

## Notes on *Puccinia* Species on Cyperaceae in Taiwan

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**ABSTRACT:** During a floristic survey of rust fungi (Uredinales) on Cyperaceae in Taiwan, thirteen *Puccinia* species were treated as new records from Taiwan. They are *Puccinia caricis* Rebertsch, *P. caricis-daisenensis* Y. Morimoto, *P. caricis-gibbae* Dietel, *P. caricis-lanceolatae* Y. Morimoto, *P. caricis-lingii* Zhuang, *P. caricis-nubigenae* Padwick et Azmatullah Khan, *P. caricis-okushiriensis* Homma, *P. dioicae* Magnus, *P. hyalina* Dietel, *P. cyperi* Arthur, *P. fimbristylidis* Arthur, *P. scirpi-ternatani* N. Hiratsuka, *P. scleritcola* Arthur. In this report, description, distribution and illustration of each species were given. A key to Formosan species of *Puccinia* on Cyperaceae is also provided.

**KEY WORDS:** *Puccinia*, Cyperaceae, Uredinales, Taiwan.

### INTRODUCTION

*Puccinia* Pers. which belongs to Pucciniaceae, Uredinales, Teliomycetes, is among the most famous and important plant pathogenic fungal genera which contains ca. 4,000 species on many families of angiosperms of cosmopolitan distribution (Hawksworth *et al.*, 1995).

Cyperaceae is a large family involving more than 3,800 species of about 70 genera distributed throughout the world. In Taiwan, 22 genera and 166 taxa have been recorded till 1978 (Koyama, 1978). Some of them are of economic importance, e.g. *Eleocharis dulcis* (Burm. F.) var. *tuberosa* (Roxb.) T. Koyama is used as a food; *Cyperus rotundus* L. and *Scleria levis* Retz. are used as traditional herb medicines; *Schoenoplectus triqueter* (L.) Palla is used as a weaving material in craft industry.

In Taiwan, rust fungi (Uredinales) on Cyperaceae were first studied by Yosaburo Fujikuro who reported eight *Puccinia* species on Cyperaceae in 1914 (Fujikuro, 1914). In 1930s, Naohide Hiratsuka and Yoshio Hashioka recorded ten *Puccinia* species on Cyperaceae in their serial reports (Hiratsuka and Hashioka, 1935a, 1935b; Hiratsuka, 1941). In the mean time, Kaneyoshi Sawada made most complete records. He reported thirteen *Puccinia* species on Cyperaceae in Taiwan. They are *P. breviculmis* Dietel, *P. leucocephala* J. Y. Zhuang and S. X. Wei (as *P. caricis-filicinae* Barclay), *P. canaliculata* (Schw.) Lagerh (as *P. cyperi-iriae* Sawada), *P. liberta* (as *P. eleocharidis* auct. non Arthur), *P. kylingiae-brevifoliae* Miura ex Ito & Homma (as *Uredo kylingiae-brevifoliae* Dietel), *P. flavipes* Sydow, *P. fuirenicola* Arthur, *P. juncelli* Dietel, *P. hennopsiana* Doidge (as *P. mariscisieberiani* Sawada), *P. philippinensis* Sydow, *P. scirpi* DC (*Puccinia scirpi -mucronati* Sawada, *P. scirpi-triqueteris* Sawada), *P. scleriae* (Pazschke) Arthur and *P. taihokuensis* Sawada (as *P. mysorensis* Syd. et Butl.) (Sawada, 1919, 1928, 1942, 1943, 1959). Recently, Jian-Yun Zhuang and Shu-xia Wei had made works of rust flora on Cyperaceae of China.

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Their works also included some species of Taiwan (Zhuang, 1988; Zhuang and Wei, 1997). Other records were also seen in floristic works from China and Japan (Hiratsuka, 1943; Hiratsuka *et al.*, 1992; Ito, 1950; Tai, 1979).

Rust flora on Cyperaceae in Taiwan was investigated as a joint research project by Dr. Tetsuo M. Koyama and junior author (Zuei-Ching Chen) from 1977 to 1979. Present authors reinvestigated it since 1994. In this article the thirteen *Puccinia* species on Cyperaceae are described as new to fungal flora of Taiwan.

## MATERIALS AND METHODS

Materials used for the study came from either collections by authors or specimens deposited in Herbarium of Department of Botany, National Taiwan University (TAI). All specimens used are now deposited in Mycological Herbarium of TAI.

After collection, fresh materials were pressed, dried and preserved as dried specimens. Specimens were first examined under dissecting microscope then prepared for light microscopic examination. In dried materials, sections were soaked with 5% potassium hydroxide (w/v), then lactophenol were applied to prepare semipermanent slides and examined under light microscope. To get precise image of spore shape and proportion, cameralucida was employed for drawing.

Characters used for identification were based on morphological features from lesions, uredinia, urediniospores, telia, teliospores and the presence/absence of some features (e.g. paraphyses, amphispores or mesospores.) Some critical references used for identification are given below (Hiratsuka *et al.*, 1992; Ito, 1950; Zhuang, 1988; Zhuang and Wei, 1997).

## RESULTS

### 1. *Puccinia caricis* Rebentisch, Fl. Neomarch. p. 356, 1804.

Fig. 1a

Spermogonia and aecia not seen. Uredinia chiefly hypophyllous, scattered, elliptic, 0.2-0.55 mm long, naked, pulverulent, brown; urediniospores subglobose, obovoid or ellipsoid, 23-32 x 17-26  $\mu\text{m}$ , wall (1.5) 2-3.5  $\mu\text{m}$  thick, cinnamon brown, echinulate, germ pores 2-4, usually 3, equatorial. Telia chiefly hypophyllous, scattered, elliptic or sometimes linear, 0.2-0.5 or up to 1 mm long, naked, pulvinate, compact, black; teliospores rarely one-celled, broadly clavate or clavate, rounded, truncate or obtuse above, narrowed below, constricted at the septum, 44-60 x 14-20  $\mu\text{m}$ , wall smooth, yellowish-brown to chestnut-brown, 5-17  $\mu\text{m}$  thick at the apex, pedicel yellowish or nearly colourless, up to 40  $\mu\text{m}$  long, persistent.

Distribution: Asia, Australia, Europe, New Zealand and North America

**Specimen examined:** II. III., on *Carex fulvo-rubescens* Hayata, TAI-M 144299, Ilan: Mt. Nanhutashan, 7 VII, 1937; *Carex brachyathera* Ohwi, TAI-M 22206, Nantou: Mt. Yu-shan, 11 VII, 1933.

### 2. *Puccinia caricis-daisenensis* Y. Morimoto, J. Jap. Bot. 49: 228-231, 1974.

Fig. 1b

Spermogonia and aecia not known. Uredinia mostly hypophyllous, scattered, minute, round, 0.3-0.5 mm in diam., long covered by the epidermis, yellowish, subpulverulent; urediniospores globose, subglobose or broadly ellipsoid, 22-45 x 21-42  $\mu\text{m}$ , wall 2.7-10  $\mu\text{m}$  thick, subhyaline, echinulate, germ pores obscure. Telia similar to uredinia, 0.1-0.5 mm long,

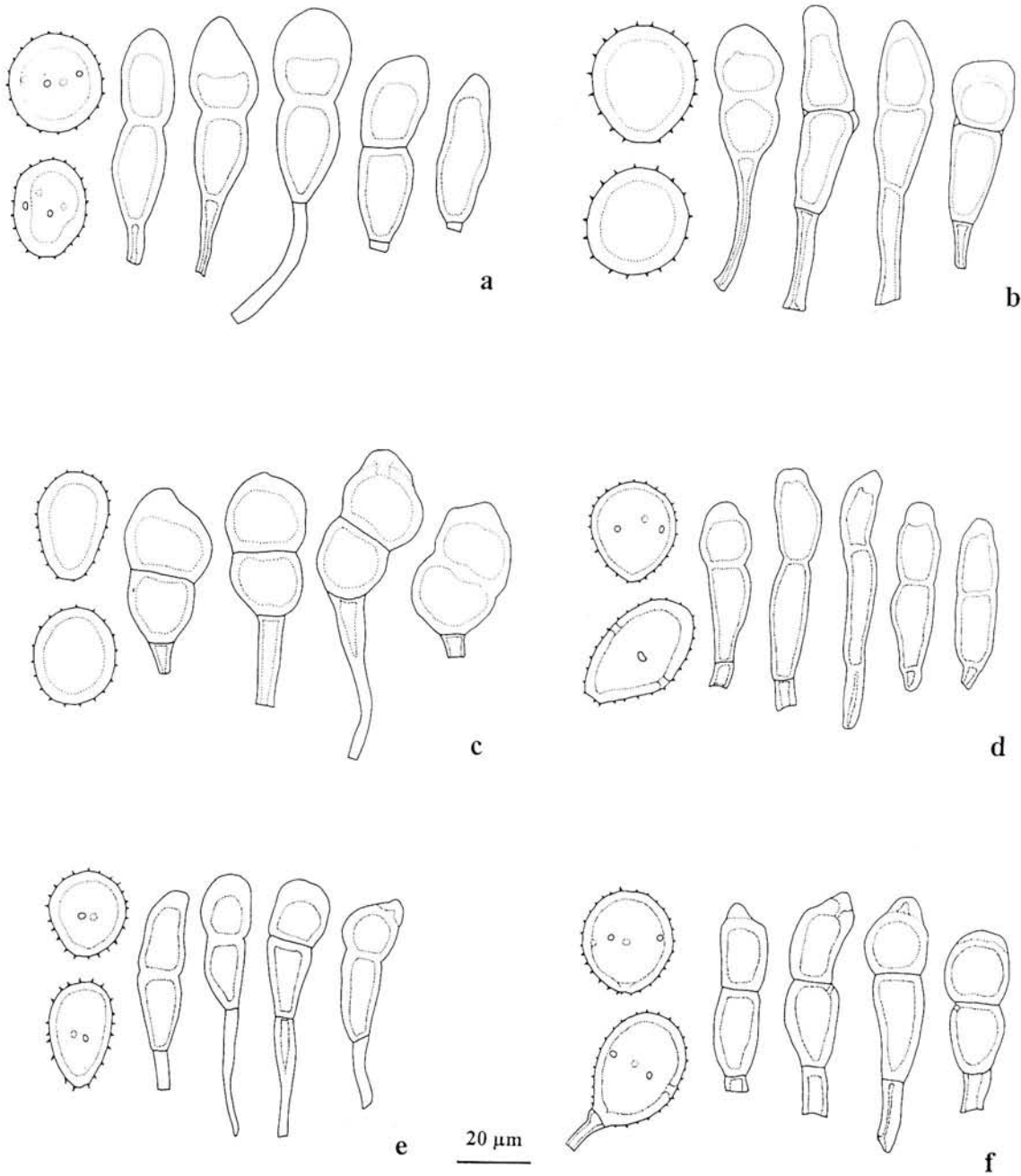


Fig. 1. a: Urediniospores and teliospores of *Puccinia caricis* Rebentisch. b: Urediniospores and teliospores of *P. caricis-daisenensis* Y. Morimoto. c: Urediniospores and teliospores of *P. caricis-gibbae* Dietel. d: Urediniospores and teliospores of *P. caricis-lanceolatae* Y. Morimoto. e: Urediniospores and teliospores of *P. caricis-lingii* Zhuang. f: Urediniospores and teliospores of *P. caricis-nubigenae* Padwick et Azmatullah Khan.

naked, brown to dark brown, pulvinate, compact; teliospores ellipsoid, oblong clavate or obovate, rounded or obtusely attenuated above, narrowed below, not to slightly constricted at the septum, 27-56 x 13-20 μm, wall smooth, brown to yellowish-brown, 5-15 μm thick at the apex, pedicel pale yellowish to nearly colourless, up to 40 μm long, persistent.

Distribution: Japan and Taiwan.

**Specimens examined:** II, III on *Carex tristachya* Thunb. subsp. *pocilliformis* (Boott.) T. Koyama, TAI-M-F 143, **Chiayi:** Alishan, 6 XI 1932; TAI-M-F 5510, **Kaohsiung:** Thiangyang-shan, 25 XII 1977; KUO 019, **Nantou:** Kwankao, 11 IX 1995; KUO 020, **Nantou:** Patungkuang, 12 IX 1995; KUO 024, **Kaohsiung:** Yakou, 1 X 1995; KUO-028, **Taipei:** Chihshingshan, 12 XI 1995; II, III on *Carex sociata* Boott, TAI-M 281017, **Chayi:** Mt. Alisan, 17 X 1928.

### 3. *Puccinia caricis-gibbae* Dietel, Ann. Myc. 4: 305, 1906.

Fig. 1c

Spermogonia and aecia not known. Uredinia hypophyllous, scattered on purple spots, oblong or linear, 0.2-0.6 mm or longer, prominent, long covered by the epidermis, pale brownish; urediniospores obovoid, enlongate-obovate or oblong, 17-28 x 22-25  $\mu\text{m}$ , wall (2) 2.5 (4)  $\mu\text{m}$  thick, pale yellowish or hyaline, echinulate, germ pores obscure. Telia hypophyllous, oblong or elliptic, 0.3-1 mm long, scattered, erumpent, surrounded by the ruptured epidermis, blackish brown; teliospores mostly clavate or oblong, rounded, obtuse, truncate or conically attenuated above, narrowed below, slightly or moderately constricted at the septum, 36-54 x 22-24  $\mu\text{m}$ , wall smooth, cinnamon-brown or yellowish, 5-12  $\mu\text{m}$  thick at the apex, pedicel colourless, up to 45  $\mu\text{m}$  long, persistent; mesospores intermixed.

Distribution: China, Japan and Taiwan.

**Specimen examined:** II, III., on *Carex filicina* Nees subsp. *pseudo-filicina* (Hayata) T. Koyama, KUO 015, **Nantou:** Lurlur, 11 IX 1995.

**Note:** The specimen examined differs from *P. caricis-filicinae* in shorter pedicels.

### 4. *Puccinia caricis-lanceolatae* Y. Morimoto, J. Jap. Bot. 47: 116, 1972.

Fig. 1d

Spermogonia and aecia not known. Uredinia hypophyllous, scattered, often evenly distributed over the whole leaf surface, rounded, small, 0.2-0.5 mm diam., long covered by the epidermis or erumpent, brown, subpulverulent; urediniospores globose, obovate or ellipsoid, 24-38 x 20-24  $\mu\text{m}$ , wall 1.5-2  $\mu\text{m}$  thick, yellowish-brown, echinulate, germ pores 2-4, usually 3, nearly equatorial. Telia similar to uredinia, erumpent, pulvinate, brown, compact; teliospores clavate, rounded, truncate or rarely acuminate above, narrowed below, constricted at the septum, 29-59 x 9-16  $\mu\text{m}$ , wall smooth, pale yellowish-brown, 2-8  $\mu\text{m}$  thick and darker at the apex, pedicel pale brown, persistent, up to 30  $\mu\text{m}$  long.

Distribution: China, Japan and Taiwan.

**Specimen examined:** II, III., on *Carex filicina* Nees subsp. *pseudo-filicina* (Hayata) T. Koyama, TAI-M-F 448, **Chiayi:** Alishan, 6 VII 1933; TAI-M-F 144, **Chiayi:** Alishan, 6 XI 1932; TAI-M-F 187, **Nantou:** Chitou, 28 IV 1978; KUO 007, **Taichung:** Anmashan, 11 VII 1995.

### 5. *Puccinia caricis-lingii* J. Y. Zhuang, Mycosystema 1: 122, 1988.

Fig. 1e

Spermogonia and aecia not known. Uredinia amphigenous, scattered or aggregated, long covered by the epidermis, rounded, 0.2-0.5 mm in diam.; urediniospores globoid, obovoid or ellipsoid, 24-30 x 17-21  $\mu\text{m}$ , wall 1.5-2.5  $\mu\text{m}$  thick, coarsely echinulate, pale brown or pale orange brown, germ pores 2, equatorial. Telia amphigenous, scattered or aggregated, erumpent, surrounded by the cleft epidermis, round, 0.2-0.5 mm diam., chocolate-brown, subpulverulent; teliospores oblong or clavate, rounded, truncate or obtuse above, attenuate below, slightly constricted at the septum, 36-47 x 12-15  $\mu\text{m}$ , wall smooth, golden, 2-2.5  $\mu\text{m}$  thick at the sides, 4-7.5  $\mu\text{m}$  thick at the apex, pedicel subhyaline, up to 45  $\mu\text{m}$  long.

Distribution: China and Taiwan.

**Specimen examined:** II. III., on *Carex daibuensis* Hayata, TAI-M-F 0495, **Ilan:** Hsuyen nursery, 20 IV 1978; TAI-M 170882, **Taipei,** 16 IV 1933.

**6. *Puccinia caricis-nubigenae*** Padwick et Azmatullah Khan, Myc. Pap. Imp. Inst. 10: 8, 1944. Fig. 1f

Spermogonia and aecia not known. Uredinia hypophyllous, scattered, elliptic or oblong, up to 1.5 mm long, surrounded by the ruptured epidermis, cinnamon-brown, pulverulent; urediniospores globose or ellipsoid, 17-22 x 14-23  $\mu\text{m}$ , wall 1.5  $\mu\text{m}$  thick, cinnamon-brown or yellowish-brown, echinulate, germ pores 2, equatorial. Telia similar to uredinia, but darker in colour; teliospores two-celled, rarely one-celled, clavate, obtusely conical above, narrowed below, slightly constricted at the septum, 29-44 x 14-16  $\mu\text{m}$ , wall smooth, cinnamon-brown, 6-9  $\mu\text{m}$  thick at the apex, pedicel yellowish or colourless, up to 26  $\mu\text{m}$  long, persistent.

Distribution: India, Southern China and Taiwan.

**Specimen Examined:** II. III., on *Carex* sp., KUO 022, **Nantou:** Lurlur, 13 IX 1995.

**7. *Puccinia caricis-okushiriensis*** Homma, Trans. Sapp. Nat. Hist. Soc. 15: 126, 1938. Fig. 2a

Spermogonia and aecia not known. Uredinia mostly hypophyllous, minute, round, ca. 0.3 mm in diam., scattered, brown; urediniospores broadly ellipsoid or globose, 31-47 x 25-37  $\mu\text{m}$ , wall 2-4  $\mu\text{m}$  thick, hyaline or yellow, echinulate, germ pores obscure. Telia mostly hypophyllous, minute, rounded, 0.3-0.4 mm diam., scattered, brown; teliospores oblong or fusiform, obtuse, angular or conoid at the apex, strongly thickened 7-14  $\mu\text{m}$ , rounded or mildly attenuate at the base, constricted at the septum, wall smooth, yellowish-brown, 34-54 x 16-23  $\mu\text{m}$ , pedicel yellowish, up to 90  $\mu\text{m}$  long, persistent.

Distribution: Japan and Taiwan.

**Specimens examined:** II. III., on *Carex* sp., TAI-M-F 0973, **Hsinchu:** Seto, 19 VII 1930; TAI-M-F 1159, **Taichu:** Maricowan, 2 VII 1936; KUO 004, **Ilan:** Shengmajenshan, 27 VI 1995.

**8. *Puccinia dioicae*** Magnus, Amtl. Ber. 50 Versamml. Deut. Naturf. Arzte, Munchen p. 199, 1877. Fig. 2b

Spermogonia and aecia not known. Uredinia chiefly hypophyllous, scattered or in lines, elliptic or oblong, 0.2-0.5 mm long, naked, surrounded by the cleft epidermis, pulverulent, brown; urediniospores obovoid or ellipsoid, 20-30 x 17-25  $\mu\text{m}$ , wall 1.5-3  $\mu\text{m}$  thick, cinnamon-brown, echinulate; germ pores 2, located at supraequatorial zone of the spores. Telia similar to uredinia, black; teliospores clavate-oblong or clavate, rounded, truncate or sometimes obtusely conoid above, narrowed below, slightly to moderately constricted at the septum, 40-52 x 16-23  $\mu\text{m}$ , wall smooth, chestnut-brown, 5-13  $\mu\text{m}$  thick at the apex, pedicel yellowish to nearly colourless, up to 53  $\mu\text{m}$  or longer, persistent.

Distribution: Asia, Europe, North America and South America.

**Specimens examined:** II. III., on *Carex orthostemon* Hayata, TAI-M-F 0965, **Hsinchu:** Mt. Izawa, 17 VII 1935; II., on *Carex nubigena* D. Don subsp. *pseudo-arenicola* (Hayata) T. Koyama, KUO 006, **Taichung:** Anmashan, 11 VII 1995; KUO 026, **Kaohsiung:** Tiantze, 1 X 1995.

**9. *Puccinia hyalina*** Dietel, Bot. Jahrb. 37: 99, 1905.

Fig. 2c

Spermogonia and aecia not known. Uredinia hypophyllous, scattered, subepidermal, pale brown; urediniospores 20-30 x 16-20  $\mu\text{m}$ , obovoid or ellipsoid, wall 1-2  $\mu\text{m}$  thick, nearly colourless, echinulate, germ pores obscure. Telia hypophyllous, scattered, rounded or elliptic, about 0.3-0.5  $\mu\text{m}$  long, dark brown, naked; teliospores 40-62 x 12-16  $\mu\text{m}$ , fusiform or oblong-ellipsoid, rounded, obtuse or somewhat acute above, rounded or narrowed below, slightly or moderately constricted at the septum, wall smooth, pale yellowish or nearly colourless, 6-13  $\mu\text{m}$  thick at the apex, pedicel nearly colourless, up to 45  $\mu\text{m}$  long, persistent, mesospores intermixed.

Distribution: China, Japan and Taiwan.

**Specimen examined:** II, III., on *Carex baccans* Nees, TAI-M 22218, **Taichung:** Tongshu, XI 1921; TAI-M-F 047, **Pingtung:** Machia, 15 IV 1978; TAI-M-F 025, **Pingtung:** Wutai, 14 IV 1978; KUO 012, **Nantou:** Tongpu, 10 IX 1995; KUO 018, **Nantou:** Kuankao, 11 IX 1995.

**10. *Puccinia cyperi*** Arthur, Bot. Gaz. p.226, 1891.

Fig. 2d

Spermogonia and aecia not known. Uredinia hypophyllous and caulicolous, scattered or aggregated, minute, elliptic to oblong, 0.2-1.3 mm long, loosely covered by the epidermis which soon ruptures, producing a brown to light brown spore mass; urediniospores mostly obovoid, subglobose, 24-40 x 21-28  $\mu\text{m}$ , wall 2-2.5  $\mu\text{m}$  thick, brown to light brown rarely pale yellowish, echinulate, germ pores 2 or 3, equatorial. Telia arising from uredinia, 0.3-0.6 mm long, erumpent, compact, blackish brown; teliospores, clavate to oblong, rounded, attenuate at the apex, slightly to moderately constricted at the septum, attenuate at the base, 50-64 x 13-21  $\mu\text{m}$ , wall smooth, brown to light-brown, 2-7  $\mu\text{m}$  thick at the apex, pedicels brown to light brown, up to 40  $\mu\text{m}$  long, persistent.

Distribution: China, Japan and Taiwan.

**Specimen examined:** II, III., on *Cyperus pilosus* Vahl., TAI-M 10025, **Taipei:** Hsintan, 27 XI 1960; KUO 032, **Taipei:** Santze, 14 III 1996.

**Note:** The specimen examined is closely related to *P. cyperi-pilosi* Homma, but differs in lacking of paraphyses in uredinia.

**11. *Puccinia fimbristylidis*** Arthur, Bull. Torr. Bot. Cl. 33: 28, 1906.

Fig. 2e

Spermogonia and aecia not known. Uredinia hypophyllous or caulicolous, scattered or aggregated, elongated, 0.5-1 mm or longer, long covered by the epidermis, pale brown; urediniospores mostly subglobose, obovate or ellipsoid, 18-25 x 15-20  $\mu\text{m}$ , wall about 2  $\mu\text{m}$  thick, pale yellowish-brown or cinnamon brown, echinulate, germ pores 2, supraequatorial. Telia not seen.

Distribution: China, North America, South America, Taiwan and West Indies.

**Specimen examined:** II on *Fimbristylis miliacea* (L.) Vahl., TAI-M-F 121, **Pingtung:** Nanjenshan, 14 IX 1978.

**Note:** This species is only seen by uredinia stage in this study, but well agrees to the descriptions of other published records of this species.

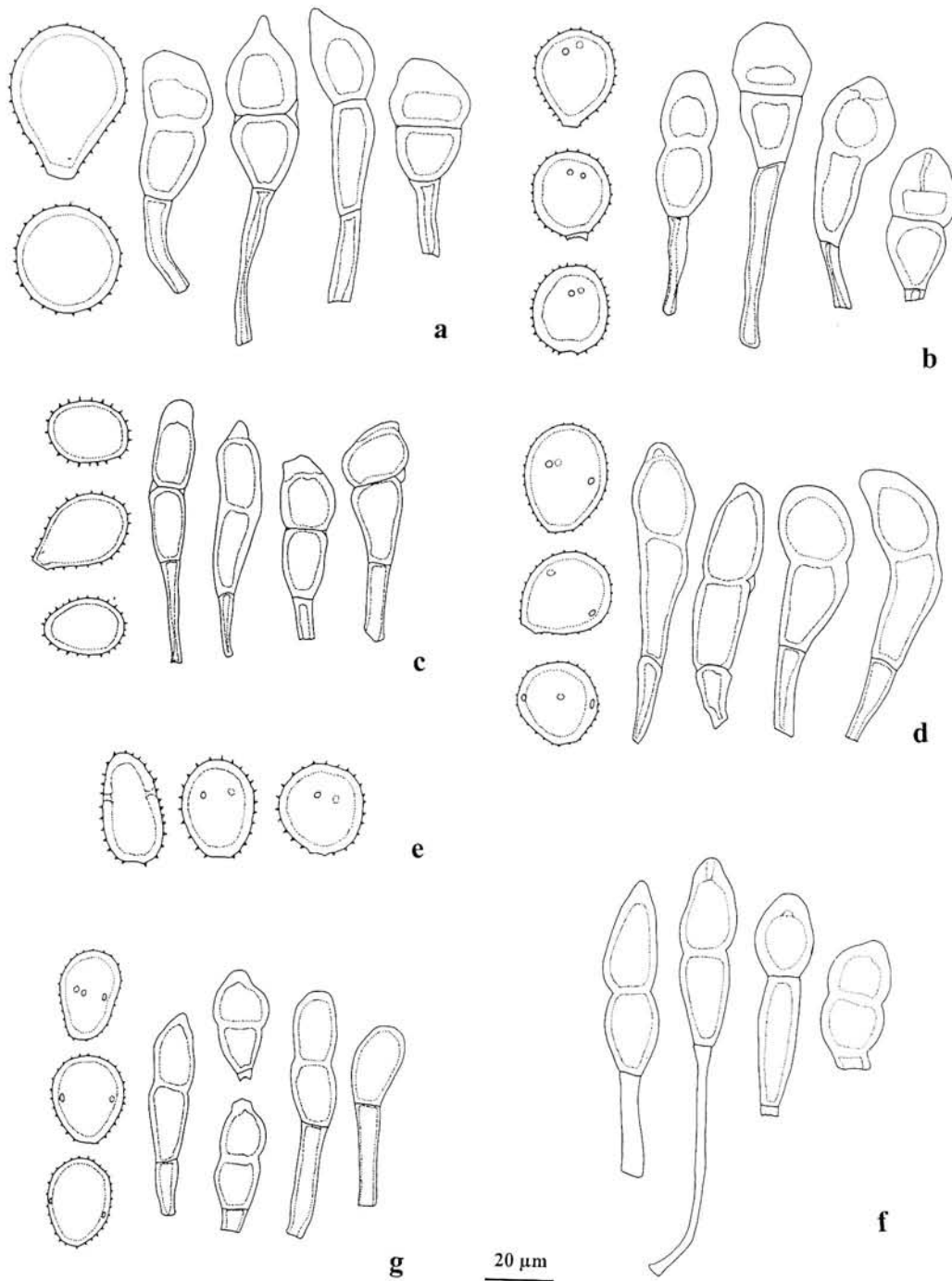


Fig. 2. a: Urediniospores and teliospores of *P. caricis-okushiriensis* Homma. b: Urediniospores and teliospores of *P. dioicae* Magnus. c: Urediniospores and teliospores of *P. hyalina* Dietel. d: Urediniospores and teliospores of *P. cyperi* Arthur. e: Urediniospores of *P. fimbriatylidis* Arthur. f: Teliospores of *P. scirpi-ternatani* N. Hiratsuka. g: Urediniospores and teliospores of *P. sclericola* Arthur.

**12. *Puccinia scirpi-ternatani* Hiratsuka, N., Trans. Sapp. Nat. His. Soc. 17: 31, 1941.**

Fig. 2f

Spermatogonia, aecia and uredinia not known. Telia hypophyllous, scattered or linear, erumpent, blackish-brown to black; teliospores clavate or fusiform, acuminate at the apex,

slightly constricted at the septum, narrow at the base, 50-70 x 11-18  $\mu\text{m}$ , wall smooth, light-brown to brown, 4-10  $\mu\text{m}$  thick at the apex, pedicel light brown, up to 70  $\mu\text{m}$  long, persistent.

Distribution: Japan and Taiwan.

**Specimen examined:** III on *Scirpus ternatanus* Reinwardt, TAI-M-F 0433, **Ilan:** Hsuyen nursery, 20 IV 1978.

**Note:** This species is featured in lacking uredinia stage. It had been recorded from Japan on the same host plant species.

### 13. *Puccinia scleriicola* Arthur, Mycologia 7: 232, 1915.

Fig. 2g

Spermogonia and aecia not known. Uredinia hypophyllous, scattered or aggregated, oblong or elliptic, small, 0.1-0.5 mm long, tardily naked, cinnamon-brown, somewhat compact; urediniospores broadly ellipsoid or obovoid, 25-32 x 18-21  $\mu\text{m}$ , wall about 1.5  $\mu\text{m}$  thick, pale yellowish, finely echinulate, germ pores 2-3, equatorial, indistinct. Telia hypophyllous, scattered or aggregated, round or elliptic, 0.1-0.3 mm long, naked, dark brown, compact; teliospores oblong or clavate-oblong, 30-44 x 12-17  $\mu\text{m}$ , round, truncate or attenuate above, slightly constricted at the septum, wall smooth, brown to cinnamon-brown, 2-4  $\mu\text{m}$  thick at the apex, pedicel up to 35  $\mu\text{m}$  long, persistent.

Distribution: Southern China, Taiwan, U. S. and West Indies.

**Specimens examined:** II, III on *Scleria terrestris* (L.) Fassett, TAI-M-F 044, **Pingtung:** Macha, 15 IV 1978; TAI-M-F 074, **Pingtung:** Nanjenshan, 21 IV 1978. KOU 029, **Taipei:** Hsienten, 18 XI 1995.

### Key to Formosan Species

- |  |                                   |
|--|-----------------------------------|
| 1. On <i>Carex</i> .....   | 2                                 |
| 1. Other hosts .....   | 12                                |
| 2. Urediniospores coloured .....   | 3                                 |
| 2. Urediniospores hyaline or pale in colour .....  | 8                                 |
| 3. Urediniospore-pores supraequatorial .....   | <i>P. dioicae</i> *               |
| 3. Urediniospore-pores equatorial .....  | 4                                 |
| 4. Urediniospore-pores 2 or sometimes three .....  | 5                                 |
| 4. Urediniospore-pores 3 or more .....   | 7                                 |
| 5. Largest urediniospores <25 $\mu\text{m}$ .....  | <i>P. caricis-nubigenae</i> *     |
| 5. Largest urediniospores >25 $\mu\text{m}$ .....  | 6                                 |
| 6. Teliospores < 15 $\mu\text{m}$ in width .....   | <i>P. caricis-lingii</i> *        |
| 6. Teliospores >15 $\mu\text{m}$ in width .....  | <i>P. leucocephala</i>            |
| 7. Teliospores strongly thicken (> 5 $\mu\text{m}$ ) at apex .....                           | <i>P. caricis</i> *               |
| 7. Teliospores moderately thicken (< 5 $\mu\text{m}$ ) at apex .....                         | <i>P. caricis-lanceolatae</i> *   |
| 8. Largest urediniospores > 40 $\mu\text{m}$ .....   | 9                                 |
| 8. Largest urediniospores < 40 $\mu\text{m}$ .....   | 10                                |
| 9. Teliospores obtuse, angular or conoid above; pedicels up to 90 $\mu\text{m}$ long .....   | <i>P. caricis-okushiriensis</i> * |
| 9. Teliospores round or obtusely attenuate above; pedicels up to 40 $\mu\text{m}$ long ..... | <i>P. caricis-daisenensis</i> *   |
| 10. Urediniospore walls thinner < 2.5 $\mu\text{m}$ m long .....                             | <i>P. hyalina</i> *               |
| 10. Urediniospore walls thicker > 2.5 $\mu\text{m}$ long .....                               | 11                                |
| 11. Mesospores present .....   | <i>P. caricis-gibbae</i> *        |
| 11. Mesospores absent .....  | <i>P. breviculmis</i>             |
| 12. On <i>Cyperus</i> .....  | 13                                |
| 12. Other hosts .....  | 15                                |
| 13. Largest urediniospores < 35 $\mu\text{m}$ .....  | 14                                |
| 13. Largest urediniospores > 35 $\mu\text{m}$ .....  | 16                                |



14. Urediniospores smaller 14-20 $\mu\text{m}$ .....	<i>P. philippinensis</i>
14. Urediniospores larger 20-30 $\mu\text{m}$ .....	<i>P. canaliculata</i>
15. Urediniospore with germ pores 2 or 3 .....	<i>P. cyperi</i> *
15. Urediniospore with germ pores 3 to 5 .....	<i>P. juncelli</i>
16. On <i>Eleocharis</i> .....	<i>P. liberta</i>
16. Other hosts .....	17
17. On <i>Fimbristylis</i> .....	18
17. Other hosts .....	19
18. Urediniospores germ pores 2 .....	<i>P. fimbristylidis</i> *
18. Urediniospores germ pores 3 .....	<i>P. flavipes</i>
19. On <i>Fuirena</i> .....	<i>P. fuirenicola</i>
19. Other hosts .....	20
20. On <i>Kyllinga</i> .....	21
20. Other hosts .....	22
21. Urediniospore germ pores mostly indistinct .....	<i>P. kyllingiae-brevifoliae</i>
21. Urediniospore germ pores 2, distinct .....	<i>P. taihokuensis</i>
22. On <i>Mariscus</i> .....	<i>P. hennopsiana</i>
22. Other hosts .....	23
23. On <i>Scirpus /Schoenoplectus</i> .....	24
23. On <i>Scleria</i> .....	25
24. Uredinia stage present .....	<i>P. scirpi</i>
24. Telia stage only .....	<i>P. scirpi-ternatani</i> *
25. Teliospores mostly 3-celled .....	<i>P. scleriae</i>
25. Teliospores 2-celled, rarely one celled .....	<i>P. scleriicola</i> *

\*: New to fungal flora of Taiwan

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## 台灣新記錄莎草科寄生柄銹菌

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### 摘 要

針對台灣產莎草科植物上寄生銹菌目之調查研究中，發現下列 13 種柄銹菌屬種類為台灣新記錄；包括 *Puccinia caricis* Rebentisch, *P. caricis-daisenensis* Y. Morimoto, *P. caricis-gibbae* Dietel, *P. caricis-lanceolatae* Y. Morimoto, *P. caricis-lingii* Zhuang, *P. caricis-nubigenae* Padwick et Azmatullah Khan, *P. caricis-okushiriensis* Homma, *P. dioicae* Magnus, *P. hyalina* Dietel, *P. cyperi* Arthur, *P. fimbristylidis* Arthur, *P. scirpi-ternatani* N. Hiratsuka, *P. scleriicola* Arthur。本報告對每個種類給予形態描述、孢子繪圖並列出其分佈及檢定之標本記錄。此外並提供已知台灣產寄生莎草科柄銹菌屬種類之檢索表。

關鍵詞：柄銹菌屬，莎草科，銹菌目，台灣。

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