *Phragmidium quinqueloculare* has mostly 5 cells, but this species has mostly 6 cells.

This species has been reported from Pakistan (Ahmad, 1956; Ono, 1992), Nepal (Durrieu, 1977) and Nyalam, China (Zhuang and Wei, 1994). This is the first record of this fungus from Yunnan, China and *R. foliolosus* is a new host plant for this fungus.

3. *Phragmidium cinnamomeum* Durrieu, Crypt. Mycol. 1: 51, 1980. (Fig. 3)

Spermogonia minutes, epiphyllous, aggregates, light to dark brown. Aecia hypophyllous, scattered, orange and paraphysate. Aeciospores

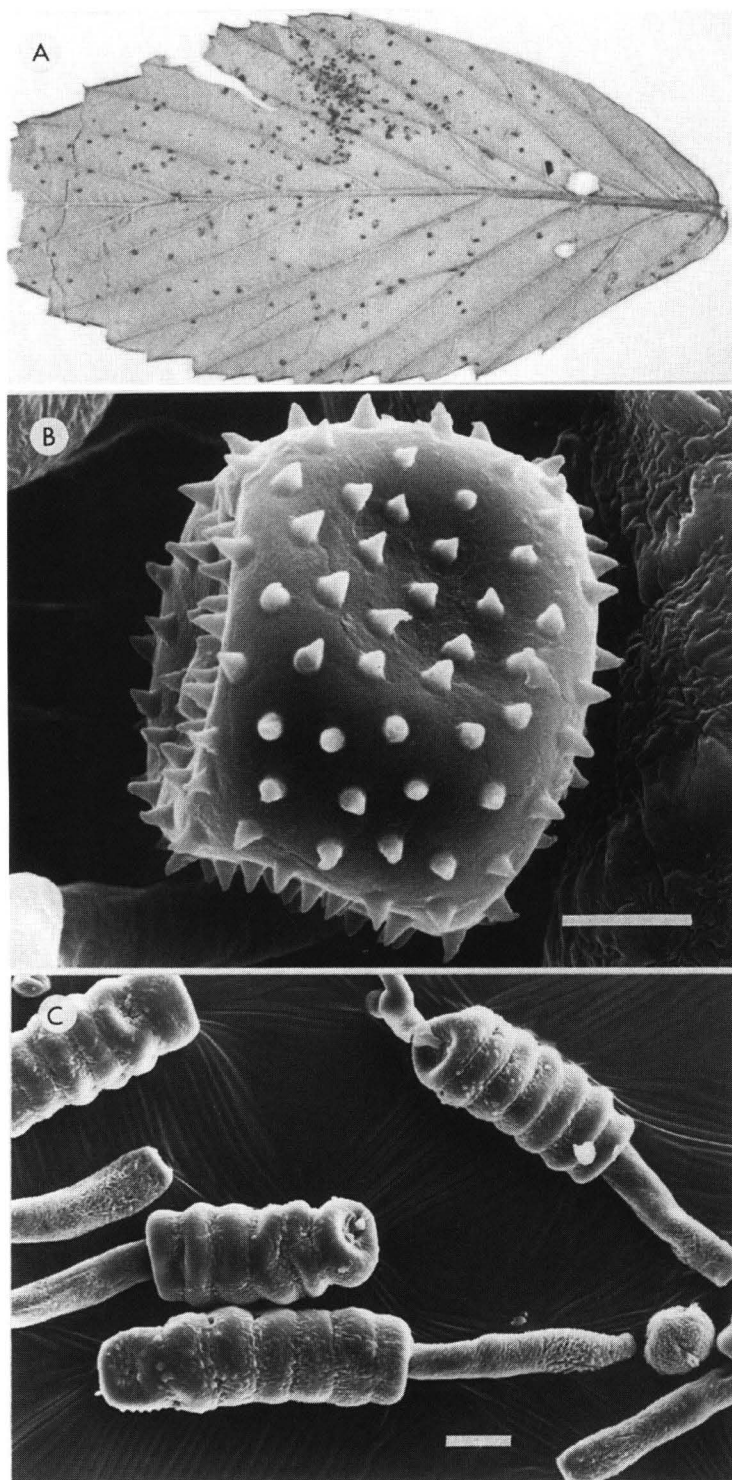


Fig. 1. *Phragmidium assamense* on *Rubus flosculosus* (TSH-R1979). A. Uredinia and telia on the leaf. B. An urediniospore observed by SEM. C. Teliospores observed by SEM. Bar: B=5 μ m, C=10 μ m.

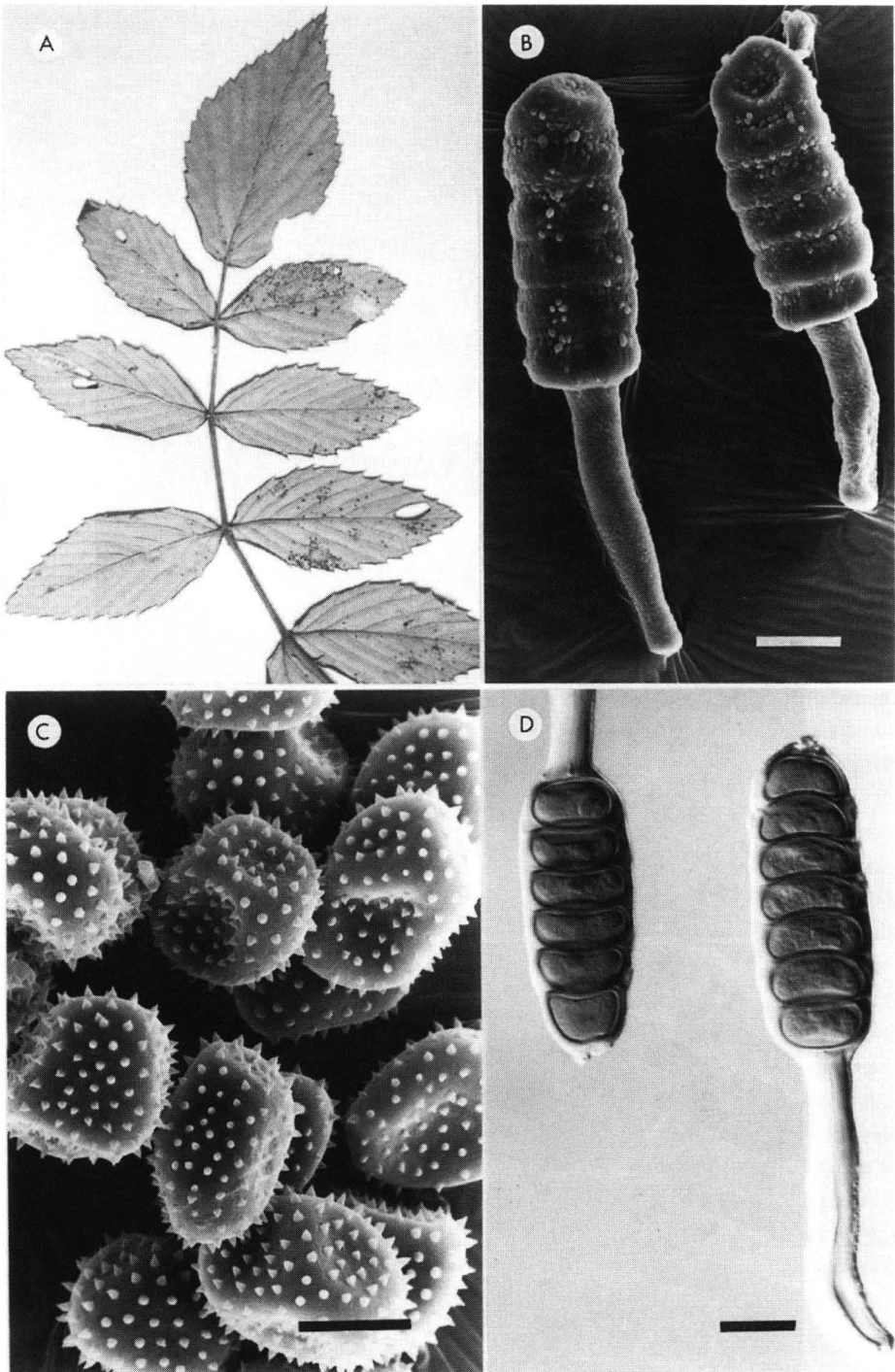


Fig. 2. *Phragmidium barclayi* on *Rubus foliolosus* (TSH-R1980). A. Uredinia and telia on the leaf. B. Teliospores observed by SEM. C. Urediniospores observed by SEM. D. Teliospores observed by LM. Bar: B=20 μ m, C=10 μ m, D=20 μ m.

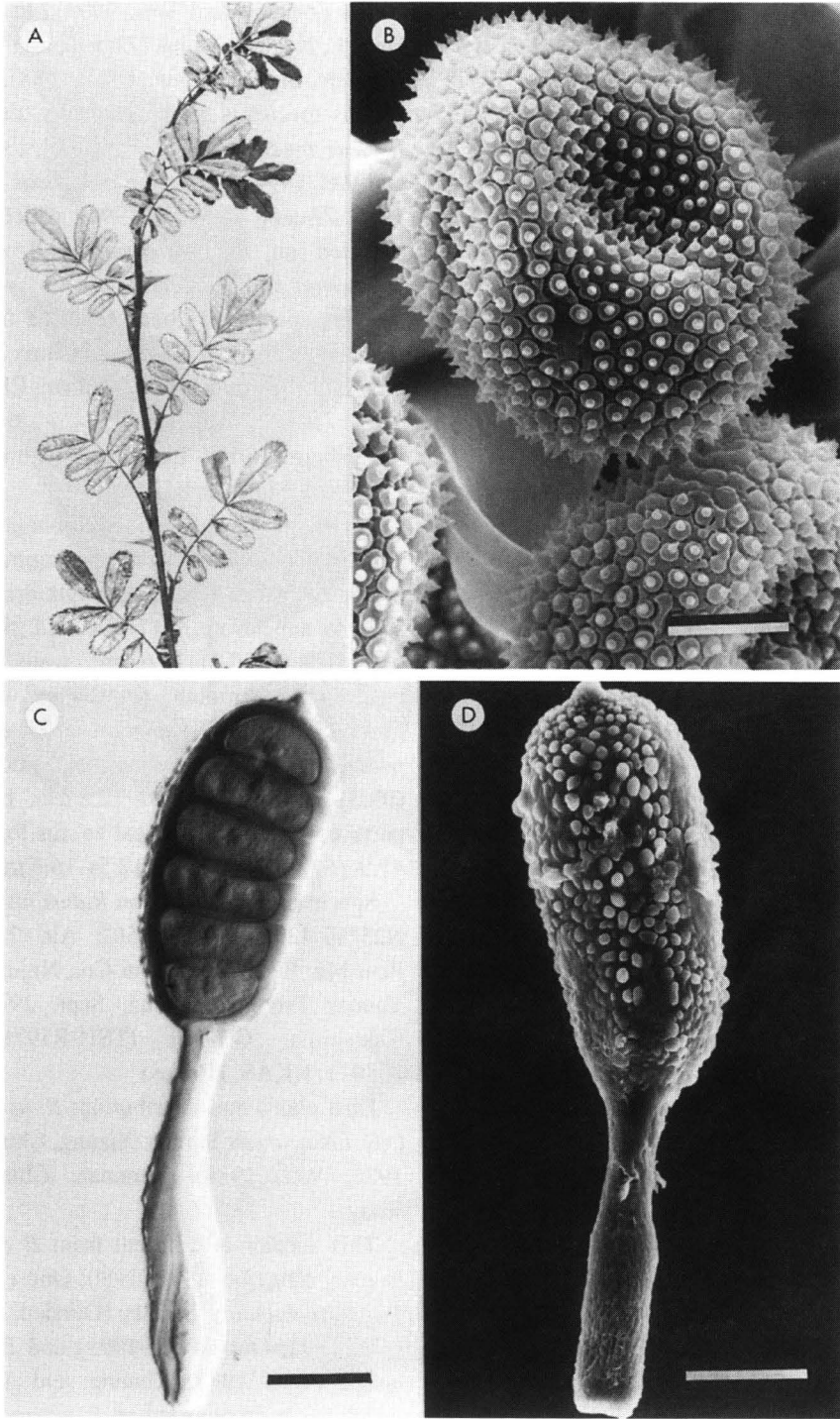


Fig. 3. *Phragmidium cinnamomeum* on *Rosa omeiensis* (TSH-R1974). A. Aecia and telia on the leaf. B. Aeciospores observed by SEM. C. A teliospore observed by LM. D. A teliospore observed by SEM. Bar: B=5 μ m, C=20 μ m, D=20 μ m.

catenulate, globose, subglobose, obovoid, 17.0–(20.7)–23.8×13.1–(16.6)–19.4 μm ; walls colorless, annulate, 1.1–(1.5)–2.0 μm thick; germ pores obscure. Paraphyses clavate, subclavate, cylindric, and weakly curved, 36.4–(58.1)–79.8×7.9–(11.3)–16.8 μm ; wall colorless, 1.1–(1.9)–3.5 μm thick. Uredinia not observed. Telia hypophyllous, scattered, light to dark brown. Teliospores cylindrical, fusiform, 3–(5)–7 celled, 52.3–(71.6)–96.8×30.5–(37.1)–45.3 μm ; walls light to dark brown, warty, 3.5–(4.8)–7.0 μm thick; apiculus acuminate to fusiform with warts, 1.3–(5.2)–9.2 μm long. Teliospore pedicels 44.9–(87.0)–119.5×8.7–(11.0)–17.0 μm ; walls colorless, smooth; hygroscopic parts clavate, subclavate and subglobose with smooth to slightly rough surfaces, colorless, 19.6–(58.5)–85.5×13.1–(18.1)–21.8 μm .

Specimen examined: on *Rosa omeiensis* Rolfe, N27°47'391"; E104°14'437"; Alt. 1760 m, Xiao Cao Ba Forest Nursery, Yiliang Co., Zhaotong District, Yunnan Province, China, Sept. 17, 1998, M. Kakishima, CH-19 (TSH-R1974, TNS-F-108067, HKAS, HMAS). on *Rosa sericea* Lindl., N27°24'906"; E103°46'670"; Alt. 1965 m, Dalong Dong Dao Guan, Zhaotong District, Yunnan Province, China, Sept. 16, 1998, M. Kakishima, CH-15 (TSH-R1975, TNS-F-108068, HKAS, HMAS); N27°47'563"; E104°18'027"; Alt. 1865 m, Cha He Zhen, Yiliang Co., Zhaotong District, Yunnan Province, China, Sept. 18, 1998, M. Kakishima, CH-37 (TSH-R1976, TNS-F-108069, HKAS, HMAS); N28°12'610"; E103°56'686"; Alt. 1695–1720 m, Shu Lin, Mu Gan Forest, Yiliang Co., Zhaotong District, Yunnan Province, China, Sept. 20, 1998, M. Kakishima, CH-46 (TSH-R1977, TNS-F-108070, HKAS, HMAS).

Host plants and distribution: *Rosa macrophylla* Lindl., Nepal (Durrieu, 1980; Ono *et al.*, 1995); *R. omeiensis* Rolfe, Sichuan, China (Wei, 1988), Nyalam, China (Zhuang and Wei, 1994), Yunnan, China (Present study); *R. sericea* Lindl. Nepal (Durrieu, 1980; Ono *et al.*, 1995), Tingri, China (Zhuang and Wei, 1994), Yunnan, China (Present study); *R. sikangensis* Yu *et al.*, Xizang, China (Wei, 1988); *R. webiana* Royle, Gyirong

China (Zhuang and Wei, 1994); *R. willmottiae* Hemsl., Nyalam, China (Zhuang and Wei, 1994); *Rosa* sp., Sichuan, China (Wei, 1988).

This species is morphologically different from *P. rosae-omeiensis* S. X. Wei (Wei, 1988; Zhuang and Wei, 1994), and *P. rosae-rugosae* Kasai (Wei, 1988; Zhuang and Wei, 1994), which have been reported on *R. omeiensis* or *R. sericea*, in teliospores and pedicels.

This species has been reported from mainly Himalayan areas of Nepal and China. This is first record of this fungus from Yunnan, China.

4. *Phragmidium himalense* Zhuang, Acta Mycol. Sinica 5: 81, 1986. (Fig. 4)

Spermogonia, aecia and uredinia not observed. Telia hypophyllous, scattered or aggregated, dark brown to black. Teliospores cylindrical, subglobose to subclavate, 4–(7)–8-celled, 64.5–(85.5)–101.2×24.0–(30.1)–33.6 μm ; walls orange to light brown, smooth, sometimes warty; germ pores 2 or 3 per cell; apiculus lacking. Teliospore pedicels colorless, cylindrical, smooth, 75.0–(99.3)–124.3×7.9–(9.8)–12.2 μm ; hygroscopic parts colorless, cylindrical to fusiform, rugose, 41.9–(57.7)–80.7×8.7–(12.5)–16.6 μm .

Specimen examined: on *Rubus niveus* Thunb., N25°59'429"; E98°39'750"; Alt. 2335 m, Xia Pian Ma, Pian Ma, Lu Sui Co., Nujiang District, Yunnan Province, China, Sept. 29, 1998, M. Kakishima, CH-101 (TSH-R1978, TNS-F-108071, HKAS, HMAS)

Host plants and distribution: *R. niveus* Thunb. (= *R. lasiocarpus* Smith), Xizang, China (Zhuang, 1986; Wei, 1988), Yunnan, China (Present study).

This species is different from *P. octaloculare* Barclay (Durrieu, 1977, 1980; Ono *et al.*, 1995), *P. quinqueloculare* Barclay (Durrieu, 1977, 1980; Ono, 1992; Ono *et al.*, 1995) and *P. rubi-thunbergii* (Wei, 1988; Zhuang and Wei, 1994), which has been reported on *R. niveus* and distributed in Himalayan areas of Nepal and China, in teliospore morphology. However, this species is morphologically similar to *P. arisanense* Hiratsuka, f. *et* Hashioka distributed in Taiwan (Wang,

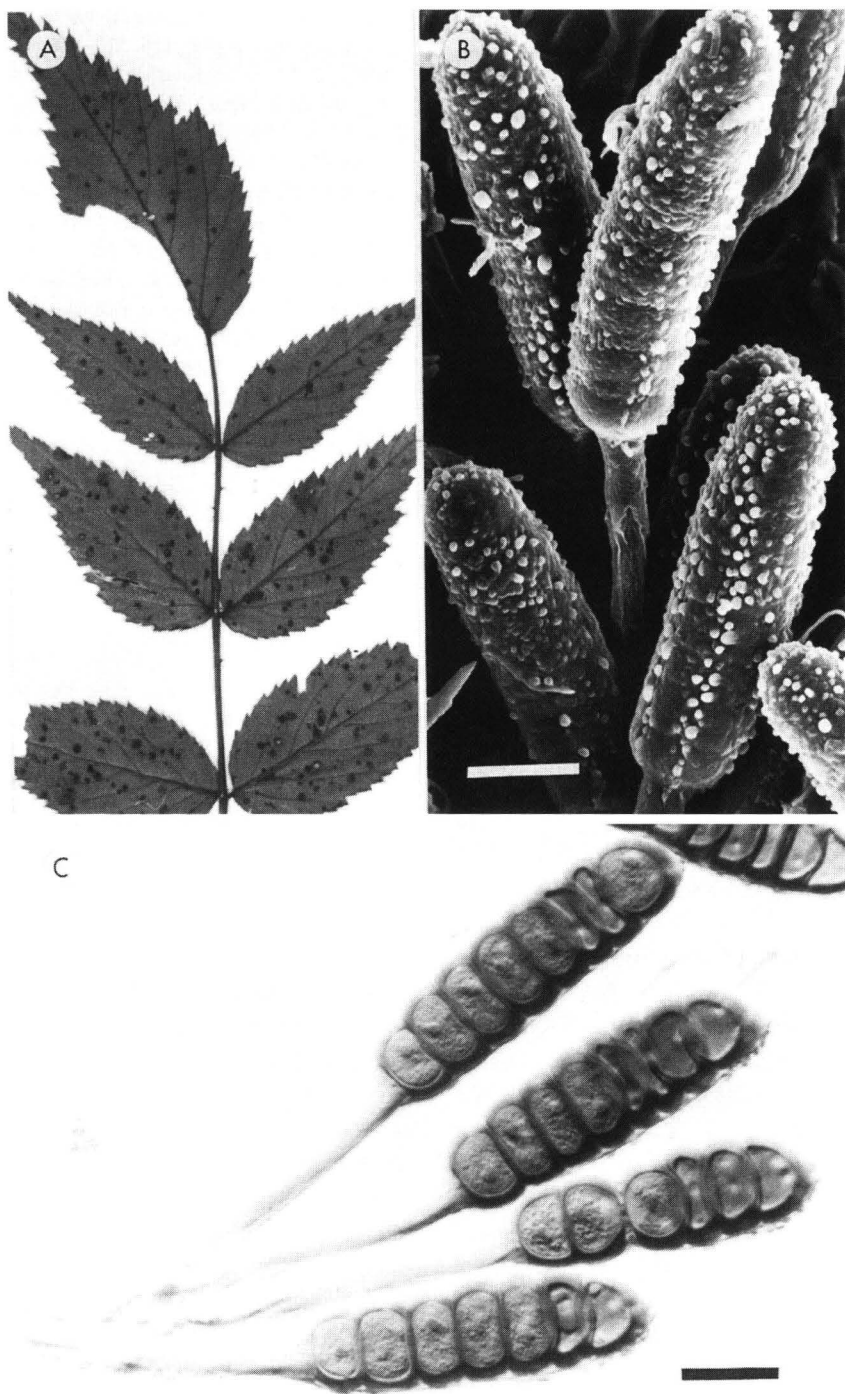


Fig. 4. *Phragmidium himalense* on *Rubus niveus* (TSH-R1978). A. Telia on the leaf. B. Teliospores observed by SEM. C. Teliospores observed by LM. Bar: B=20 μ m, C=20 μ m.

1951; Tai, 1979; Wei, 1988).

This rust fungus has been reported only from Xizang, Eastern Himalaya, China. This is first record of this fungus from Yunnan, China.

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