

Two new species of Erysiphaceae from Japan

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Two new powdery mildew fungi were found on *Celosia argentea* var. *argentea* (Amaranthaceae) and *Lonicera ramosissima* (Caprifoliaceae), respectively. They were newly named and described as *Erysiphe celosiae* and *Microsphaera lonicerae-ramosissimae*.

Key Words—Erysiphaceae; *Erysiphe celosiae*; *Microsphaera lonicerae-ramosissimae*; new taxon.

1. An *Erysiphe* fungus on feather cockscomb

Feather cockscomb (*Celosia argentea* L. var. *argentea*, fam. Amaranthaceae) is an annual plant that was introduced into Japan from a tropical habitat in ancient times. This flowering plant grows wild in the central and western parts of the country, and it is cultivated in gardens and fields as an ornamental plant. Recently a powdery mildew was found on this plant. Disease on this plant had previously been reported only from Italy, but the taxonomic status of the causal fungus is not reliably known (Amano, 1986). Through examination of the holomorph of the Japanese causal fungus, it was regarded as a new species of the genus *Erysiphe*.

Erysiphe celosiae Tanda, sp. nov. Figs. 1, 2

Mycelium amphigenum in foliis etiam cauligenum, persistens, pelliculas albas subrotundas vel irregulariter ad ambiguas efformans, frequenter occupans tota superficiem folii. Cleistothecia sparsa vel gregaria, atrobrunnea, subglobosa vel depresso-globosa, 82–129 μm diametro, cellulis peridii irregulariter polygonalibus, 14–25 \times 11–18 μm . Appendices 25–40, simplices vel plerumque dichotome 1–2 irregulariter ramosae, mycelioideae vel coralloideae, tenuitunicatae, hyalinae vel ad basim pallide brunneae, curvatae vel geniculatae, aseptatae vel uniseptatae, perraro biseptatae, 25–170 μm longae (diametro cleistothecii 0.2–1.6 plo longiores), prope apicem 4.7–6.2 μm et prope basim 5.2–6.5 μm latae. Asci 4–8, ellipsoidei vel ovati, sessiles vel brevistipitati, 54–68 \times 29–39(–54) μm . Ascospores 2–4, pallide flavae, ellipsoideae vel ovatae, raro pyriformes, 18–31 \times 10–13 μm . Conidia singularia, ellipsoidea vel subcylindracea, vacuolata, (28–)33–41(–50) \times 16–20 μm . Conidiophora recta vel interdum leviter curvata, 1–2 septata.

Holotypus: in foliis et caulibus vivis *Celosiae argenteae* L. var. *argenteae* (feather cockscomb). Tokyo University of Agriculture, Setagaya-ku, Tokyo, Japan, 12 Oct. 1997. leg. S. Tanda (TUAMH5129).

Mycelia on stems and leaves, amphigenous or

cauligenous, developing subcircular to irregular, white, persistent patches, often covering the whole surface of the leaves, discoloring the affected leaf to reddish purple; conidia solitary, ellipsoidal or subcylindrical, vacuolate, (28–)33–41(–50) \times 16–20 μm (av. 37.7 \pm 0.98 \times 17.2 \pm 0.24 μm), length/width ratio 1.3–2.6(–3.1) (av. 2.21 \pm 0.07); conidiophores erect, branching from hyphae on the surfaces of the leaves, 1- or 2-septate, straight or loosely curved, foot-cells cylindrical, 25–60 \times 7–10 μm (av. 39.3 \pm 4.0 \times 8.4 \pm 0.29 μm); cleistothecia scattered or gregarious, dark brown, subglobose or depressed globose, 82–129 μm (av. 105.4 \pm 1.6 μm) in diam, wall cells irregularly polygonal, 14–25 \times 11–18 μm (av. 19.4 \pm 1.0 \times 14.7 \pm 1.1 μm); cleistothecial appendages produced 25–40 (av. 32.0 \pm 3.0) in number on the lower half part of the cleistothecium, mycelioid, simple or frequently branched 1 or 2 times in coral-like manner, often interwoven with mycelium, thin-walled throughout, hyaline or light brownish towards the base, curved or geniculate, aseptate or uniseptate, rarely biseptate, 25–170 μm (av. 96.0 \pm 12.8 μm) long (0.2–1.6 times as long as the cleistothecial diam), 4.7–6.2 μm (av. 5.34 \pm 0.16 μm) wide at the upper part, 5.2–6.5 μm (av. 5.60 \pm 0.17 μm) wide near the base; asci 4–8 (av. 5.9 \pm 0.51) in number, ellipsoid or ovate, sessile or short pedicellate, wall thick, 54–68 \times 29–39(–54) μm (av. 61.5 \pm 0.59 \times 35.1 \pm 0.64 μm); ascospores 2–4 in number (av. 2.8 \pm 0.10), light yellow, ellipsoid, ovoid or somewhat pyriform, granular, 18–31 \times 10–13 μm (av. 26.3 \pm 1.4 \times 12.3 \pm 0.31 μm).

Remarks: In the early autumn of 1997, a powdery mildew was found on leaves and stems of *C. argentea* var. *argentea* in a garden in Tokyo (Fig. 2). Soon after, numerous ascocarps developed on the affected leaves. The holomorphic characteristics of the causal fungus were carefully examined.

To confirm the parasitism of ascospores, inoculation was attempted in late May 1998 by attaching leaves of the host plant bearing many ascocarps, which had been overwintered according to my previous experiments (Tanda, 1994), to five plants of *C. argentea* and its a variety, var. *plumosa* Hort. It was ascertained under

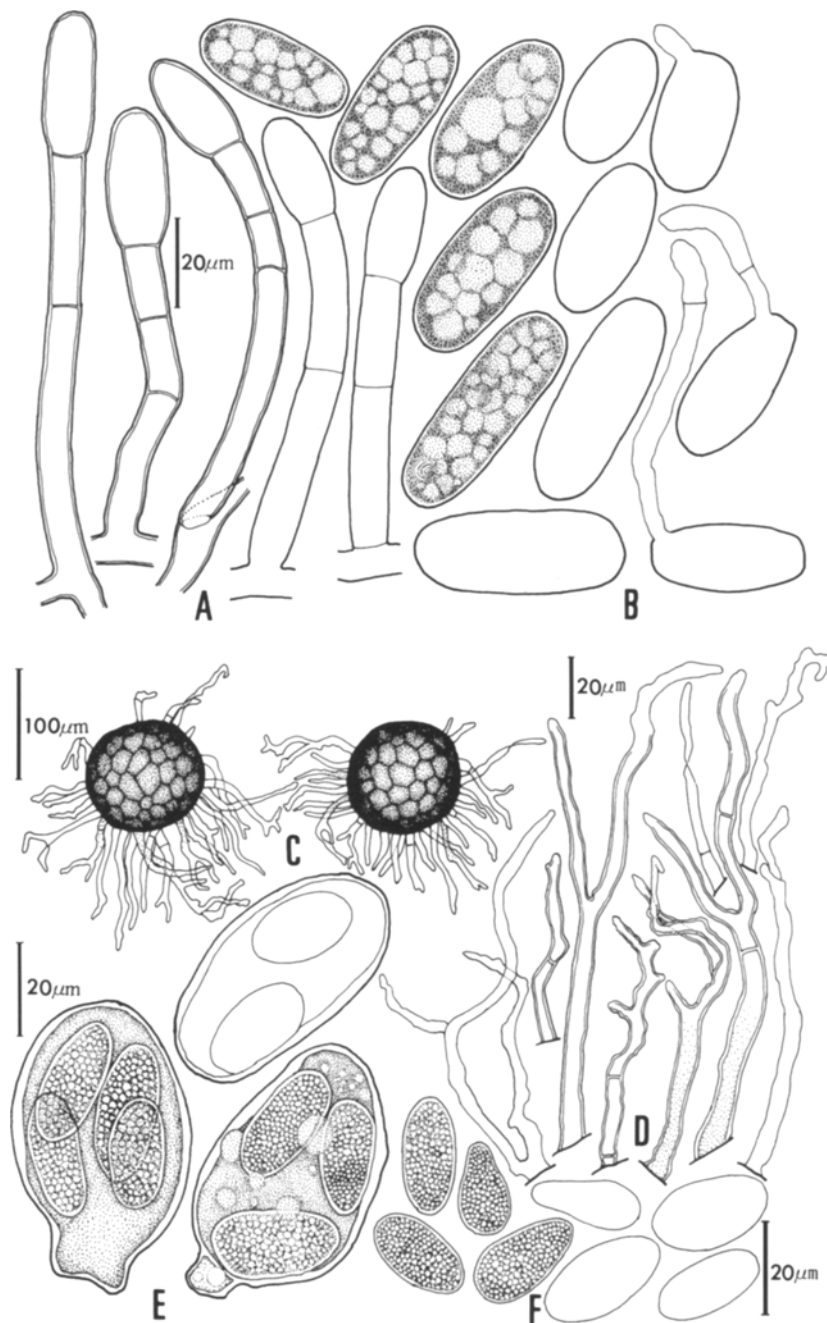


Fig. 1. *Erysiphe celosiae*. A: Conidia and conidiophores; B: Conidia; C: Cleistothecia; D: Appendages of cleistothecium; E: Asci and ascospores; F: Ascospores.

the microscope that the ascocarps used for inoculation contained many fresh ascospores. The plants were kept in a greenhouse.

Although observations were carried out up to the late autumn, no sign of the disease was seen at all on the leaves of two varieties of *C. argentea* tested.

In the field, two varieties of *C. argentea* (var. *cristata* Kuntze and var. *plumosa* Hort.) were planted near a diseased host plant, but no signs of the disease were recognized on them.

The fungus on *C. argentea* from Italy has been denominated '*Erysiphe communis*', but its taxonomic position is not reliably known (Amano, 1986). An omnivorous powdery mildew fungus, *Leveillula taurica* (Lév.) G. Arnaud has been reported on another species of *Celosia* from many countries in Asia and Europe.

The anamorph of the Japanese fungus on *C. argentea* var. *argentea* is neither endophytic nor of the Oidiopsis type, but superficial and of the Pseudoidium type. The cleistothecial appendages and asci of the

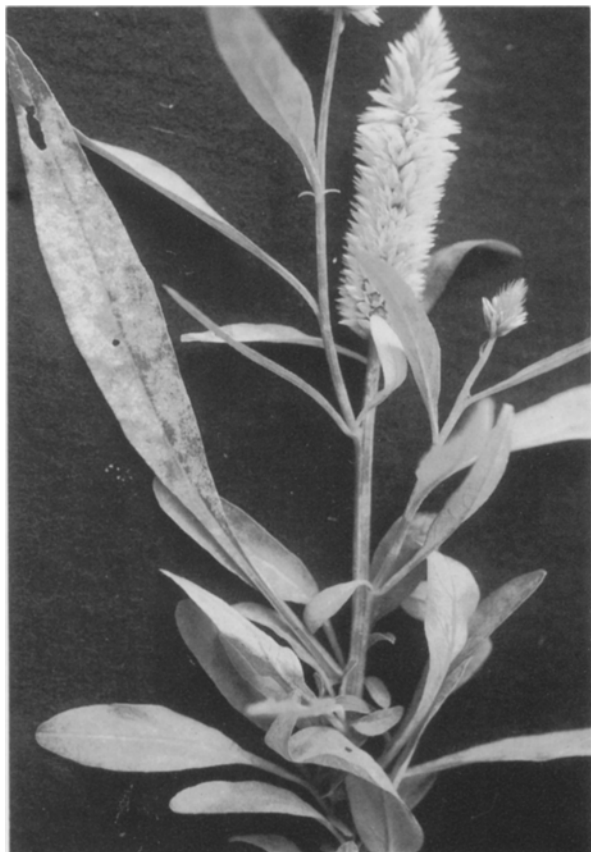


Fig. 2. Mycelial patches of *Erysiphe celosiae* on the leaves and stems of *Celosia argentea* var. *argentea*.

fungus clearly showed characteristics of *Erysiphe*.

The appendages of four *Erysiphe* fungi, *E. paeoniae* R. Y. Zheng et G. Q. Chen, *E. viciae-unijugae* (Homma) U. Braun, *E. betae* (Vaňha) Weltzien, and *E. heraclei* DC., which are parasitic on other plants, and which have been described by Zheng and Chen (1981), Braun (1987), Otani (1987) and Nomura (1997), were similar to those of the present fungus in the manner of furcation and coloration. However, they differed from the *Erysiphe* fungus on *C. argentea* var. *argentea* in the size of the foot-cells of conidiophores, asci, and ascospores, and the number of ascospores (Table 1).

Some powdery mildew fungi have been recorded on five species of the genus *Amaranthus* from various localities of the world (Amano, 1986). Among them, *Oidium amaranthi* R. L. Mathur, B. L. Mathur et L. Bhargavan on *Amaranthus caudata* L. which was described in Braun's monograph (1987), is similar to the anamorph of the present fungus. However, as far as I know, its teleomorph is unknown.

2. A *Microsphaera* fungi on *Lonicera ramosissima*

Lonicera ramosissima Franch. et Savat. (fam. Caprifoliaceae) is a deciduous bush growing in the mountains of Honshu and Shikoku, Japan. A powdery mildew was found on this plant in a park in Kanagawa Prefecture. The causal fungus was easily identified as a species of the genus *Microsphaera* by means of its teleomorphic characters. Powdery mildew has been recorded on about 73 species (including varieties) of *Lonicera* plants worldwide (Sawada, 1914; Shirai and Miyake, 1917; Terui and Harada, 1975; Amano, 1986), but *L. ramosissima* does not appear in any host indexes of the family Erysiphaceae. Five reliable species and two varieties of

Table 1. Holomorph of *Erysiphe celosiae* and related species.

Character	<i>E. paeoniae</i>	<i>E. viciae-unijugae</i>	<i>E. heraclei</i>	<i>E. betae</i>	<i>E. celosiae</i>
Size of foot-cell of conidiophore (μm)	25-40 \times 7-12	30-60 \times 8-10	25-90 \times 7-12	25-50 \times 8-12	25-60 \times 7-10
Cleistothecium					
Diameter (μm)	70-140	85-145	75-170	75-135	82-129
Length of appendage (μm)	0.25-1.5 times as long as cleistothecial diameter	0.3-2 times	0.3-2 times	0.5-2.5 times	1-2 times
Ascus					
Number	3-16	4-16	2-9	2-8	4-8
Dimension (μm)	45-75 \times 25-55	40-81 \times 25-58	40-89 \times 30-68	45-75 \times 30-50	54-68 \times 29-54
Ascospore					
Number	2-7	3-7	2-6	2-5	2-4
Dimension (μm)	12-30 \times 7-15	17-28 \times 8-19	17-34 \times 10-22	17-33 \times 7-18	18-31 \times 10-13
Host (Family)	Ranunculaceae	Leguminosae	Umbelliferae	Chenopodiaceae	Amaranthaceae
Reference	Zheng and Chen (1981), Braun (1987), Otani (1988), Nomura (1997)	Zheng and Chen (1981), Braun (1987), Otani (1988), Nomura (1997)	Zheng and Chen (1981), Braun (1987), Otani (1988), Nomura (1997)	Zheng and Chen (1981), Braun (1987), Otani (1988), Nomura (1997)	Author

Microsphaera have been described on *Lonicera* plants worldwide (Blumer, 1967; Braun, 1982a, 1983, 1984, 1987; Yu and Lai, 1983) (Table 2). However, the present *Microsphaera* fungus clearly differs from other species of the same genus which have been described on *Lonicera* or plants of other families. Therefore, it should be considered as a new, independent species of *Microsphaera*.

***Microsphaera loniceriae-ramosissimae* Tanda, sp. nov.**

Fig. 3

Mycelium amphigenum in foliis, persistens, pelliculas albas rotundas ad ambiguas efformans, frequenter occupans tota superficiem folii. Cleistothecia sparsa, atro-brunnea, globosa vel subglobosa, 71–86 μm diametro, cellulis peridii irregulariter polygonalibus, 14–29 \times 7–18 μm . Appendices 6–8(–11), prope aequatorem cleistothecii exorientes, rectae vel curvatae, frequenter geniculatae, tenuitunicatae, sursum leniter attenuatae vel plerumque in latitudine aequales, uniseptatae vel raro aseptatae, hyalinae et ad basim pallide brunneae, superne (1–)3–6 irregulariter dichotome ramosae, ramulis ultimis rectis, 111–186 μm longae (diam. cleistothecii 1.4–2.3 plo longiores), prope apicem 5.2–7.0 μm et prope basim 5.2–6.8 μm latae. Asci (2–)3(–4), late ellipsoidei vel subglobosi, brevistipitati vel sessiles, 46–54 \times (32–)36–39 μm . Ascosporae 4–6, ellipsoideae vel ovatae, hyalinae, 16–22 \times 9–12 μm .

Holotypus: in foliis vivis *Lonicerae ramosissimae* Franch. et Sav. (ko-uguisukagura), Kodomonokuni children's park, Aoba-ku, Yokohama, Kanagawa-Pref., Japan, 2 Nov. 1980, leg. S. Tanda (TUAMH1462).

Mycelia amphigenous, developing whitish, circular patches, the margin obscure, often occupying the whole surface of the leaves, persistent; cleistothecia scattered, globose or subglobose, dark brown, 71–86 μm (av. 79.4 \pm 2.0 μm) in diam, wall cells irregularly polygonal, 14–29 \times 7–18 μm (av. 18.6 \pm 1.5 \times 13.5 \pm 1.2 μm); appendages produced 6–8(–11) (av. 7.7 \pm 0.71) near the equatorial part of the cleistothecium, their stalk straight or curved, often geniculate about the middle, thin-walled, slightly attenuated upwards, usually the same thickness throughout, uniseptate near the middle, rarely aseptate, hyaline, light brown towards the base, (1–)3–6 (av. 4.3 \pm 0.37) times rather irregularly and dichotomously branched at the apex, most of the primary branches longer than others, and recurved distinctly, tips of the ultimate branches usually straight, 111–186 μm (av. 141.9 \pm 3.7 μm) long (1.4–2.3 times as long as the cleistothecial diam), stalk 5.2–7.0 μm (av. 5.95 \pm 0.22 μm) wide near the apices, 5.2–6.8 μm (av. 6.04 \pm 0.18 μm) near the base; asci (2–)3(–4) (av. 3.0 \pm 0.25) in number, broadly ellipsoid or subglobose, short pedicellate or sessile, 46–54 \times (32–)36–39 μm (av. 49.6 \pm 0.64 \times 38.2 \pm 0.76 μm); ascospores 4–6 (av. 5.0 \pm 0.5) in number, ellipsoid or ovate, hyaline, granular, 16–22 \times 9–12 μm (av. 18.6 \pm 0.32 \times 10.6 \pm 0.21 μm).

Remarks: The specimens of the fungus were obtained in early November 1980. At first I considered it to be the teleomorph of *Microsphaera loniceriae* (DC.) G. Winter or a variety parasitic on a number of *Lonicera* plants. When differences were subsequently found, more careful comparisons were conducted.

Seven species of *Microsphaera* including two varie-

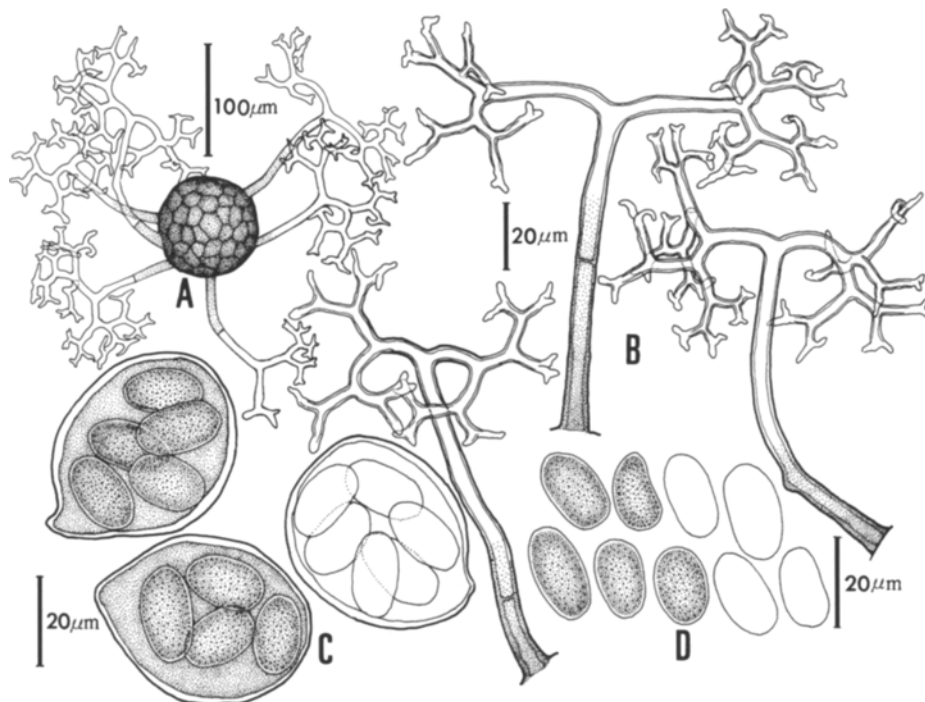


Fig. 3. *Microsphaera loniceriae-ramosissimae*. A: Cleistothecium; B: Appendages of cleistothecium; C: Asci and ascospores; D: Ascospores.

Table 2. Morphological characteristics of teleomorphs of *Microsphaera lonicerarum* and other related *Microsphaera* fungi on *Lonicera* plants.

Character	<i>M. caprifoliacearum</i>			<i>M. lonicerarum</i>		<i>M. lonicerarum</i> <i>ramosissimae</i>
	<i>var. caprifoliacearum</i>	<i>var. flexuosa</i>	<i>var. lonicerarum</i>	<i>var. lonicerarum</i>	<i>var. ehrenbergii</i>	
Cleistothecium						
Diameter (μm)	70-110(-130)	60-90(-100)	75-120(-130)	(60-)70-110(-120)		71-86
Size of wall cell (μm)	8-25 × 10-15	10-20 diam	10-25 diam	10-20 diam		14-29 × 7-18
Appendage						
Number	3-15(-20)	5-15	3-20	6-12	10-20	6-8(-11)
Shape of stalk	stiff, straight to curved	rather stiff	stiff or somewhat flexuous	flexuous, longer curved	rather stiff	geniculate, often straight
Number of branching	4-6	3-5	4-6	3-5		(1)-3-6
Shape of branch	closely, regularly branched, primary branch elongated	deeply cleft, forked in lower half, primary branch elongated	closely, regularly branched, primary branch elongated	loosely, irregularly branched, diffuse, primary branch elongated	diffuse to close, regularly branched	rather irregularly branched, primary branch elongated
Number of septum	0-1	0-1	0-1	0-3		0-1
Colour	hyaline or brown at base	hyaline or coloured at base	hyaline or coloured at very base	hyaline, coloured at base or in lower half		hyaline or light brown toward base
Shape of tip	recurved	recurved	recurved	straight or recurved	straight	straight
Dimension (μm)	0.5-1.3 times as long as cleistothecial diam in length, 8-10 wide	1-2 times, 6-10 wide	1-2.5 times, 8-12 wide	1-3 times, 6-9 wide	1-2 times	1.4-2.3 times, 5.2-6.8 wide
Ascus						
Number	(2)-3(-5)-8	3-5	3-10	2-8		(2)-3(-4)
Dimension (μm)	39-60 × 30-50	40-65 × 25-50	40-70 × 25-45	40-55 × 25-45(-50)		46-54 × (32)-39
Ascospore						
Number	(3)-4(-5)-7	4-5	(2)-4(-5)	4-5	(3)-4(-5)-6	4-6
Dimension (μm)	15.0-22.5 × 7.5-12.5	16-25 × 11-15	(15)-18-26 × (9)-10-14	15-24 × 8-14	15-25 × 8-15	16-22 × 9-12
Host (<i>Lonicera</i> spp.)	5 spp.	5 spp.	7 spp.	3 spp.	18 spp.	<i>L. ramosissimae</i>
Distribution	Asia (including Japan)	Asia (Japan, China)	N. America	N. America	Europe; Asia (Japan)	Europe; Asia (Japan)
Reference	Yu and Lai (1983), Braun (1987)	Braun (1983, 1987)	Blumer (1967), Braun (1982, 1987)	Braun (1982, 1984, 1987)	Braun (1987)	Braun (1982, 1987)
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ties have been described on many *Lonicera* plants. Among them, the cleistothecial appendages of *M. erlangshanensis* Y.N. Yu, *M. miurae* U. Braun, *M. magnusii* S. Blumer, and *M. caprifoliacearum* U. Braun var. *caprifoliacearum* are more numerous than those of the present fungus, and the tips of their ultimate branches are recurved ordinarily.

The cleistothecia of *M. caprifoliacearum* and *M. loniceræ* are larger, and contain more asci than those of the fungus on *L. ramosissima*. Furthermore, *M. caprifoliacearum* var. *flexuosa* (U. Braun) U. Braun and *M. loniceræ* including var. *ehrenbergii* (Lév.) U. Braun were distinguishable by differences in the number, length, or septation of their appendages (Table 2).

From the results described above, the fungus on *L. ramosissimæ* is clearly new species.

The type materials of the two fungi are kept in the Mycological Herbarium of the Tokyo University of Agriculture, Kanagawa, Japan (TUAMH).

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