

CHAPTER 4

RESULTS AND DISCUSSION

Taxonomic Part

The powdery mildew fungi having teleomorphic states were identified, using the general keys to species as described in a Monograph of the Erysiphales (Powdery Mildews) by Braun (1987), the Powdery Mildews (Erysiphales) of Europe (Braun, 1995) and Erysiphaceae of Korea (Shin, 2000). The fungi that produce only anamorphic states, the following dichotomous key is proposed to identify the fungal genera or subgenera as follows :-

Teleomorphic key to genera of Powdery Mildew in Tribe Erysipheae :

Ectoparasitic (mycelium external), poly asci, conidia formed singly

A. Appendage dichotomously, helicoid or myceloid

1. Peridium more than one layer (*Erysiphe*, *Uncinula*, *Microsphaera*).....

.....Genus *Erysiphe*.

2. Peridium one layer, conidial state not found.....Genus *Brasiliomyces*.

B. With out true appendages (club shaped cell)

3. Conidial state not found.....Genus *Typhulochaeta*.

Anamorphic key to genera and subgenera of the *Erysiphaceae* :

1. Mycelium ectophytic, conidiophores arise from the epiphytic mycelium.....

The fungi belong to the hyphomycetes genus *Oidium*, Subgenus.....2.

2. Conidia singly, produced one at a time without fibrosin bodies, germ tubes

Polygoni-type, teleomorphic state belongs to *Erysiphe*.....Subgenus *Pseudoidium*.

Table. 1 Collection of Powdery Mildew specimens in Tribe Erysiphaceae found in Thailand.

Fungal species	Host Plants	Family name	Thai name	Location	Voucher collection
<i>Brasiliomyces</i>	<i>Castanopsis echinocarpa</i>	Fagaceae	ก่อหนาม	Bhubing, CM	MUMH 4989
	<i>C. indica</i>	Fagaceae	ก่อส้ม	Botanical , CM	MUMH 4990
	<i>C. calathiformis</i>	Fagaceae	ก่อหนูดอย	KhunJae, CR	MUMH 4991
	<i>C. argyrophylla</i>	Fagaceae	ก่อหุ้ม	KhunTan, LP	MUMH 4987
	<i>C. tribuloides</i>	Fagaceae	ก่อใบเลื่อม	Maehongsorn	MUMH 4988
	<i>C. diversifolia</i>	Fagaceae	ก่อเป็น	Chiang Rai	MUMH 4992
	<i>Lithocarpus elegans</i>	Fagaceae	ก่อหม่น	Maehongsorn	MUMH 4985
	<i>L. polystachyus</i>	Fagaceae	ก่อนก	Maehongsorn	MUMH 4986
	<i>Dalbergia cultrata</i>	Leguminosae	กระพี้เขาควาย	Botanical , CM	MUMH 4993

Fungal species	Host Plants	Family name	Thai name	Location	Voucher collection
<i>Pseudoidium</i>	<i>Acacia auriculaformis</i>	Fabaceae	กระถินณรงค์	Chiang Mai	MUMH 1805
	<i>Aeschynomene americana</i>	Fabaceae	โสนขน	Chiang Mai	MUMH 1841
	<i>Antigonon leptopus</i>	Nyctaginaceae	พวงชมพู	Botanical , CM	MUMH 4701
	<i>Aristolochia indica</i>	Aristolochiaceae	กระเช้าสีดา	Chiang Mai	MUMH 4702
	<i>Bauhinia purpurea</i>	Leguminosae	ชงโค	Chiang Mai	MUMH 1816
	<i>Begonia spp.</i>	Begoniaceae	ส้มกุ้ง	Bhubing, CM	MUMH 3714
	<i>Bixa orellana</i>	Bixaceae	กำแสด	CMU	MUMH 3231
	<i>Brassica parachinensis</i>	Brassicaceae	พืชกวางตุ้ง	Chiang Mai	MUMH 4703
	<i>Carica papaya</i>	Caricaceae	มะละกอ	Bhubing, CM	MUMH 1853
	<i>Cissampelos pareira</i>	Menispermaceae	-	Chiang Mai	MUMH 4704
	<i>Cleome chelidonii</i>	Capparaceae	เสี้ยนฝรั่ง	Chiang Mai	MUMH 3713
	<i>Clitoria ternatea</i>	Leguminosae	อัญชัน	Chiang Mai	MUMH 4705
	<i>Colubrina longipes</i>	Rhamnaceae	ผักก้านตรง	Chiang Mai	MUMH 4706
	<i>Cyclea barbata</i>	Menispermaceae	หญ้านม่น้อย	Chiang Mai	MUMH 1826
	<i>Desmodium triflorum</i>	Leguminosae	หญ้านกเลือดหอย	Chiang Mai	MUMH 1213
	<i>Eucalyptus camaldulensis</i>	Myrtaceae	ยูคาลิปตัส	Chiang Mai	MUMH 4708
	<i>Glycine max</i>	Leguminosae	ถั่วเหลือง	Chiang Mai	MUMH 4709
	<i>Hibiscus floccosus</i>	Malvaceae	ชบาแดง	Bhubing, CM	MUMH1832
	<i>Hydrangea hortensis</i>	Sessifragaceae	ไฮเดรนเยีย	Chiang Mai	MUMH 4710
	<i>Hydrocotyle javanica</i>	Umbelliferae	แว่นแก้ว	Chiang Mai	MUMH 4711
	<i>Indigofera dosua</i>	Fabaceae	ถั่วดิน	Chiang Mai	MUMH 4712
	<i>Indigofera linnaei</i>	Leguminosae	-	Chiang Mai	MUMH 1746
	<i>Inula cappa</i>	Asteraceae	หนาดคำ	Chiang Mai	MUMH 1771
	<i>Ipomoea aquatica</i>	Convolvulaceae	ผักบุ้ง	Chiang Mai	MUMH 1744
	<i>Ipomoea obscura</i>	Convolvulaceae	สะอึก	Chiang Mai	MUMH 1755
	<i>Kydia calycina</i>	Malvaceae	เสียงฟ้า	Chiang Mai	MUMH 1756
	<i>Lagerstroemia indica</i>	Lythraceae	ชี่พั่ง	Chiang Mai	MUMH 4713
	<i>Lithocarpus truncates</i>	Fagaceae	ก่อดำ	Maehongson	MUMH 4714
	<i>Lithocarpus lindleyanus</i>	Fagaceae	ก่อดำง	Bhubing,CM	MUMH 4715
	<i>Ludwigia hyssopifolia</i>	Onagraceae	แพงพวย	Chiang Mai	MUMH 1838

Fungal species	Host Plants	Family name	Thai name	Location	Voucher collection
<i>Pseudoidium</i>	<i>Lycopersicon esculentum</i>	Solanaceae	มะเขือเทศ	Bhubing, CM	MUMH 1847
	<i>Mangifera indica</i>	Anacardiaceae	มะม่วง	Bhubing, CM	MUMH 3268
	<i>Microtoena insuavis</i>	Labiatae	คำปอง	Chiang Mai	MUMH 1757
	<i>Mimosa invisa</i>	Leguminosae	ไมชราบลี้อย	Chiang Mai	MUMH 3820
	<i>Mirabillis jalapa</i>	Nyctaginaceae	บานชื่น	Chiang Mai	MUMH 1787
	<i>Mohamla siamosis</i>	Berberidaceae	ขมิ้นดิน	Bhubing, CM	MUMH 4716
	<i>Mucuna bractecta</i>	Leguminosae	หมาขี้	Chiang Mai	MUMH 4717
	<i>Muehlenbeckia platyclada</i>	Polygonaceae	ตะขาบบิน	Botanical, CM	MUMH 1800
	<i>Nelumbo nucifera</i>	Nelumbonaceae	บัว	Botanical, CM	MUMH 4718
	<i>Ocimum sanctum</i>	Lamiaceae	กระเพรา	Chiang Mai	MUMH 4719
	<i>Oxalis corniculata</i>	Oxalidaceae	ส้มดิน	Chiang Mai	MUMH 4720
	<i>Peltophorum pterocarpum</i>	Caesalpiniaceae	นนทรี	CMU	MUMH 4721
	<i>Pilea trinervia</i>	Urticaceae	ขมิ้นสามทาง	Chiang Mai	MUMH 4722
	<i>Pisum sativum</i>	Fabaceae	ถั่วลันเตา	Chiang Mai	MUMH 1850
	<i>Pogostemon sp.</i>	Labiatae	พิมเสนดิน	Chiang Mai	MUMH 4723
	<i>Polygonum odoratum</i>	Polygonaceae	ผักไผ่	Chiang Mai	MUMH 2920
	<i>Quercus vestitus</i>	Fagaceae	ก่อแอบ	Maehongson	MUMH 4994
	<i>Q.kingiana</i>	Fagaceae	ก่อแดง	Maehongson	MUMH 4995
	<i>Rhododendron sp.</i>	Ericaceae	กุหลาบพันปี	Bhubing, CM	MUMH 4724
	<i>Sesbania grandiflora</i>	Leguminosae	แค	Chiang Mai	MUMH 1828
	<i>Stachytarpheta indica</i>	Verbenaceae	พันธุเขียว	Chiang Mai	MUMH 1843
	<i>Stephania venosa</i>	Menispermaceae	สมุนไพร	Chiang Mai	MUMH 4725
	<i>Tamarindus indica</i>	Fabaceae	มะขาม	Chiang Mai	MUMH 1750
	<i>Tectona grandis</i>	Verbenaceae	สัก	Chiang Mai	MUMH 1489
	<i>Tiliacora triandra</i>	Menispermaceae	ผักข่านาง	Chiang Mai	MUMH 4726
	<i>Urena lobata</i>	Malvaceae	-	Chiang Mai	MUMH 1851
	<i>Viburnum inopinatum</i>	Capritoliaceae	ฮูน	Chiang Mai	MUMH 4728
	<i>Vitis vinifera</i>	Vitaceae	องุ่น	Chiang Mai	MUMH 1835
	<i>Zizyphus nummularia</i>	Rhamnaceae	พุทรา	CMU	MUMH 1799

Description and Phylogenetic Analysis

Erysiphe (Brasiliomyces)

The fungi in this genus are ectophytic, produce external mycelia on the host surface; mycelium is superficial, conidial state is unknown. Erysiphaceous chasmothecia are globoid to depressed-globose, usually fairly small, about 45–80 µm in diam; peridium is very thin, composes of only one conspicuous layer; wall is yellowish to light brown, semitransparent; appendages are very sparsely developed, mycelioid, few, often nearly absent or even lacking; asci have more than 1, 2–8-spored ascus (Type species = *Brasiliomyces mylvastri* Viégas = *B.malachrae* (Seaver) Boesewinkel) by Zheng (1984).

1. *Erysiphe* on *Castanopsis tribuloides*, Fagaceae; (ก่อใบเลื่อม)

Colonies appear on both upper and lower sides of the leaves, amphigenous, mainly epiphyllous, white, persistent, forming irregular white patches on the host surface.

Hyphae are hyaline and superficial, 4–6 µm wide, branching. Appressoria are well-developed, coral-like, single or occasionally opposite in pairs. Conidiophores and conidia are unknown.

Chasmothecia are scattered to gregarious, globose to subglobose, (55.5–)58–82.5 (–85) μm in diameter (average 68.9 μm); peridium is thin, one conspicuous layer, yellowish to light brown when mature, semitransparent; appendages are present, poorly developed, often branched, rarely absent, mycelioid, (15.5–)18–66(–75) \times (2.5–)3–6(–7.5) μm (average 33.1 \times 4.6 μm), colourless, aseptate, thin-walled, smooth. Asci; sessile or shortly stalked, (34–)36–58(–61) \times (24–)28–49(–52) μm (average 45.5 \times 37.8 μm). Ascospore; 4–6 spored, ascospores are ellipsoid-ovoid, hyaline (11–)12.5–25(26) \times (6–)7.5–13(–14.5) μm (average 20.33 \times 10.33 μm) (Fig. 12-13).

Examination of Specimens on *Castanopsis tribuloides*, MUMH 4988.

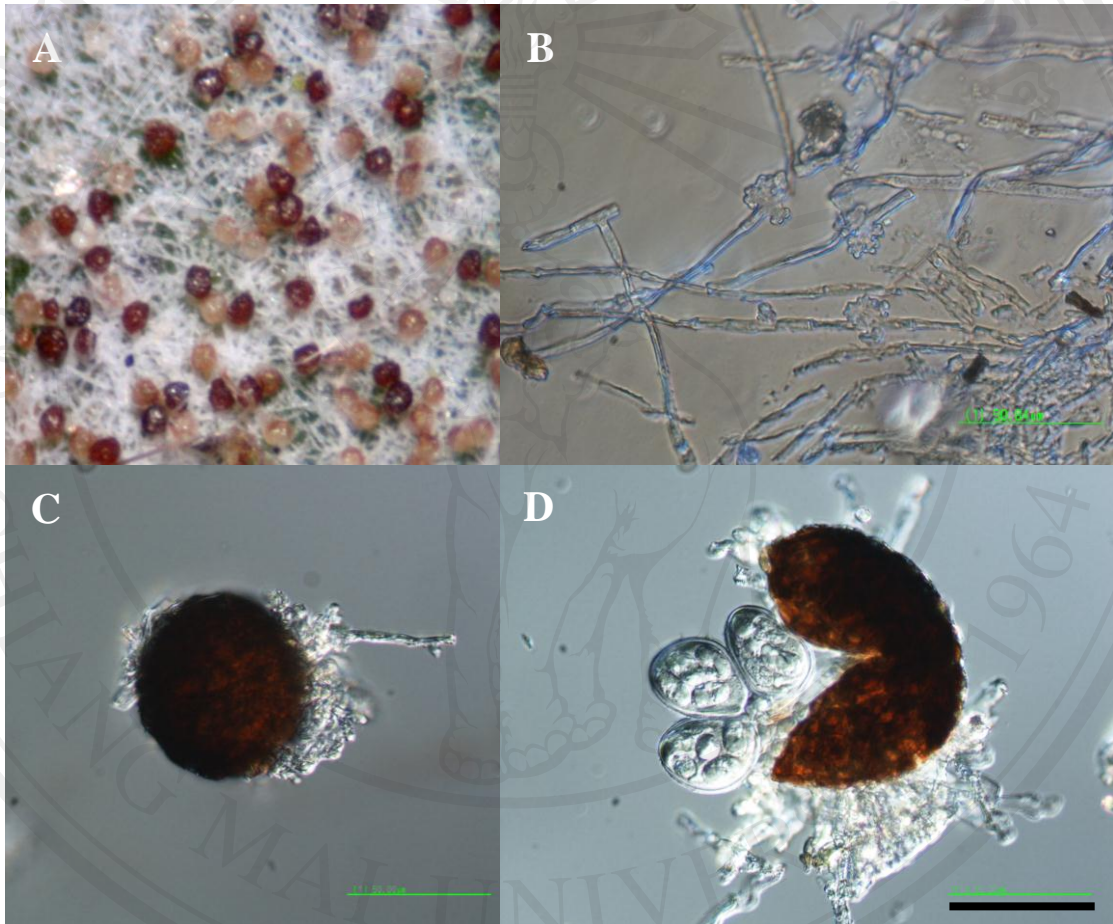


Fig. 12 *Erysiphe* MUMH 4988 on leaves of *Castanopsis tribuloides*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μ m).

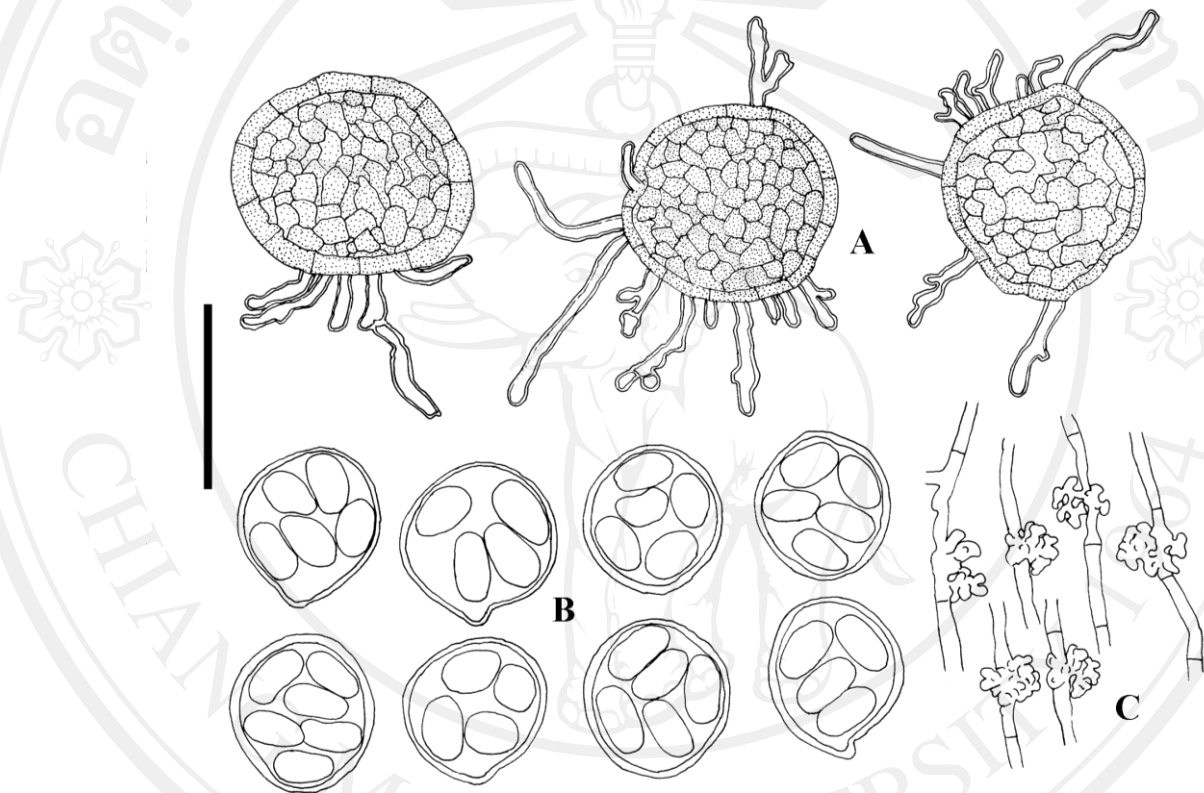


Fig. 13 Drawing of *Erysiphe* MUMH 4988 on *Castanopsis tribuloides*.

A : Chasmothecia. B : Asci and ascospores.

C : Hyphae and appressoria (bar – 50 μ m).

2. *Erysiphe* on *Lithocarpus polystachyus*, Fagaceae; (ก่อเนก)

Colonies are on both upper and lower sides of the leaves, amphigenous, mostly epiphyllous, white, persistent, dense patches or irregular, profusely branched, superficial; hyphae are substraight to somewhat wavy, 4–5 μm wide, branching at right or narrow angles; conidial state and conidia are not found. Appressoria ; nipple to belong club-shaped single or occasionally opposite in pairs. Chasmothecia are scattered to gregarious, globose to subglobose, 50–55 μm in diam (average 53 μm); peridium is thin, one conspicuous layer, dark brown to blackish when mature, semitransparent, few basal appendages, sometimes lacking, very short, mycelioid, thin wall, hyaline, sometimes pale brown near the base. Asci ; 2–3 asci, sessile or shortly stalked, thin walled, 50–55(–57.5) \times 45–47.5(–52.5) μm (average 53.08 \times 46.58 μm). Ascospore ; 4–5 spored, ascospores are ellipsoid-ovoid, hyaline or olivaceous to pale greenish due to oil drops, 20–27.5 \times 12.5–15 μm (average 24.5 \times 14 μm) (Fig. 14).

Examination of Specimens on *Lithocarpus polystachyus*, MUMH 4986.

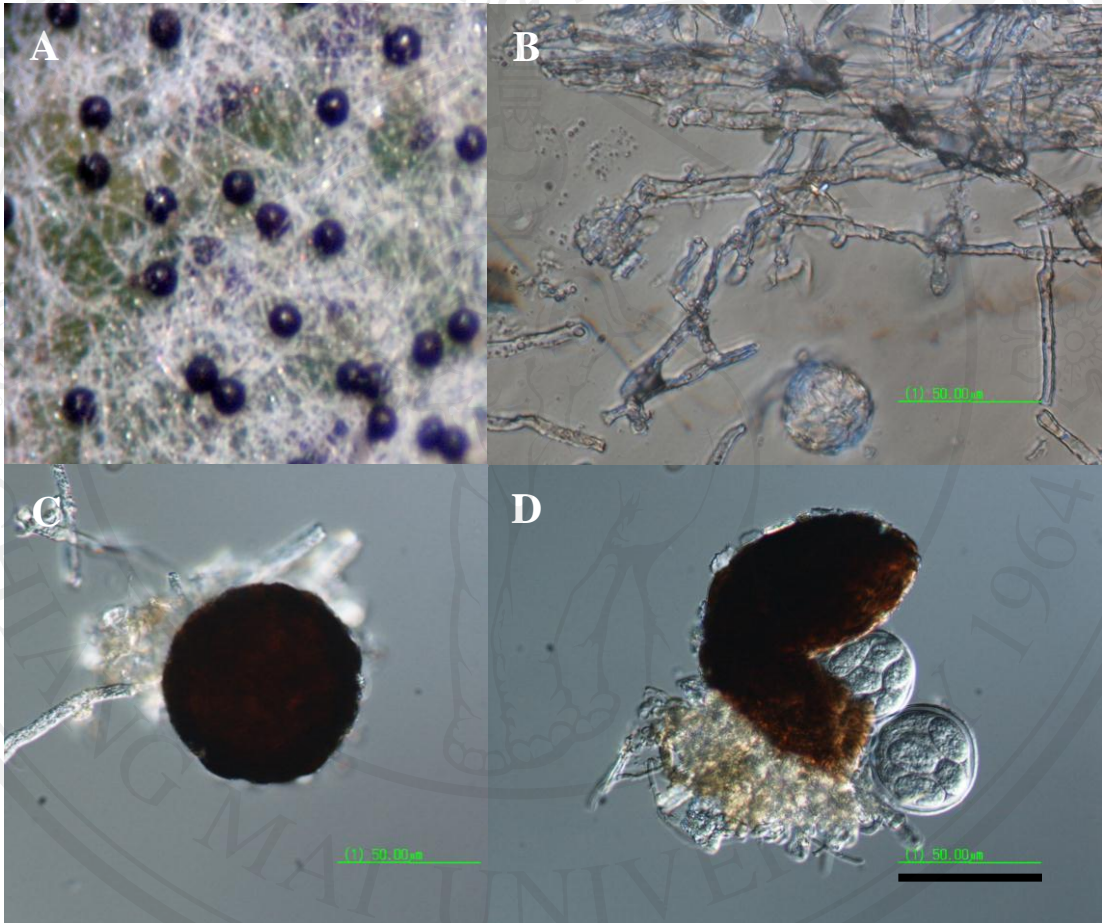


Fig. 14 *Erysiphe* MUMH 4986 on leaves of *Lithocarpus polystachyus*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μm).

3. *Erysiphe* on *Lithocarpus elegans* , Fagaceae; (ถ่อหม่น)

Colonies are on the upper sides of the leaves, amphigenous, white, persistent, dense patches or irregular, profusely branched, superficial; hyphae are hyaline and substraight to somewhat wavy, 4–5 μm wide, branching at right or narrow angles.

Appressoria are well-developed , coral-like, single or occasionally opposite in pairs.

Conidiophores and conidia are unknown. Chasmothecia are scattered to gregarious, globose to subglobose, (55–)57.5–65(–67.5) μm in diam (average 61.41 μm);

peridium is thin, one conspicuous layer, pale brown to dark brown when mature, semitransparent, few basal appendages, sometimes lacking, very short, mycelioid, thin

wall, hyaline, sometimes pale brown near the base. Asci ; 2–4 asci, sessile or shortly stalked, thin walled, (40–)45–62.5 \times 35–50 μm (average 50.5 \times 41.08 μm). Ascospore ;

5–6 spored, ascospores are ellipsoid-ovoid, hyaline (20–)22.5–27.5 \times 12.5–17.5 μm (average 25.25 \times 13.16 μm) (Fig. 15).

Examination of Specimens on *Lithocarpus elegans*, MUMH 4985.

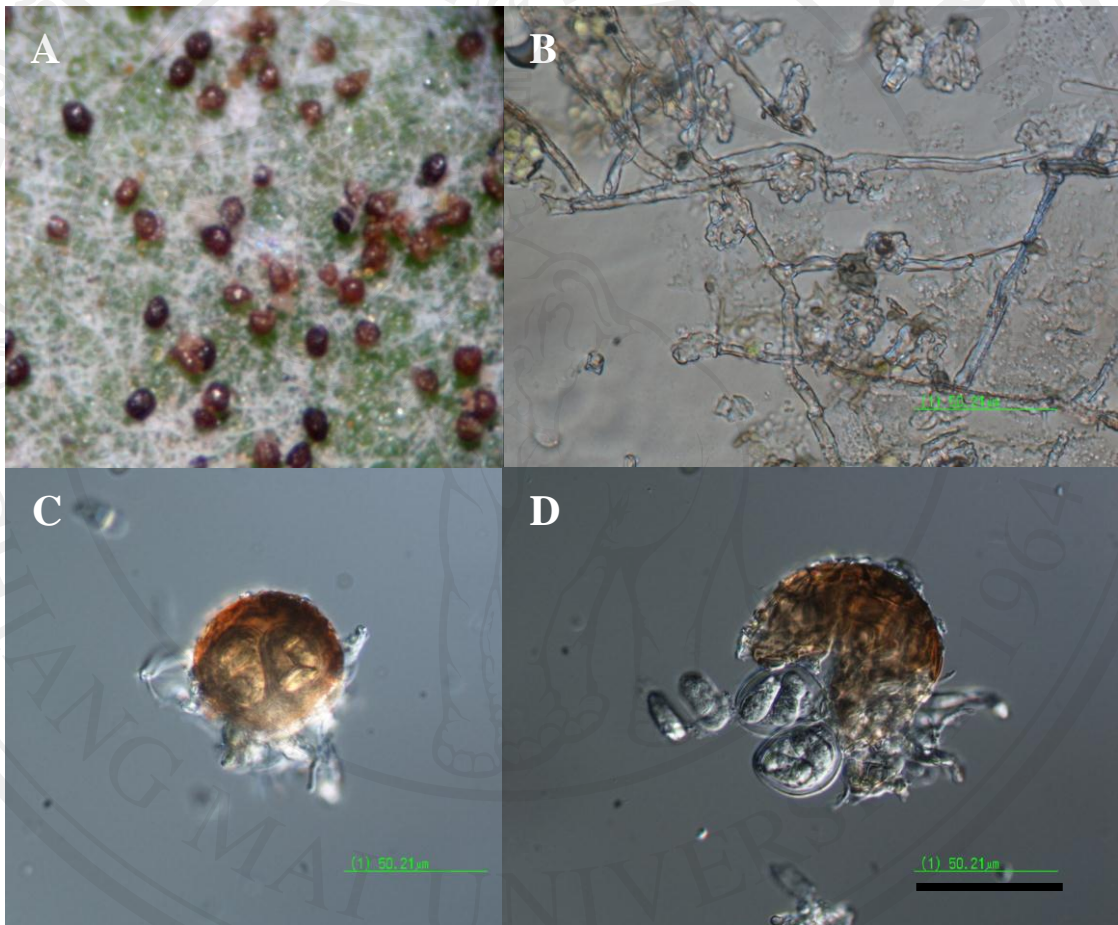


Fig. 15 *Erysiphe* MUMH 4985 on leaves of *Lithocarpus elegans*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μ m).

4. *Erysiphe* on *Castanopsis argyrophylla*, Fagaceae; (ก่อหยุ่ม)

Colonies are on upper side of the leaves, amphigenous, white, persistent, dense patches or irregular, profusely branched, superficial; hyphae are hyaline, 5 μm wide, branching at right or narrow angles, branching. Appressoria are well-developed, coral-like, single or occasionally opposite in pairs. Conidiophores and conidia are unknown. Chasmothecia are scattered to gregarious, globose to subglobose (55–)57.5–67.5 μm in diam (average 61.91 μm); peridium is thin, one conspicuous layer, pale brown to dark brown when mature, semitransparent, few basal appendages, sometimes lacking, very short, mycelioid, thin wall, hyaline, sometimes pale brown near the base. Asci ; 3 asci, sessile or shortly stalked, thin walled, 42.5–50 (–57.5)×(32.5–)35–42.5(–45) μm (average 46.83×38.83 μm). Ascospore ; 4–5 spored, ascospores are ellipsoid-ovoid, hyaline 20–25×12.5–15 μm (average 21.83×14.16 μm) (Fig. 16).

Examination of Specimens on *Castanopsis argyrophylla*, MUMH 4987.

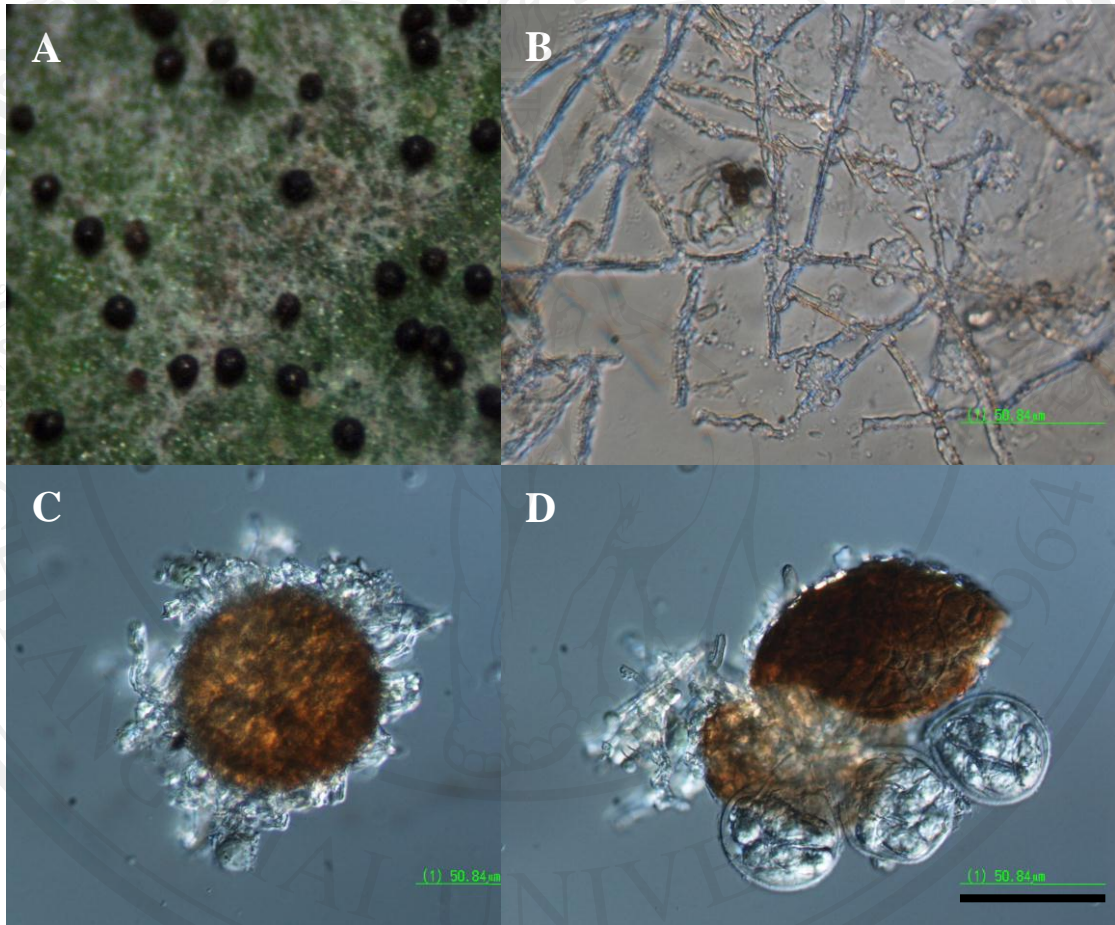


Fig. 16 *Erysiphe* MUMH 4987 on leaves of *Castanopsis argyrophylla*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μ m).

5. *Erysiphe* on *Castanopsis indica*, Fagaceae; (ก่อลิ้ม)

Colonies can be found on both sides of the leaves, amphigenous, abundantly epiphyllous, usually forming thin to moderately thick white film or circular to subcircular white patches on the upper leaf surface, superficial, almost straight to somewhat undulate, 4–5 μm wide, branching at right or narrow angles, conidial state and conidia are not found. Appressoria are well-developed, coral-like, single or occasionally opposite in pairs. Chasmothecia are scattered to gregarious, globose to subglobose, 57.5–67.5(–82.5) μm in diam (average 63 μm), peridium is thin, one conspicuous layer, pale brown to dark brown when mature, semitransparent, few basal appendages, sometimes lacking, very short, mycelioid, thin wall, hyaline, sometimes pale brown near the base. Asci ; 3 asci, sessile or shortly stalked, thin walled, (37.5–)40–57.5(–75) \times 27.5–47.5(–57.5) μm (average 50.33 \times 41.08 μm). Ascospore ; 6 spored, ascospores are ellipsoid-ovoid, hyaline or olivaceous to pale greenish due to oil drops, 25–27.5 \times 12.5–15 μm (average 26 \times 13.5 μm) (Fig. 17).

Examination of Specimens on *Castanopsis indica*, MUMH 4990, MUMH 5062.

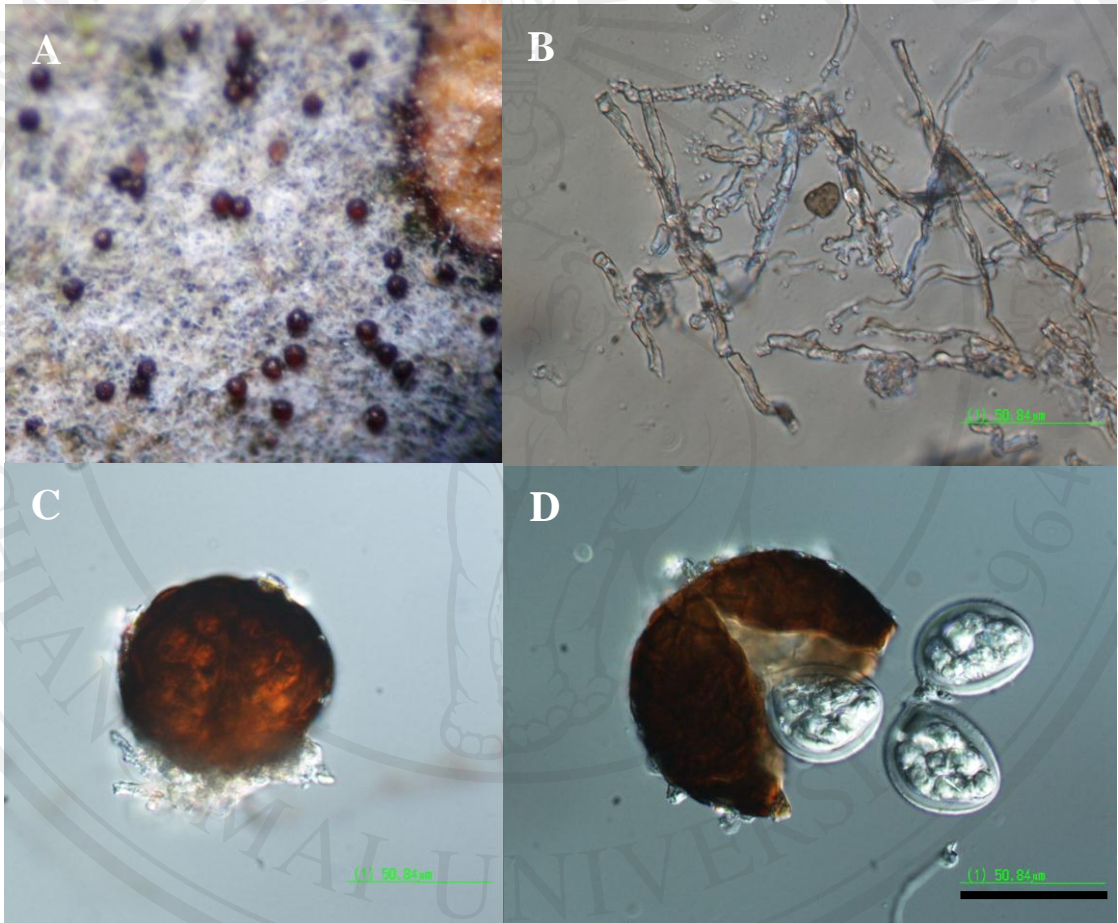


Fig. 17 *Erysiphe* MUMH 4990 on leaves of *Castanopsis indica*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μm).

6. *Erysiphe* on *Castanopsis calathiformis*, Fagaceae; (ก่อหมุดอย)

Colonies can be found on both sides of the leaves, amphigenous, abundantly epiphyllous, persistent, round definite patches, forming irregular white, effused, later covering the entire surface of the leaves; hyphae are hyaline, superficial, almost straight to somewhat undulate, 4–5 μm wide, branching at right or narrow angles.

Appressoria are well-developed, coral-like, single or occasionally opposite in pairs.

Conidiophores and conidia are unknown. Chasmothecia are scattered to gregarious, globose to subglobose (50–)52.5–62.5(–65) μm in diam (average 57.25 μm); peridium is thin, one conspicuous layer, pale brown to dark brown when mature, semitransparent, few basal appendages, sometimes lacking, very short, mycelioid, thin wall, hyaline, sometimes pale brown near the base. Asci ; 3 asci, sessile or shortly stalked, thin walled, 45–52.5(–57.5)×(37.5–)42.5–50(–52.5) μm (average 49.58×45.5 μm). Ascospore ; 6 spored, ascospores are ellipsoid-ovoid, hyaline or olivaceous to pale greenish due to oil drops, (17.5–)20–25×10–12.5(–15) μm (average 22.91×12.16 μm) (Fig. 18).

Examination of Specimens on *Castanopsis calathiformis*, MUMH 4991.

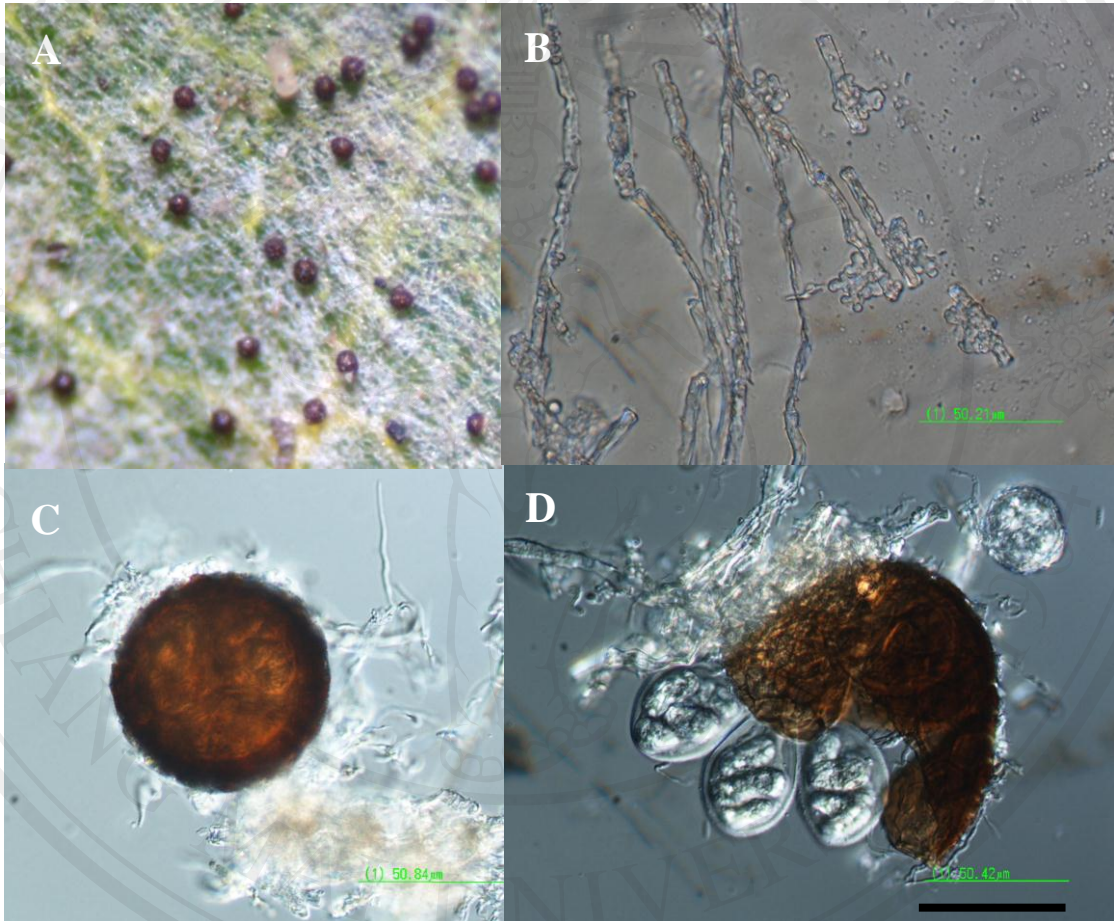


Fig. 18 *Erysiphe MUMH 4991* on leaves of *Castanopsis calathiformis*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μm).

7. *Erysiphe* on *Castanopsis diversifolia*, Fagaceae; (ก่อเป็น)

Colonies are on lower sides of the leaves, amphigenous, hypophyllous, persistent, forming irregular white patches on host surfaces; hyphae are hyaline, superficial, 4–6 μm wide. Appressoria are well-developed, coral-like, single or occasionally opposite in pairs. Conidiophores and conidia are unknown. Chasmothecia are scattered, (51–)57–74(–78) μm diameter (average 65.91 μm), containing only 2 asci; peridium is thin, one conspicuous layer, yellowish to light brown, semitransparent; chasmothecial appendages are often absent or rudimentary, if present poorly developed, mycelioid, (31–)45–51(–66)×(4–)4.5–5(–5.5) μm (average 48.6×4.8 μm), branched, hyaline, aseptate, thin-walled, smooth. Asci are sessile or short-stalked, (45–)46–59(–62)×(38–)40–53(–57.5) μm (average 51.5×45.6 μm). Ascospore ; 6–8 spored, ascospores are ellipsoid-ovoid shape, olivaceous brown, (16–)18–25(–28)×(8.5–)9–15(–16.5) μm (average 21.5×12.2 μm) (Fig. 19-20).

Examination of Specimens on *Castanopsis diversifolia*, MUMH 4992.

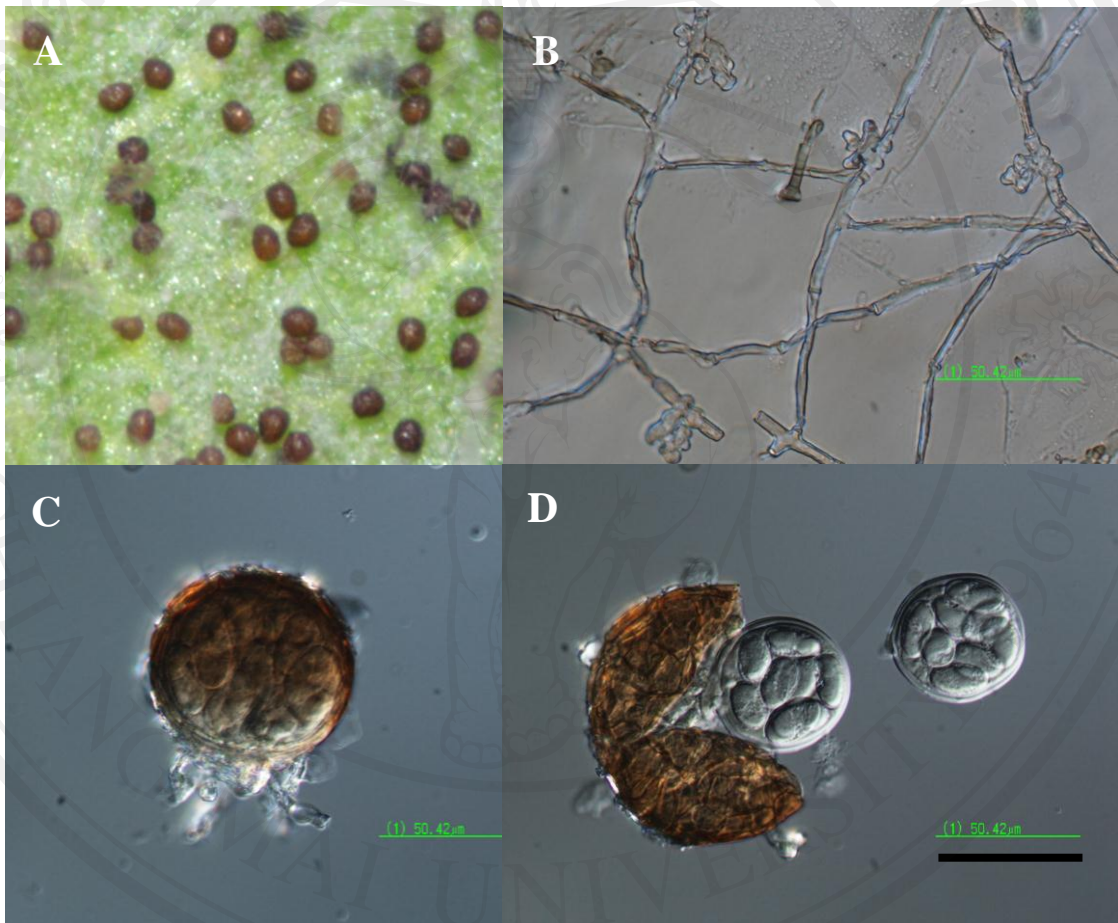


Fig. 19 *Erysiphe* MUMH 4992 on leaves of *Castanopsis diversifolia*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 μ m).

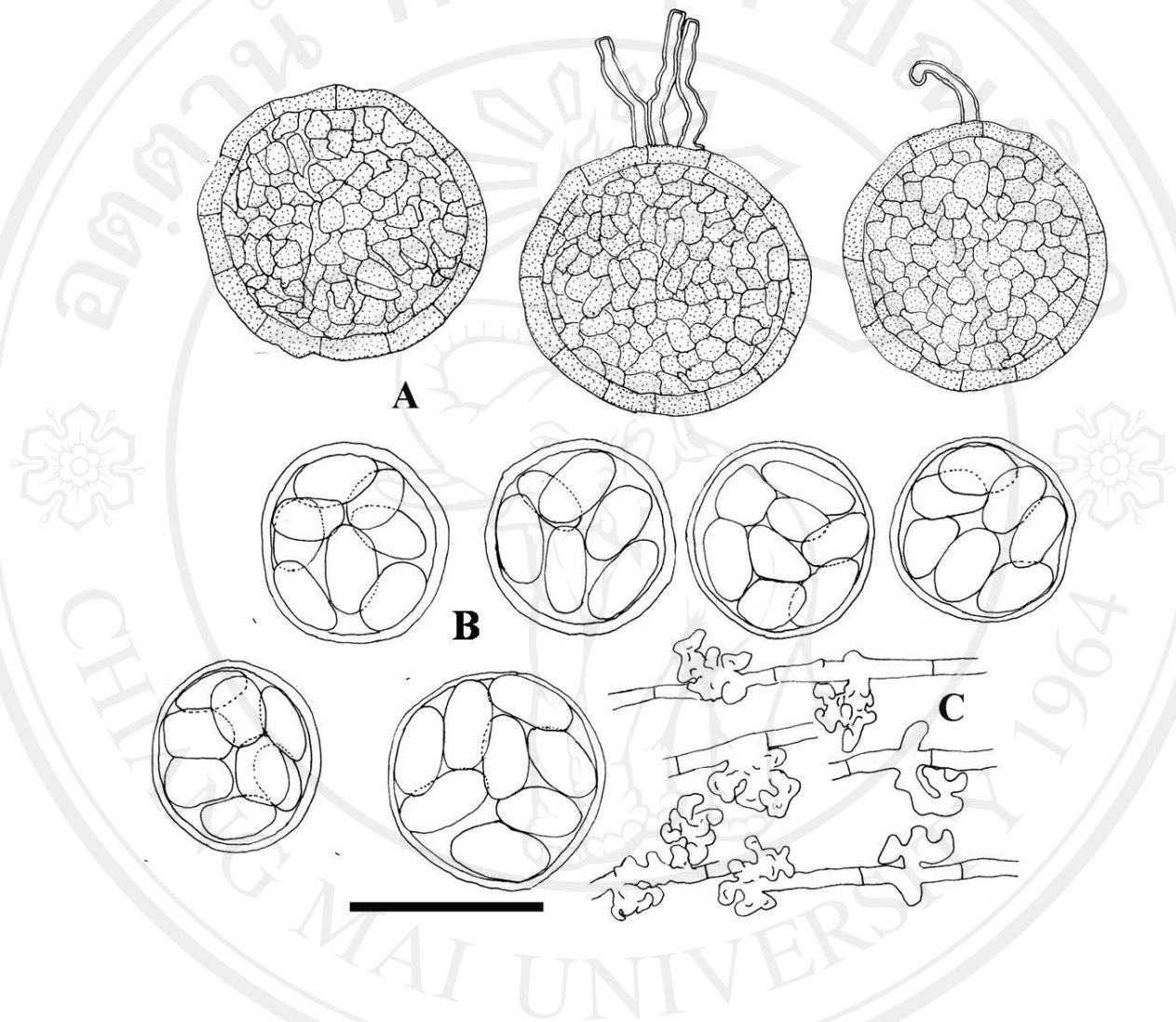


Fig. 20 Drawing of *Erysiphe* MUMH 4992 on *Castanopsis diversifolia*.

A : Chasmothecia. B : Asci and ascospores.

C : Hyphae and appressoria (bar – 50 μm).

8. *Erysiphe* on *Castanopsis echinocarpa*, Fagaceae; (ก่อหนาม)

Colonies are on lower sides of the leaves, amphigenous, hypophyllous, white patches on the surface of lower leaves; hyphae are hyaline, persistent to subevanescent, dense patches or irregular, 3.5–5.5 μm wide, branching. Appressoria are well-developed, coral-like, single or occasionally opposite in pairs. Conidiophores and conidia are unknown. Chasmothecia are scattered to gregarious, globose to subglobose (50–)57.5–70(–75) μm in diam (average 63.66 μm), cells of the wall daedaleoid when mature; peridium is thin, one conspicuous layer, yellowish to light brown, semitransparent, with a few basal appendages, sometimes lacking, very short, mycelioid, thin-walled, hyaline, sometimes pale brown near the base, aseptate, often branched, coral-like, almost uniform in width. Asci ; 2 asci, sessile or shortly stalked, thin walled, (45–)50–60(–62.5)×37.5–52.5 μm (average 53.33×44.58 μm). Ascospore ; 8-spored, ascospores are ellipsoid-ovoid, olivaceous to pale greenish due to oil drops, 17.5–25(–27.5)×(10–)12.5–12.5(–15) μm (average 21.5×12.58 μm)

(Fig. 21).

Examination of Specimens on *Castanopsis echinocarpa*, MUMH 4989.

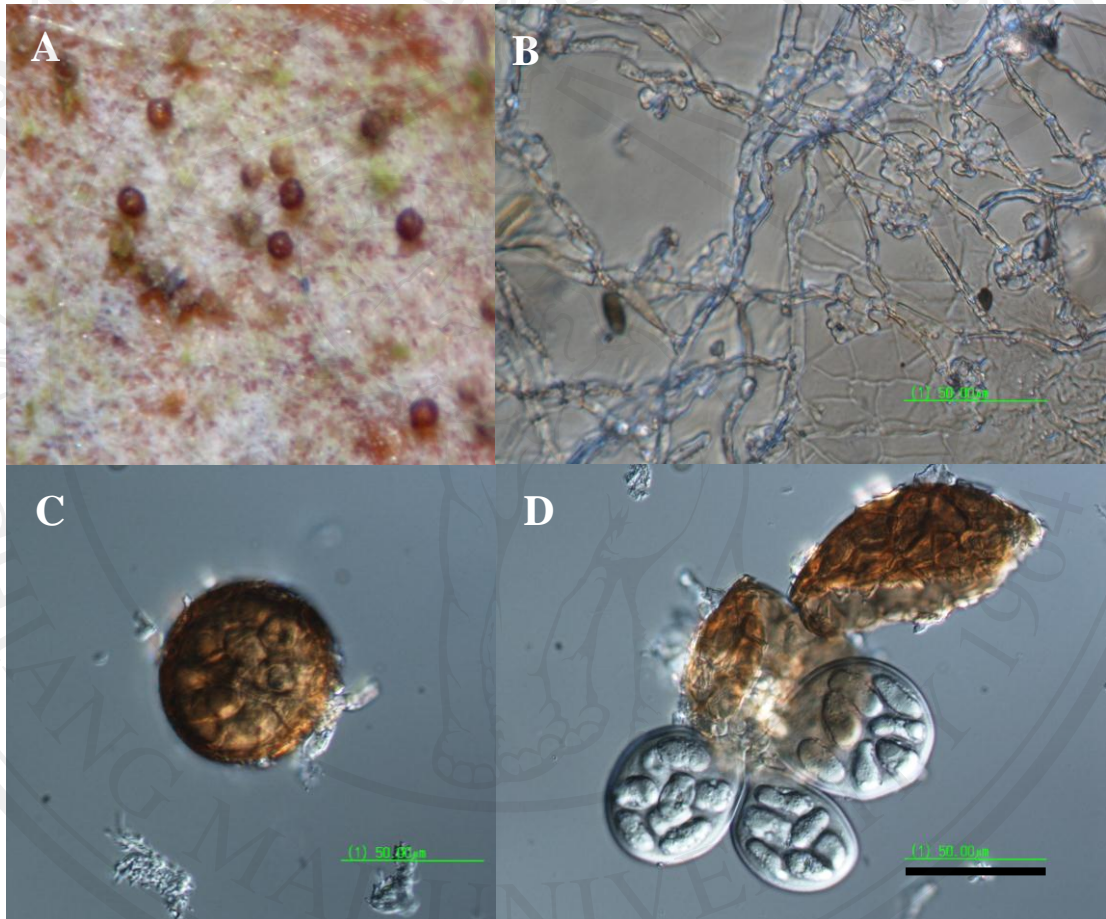


Fig. 21 *Erysiphe* MUMH 4989 on leaves of *Castanopsis echinocarpa*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 µm).

9. *Brasiliomyces chiangmaiensis* on *Dalbergia cultrate*, Leguminosae;

(กระพี้เขาควาย).

Colonies can be found on both sides of the leaves, amphigenous, mainly epiphyllous, persistent, forming irregular white patches; hyphae are hyaline, superficial, almost straight to somewhat undulate, 3–4 μm wide, branching at right or narrow angles.

Appressoria are nipple shaped, anamorphic state is unknown. Chasmothecia are scattered to gregarious, (37.5–)40–47.5(–52.5) μm in diam (average 42.58 μm), cells of the wall are daedaleoid when mature; peridium is thin, one conspicuous layer, yellowish to light brown, semitransparent, few basal appendages, sometimes lacking, very short, mycelioid, thin wall, hyaline, sometimes pale brown near the base, aseptate, often branched, coral-like. Asci ; 2 asci, sessile or shortly stalked, thin walled, (32.5–)35–37.5(–47.5) \times (25–)30–35(–37.5) μm (average 36.75 \times 33.33 μm), Ascospore ; 5-6 spored, ascospores are ellipsoid-ovoid, hyaline or yellowish, (12.5–)15–17.5(–20) \times 7.5–10 μm (average 16.5 \times 8.6 μm) (Fig. 22).

Examination of Specimens on *Dalbergia cultrata* var. *cultrate* R. Grah.,

MUMH 1785, MUMH 1811, MUMH 1821, MUMH 4993.

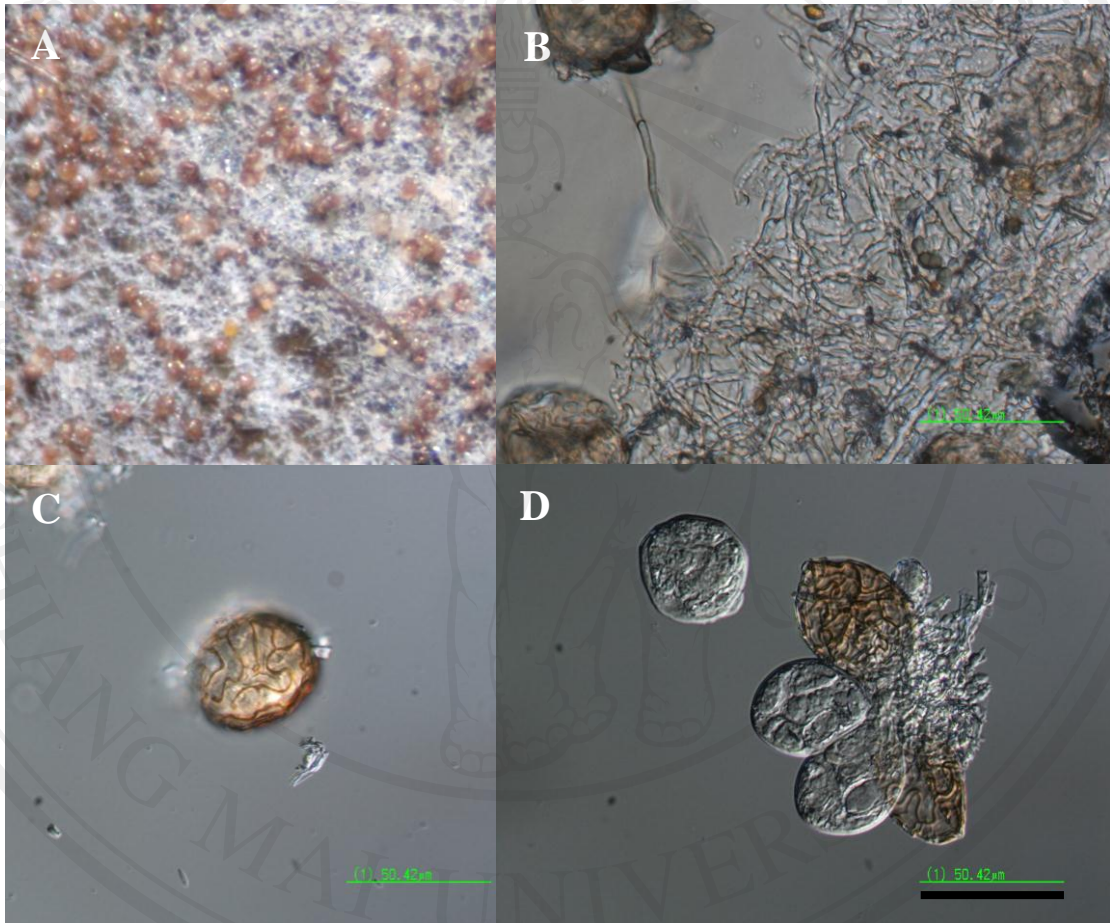


Fig. 22 *Brasiliomyces MUMH 4993* on leaves of *Dalbergia cultrate*.

A : Chasmothecia. B : Mycelia and appressoria. C : Chasmothecium.

D : Chasmothecium with asci and ascospores (bar =50 µm).

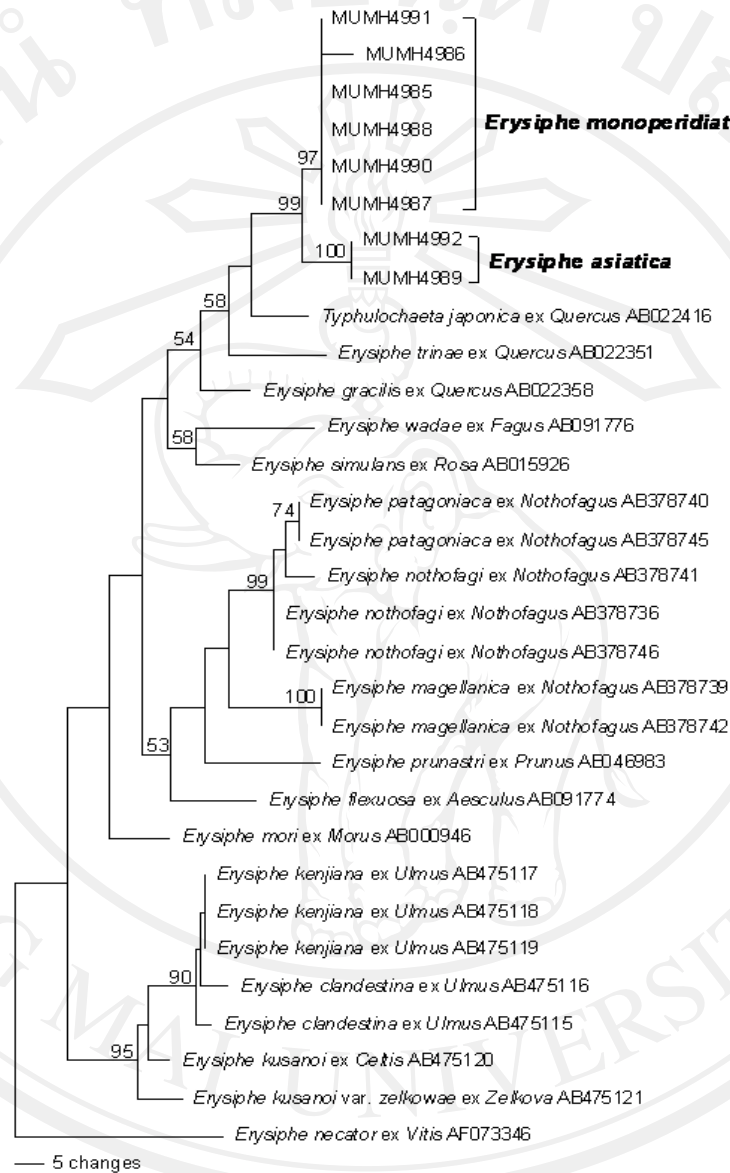


Fig. 23 Phylogenetic analysis of the nucleotide sequences of the internal transcribed spacer (ITS) region including 5.8S rDNA for eight newly determined sequences and 23 sequences from *Erysiphe* species and *Typhulochaeta japonicae*. The tree is one of the 174 equally parsimonious trees with 311 steps, which was obtained by the parsimony ratchet method. Gaps were treated as missing data. Horizontal branch lengths are proportional to the number of nucleotide substitutions that were inferred to have occurred along a particular branch of the tree. Percentage bootstrap support (1000 replications; $\geq 50\%$) is shown on branches.

Eight sequences of the rDNA ITS region from MUMH4491, MUMH4986, MUMH4985, MUMH4988, MUMH4990, MUMH4987, MUMH4992 and MUMH4989 determined in this study were aligned manually with 23 sequences from the genus *Erysiphe*, including *Typhulochaeta japonica* and *Erysiphe trinae* (= *Brasiliomyces trini*) used in Heluta *et al.* (2009). This data set consisted of 31 sequences and 674 sites, of which 180 ambiguously aligned sites were removed from the following phylogenetic analysis. The alignments were deposited in tree base (<http://www.treebase.org/>) under the accession number of S11366. Phylogenetic analysis of the 494 total characters used in this analysis, 331 characters were constant, 61 characters were variable and parsimony-uninformative and 102 characters were parsimony informative. A total of 174 equally parsimonious trees with 311 steps (CI = 0.675, RI = 0.799, RC = 0.539) were generated by the parsimony ratchet analysis. One of the best trees is shown in Fig. 23. First group of collections and the second group each formed separate clades with 97% and 100% bootstrap support, respectively. These two clades further formed a larger clade with 99% bootstrap support. This large clade was grouped with *Typhulochaeta japonica*, *Erysiphe trinae* and *E.gracilis*, but with weak (54%) bootstrap support. The phylogenetic analysis represented by MP tree indicated that the first group of collections in Thailand from many provinces were examined on *Lithocarpus polystachyus* Rehder, (Fagaceae),

THAILAND, at Mae Hong Son Province, 1 March 2010 (MUMH 4986); on *Lithocarpus elegans* (Blume) Hatus. ex Soepadmo, THAILAND, Mae Hong Son Province, 1 March 2010 (MUMH 4985); on *Castanopsis tribuloides* A.DC., THAILAND, at Mae Hong Son Province, Huai Nam Dang National Park, 1 March 2010 (TNS-F-39216, holotype; MUMH 4988, isotype); on *Castanopsis calathiformis* Rehder & E.H.Wilson, THAILAND, at Chiang Rai Province, Khun Chae National Park, 5 March 2010 (MUMH 4991); on *Castanopsis indica* A.DC., THAILAND, at Chiang Mai Province, Botanical Garden, 10 March 2010 (MUMH 4990) and on *Castanopsis argyrophylla* King ex Hook.f. (Fagaceae), THAILAND, at Chiang Mai Province, Doi Khuntan, 21 March 2010 (MUMH 4987). Colonies are amphigenous, mainly epiphyllous, persistent, forming irregular white patches on the host surfaces. Hyphae are hyaline, superficial, 4–6 μm wide, branching. Appressoria are well-developed, coral-like, single or occasionally opposite in pairs. Conidiophores and conidia are unknown. Chasmothecia are scattered to gregarious, (55.5–)58–82.5(–85) μm diameter (\bar{x} = 68.9 μm), containing 2–4 asci. Peridium is thin, one conspicuous layer, yellowish to light brown, semitransparent, appendages present, poorly developed, often branched, rarely absent, mycelioid, (15.5–)18–66(–75) × (2.5–)3–6(–7.5) μm (\bar{x} = 33.1 × 4.6 μm), colourless, aseptate, thin-walled, smooth. Asci are sessile or short-stalked, (34–)36–58(–61) × (24–)28–49(–52) μm (\bar{x} = 45.5 × 37.8 μm),

4–6–spored. Ascospores are ellipsoid-ovoid, hyaline, (11–)12.5–25(–26)×(6–)7.5–13(–14.5) μm (\bar{x} = 20.3×10.3 μm). Etymology ; monoperidiata refers to the chasmothecia of this species with a single peridium cell layer. *Erysiphe trinae* similis, sed ascis 4–6–sporis distinguitur, which is a morphological character of the genus *Brasiliomyces*. Recently, molecular phylogenetic analyses indicated that *Brasiliomyces* is polyphyletic and belongs to the *Erysiphe* lineage with *Oidium* subgenus *Pseudoidium* anamorphs. Therefore, they are described as *Erysiphe monoperidiata* sp. nov. and its host range and distribution are on *Castanopsis argyrophylla*, *C.calathiformis*, *C.indica*, *C.tribuloides*, *Lithocarpus elegans*, and *L.polystachyus* (Fagaceae), Asia, Thailand. The second group of collections examined on *Castanopsis diversifolia* King ex Hook.f., THAILAND, Chiang Mai Province, Doi Pui National Park, 1 March 2010 (TNS-F-39215, holotype; MUMH 4992, isotype) and on *Castanopsis echinocarpa* Miq., THAILAND, Chiang Mai Province, Phu Ping Palace, 19 March 2010 (MUMH 4989). Colonies are hypophyllous, persistent, forming irregular white patches on host surfaces. Hyphae are hyaline, superficial, 4–6 μm wide. Appressoria are well developed, coral-like, single or occasionally opposite in pairs. Conidiophores and conidia are unknown. Chasmothecia are scattered, (51–)57–74(–78) μm diameter (\bar{x} = 65.9 μm), containing only 2 asci. Peridium is thin, one conspicuous layer, yellowish to light brown,

semitransparent, chasmothecial appendages often absent or rudimentary, if present poorly developed, mycelioid, (31–)45–51(–66)×(4–)4.5–5(–5.5) μm (\bar{x} = 48.6×4.8 μm), branched, hyaline, aseptate, thin-walled, smooth. Asci are sessile or short-stalked, (45–)46–59(–62)×(38–)40–53(–57.5) μm (\bar{x} = 51.5×45.6 μm), 6–8-spored. Ascospores are ellipsoid-ovoid, olivaceous brown, (16–)18–25(–28)×(8.5–)9–15(–16.5) μm (\bar{x} = 21.5×12.2 μm). Etymology ; asiatica, a fungus found in Asia.

Erysiphe trinae similis, sed ascis 6–8–sporis distinguitur, which is a morphological character of the genus *Brasiliomyces*. The molecular phylogenetic analysis indicates that *Brasiliomyces* is polyphyletic and belong to the *Erysiphe* lineage with *Oidium* subgenus *Pseudoidium* anamorphs. It is described as *Erysiphe asiatica* sp. nov. and its host range and distribution are on *Castanopsis diversifolia*, *C.echinocarpa* (Fagaceae) in Asia, Thailand and Indonesia (Java).

This study describes two new *Erysiphe* species recently found in northern Thailand. Both species have distinct morphological characteristics of the genus *Brasiliomyces*. However, recent molecular phylogenetic analyses revealed that *Brasiliomyces* is polyphyletic (Takamatsu *in litt.*) and the delimitation of this genus needs to be revised. Due to the phylogenetic position of the two new taxa within the *Erydiphe* clade and prefer to assign them to *Erysiphe*.

The Genus *Oidium* :

The fungi belonging to this genus are ectophytic, produce external mycelia on the host surface. Conidiophores are erect, simple, arising from epiphytic hyphae, produce conidia in chains or singly, with or without fibrosin bodies. There are nine subgenera in this genus (Braun, 1987).

***Oidium* subgenus *Pseudoidium* Jacz. :**

Mycelium is ectophytic; appressoria are lobed to multilobed, single or opposite in pairs; conidiophores are single or occasionally two on a hyphal cell, arising from the upper part of mother cells, producing conidia singly; conidia are single-celled, hyaline, conspicuous fibrosin bodies absent (Braun, 1987).

10. *Pseudoidium* on *Acacia auriculaformis*, Fabaceae;

(Wattle, *Acacia* tree, กระถินณรงค์)

Colonies: mycelium is amphigenous, mostly epiphyllous, effuse or patchy, often covering the entire leaf surface, persistent to evanescent; hyphae are substraight to somewhat wavy, 5–7 μm wide, branching at right or narrow angle, with a septum near the branching

point; appressoria are well-developed, multilobed to lobed, opposite in pairs or single; conidiophores are erect, arising from the upper part of mother cells, position mostly central, (48.9–)51–77.2(–87.5) μm long, 7.5–12.75 μm wide (average 63.3 \times 10.5 μm); foot-cells are cylindric, 17.5–22.5(–27.5) μm long, 5–8.75 μm wide (average 20.1 \times 7.5 μm), flexuous or slightly curved at the base, producing conidia singly, followed by 1–2 shorter cells, with a basal septum at the branching point of the mycelium; conidia are formed singly, ellipsoid or doliiform, ca. (27.5–)30–40(45) \times (12.5–)15–17.5(–18.8) μm (average 33.7 \times 15.8 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-typed), moderately long, terminating in lobed appressoria (Fig. 24).

Examination of Specimens on *Acacia auriculaformis* A. Cunn., MUMH 1805.

Six powdery mildews, e.g., *Phyllactinia acaciae*, *E.acacia*, *E.communis*, *E.alni*, *L.taurica* and *Oidium* sp., have been found on 27 species of *Acacia* spp. in the world (Amano, 1986). Braun (1981) reported *E.acaciae* on *Acacia catechu* in India, Poona, and Bombay. Only teleomorphic characteristics were described. Owing to the teleomorphic state of the fungus is not found in this study, so only the anamorphic characteristics are described in detail. Then, the sequence of *Oidium* subgenus *Pseudoidium* on *Acacia auriculaformis* is combined with the data matrix of *Erysiphe*

species. A phylogenetic tree was constructed by the neighbor-joining method (Fig.73). Although *Oidium* subgenus *Pseudoidium* on *Acacia auriculaformis* has a sequence identical to *E.alphitoides* on *Quercus phillyraeoides*, there are some differences between the two fungi, i.e., conidia of *E.alphitoides* on *Quercus phillyraeoides* are slightly longer (L/W 2.5) than *Oidium* subgenus *Pseudoidium* on *Acacia auriculaformis* (L/W 2.1).

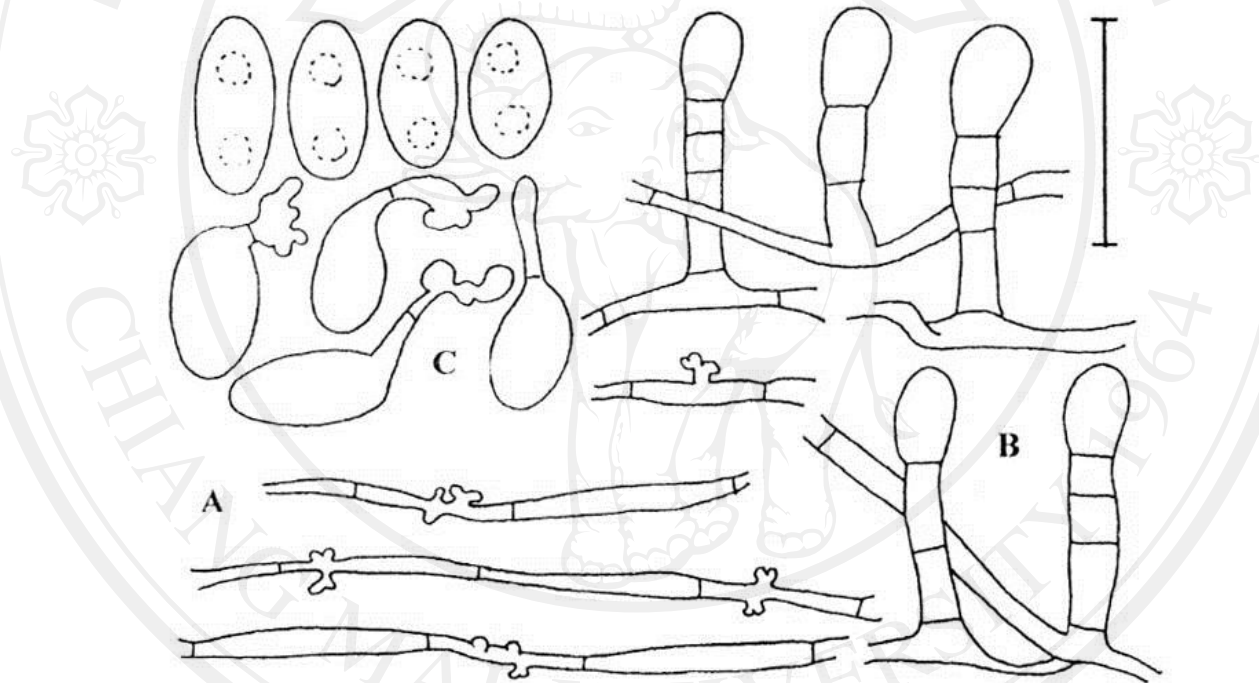


Fig. 24 *Oidium* subgenus *Pseudoidium* MUMH 1805 on *Acacia auriculaformis*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

11. *Pseudoidium* on *Aeschynomene americana* L. var. *americana*, Fabaceae;

(โสมขน)

Colonies: Mycelium is amphigenous, mostly epiphyllous on leaves and pods, persistent to subevanescent; hyphae are substraight to somewhat wavy, 4 μm wide, mostly branching at right angle, with a septum at the branching point; appressoria are well-developed, multilobed, opposite in pairs or single; conidiophores are single or double on a hyphal cell, erect, arising from the upper part of mother cells, position central to non-central, 45–102.5 μm long, 7.5–10 μm wide (average 73 \times 7.8 μm); foot-cells are cylindrical, 12.5–47.5 μm long, 7.5–10 μm wide (average 31 \times 7.8 μm), flexuous or slightly curved at the base, producing conidia, followed by 1–3 shorter cells, with a basal septum at the branching point of the mycelium; conidia are formed singly, cylindrical to oval, (30–)31.5–37.5(42.5) \times (10–)15–17.5(–20) μm (average 33.5 \times 16 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-typed), long to moderately long, terminating in lobed appressoria.

Examinations of Specimens on *Aeschynomene americana* var. *americana* L., MUMH

1760, MUMH 1783, MUMH 1841.

Three plant species of *Aeschynomene americana*, *Aeschynomene indica* and *Aeschynomene virginica* have been reported as host of the powdery mildews throughout the world (Amano, 1986). Shin (1988) reported *E. pisi* on *Aeschynomene indica* in Korea. Anamorphic characteristics of *E. pisi* were somewhat different from *Oidium* subgenus *Pseudoidium* on *Aeschynomene indica* in its larger conidia (mostly 32–48×16–20) and longer conidiophores (mostly 70–120×7–8(–10)). To clarify the identification, sequence of the powdery mildew on *Aeschynomene americana* is constructed to a phylogenetic tree (Fig. 73). Powdery mildew on *Aeschynomene americana* has identical nucleotide sequence with *Oidium* sp. on *Cassia minosoides* subsp. *nomame*. This is the first report of powdery mildew on *Aeschynomene americana* in Thailand.

12. *Pseudoidium* on *Antigonon leptopus* Hook.et.Arn., Nyctaginaceae;

(พวงชมพู)

Colonies: Mycelium is mostly epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69–4.99 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (108.24–)123–169.74(–182.04) \times 9.84–12.3(–13.53) μm (average 145.16 \times 11.44 μm), straight or mildly flexuous at the base; foot-cells are cylindric (19.68–)73.8–81.18(–105.78) \times 4.92–6.15(–7.38) μm (average 64.28 \times 5.73 μm), flexuous or slightly curved at the base, producing conidia singly, followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium; Conidia are formed singly, ellipsoid-ovoid (31.98–)34.44–41.82(–44.28) \times (13.53–)14.76–17.22(–22.14) μm (average 37.88 \times 15.82 μm), without conspicuous fibrosin bodies, containing oil drop,

producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 25).

Examination of Specimens on *Antigonon leptopus* Hook.et.Arn., MUMH 4701.

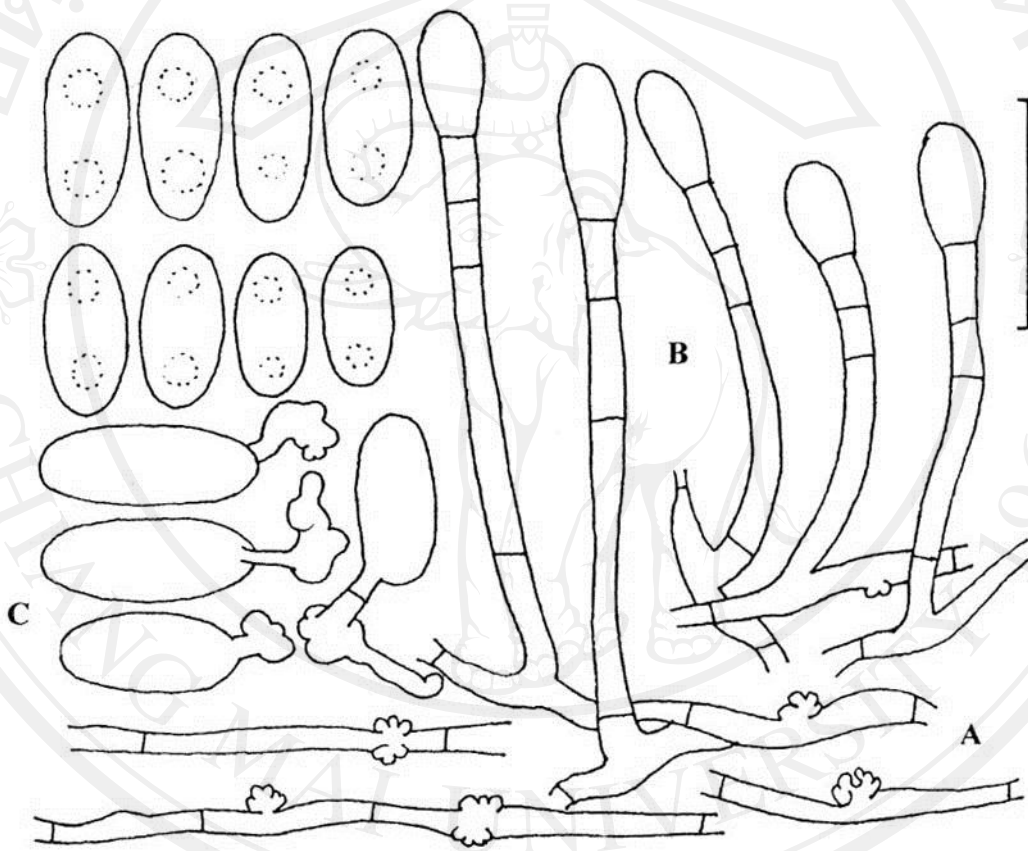


Fig. 25 *Oidium* subgenus *Pseudoidium* MUMH 4701 on *Antigonon leptopus*.

A : Hyphae and appressorium. B : Conidiophores.

C : Conidia and conidia with germ tubed (bar =50 μ m).

13. *Pseudoidium* on *Aristolochia indica* L., Aristolochiaceae; (กระเช้าสีดา)

Colonies: Mycelium is epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69–5.88 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, position mostly central, (91.18–)95.94–110.29 \times (14.76–)17.64–18.38 μm (average 75.6 \times 11.44 μm), straight or mildly flexuous at the base; foot-cells are cylindrical (13.24–)23.53–27.06 (–41.82) \times (7.38–)8.82–9.56(–10.29) μm (average 26.31 \times 9.01 μm), flexuous or slightly curved at the base, producing conidia followed by 1–2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindrical (45.5–)46.32–47.79 \times (18.38–)19.12–21.32(–22.06) μm (average 46.66 \times 20.14 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 26).

Examinations of Specimens on *Aristolochia indica* L., MUMH 4702.

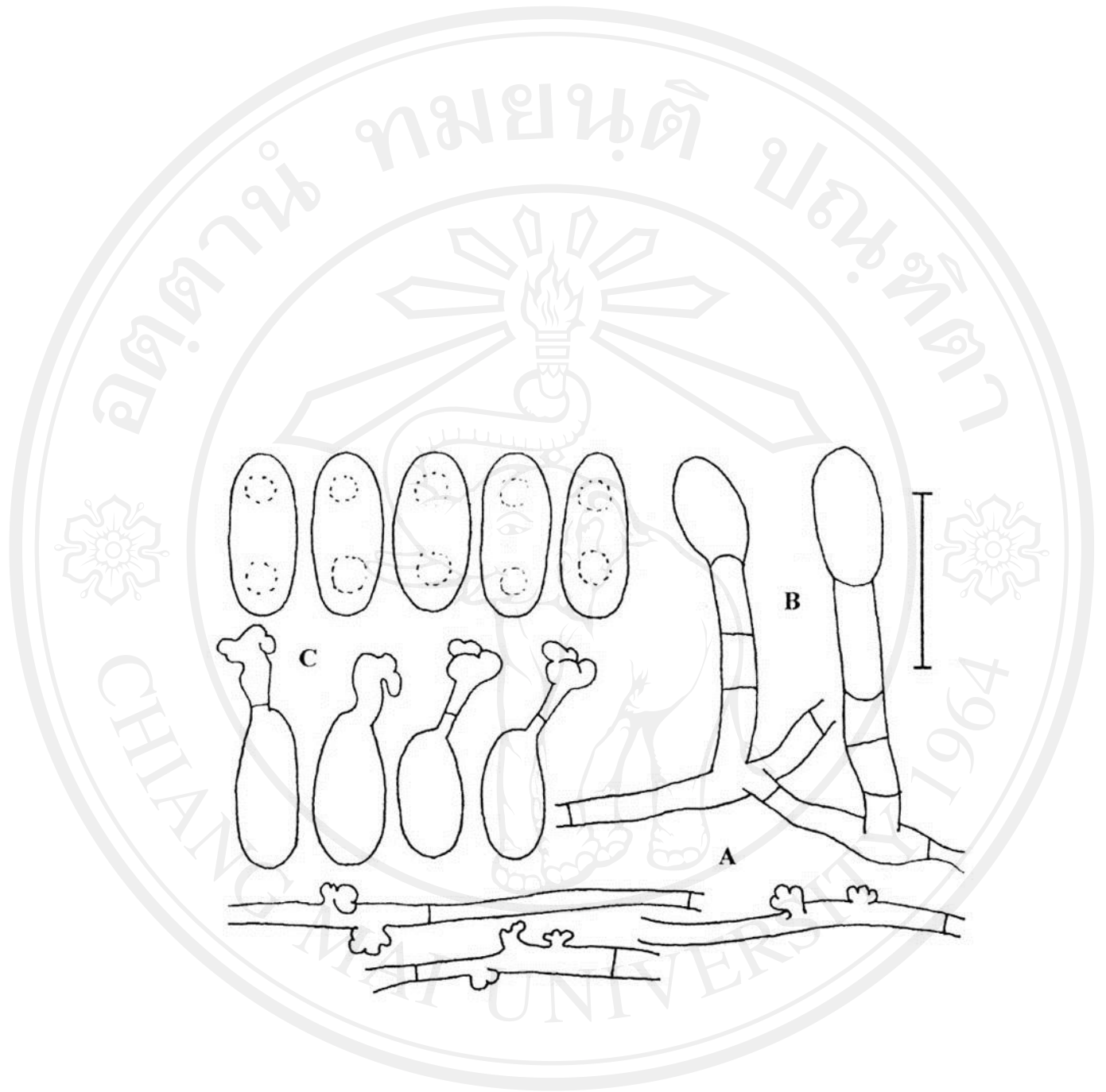


Fig. 26. *Oidium* subgenus *Pseudoidium* MUMH 4702 on *Aristolochia indica*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

14. *Pseudoidium* on *Bauhinia purpurea*, Leguminosae; (ชงโค)

Colonies: Mycelium are abundantly epiphyllous, white effused or patches on the upper leaf surface, stem and pods, persistent to subevanescent; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the upper part of mother cells, mostly central position, (70–)85–107.5 (–127.5)×7.5 μm (average 101.13×7.5 μm); foot-cells are cylindric, (27.5–)32.5–57.5(–67.5)×7.5 μm (average 47.12×7.5 μm) flexous or slightly curved at the base, producing conidia, followed by 4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, (27.5–)30–40 (–42.5)×10(–)12–17.5 μm (average 29×15.5 μm), without conspicuous fibrosin bodies (Fig. 27).

Examination of Specimens on *Bauhinia purpurea* L., MUMH 1816.

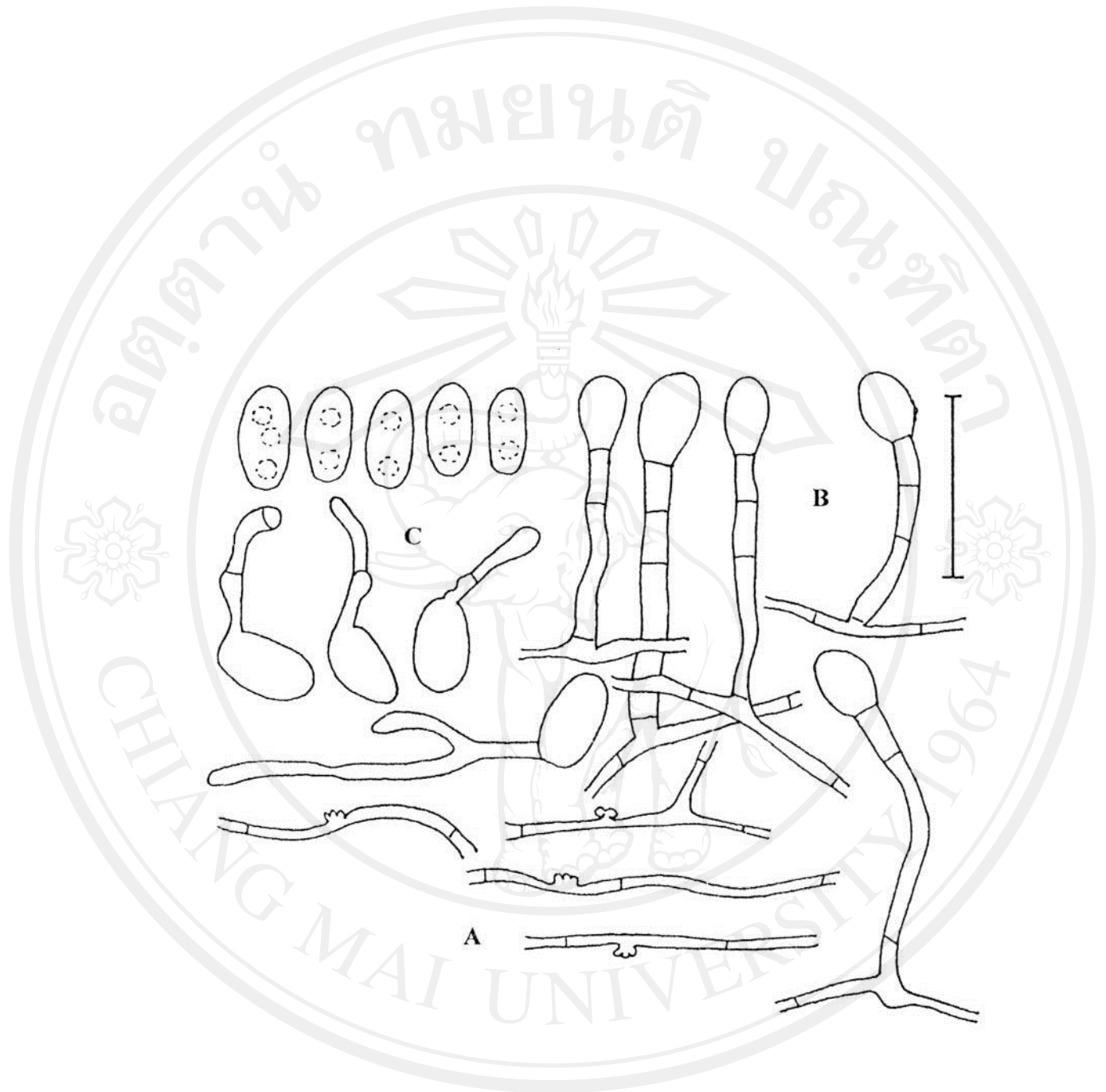


Fig. 27 *Oidium* subgenus *Pseudoidium* MUMH 1816 on *Bauhinia purpurea*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

Two powdery mildew fungi, i.e., *Oidium bauhiniae* on *Bauhinia galpinii* in South Africa (Gorter and Eicker, 1985) and *Oidium caesalpinia* on *Bauhinia* sp. in Asia (India) (Hosagoudar, 1984), were reported. *Oidium bauhiniae* differs from *Oidium caesalpinia* by multilobed appressoria. Anamorphic features of *Oidium* subgenus *Pseudoidium* on *Bauhinia* in Thailand are in good agreement with *Oidium bauhinia* (Gorter and Eicker, 1985). Then, the sequence of *Oidium* subgenus *Pseudoidium* on *Bauhinia purpurea* is combined with the data matrix of *Erysiphe* species. The ITS sequence of *Oidium* subgenus *Pseudoidium* on *Bauhinia purpurea* has identical nucleotide sequence with that of *Erysiphe lespedezae* on *Lespedeza thunbergii*. A phylogenetic tree (NJ Tree) is shown in Fig. 73. The result shows that *Oidium* subgenus *Pseudoidium* on *Bauhinia purpurea* form a distinct clade with *Erysiphe lespedezae* on *Lespedeza pilosa*, *Lespedeza cuneata* and *Lespedeza thunbergii* with a bootstrap value of 100%. *Oidium* subgenus *Pseudoidium* on *Bauhinia purpurea* has an identical ITS sequence with *Erysiphe lespedezae* on *Lespedeza thunbergii*. Based on the morphological and molecular characteristics, powdery mildew on *Bauhinia purpurea* in Thailand may be identified as *Erysiphe lespedezae*. This is the first report of powdery mildew on *Bauhinia purpurea* in Thailand.

15. *Pseudoidium* on *Begonia* sp., Begoniaceae; (ส้มกุ้ง)

Colonies: Mycelium is epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 4.88-5.61 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position,

(85.37–)92.68–114.63(–124.39) \times 7.32–9.76 μm (average 102.11 \times 9.35 μm), straight or

mildly flexuous at the base; foot-cells are cylindric (48.78–)51.22–65.85

(–68.29) \times 7.32–9.76 μm (average 58.29 \times 8.05 μm), flexuous or slightly curved at the

base, producing conidia followed by 1–2 shorter cells, with a basal septum at the

branching point of the mycelium; Conidia are formed singly, ellipsoid-ovoid 36.59

–41.46 \times 17.07–19.51 μm (average 39.67 \times 19.02 μm), without conspicuous fibrosin

bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed

appressoria (Fig. 28).

Examinations of Specimens on *Begonia* sp., MUMH 3714.

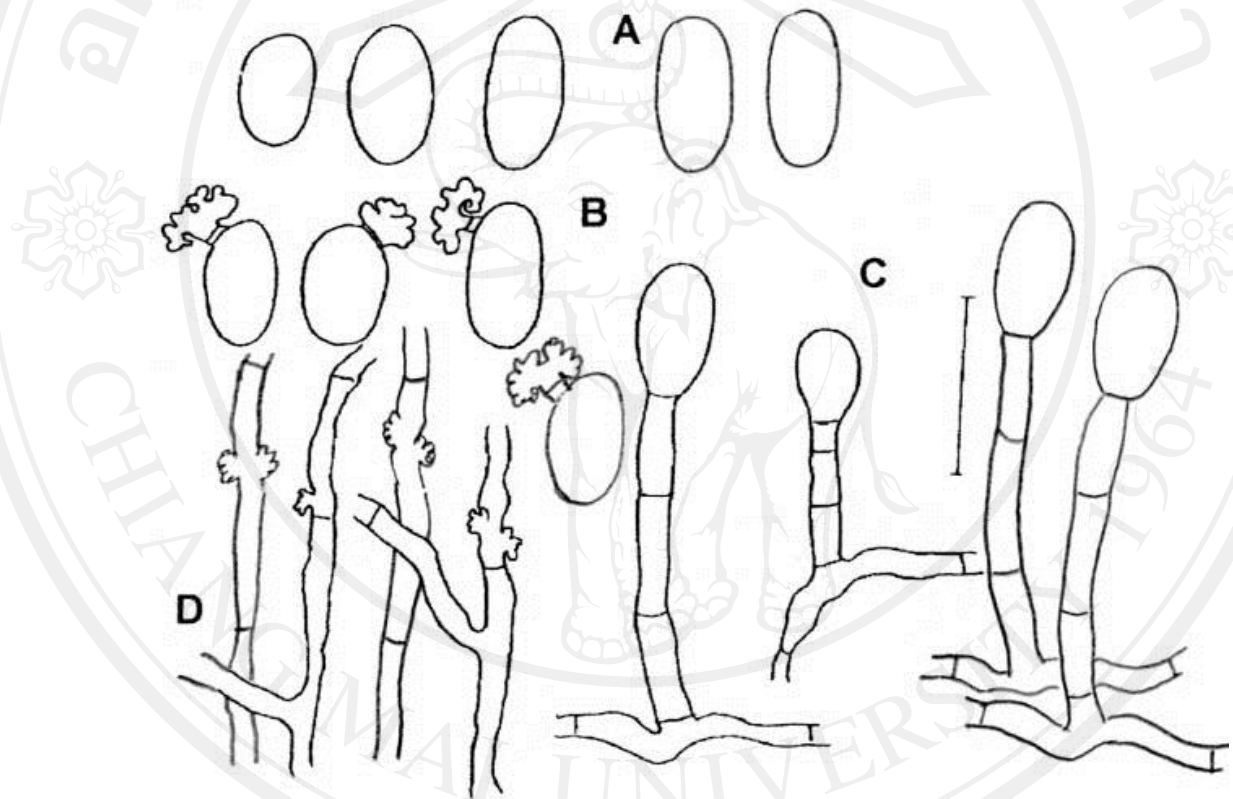


Fig. 28 *Oidium* subgenus *Pseudoidium* MUMH 3714 on *Begonia* sp.

A : Conidia. B : Conidia with germ tubes. C : Conidiophores.

D : Hyphae and appressoria (bar =50 μ m).

16. *Pseudoidium* on *Bixa orellana*, Bixaceae ; (คำแสดง)

Colonies: Mycelium is amphigenous, effuse or patchy, persistent to evanescent; hyphae substraight to somewhat wavy, 4-6 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, nipple-shaped to moderately lobed, opposite in pairs or single. Conidiophores are erect, single or two on a hyphal cell, arising from the upper part of mother cells, position mostly central, 35–93 \times 6.2–9.3 μm (average 65.3 \times 7.8 μm), straight or mildly flexuous at the base; foot-cells are cylindric, 11.5–44 \times 6.2–8.7 μm (average 25.7 \times 7.2 μm), constricted at the branching point, producing conidia singly, followed by 1-4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ovoid-doliform, (28–) 31–38(–40) \times (15–)16.3–20(–21) μm (average 34.5 \times 18 μm), without conspicuous fibrosin bodies, producing germ tubes at an end of the spore or on the shoulder (Polygoni-typed), terminating in lobed appressoria (Fig. 29).

Examinations of Specimens on *Bixa orellana* Bixaceae, MUMH 2606, MUMH

2330, MUMH 3231.

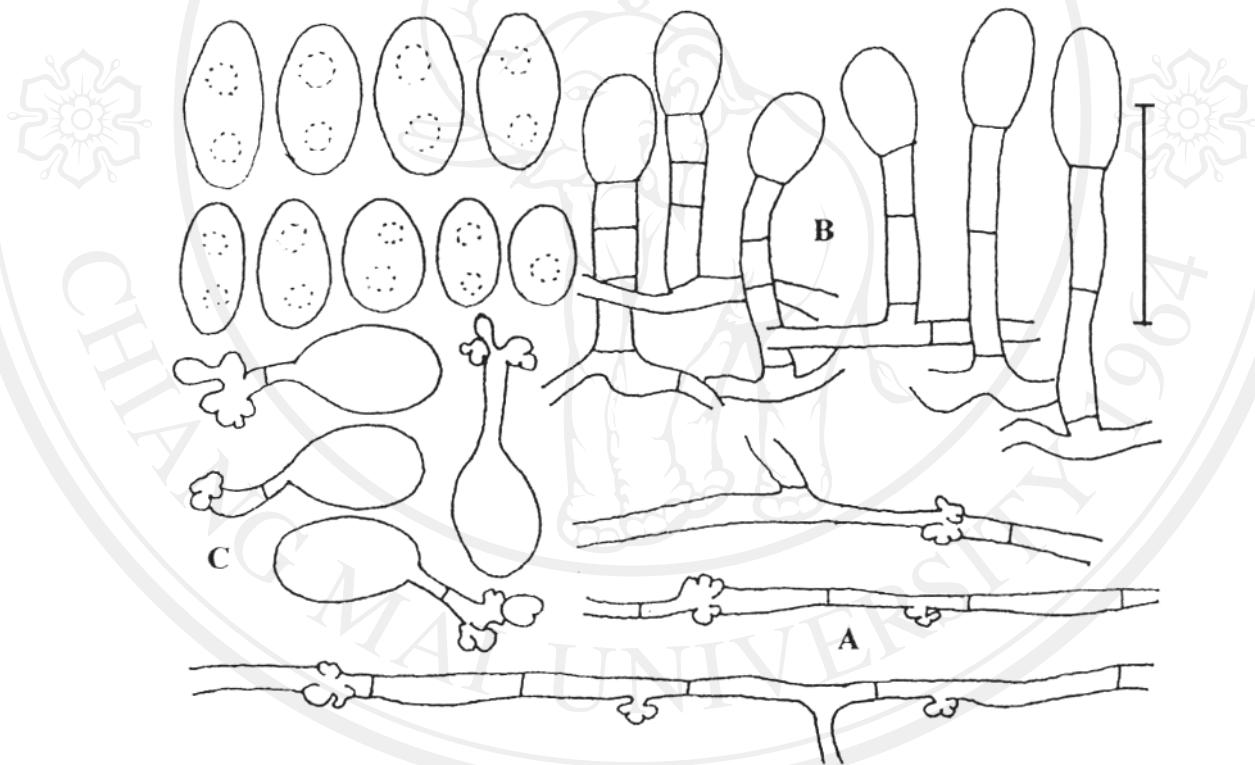


Fig. 29 *Oidium* subgenus *Pseudoidium* MUMH 3231 on *Bixa orellana*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

Two species of *Mallotus japonicus* and *Mallotus lianus* have been recorded as the host plants of *G. cichoracearum*, *Erysiphe* sp, *E.smalli*, *P.malloti*, *E.sinensis* and *Oidium* sp. in the world (Amano, 1986). Zhao (1981) reported on the teleomorphic characteristics of the fungus on *Mallotus* species in China and named it a new species *Podosphaera (Sphaerotheca) malloti*. Chen *et al.*, (1984) described characteristics of *E.malloti* on *Mallotus lianus* and *M.japonicus* in China and Japan. Sizes of conidia and conidiophores of the present fungus are similar to *E. malloti*.

17. *Pseudoidium* on *Brassica parachinensis* Bail., Brassicaceae;

(ผักกาดเขียววางตุ้ง).

Colonies: Mycelium is epiphyllous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69–4.18 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (56.58)66.42–86.1 (–93.48) \times 9.84–12.3 (–13.53) μm (average 75.6 \times 11.44 μm), straight or mildly flexuous at the base; foot-cells are cylindrical (11.07–)14.76–24.6 (–31.98) \times 4.92–7.38 (–8.61) μm (average 19.98 \times 6.47 μm), flexuous or slightly curved at the base, producing conidia followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric (31.98–)34.44–44.28 \times (12.3–)13.53–17.22 (–19.68) μm (average 38.62 \times 15.08 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 30).

Examination of Specimens on *Brassica parachinensis* Bail., MUMH 4703.

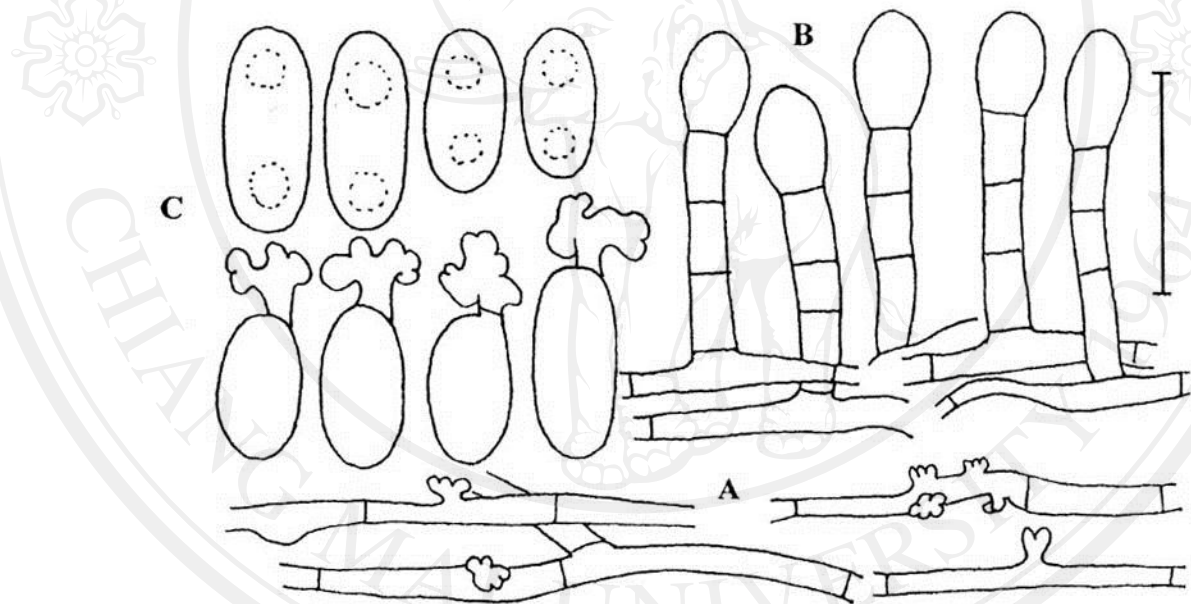


Fig. 30 *Oidium* subgenus *Pseudoidium* MUMH 4703 on *Brassica parachinensis*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

18. *Pseudoidium* on *Carica papaya* Linn., Caricaceae; (มะละกอ)

Colonies: Mycelium is amphigenous, mostly hypophyllous, branching at right or narrow angles, white patches, persistent to subevanescent, 3.49-7.38 μm wide; appressoria are well-developed, lobed to multilobed, single. Conidiophores are erect, arising from the side of mother cells, position mostly central, (76.26–)96–129.6 \times 7.38–9.6 μm (average 112.18 \times 8.53 μm), foot-cells are cylindrical, (27.06–)31.98–49.20(–73.8) \times 6.15–8.61(–9.82) μm (average 40.64 \times 7.33 μm), flexuous or slightly curved at the base, producing conidia followed by 1-3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric, (34.44–)39.36–46.74(–49.2) \times 14.76–18.45(–19.68) μm (average 43.1 \times 16.25 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 31).

Examinations of Specimens on *Carica papaya* Linn., MUMH 1853.



Fig. 31 *Oidium* subgenus *Pseudoidium* MUMH 1853 on *Carica papaya*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

19. *Pseudoidium* on *Cissampelos pareira* L., Menispermaceae

Colonies: Mycelium is amphigenous, ectophytic and epiphyllous, white superficial cover the upper leaf surface, profusely branched and branching at right or narrow angles, hyphae substraight to somewhat wavy ; 3.69–4.92 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (66.42–)81.18–118.08(–127.92) \times (9.84–)11.07–17.22 μm (average 102.9 \times 13.7 μm), foot-cells are cylindric (24.6–)27.06–41.82(–49.2) \times (4.92–)6.15–8.61(–9.84) μm (average 34.86 \times 7.31 μm), flexuous or slightly curved at the base, producing conidia followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid (34.44–)39.36–51.66(–54.12) \times (14.76–)15.99–19.68 μm (average 44.7 \times 17.64 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 32).

Examination of Specimens on *Cissampelos pareira* L., MUMH 4704.

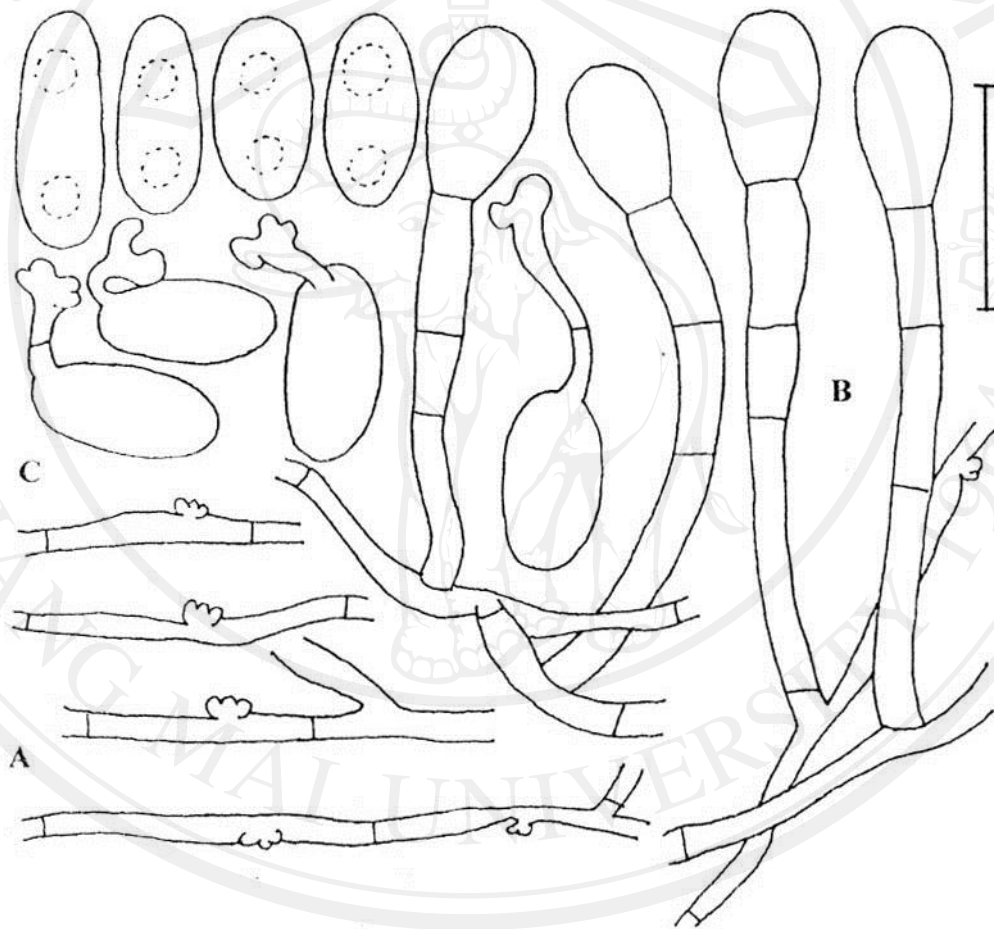


Fig. 32 *Oidium* subgenus *Pseudoidium* MUMH 4704 on *Cissampelos pareira*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

20. *Pseudoidium* on *Clome chelidonii*, Capparaceae; (เสี้ยนฝรั่ง)

Colonies: Mycelium is white superficial cover the surface of leaf, persistent to subevanescent, hyphae substraight to somewhat wavy; average 4.38 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, single or two on a hyphal cell, arising from the side of mother cells, mostly central position, 73.8-86.1(-100.86) \times (7.38-)8.61-9.84 μm (average 87.99 \times 8.81 μm), foot-cells are cylindrical, (17.22-)19.68-27.06 (-34.44) \times (6.15-) 7.38-8.61 μm (average 23.86 \times 7.56 μm), flexuous or slightly curved at the base, producing conidia followed by 3-4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid, (29.52-)31.98-41.82(-44.28) \times (14.76)15.99-17.22(-18.45) μm (average 34.86 \times 16.48 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 33).

Examination of Specimens on *Clome chelidonii*, MUMH 1853.

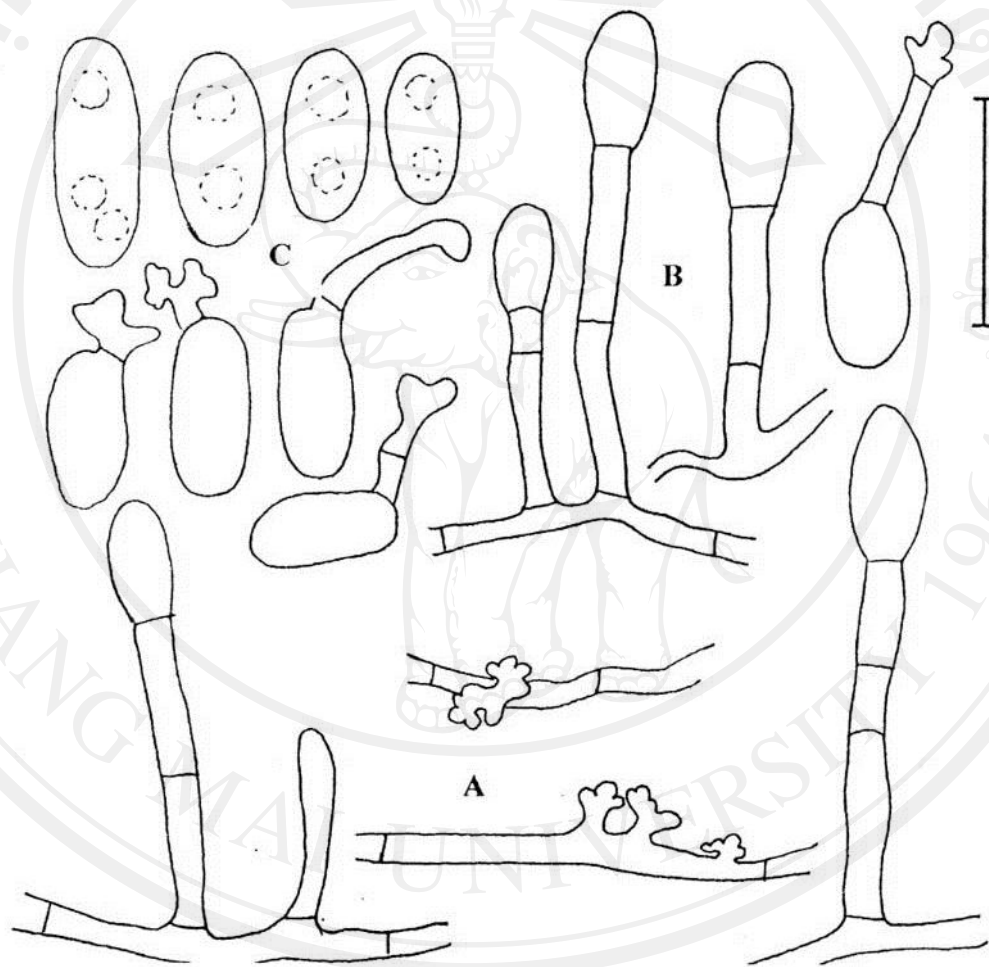


Fig. 33 *Oidium* subgenus *Pseudoidium* MUMH 1853 on *Clome chelidonii*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

21. *Pseudoidium* on *Clitoria ternatea* Linn, Leguminosae ; (อัญชัน)

Colonies: Mycelium is amphigenous, effuse or patchy, persistent to evanescent; hyphae smooth, substraight to somewhat wavy, average 4.92 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, single or two on a hyphal cell, arising from the upper part of mother cells, position mostly central, (88.56–)100.86–130.38(–147.6) \times 7.38–9.84 μm , straight or mildly flexuous at the base; foot-cells are cylindric, (19.68–)36.9–54.12(–68.88) \times (6.15–)7.38–8.61 μm (average 45.02 \times 7.92 μm), constricted at the branching point, producing conidia followed by 2-4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric, (31.98–)39.36–47.97(–51.66) \times 17.22–19.68(–20.91) μm , without conspicuous fibrosin bodies, containing oil drop, producing germ tubes at an end of the spore or on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 34).

Examination of Specimens on *Clitoria ternatea* Linn., MUMH 4705.

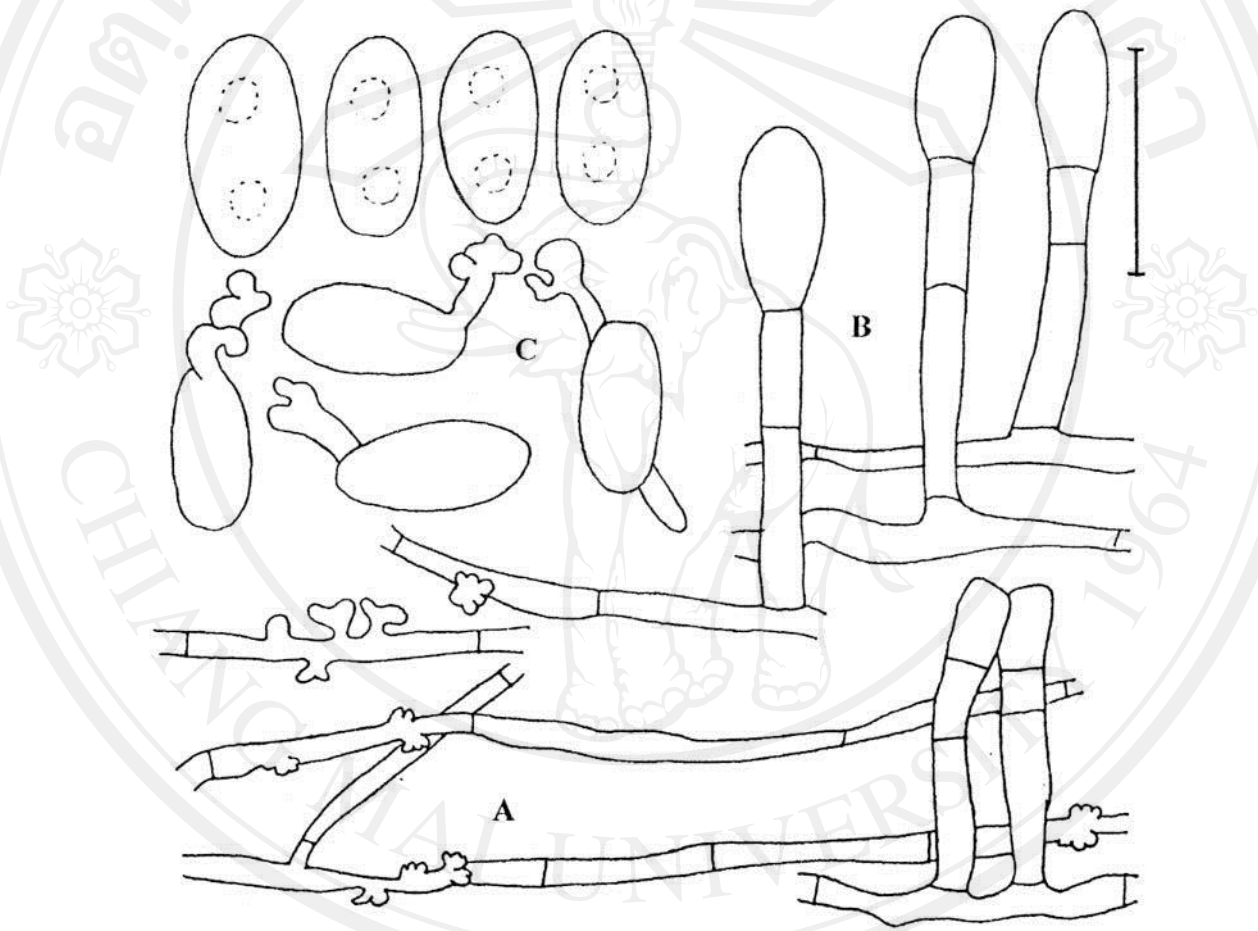


Fig. 34. *Oidium* subgenus *Pseudoidium* MUMH 4705 on *Clitoria ternatea*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

22. *Pseudoidium* on *Colubrina longipes* Back, Rhamnaceae; (ผักก้านตรง)

Colonies: Mycelium is amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69–4.31 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, position mostly central, (61.5–)73.8–93.48(–110.7) \times (9.84–)11.07–14.76(–15.99) μm (average 83.71 \times 12.96 μm); foot-cells are cylindric 29.52–41.82 \times 4.92–7.38(–9.84) μm (average 34.69 \times 6.69 μm), flexuous or slightly curved at the base, producing conidia followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid (22.14–)27.06–31.98(–36.9) \times (13.53–)14.76–17.22 μm (average 29.35 \times 15.33 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 35).

Examination of Specimens on *Colubrina longipes* Back., MUMH 4706.

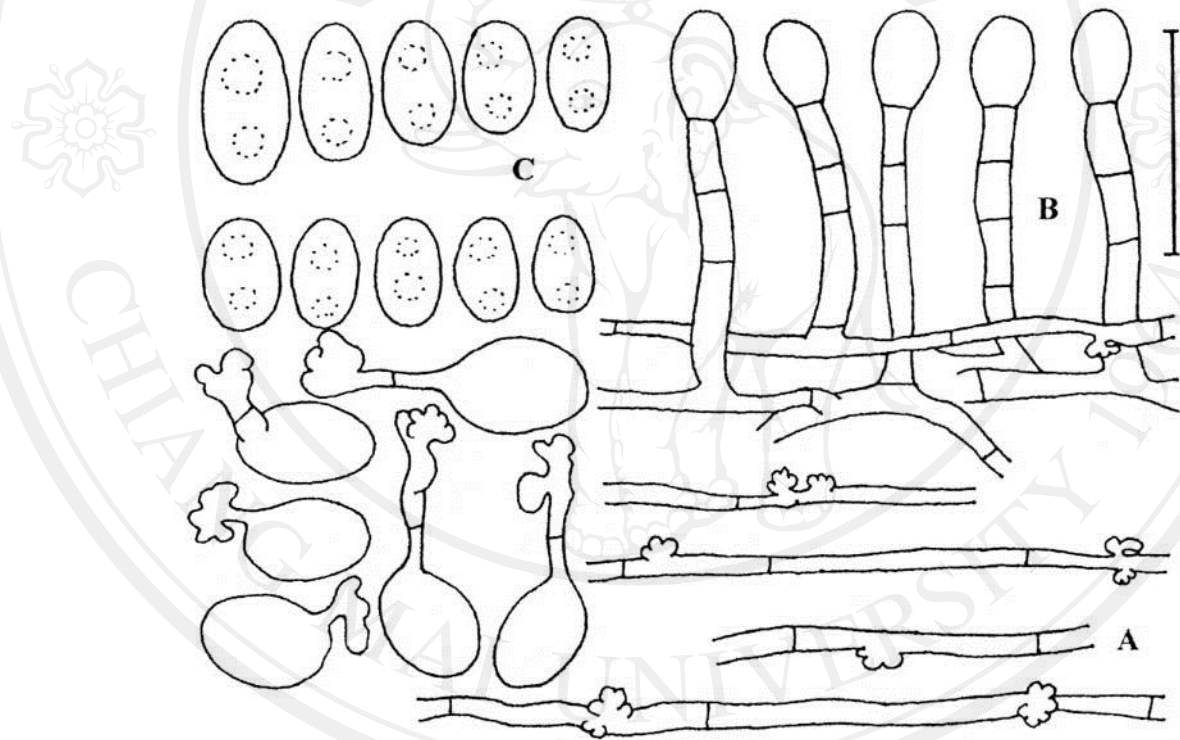


Fig. 35 *Oidium* subgenus *Pseudoidium* MUMH 4706 on *Colubrina longipes*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

23. *Pseudoidium* on *Cyclea barbata*, Menispermaceae; (หญ้ามะน้อย)

Colonies: Mycelium is epiphyllous, white patches on the upper leaf surface, mostly on young leaves; appressoria are well-developed, variable in shape, multilobed to moderately lobed, opposite in pairs or single. Conidiophores are erect, (67.5–)72.5–112.5(–122.5)×7.5–8.8 (average 90.6×7.5 μm); foot-cells are cylindric, (17.5–)25–47.5(–62.5)×7.5–8.8 (average 37.2×7.5 μm), striaght to flexuous or curved at the base, producing conidia followed by 2–4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, oval-cylindric, (35–)37.5–45(–50)×15–)17.5–22.5(–25) μm (average 40.4×19.8 μm), without conspicuous fibrosin bodies, producing germ tubes Polygoni-type (Fig. 36).

Examination of Specimens on *Cyclea barbata* Miers., MUMH 1826.

The family Menispermaceae includes a numerous host species of powdery mildews in this family. *Cyclea barbata* is a member of this family. This is the first report of powdery mildew on *C. barbata*. The teleomorph of this fungus has not been found in Thailand. Only anamorphic state is described in details. *Oidium* subgenus *Pseudoidium* on *C. barbata* is sequenced and the combined with the data matrix of *Erysiphe* species to construct a phylogenetic tree by the neighbor-joining method (NJ tree, Fig. 73). The percentage similarity is the highest match with *E. pseudolonicera* on *Cocculus trilobus* (99.3%) and *Oidium* subgenus *Pseudoidium* on *Ipomoea obscura* (98.6%). They form a small clade with low bootstrap value (51%). In this clade, two isolates of powdery mildew on Menispermaceae; *Cocculus trilobus* and *Cyclea barbata* are closely related to each other.

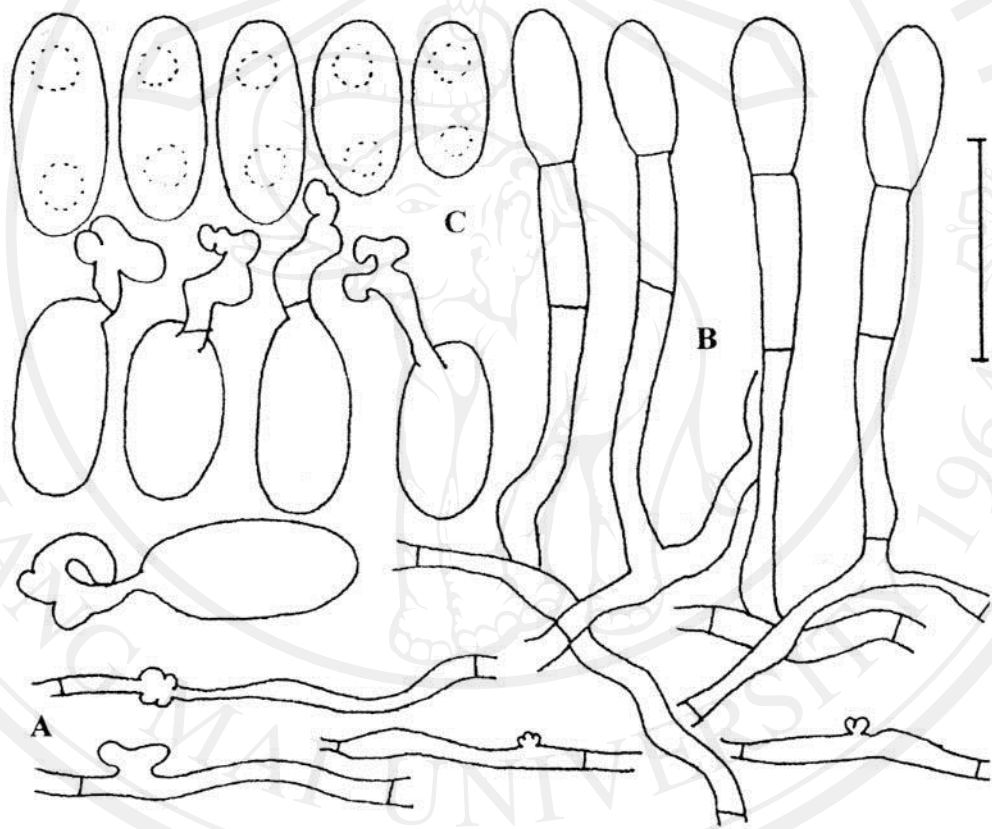


Fig. 36 *Oidium* subgenus *Pseudoidium* MUMH 1826 on *Cyclea barbata*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

24. *Pseudoidium* on *Desmodium triflorum* (L.) DC., Leguminosae; (หญ้าเกี๋ยดหอย)

Colonies: Mycelium is amphigenous, ectophytic, white superficial cover the upper leaf surface, profusely branched and branching at right or narrow angles, persistent to subevanescent, hyphae substraight to somewhat wavy; 3.69–4.92 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (66.42–)78.72–103.32(–127.92) \times 9.84–17.22 μm (average 90.04 \times 14.02 μm), foot-cells cylindric (17.22–)27.06–56.58(–66.42) \times 6.15–7.38(–8.61) μm (average 36.97 \times 6.96 μm), flexuous or slightly curved at the base, producing conidia followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium.

Conidia are formed singly, ellipsoid 31.98–41.82(–44.28) \times 14.76–18.45 μm (average 37.88 \times 16.65 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 37).

Examination of Specimens on *Desmodium triflorum* (L.) DC., MUMH 1213.

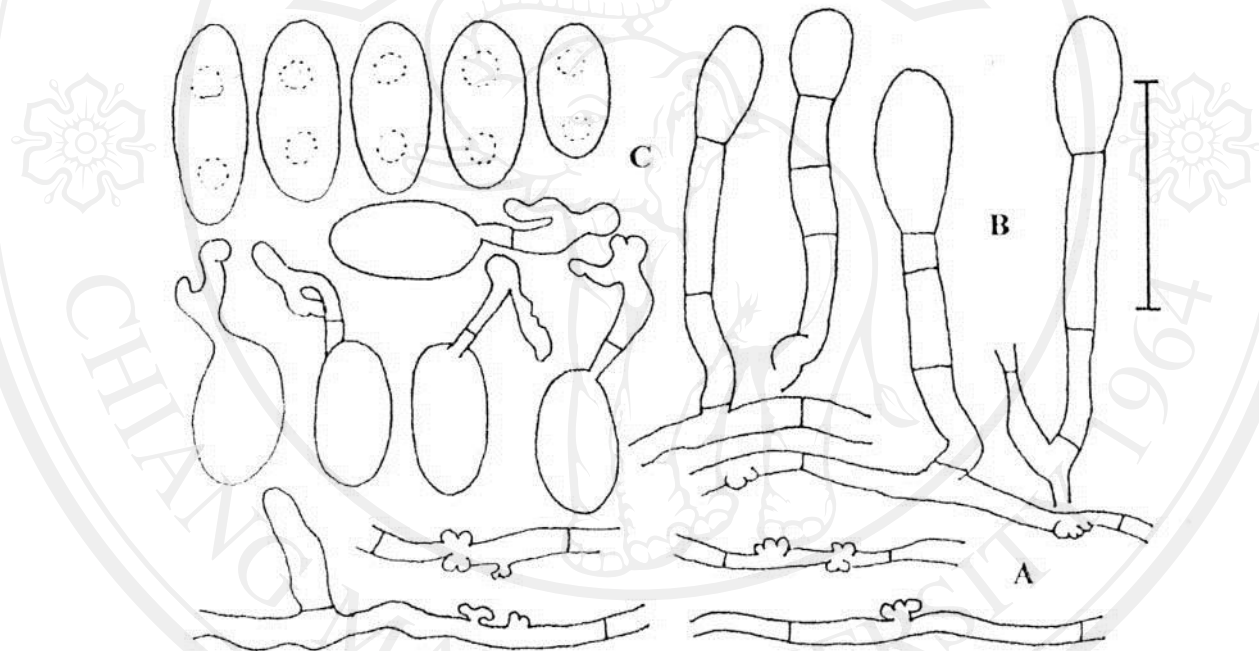


Fig. 37 *Oidium* subgenus *Pseudoidium* MUMH 1213 on *Desmodium triflorum*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

25. *Pseudoidium* on *Eucalyptus camaldulensis* Dehnh., Myrtaceae; (ยูคาลิปตัส)

Colonies: Mycelium is mostly epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 4.92–5.61 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (68.88)73.8–93.48(–98.4)×(12.3–)13.53–17.22 μm (average 82.66×14.78 μm), straight or mildly flexuous at the base; foot-cells are cylindric (27.5–)35–52.5(–72.5)×(5–)7.5–8.75(–10) μm (average 43.29×7.66 μm), flexuous or slightly curved at the base, producing conidia followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid (26.25–)30–40×(13.75–)15–16.25(–17.5) μm (average 35.41×15.41 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 38).

Examination of Specimens on *Eucalyptus camaldulensis* Dehnh., MUMH 4708.

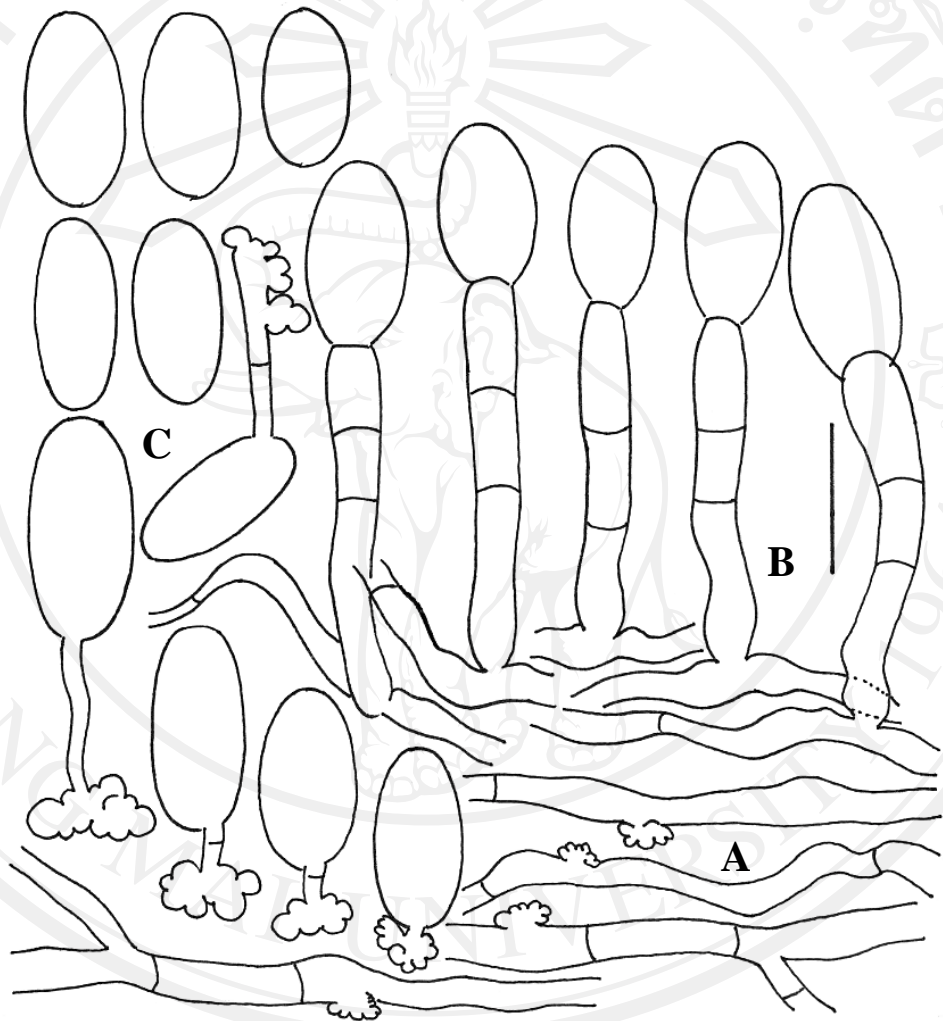


Fig. 38 *Oidium* subgenus *Pseudoidium* MUMH 4708 on *Eucalyptus camaldulensis*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m)

26. *Pseudoidium* on *Glycine max* (L.) Merr., Leguminosea; (ถั่วเหลือง)

Colonies: Mycelium is mostly epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 4.92–5.61 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position,

(68.88)73.8–93.48(–98.4)×(12.3–)13.53–17.22 μm (average 82.66×14.78 μm),

straight or mildly flexuous at the base; foot-cells are cylindric (17.22–)19.68–36.9

(–41.82)×(6.15–)7.38–8.61(–9.84) μm (average 28.04×7.82 μm), flexuous or slightly

curved at the base, producing conidia followed by 1-2 shorter cells, with a basal

septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-

ovoid (29.52–)31.98–39.36(–44.28)×(14.76–)15.99–18.45(–19.68) μm (average

35.3×17.1 μm), without conspicuous fibrosin bodies, containing oil drop, producing

germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria

(Fig. 39).

Examination of Specimens on *Glycine max* (L.) Merr., MUMH 4709.

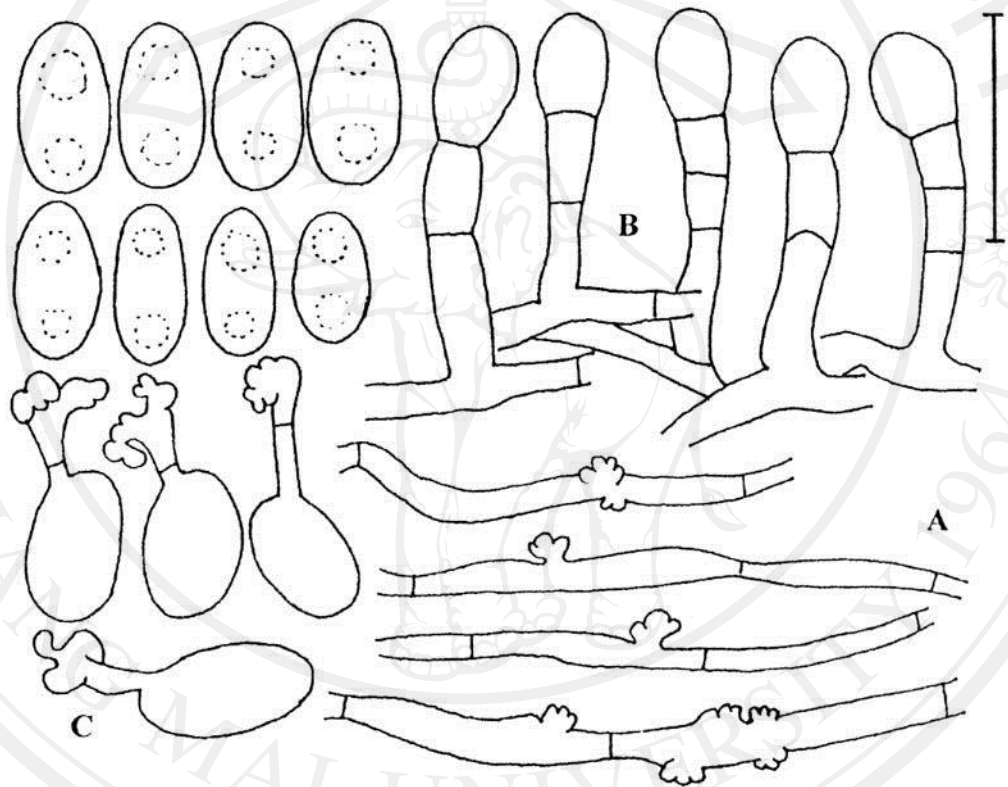


Fig. 39 *Oidium* subgenus *Pseudoidium* MUMH 4709 on *Glycine max.*

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

27. *Pseudoidium* on *Hibiscus floccosus*, Malvaceae; (ชบาแดง)

Colonies: Mycelium is amphigenous, abundantly epiphyllous, usually forming thin to moderately thick white film or circular to subcircular white patches on the upper leaf surface; hyphae are substraight to somewhat wavy, 5–7 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are nipple to multi-lobed single or opposite in pairs. Conidiophores are erect, arising from the upper part of mother cells, mostly central position, (47.5–)55–92.5(–102.5) \times 7.5–10 μm , foot-cells are cylindric, (20–)22.5–37.5(–45) \times 7.5–10 μm , flexuous or slightly curved at the base, producing conidia followed by 1–3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, 30–37.5(–42.5) \times (12.5–)15–17.5(–20) μm , without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), long to moderately long, terminating in lobed appressoria.

Examination of Specimens on *Hibiscus floccosus* L., MUMH 1832.

Ten species of *Hibiscus* spp. have been reported as host plants of powdery mildews in the world (Amano, 1986). Braun (1987) recorded four species of powdery mildews on *Hibiscus* sp. They are *E.americana*, *G.orontii*, *L.taurica* and *P.hibiscicola*. Shin (2000) described anamorphic characteristics of *Oidium* sp. on *Hibiscus syriacus* in Korea. *Oidium* subgenus *Pseudoidium* on *Hibiscus floccosus* in Thailand are closely similar to the *Oidium* sp. described by Shin 2000. **This is the first report of powdery mildew on *Hibiscus floccosus* in Thailand.**

28. *Pseudoidium* on *Hydrangea hortensis* Roxb., Sessifragaceae; (ไฮเดรนเยีย)

Colonies: Mycelium is amphigenous, ectophytic, white superficial cover the upper leaf surface, persistent to subevanescent, hyphae substraight to somewhat wavy; 4.92–5.41 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (39.36–)54.12–78.72(–98.4) \times 12.3–19.68(–24.6) μm (average 67.82 \times 17.03 μm); foot-cells are cylindric (8.61–)12.3–27.06(–44.28) \times (7.38–)9.84–11.07(–12.3) μm (average 19.48 \times 10.01 μm), flexuous or slightly curved at the base, producing conidia followed by 2–4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid, 29.52–36.9(–41.82) \times 17.22–22.14(–24.6) μm (average 34.37 \times 20.42 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 40).

Examination of Specimens on *Hydrangea hortensis* Roxb., MUMH 4710.



Fig. 40 *Oidium* subgenus *Pseudoidium* MUMH 4710 on *Hydrangea hortensis*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

29. *Pseudoidium* on *Hydrocotyle javanica* Thumb, Umbelliferae; (แวนแก้ว)

Colonies: Mycelium is epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69–5.61 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (44.28–)61.5–108.24(–127.92)×9.84–13.53(–14.76) μm (average 91.56×12.13 μm), straight or mildly flexuous at the base; foot-cells are cylindric (14.76–)19.68–36.9(–54.12)×6.15–8.61(–9.84) μm (average 27.48×7.58 μm), flexuous or slightly curved at the base, producing conidia followed by 1–2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid 31.98–41.82(–44.28)×(12.3–)13.53–17.22(–19.68) μm (average 36.3×15.18 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 41).

Examination of Specimens on *Hydrocotyle javanica* Thumb., MUMH 4711.



Fig. 41 *Oidium* subgenus *Pseudoidium* MUMH 4711 on *Hydrocotyle javanica*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

30. *Pseudoidium* on *Indigofera dosua*, Fabaceae; (ถั่วดิน)

Colonies: Mycelium is abundantly epiphyllous, usually forming thin to moderately thick white film or circular to subcircular white patches on the upper leaf surface, 3.69–4.92 μm ; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the upper part of mother cells, mostly central position, (41.82–)51.66–63.96(–81.18) \times 7.38–9.84 μm (average 57.88 \times 8.66 μm); foot-cells are cylindrical, (14.76–)17.22–24.6(–27.06) \times (6.15–)7.38–8.61 μm (average 20.74 \times 7.63 μm), flexuous or slightly curved at the base, producing conidia followed by 3–4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid ovoid, (24.60–)27.06–36.9 \times (14.76–)15.99–19.68 μm , without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type) (Fig. 42).

Examination of Specimens on *Indigofera dosua*, MUMH 4712.

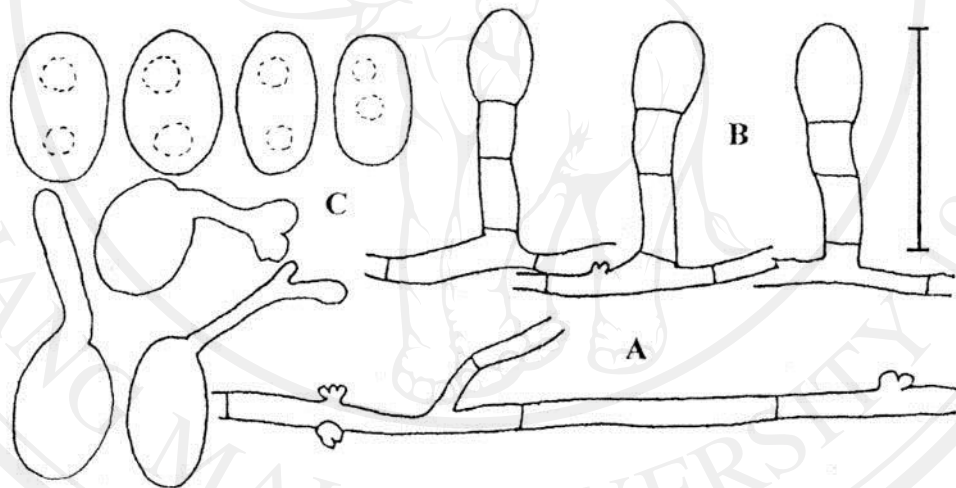


Fig. 42 *Oidium* subgenus *Pseudoidium* MUMH 4712 on *Indigofera dosua*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

31. *Pseudoidium* on *Indigofera linnaei*, Leguminosae

Colonies: Mycelium is epiphyllous, mostly epiphyllous, patches cover the leaf surfaces; hyphae substraight to flexous, sometime wavy, branching at right or narrow angle, with a septum near the branching point; appressoria are well develop, lobed appressoria; conidiophores are single on a hyphal cell arising from the side of mother cell, produce conidia singly with basal septum at the branching point of mycelium, foot-cells are straight to some flexous. Conidia are oval to cylindric, without conspicuous fibrosin bodies.

Examination of Specimens on *Indigofera linnaei* L., MUMH 1746.

Yen (1966a) described anamorphic characteristics of *Oidium indigoferae* on *Indigofera hirsute* in Asia (Singapore). The species was also reported in Australia and Africa (Ghana, South Africa) (Braun, 1987). The teleomorphic state of this fungus was first described by Shin (1988) on *I. kirilowii* in Korea and named a new species *Microsphaera indigoferae* H.D. Shin & Y.J. La [= *Erysiphe indigoferae* (H.D. Shin & Y.J. La) U. Braun & S. Takamatsu]. This species was also reported in Asia (Indonesia, Japan) and South Africa (Shin, 2000). Unfortunately, we could not

observe the size of conidia, conidiophores and foot-cells. Because the specimen was contaminated with other fungi and could not find the sequence of the powdery mildew on this plant. Based on the non-catenate conidia without fibrosin bodies, the powdery mildew on *Indigofera linnaei* should be identified as *Oidium* subgenus *Pseudoidium*.

32. *Pseudoidium* on *Inula cappa*, Asteraceae ; (หนาดคำ)

Colonies: Mycelium is amphigenous, mostly epiphyllous, patchy, persistent to evanescent; hyphae tortuose, substraight to sometime wavy, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, moderately lobed to lobed, opposite in pairs or single. Conidiophores are erect, single on a hyphal cell, arising from the upper part of mother cells, mostly central position; foot-cells are cylindric, constricted at the branching point, producing conidia

with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric-ovoid, without conspicuous fibrosin bodies, producing germ tubes at an end of the spore or on the shoulder (Polygoni-type), terminating in lobed appressoria.

Examination of Specimens on *Inula cappa* (Ham. ex D. Don) DC., MUMH 1771.

Four powdery mildews, e.g., *L.taurica*, *E.communis*, *G.cichoracearum*, *P.fulginea* have been reported on 23 species of *Inula* in the world (Amano, 1986).

Shin (2000) found *P.fusca* and *G.cichoracearum* on *Inula halenium* in Korea but these fungi differ from the fungus in this study by anamorphic characteristics.

Unfortunately, the size of conidia, conidiophores and foot-cells could not be observed.

Because the specimen was contaminated with other fungi the sequence of the powdery mildew in this plant. The powdery mildew found on *Inula cappa* in this work is the new fungus on this plant.

33. *Pseudoidium* on *Ipomoea aquatica*, Convolvulaceae ; (ผักบุ้ง)

Colonies: Mycelium is amphigenous, mostly epiphyllous, effuse or patchy, persistent to evanescent; hyphae tortuose, substraight to somewhat wavy, 5-8 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, nipple-shaped to moderately lobed, opposite in pairs or single. Conidiophores are erect, single on a hyphal cell, arising from the upper part of mother cells, mostly central position; foot-cells are cylindrical, constricted at the branching point, producing conidia followed by 2-4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindrical-ovoid, without conspicuous fibrosin bodies, producing germ tubes at an end of the spore or on the shoulder (Polygoni-type), terminating in lobed appressoria.

Examination of Specimens on *Ipomoea aquatica* Forsskal, MUMH 1744, MUMH

1769.

Out of 42 species of the host plants in family Convolvulaceae, 13 species belong to the genus *Ipomoea*. Six powdery mildews have been recorded on *Ipomoea* spp. in the world. They are *E.communis*, *E.convolvuli*, *L.taurica*, *P.macularis*, *Oidium* sp. and *Oidium pharbitis* (Amano, 1986). **This paper is the first report of powdery mildew of *Ipomoea aquatica*.** Teleomorph of this fungus has not been found. Unfortunately, the size of conidia, conidiophores and foot-cells could not be observed due to the specimen was contaminated with other fungi, and could not see the sequence of the powdery mildew in this plant. Based on the non-catenate conidia without fibrosin bodies, the powdery mildew found on *Ipomoea aquatica* should be identified as *Oidium* subgenus *Pseudoidium*.

34. *Pseudoidium* on *Ipomoea obscura*, Convolvulaceae; (สระอึก)

Colonies: Mycelium is mostly epiphyllous, effuse or patchy, persistent to evanescent; hyphae tortuose, substraight to wavy, 5–8 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, nipple-shaped to moderately lobed, opposite in pairs or single. Conidiophores are erect, single or two on a hyphal cell, arising from the upper part of mother cells, mostly central position, 55–110 \times 7.5–12.5 μm (average 85 \times 10 μm), straight, foot-cells cylindric, 12.5–47.5 \times 7.5–12.5 μm (average 30 \times 10 μm), constricted at the branching point, producing conidia followed by 2–4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric-ovoid, (35–)37.5–47.5 (–50) \times (15–)17.5–22.5(–25) μm (average 43 \times 19.4 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 43).

Examination of Specimens on *Ipomoea obscura* Ker-Gawl, MUMH 1755, MUMH 1792.

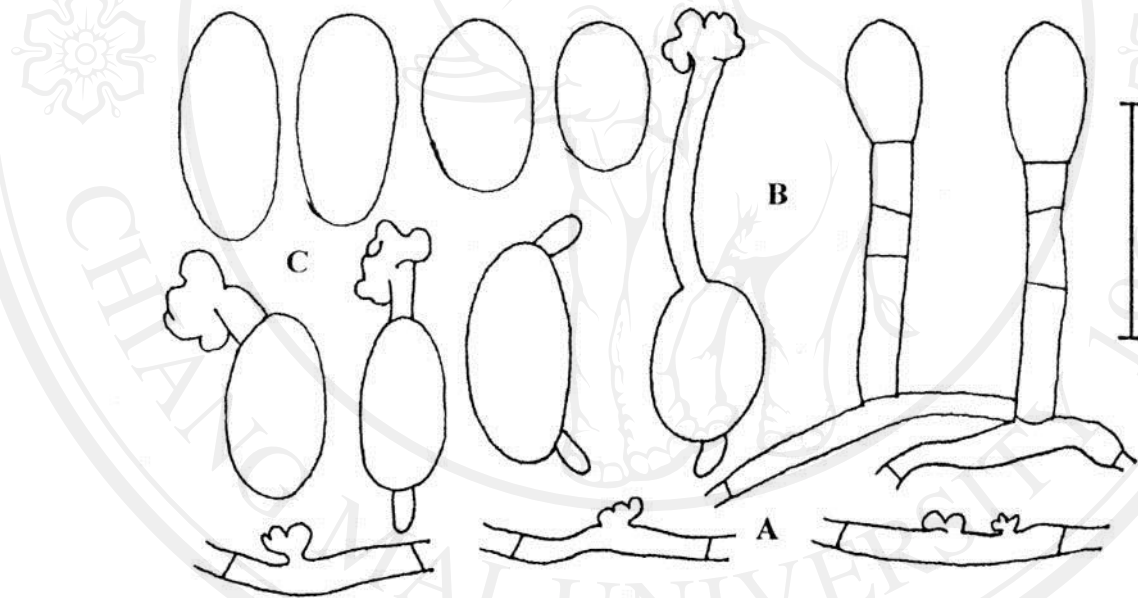


Fig. 43 *Oidium* subgenus *Pseudoidium* MUMH 1755 on *Ipomoea obscura*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

Yen and Wang (1973) and Braun (1986) described details of the anamorphic characteristics of *Oidium ipomoeae* on *Ipomoea obscura* collected from India and Taiwan. Morphological characteristics of *Oidium* subgenus *Pseudoidium* on *Ipomoea obscura* resemble those of *Oidium ipomoeae* (Yen and Wang, 1973 and Braun, 1986). To clarify the identification, the powdery mildew on *Ipomoea obscura* was sequenced and combined with the data matrix of *Erysiphe* species. The percentage similarity between ITS region of *Oidium* subgenus *Pseudoidium* on *Ipomoea obscura* and their suspected teleomorph were calculated. Nucleotide sequence of *Oidium* subgenus *Pseudoidium* on *Ipomoea obscura* has 99.3% similarity with *Oidium* subgenus *Pseudoidium* on *Cyclea barbata* and 99.2% similarity with *E. pseudolonicerea* on *Cocculus trilobus*. A phylogenetic tree (Fig. 73) constructed by the neighbor-joining method shows that they form a small clade with low bootstrap value (51%). **This is the first record of powdery mildew on *Ipomoea obscura* in Thailand.**

35. *Pseudoidium* on *Kydia calycina*, Malvaceae; (เลียงฟ้าข)

Colonies: Mycelium is amphigenous, mostly epiphyllous, patchy, persistent to evanescent; hyphae are tortuose, substraight to sometime wavy, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, moderately lobed to lobed, opposite in pairs or single. Conidiophores are erect, single on a hyphal cell, arising from the upper part of mother cells, mostly central position; foot-cells are cylindric, constricted at the branching point, producing conidia with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric-ovoid, without conspicuous fibrosin bodies, producing germ tubes at an end of the spore or on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 44).

Examination of Specimens on *Kydia calycina* Roxb., MUMH 1756.



Fig. 44 *Oidium* subgenus *Pseudoidium* MUMH 1756 on *Kydia calycina*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

The genus *Kydia* belongs to family Malvaceae. Powdery mildews have been recorded on numerous host species of the family Malvaceae, but not on *Kydia calycina*. **This study is the first record of powdery mildew on *Kydia calycina*.**

Unfortunately, the size of conidia, conidiophores and foot-cells could not be observed.

Because the specimen was contaminated with other fungi, and could not see the sequence of the powdery mildew in this plant. The non-catenate conidia are without fibrosin bodies, powdery mildew on *Kydia calycina* should be identified as *Oidium* subgenus *Pseudoidium*.

36. *Pseudoidium* on *Lagerstroemia indica*, Lythraceae; (เชียงใหม่)

Colonies: Mycelium is epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 4.88–5.2 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (75.61–)80.49–95.12(–97.56) \times 7.32–9.76 μm (average 87.15 \times 8.46 μm), straight or mildly flexuous at the base; foot-cells are cylindric (19.51–)21.95–34.15(–36.59) \times 7.32–9.76 μm (average 26.5 \times 8.05 μm), flexuous or slightly curved at the base, producing conidia followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid 31.71–36.59 \times 14.63–17.07 μm (average 34.15 \times 15.61 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 45).

Examination of Specimens on *Lagerstroemia indica*, MUMH 4713.

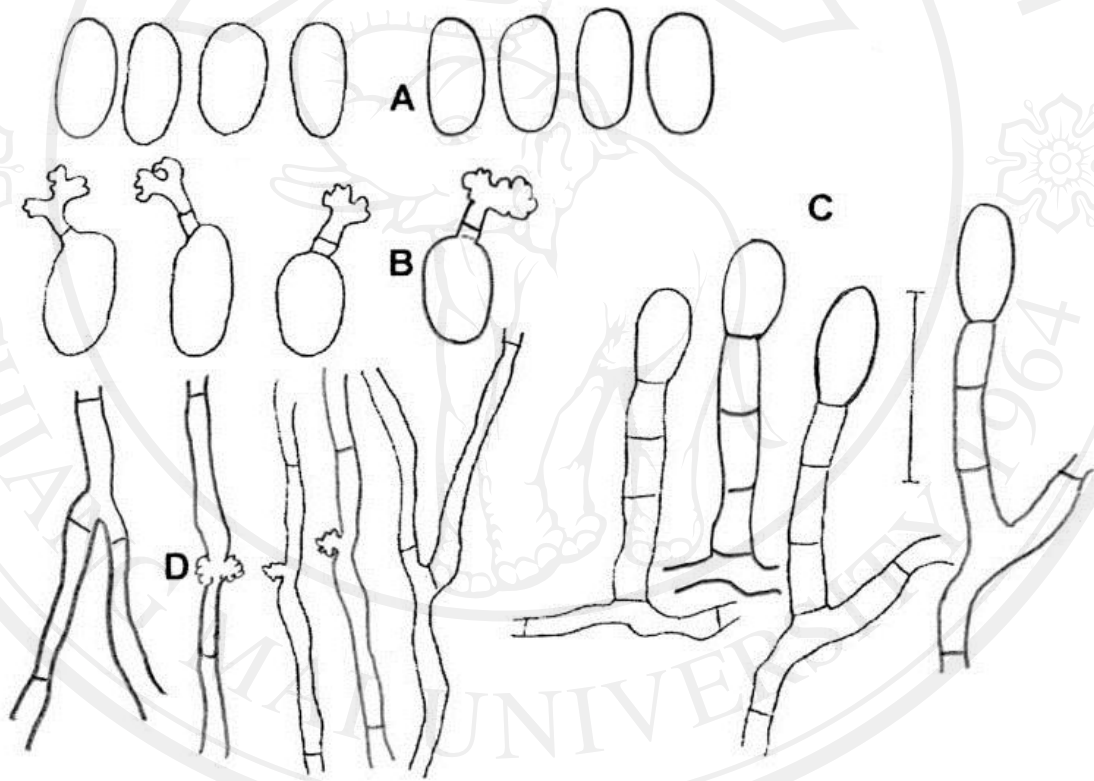


Fig. 45 *Oidium* subgenus *Pseudoidium* MUMH 4713 on *Lagerstroemia indica*.

A : Conidia. B : Conidia with germ tubes.

C : Conidiophores. D : Hyphae and appressoria (bar =50 μ m).

37. *Pseudoidium* on *Lithocarpus truncatus*, Fagaceae ; (ก้อดำ)

Colonies: Mycelium is amphigenous, ectophytic, white superficial cover the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy.

Appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, single on a hyphal cell, arise from the side of hyphae to bend

at the base, and produce conidia, $(45-67.5-82.5(85-)) \times 5 \mu\text{m}$ (average $71 \times 5 \mu\text{m}$);

foot-cells are cylindric, (average $41.25 \times 7.5 \mu\text{m}$), flexuous or slightly curved at the

base, producing conidia singly, followed by 1–2 shorter cells, with a basal septum at

the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric,

$(33.75-36.25-42.5(-45)) \times 12.5-17.5 \mu\text{m}$ (average $39.33 \times 15.58 \mu\text{m}$), without

conspicuous fibrosin bodies, and produce germ tubed with lobed appressoria

(Polygoni-type) (Fig. 46).

Examination of Specimens on *Lithocarpus truncates*, MUMH 4714.



Fig. 46 *Oidium* subgenus *Pseudoidium* MUMH 4714 on *Lithocarpus truncates*.

A : Conidiophore. B : Hyphae with appressoria.

C : Conidium. D : Conidium with germ tube (bar =50 μ m).

38. *Pseudoidium* on *Lithocarpus lindleyanus*, Fagaceae; (ก้อต่าง)

Colonies: Mycelium can be found on both sides of the leaves, amphigenous, ectophytic, abundantly epiphyllous, persistent, round definite patches, forming irregular white effused, later covering the entire surface of the leaves; hyphae are superficial, almost straight to somewhat undulate, 3.69 μm wide, profusely branched and branching at right or narrow angles. Appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (81.18–)86.1–123(–140.22)×11.07–14.76 (–15.99) μm (average 103.15×13.33 μm), foot-cells cylindric, (14.76–)34.44–51.66 (–61.5)×(6.15–)7.38–8.61 μm (average 41.75×7.45 μm), flexuous or slightly curved at the base, producing conidia followed by 3-4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric, (34.44–)39.36–46.74×12.3–14.76 μm (average 41.57×13.65 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 47).

Examination of Specimens on *Lithocarpus lindleyanus*, MUMH 4715.

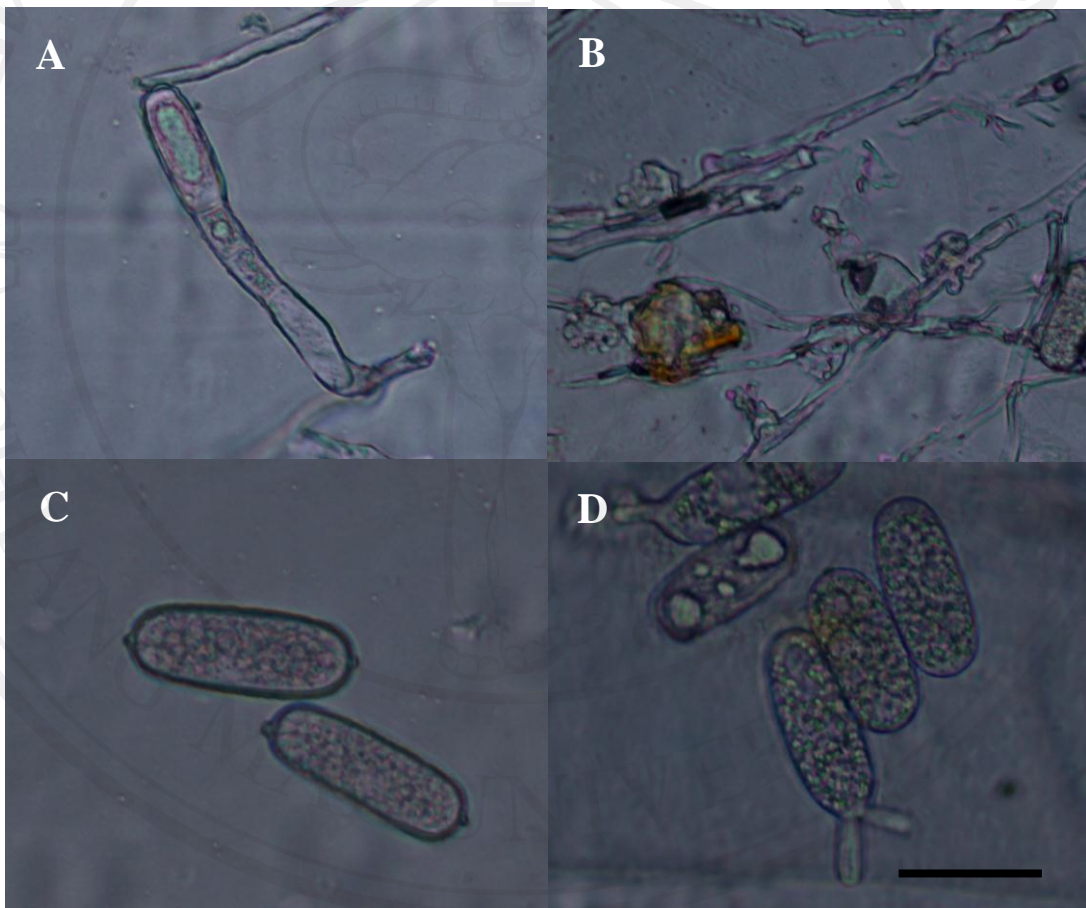


Fig. 47 *Oidium* subgenus *Pseudoidium* MUMH 4715 on *Lithocarpus lindleyanus*.

A : Conidiophore. B : Hyphae with appressoria.

C : Conidia. D : Conidia with germ tubes (bar =50 μ m).

39. *Pseudoidium* on *Ludwigia hyssopifolia*, Onagraceae; (แพ่งพวย)

Colonies: Mycelium on stems and leaves is amphigenous, effused or patches, persistent to subevanescent; hyphae are substraight to somewhat wavy, 4–8 μm wide, fairly uniform or sometimes irregular in width, branching at right or narrow angle, with a septum near the branching point; appressoria are lobed to multilobed, single.

Conidiophores are straight, erect, single on a hyphal cell, arising from the upper part of mother cells, position central to non-central, 60–90(–100)×5–10 μm ; foot-cells are (30–)35–72.5(–75)×(10–)12.5–15 μm , constricted at the branching point, producing with crenate edge, with a basal septum at the branching point of the mycelium.

Conidia are ellipsoid-ovoid to doliform, (25–)27.5–35(–37.5)×12.5–20 μm , without conspicuous fibrosin bodies.

Examination of Specimens on *Ludwigia hyssopifolia* (G. Don f.), MUMH 1838.

The family Onagraceae includes a numerous host species of powdery mildews in *Ludwigia hyssopifolia* is a member of this family. **This is the first report of powdery mildew on *Ludwigia hyssopifolia*.** Teleomorph of this fungus has not been found in Thailand. Only anamorphic state is described in details. To clarify the identification, the sequence of *Oidium* subgenus *Pseudoidium* on *Ludwigia hyssopifolia* is combined the sequence with the data matrix of *Erysiphe* species to construct a phylogenetic tree. The sequence shows the highest similarity with the sequences of *Pseudoidium* on *Nicotiana tabacum* and *Glycine max*, *Oidium neolycopersici* on *Lycopersicon esculentum* (99.7%). A phylogenetic tree (NJ tree, Fig. 73) shown that *Oidium* subgenus *Pseudoidium* on *Ludwigia hyssopifolia* forms a large clade with *Oidium* subgenus *Pseudoidium* on *Nicotiana tabaci*, *Glycine max*, *Boronia megastigma*, *Sedum bulbifrum*, *Stachytarpheta indica* and *Zizyphus nummularia* and *Oidium neolycopersici* on *Lycopersicon esculentum* with 100% bootstrap value. They form a clade at the base of the phylogenetic tree.

40. *Pseudoidium* on *Lycopersicon esculentum*, Solanaceae; (มะเขือเทศ)

Colonies: Mycelium is amphigenous, mostly epiphyllous, white, thin, also at stems; hyphae hyaline, septate, branched, substraight to somewhat wavy, 4–7 μm wide, mostly branching at right angle, with a septum at the branching point; appressoria are well-developed, nipple-shaped to lobed, opposite in pairs or single. Conidiophores are single or double on a hyphal cell, erect, arising from the upper part of mother cells, central position to non-central, (57.5–)65–100(–112.5) \times 7.5–8.75(–10) μm ; foot-cells are cylindric, (15–)17.5–40(–45) \times 7.5–8.75(–10) μm , flexuous, producing conidia followed by 3–6 shorter cells; foot-cells are occasionally somewhat inflated in the middle and constricted at the base and at the following septum, with a basal septum at the branching point or away from it. Conidia are formed singly, ellipsoid-oval, 30–40(–42.5) \times 17.5–20(–21.25) μm , without conspicuous fibrosin bodies, producing germ tubes from an end or on the shoulder (Polygoni-type), increasing in width from base to top, moderately long, terminating in lobed appressoria (Fig. 48).

Examination of Specimens on *Lycopersicon esculentum* Mill., MUMH 1847.

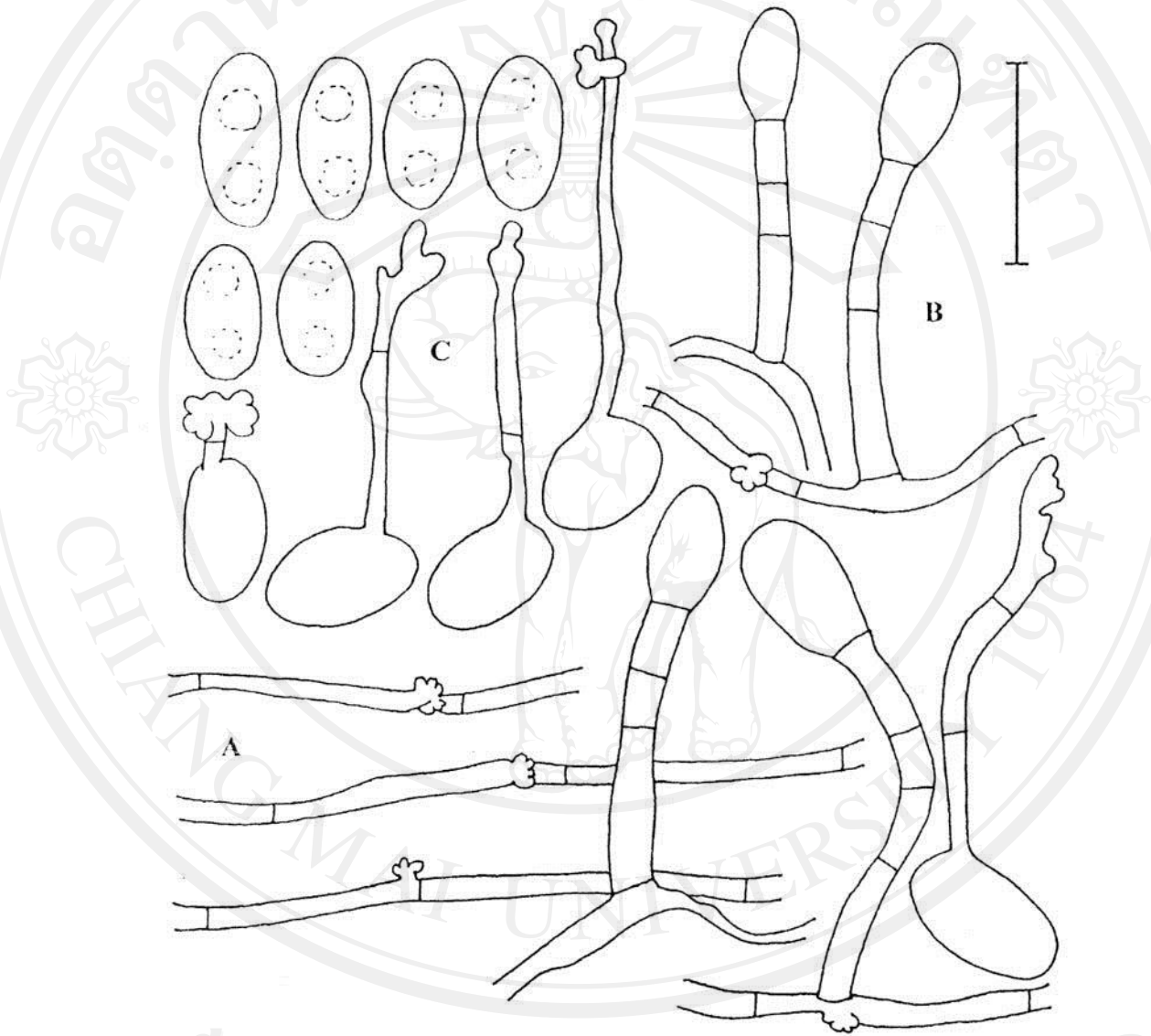


Fig. 48 *Oidium* subgenus *Pseudoidium* MUMH 1847 on *Lycopersicon esculentum*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

A powdery mildew with non-catenate conidia and lobed appresorium on tomato is widely spread in Europe, Africa, North and South America and Asia and was identified as an *Oidium* subgen. *Pseudoidium* species (teleomorph: *Erysiphe* sect. *Erysiphe*). It is now recognized as a distinct species, *Oidium neolycopersici* (Kiss *et al.*, 2001). A phylogenetic analysis of the ITS sequence of rDNA indicated that *O. neolycopersici* is closely related to *E. maclerayae*, *E. aquilegiae* and other *Pseudoidium* species (Kiss *et al.*, 2001). Based on the morphological characteristics, this powdery mildew fungus in Thailand likely to be identified as *Oidium neolycopersici*.

41. *Pseudoidium* on *Mangifera indica*, Anacardiaceae; (มะม่วง)

Colonies: Mycelium is mostly epiphyllous, effuse or patchy, often covering the entire leaf surface, persistent to evanescent; appressoria are well-developed, multilobed to lobed, opposite in pairs or single. Conidiophores are erect, arising from the upper part of mother cells, mostly central position, foot-cells are cylindric, $25.7\text{--}120.9 \times 5.8\text{--}7.8$ μm (average 73.3×6.8 μm), flexuous or slightly curved at the base, producing conidia followed by 1–2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindrical, $21.4\text{--}54 \times 14.2\text{--}25.7$ μm (average 37.7×19.9 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), moderately long, terminating in lobed appressoria.

Examination of Specimens on *Mangifera indica*, MUMH 3268.

42. *Pseudoidium* on *Microtoena insuavis*, Labiatae; (คำปอง)

Colonies: Mycelium is mostly epiphyllous, patches cover the leaf surfaces, persistent to subevanescent; hyphae are substraight to flexous, sometime wavy; appressoria are well developed lobed to multilobed single or opposite. Conidiophores are single on a hyphal cell arising from the side of mother cells, producing conidia with basal septum at the branching point, foot-cells are straight to some flexous. Conidia are formed singly, oval to cylindric, without conspicuous fibrosin bodies.

Examination of Specimens on *Microtoena insuavis* (hance) Prain, MUMH 1757.

Microtoena insuavis belongs to the family Labiatae. Powdery mildews have been recorded on numerous species of Labiatae, but not on *Microtoena insuavis*.

This study is the first record of powdery mildew on *Microtoena insuavis*.

Microtoena distributes in many areas from the Himalaya Mountains to Western China, and it was also found in Northern Thailand in this study. Unfortunately, did

not to observe the size of conidia, conidiophores and foot-cells could not be observed due to contamination of the specimens with other fungi and could not see the sequence of the powdery mildew on this plant. Based on the non-catenate conidia

without fibrosin bodies, the powdery mildew on *Microtoena insuavis* should be identified as *Oidium* subgenus *Pseudoidium*.

43. *Pseudoidium* on *Mimosa invisa*, Leguminosae; (ไมยราบเลื้อย)

Colonies: Mycelium is mostly epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 4.88-5.16 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, position mostly central, (100-)104.88-121.95(-126.83) \times 7.32-9.76 μm (average 113.33 \times 9.11 μm), straight or mildly flexuous at the base; foot-cells are cylindrical (34.15-)36.59-43.9 (-48.78) \times 7.32-9.76 μm (average 39.59 \times 9.35 μm), flexuous or slightly curved at the base, producing conidia followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid (34.15-)41.46 \times 14.63-17.07(-19.51) μm (average 37.64 \times 16.91 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig.49).

Examination of Specimens on *Mimosa invisa*, MUMH 3820.

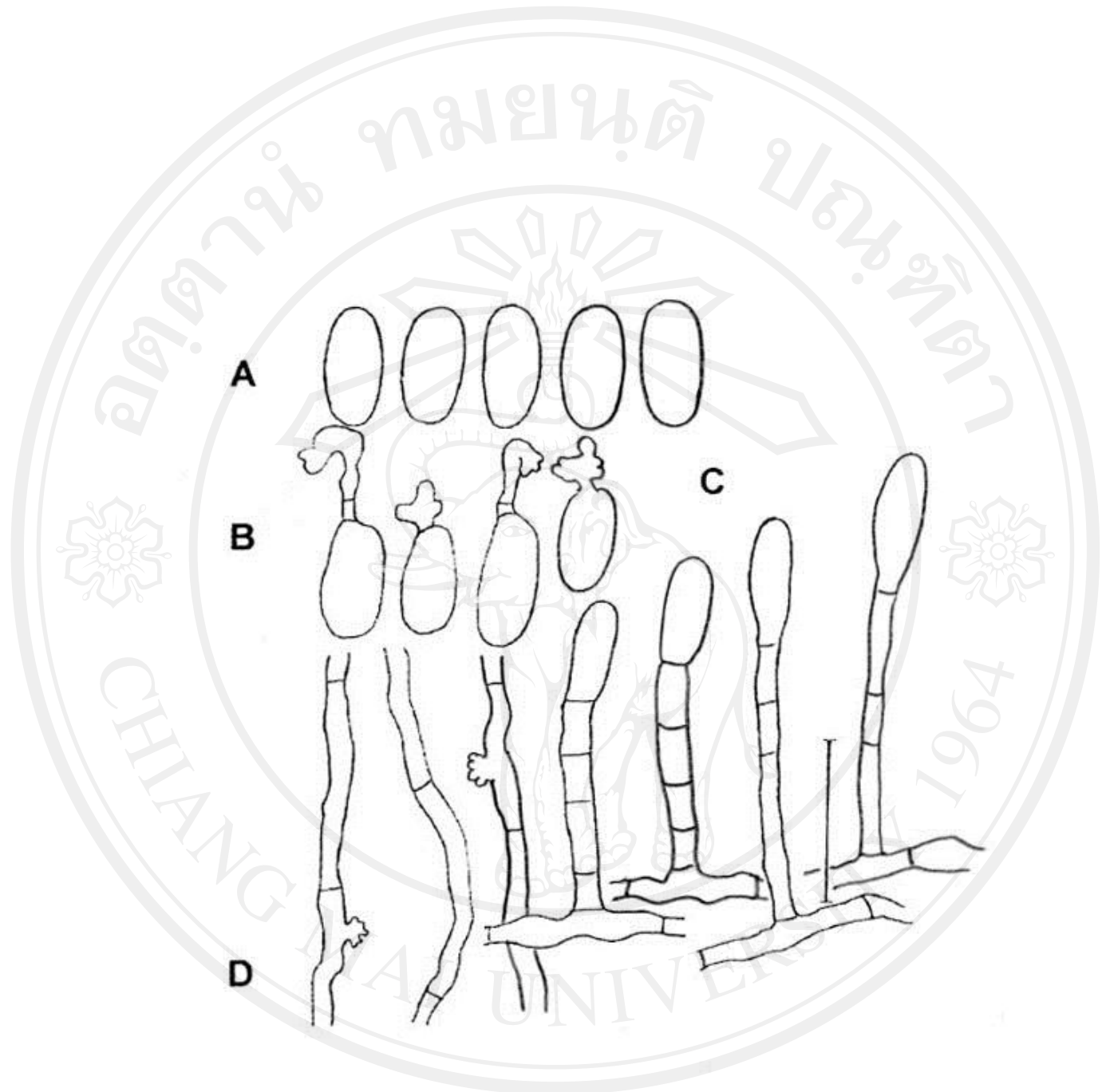


Fig. 49 *Oidium* subgenus *Pseudoidium* MUMH 3820 on *Mimosa invisa*.

A : Conidia. B : Conidium with germ tubes.

C : Conidiophores. D : Hyphae and appressoria (bar =50 μ m).

44. *Pseudoidium* on *Mirabilis jalapa*, Nyctaginaceae ; (บานเย็น)

Colonies: Mycelium is amphigenous, abundantly epiphyllous, white patches on the upper leaf surface, persistent to subevanescent; Appressoria are well-developed, nipple-shaped to lobed single. Conidiophores are erect, arising from the upper part of mother cells, mostly central position, $(81.3-95-132.5(-147.5) \times 7.5-10 \mu\text{m}$ (average $115.2 \times 8.2 \mu\text{m}$.); foot-cells are cylindric, $(27.5-30-42.5(-60) \times 7.5-10 \mu\text{m}$ (average $35.8 \times 8.16 \mu\text{m}$), flexuous or slightly curved at the base, producing conidia followed by 3-4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, $(35-37.5-47.5(-50) \times 15-16.2-18.8(-20) \mu\text{m}$ (average $43.6 \times 17.2 \mu\text{m}$), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), moderately long, terminating in lobed appressoria (Fig. 50).

Examination of Specimens on *Mirabilis jalapa* L., MUMH 1787, MUMH 1833.

Three powdery mildews, e.g., *Oidium* sp. (China, India, Java and Srilanka), *E.polygoni* (Canar and Japan) and *Erysiphe* sp. (Japan), have been reported on *Mirabilis jalapa* (Amano, 1986). Teleomorphic characteristic of the fungus in this study has not been found in Thailand. The present study describes only anamorphic state in details. To identify this fungus, the ITS region of the powdery mildew on *Mirabilis jalapa* is sequenced and combined with the data matrix of *Erysiphe* species.

A phylogenetic tree constructed by the neighbor-joining method is shown in Fig. 73.

The result shows that *Oidium* subgenus *Pseudoidium* on *Mirabilis jalapa* has only one nucleotide sequence, different from *Erysiphe* sp. on *Mirabilis jalapa* from Japan.

Erysiphe sp. on *Mirabilis jalapa* from Japan had an identical ITS sequence with *Oidium* sp. on *Vicia faba* and *Eustoma rusellianum*. The result indicates that powdery mildew on *Mirabilis jalapa* from Thailand is closely related to *Erysiphe* sp. on *Mirabilis jalapa* from Japan. Therefore, based on the morphological and molecular

characteristic, the powdery mildew on *Mirabilis jalapa* in Thailand belongs to the same species with *Oidium* sp. on *M.jalapa* from Japan. **This is the first report of**

powdery mildew on *M.jalapa* in Thailand.



Fig. 50 *Oidium* subgenus *Pseudoidium* MUMH 1787 on *Mirabilis jalap*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

45. *Pseudoidium* on *Mohamla siamosis* Jakeda, Berberidaceae; (ขมิ้นต้น)

Colonies: Mycelium is amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69–4.43 μm wide ; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, position mostly central, (56.58–)61.5–95.94(–103.32) \times 11.07–14.76(–15.99) μm (average 82.9 \times 12.72 μm); foot-cells are cylindric (27.06–)39.52–41.82(–46.74) \times 6.15–8.61 μm (average 34.93 \times 7.45 μm), flexuous or slightly curved at the base, producing conidia followed by 1–2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid (30.75–)31.98–34.44(–39.36) \times (12.3–)13.53–14.76 μm (average 33.33 \times 14.39 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 51).

Examination of Specimens on *Mohamla siamosis* Jakeda., MUMH 4716.

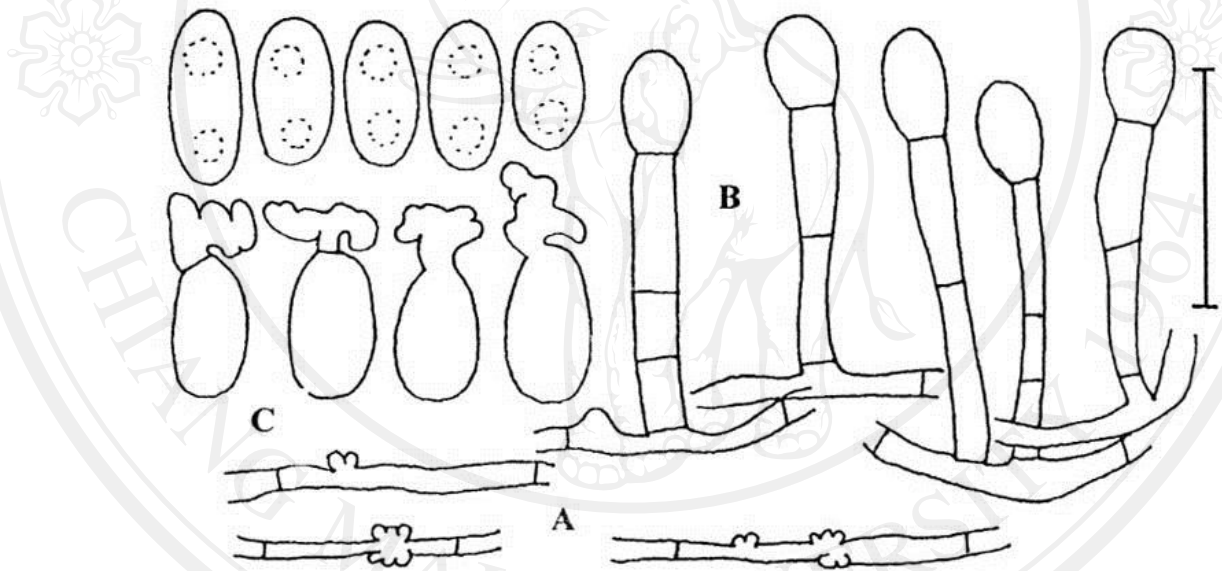


Fig. 51 *Oidium* subgenus *Pseudoidium* MUMH 4716 on *Mohamla siamosis*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

46. *Pseudoidium* on *Mucuna bractecta* A.DC., Leguminosae; (หมามุ่ย)

Colonies: Mycelium mostly hypophyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69-4.11 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single ; conidiophores are erect, arising from the side of mother cells, mostly central position, (68.88–)93.48–130.38(–152.52) \times (7.38–)9.84–13.53(–14.76) μm (average 109.54 \times 11.61 μm); foot-cells are cylindric (14.76–)34.44–59.04(–76.26) \times 4.92–7.38 (–9.84) μm (average 46.17 \times 6.1 μm), flexuous or slightly curved at the base, producing conidia followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid (29.52–)31.98–44.28(–73.8) \times (13.53–)15.99–19.68 μm (average 36.98 \times 17.84 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type) (Fig. 52).

Examination of Specimens on *Mucuna bractecta* A.DC., MUMH 4717.

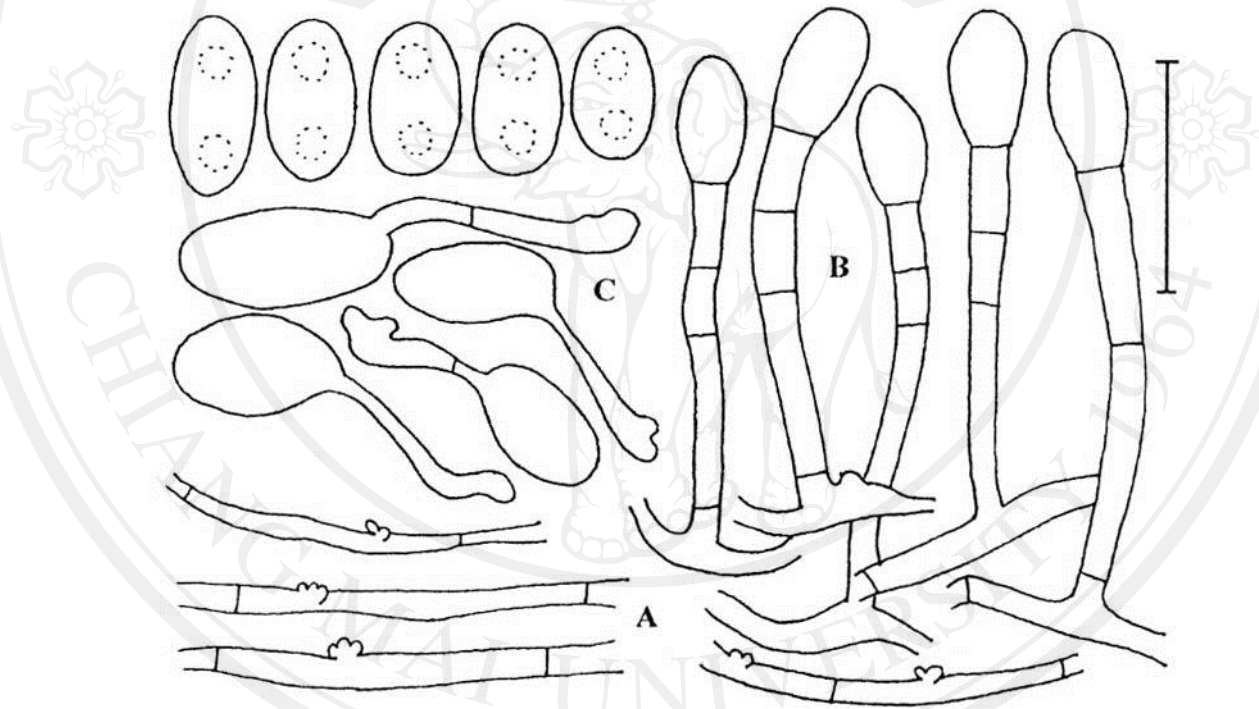


Fig. 52 *Oidium* subgenus *Pseudoidium* MUMH 4717 on *Mucuna bractecta*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

47. *Pseudoidium* on *Muehlenbeckia platyclada*, Polygonaceae; (ตะขาบบิน)

Colonies: Mycelium is abundantly epiphyllous, effuse or patchy, persistent to evanescent patches on the upper leaf surface and stem; hyphae substraight to wavy, 5-7 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the upper part of mother cells, mostly central position, (70-)85-107.5(-127) \times 7.5 μm (average 101.1 \times 7.5 μm); foot-cells are cylindric, (27.5-)32.5-57.5(-67.5) \times 7.5 μm wide (average 47.1 \times 7.5 μm), flexuous or slightly curved at the base, producing conidia followed by 2-4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, (27.5-)30-40(-42.5) \times (10-)12.5-17.5 μm (average 29 \times 15 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder, long to moderately long, terminating in lobed appressoria (Fig. 53).

Examination of Specimens on *Muehlenbeckia platyclada* Meissn., MUMH 1800.

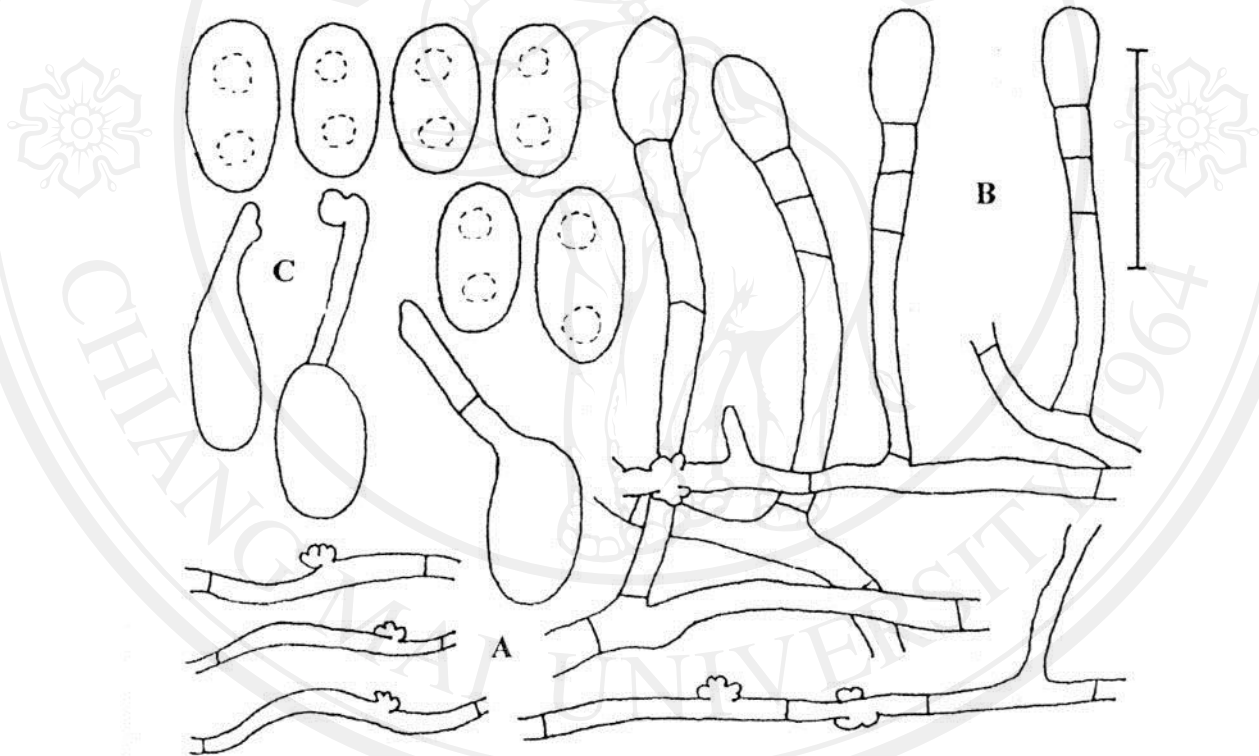


Fig. 53 *Oidium* subgenus *Pseudoidium* MUMH 1800 on *Muehlenbeckia platyclada*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

Two powdery mildews, i.e., *L. taurica* and *Oidium* sp., have been found on *Muehlenbeckia platyclada* world wide (Amano, 1986). *Erysiphe polygoni* was also recorded as pathogen on various host plants including *Muehlenbeckia platyclada* (Braun, 1987). To clarify the identification, sequence the ITS region of the fungus is combined with the data matrix of *Erysiphe* species. The ITS sequence of *Muehlenbeckia platyclada* has the highest sequence similarity with *Oidium* sp. on *Rumex obtusifolius* (99.3%). The phylogenetic tree (NJ Tree) is shown in Fig. 73 suggests that powdery mildews on *Rumex obtusifolius* and *Muehlenbeckia platyclada* (both are in the family Polygonaceae) are closely related to each other. *Erysiphe polygoni* is commonly reported as pathogen on *Rumex* spp. and *Muehlenbeckia platyclada* all over the world (Braun, 1987). Therefore, powdery mildew on *Muehlenbeckia platyclada* should be identified as *Erysiphe polygoni*. **This is the first record of powdery mildew on *M. platyclada* in Thailand.**

48. *Pseudoidium* on *Nelumbo nucifera* Gaerth, Nelumbonaceae; (บัว)

Colonies: Mycelium is white superficial, covers the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy, average 4.92 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (61.50–)76.26–118.08(–137.76) \times 9.84–12.30(–17.22) μm (average 98.08 \times 10.75 μm);

foot-cells are cylindric, (27.06–)31.98–46.74(–61.50) \times 6.15–7.38 μm (average 40.27 \times 7.01 μm), flexuous or slightly curved at the base, producing conidia followed

by 3-4 shorter cells, with a basal septum at the branching point of the mycelium.

Conidia are formed singly, ellipsoid-ovoid, (36.90–)46.74–49.20(–54.12) \times (14.76–)15.99–18.45 μm (average 44.28 \times 16.80 μm), without conspicuous fibrosin bodies,

containing oil drop, producing germ tubes on the shoulder (Polygoni-type) (Fig. 54).

Examination of Specimens on *Nelumbo nucifera* Gaerth., MUMH 4718.

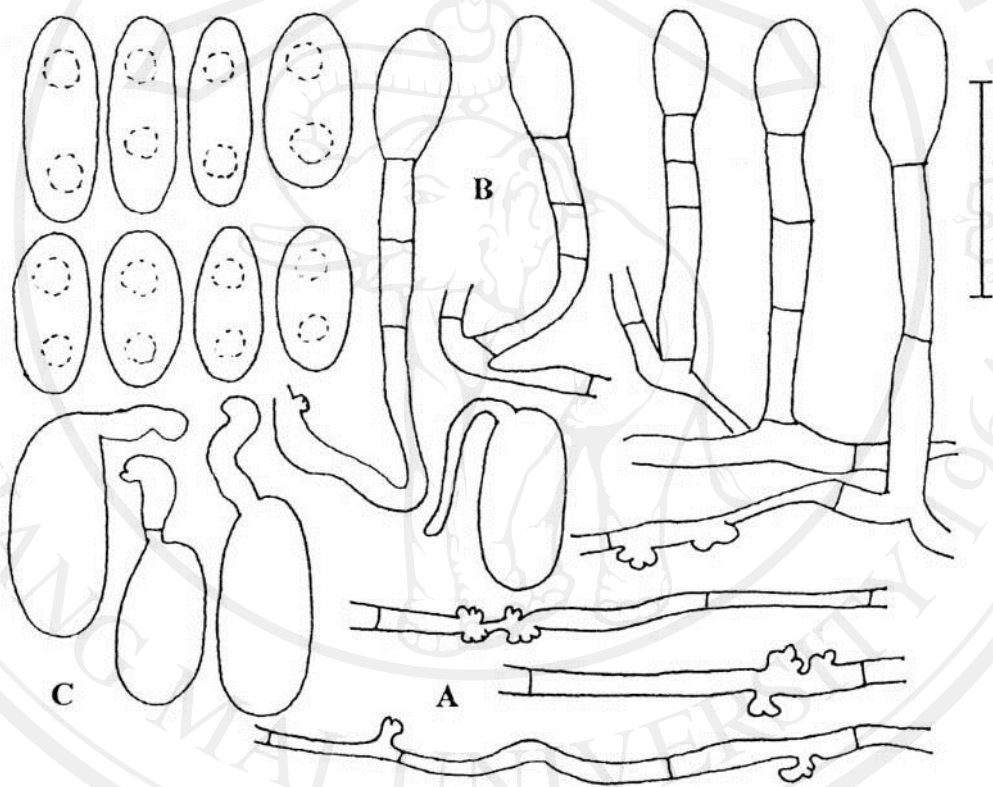


Fig. 54 *Oidium* subgenus *Pseudoidium* MUMH 4718 on *Nelumbo nucifera*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

49. *Pseudoidium* on *Ocimum sanctum* Linn., Lamiaceae; (กระเพรา)

Colonies: Mycelium is amphigenous, ectophytic, white superficial cover the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy, 3.69–4.92 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (71.34–)73.8–98.4(–115.62) \times 7.38–9.84 μm (average 90.77 \times 8.41 μm); foot-cells are cylindric (17.22–)31.98–46.74(–51.66) \times 6.15–8.61(–9.84) μm (average 37.64 \times 7.55 μm), flexuous or slightly curved at the base, producing conidia followed by 3-5 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid, (29.52–)30.75–36.9 \times 17.22–22.14(–24.6) μm (average 33.99 \times 19.61 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 55).

Examination of Specimens on *Ocimum sanctum* Linn., MUMH 4719.



Fig. 55 *Oidium* subgenus *Pseudoidium* MUMH 4719 on *Ocimum sanctum*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidium with germ tubes (bar =50 μ m).

50. *Pseudoidium* on *Oxalis corniculata* Linn., Oxalidaceae; (ส้มดิน)

Colonies: Mycelium is white superficial, covers the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy, average 3.62 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (71.34–)81.18–115.62(–127.92) \times 4.92–7.38 μm (average 95.62 \times 6.47 μm); foot-cells are cylindric, (22.14–)27.06–44.28(–73.8) \times 4.92–6.15 μm (average 37.4 \times 5.66 μm), flexuous or slightly curved at the base, producing conidia followed by 3-4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid, (29.52–)31.98–34.44 \times 12.3–14.76 μm (average 32.4 \times 14.1 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type) (Fig. 56).

Examination of Specimens on *Oxalis corniculata* Linn., MUMH 4720.



Fig. 56 *Oidium* subgenus *Pseudoidium* MUMH 4720 on *Oxalis corniculata*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

51. *Pseudoidium* on *Peltophorum pterocarpum* (DC.) Back., Caesalpiniaceae;

(นนทรี)

Colonies: Mycelium is mostly epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 3.69-4.75 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, (61.5–)68.88–95.94(–115.99) \times (9.84–)12.3–15.99(–17.22) μm (average 85.93 \times 13.65 μm), straight or mildly flexuous at the base; foot-cells are cylindrical (14.76–)24.6–43.05(–66.42) \times (4.92–)6.15–7.38(–8.61) μm (average 35.01 \times 6.72 μm), flexuous or slightly curved at the base, producing conidia followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid (29.52–)33.21–39.36(–44.28) \times (14.76–)15.99–19.68(–20.91) μm (average 36.38 \times 17.54 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type) terminating in lobed appressoria (Fig. 57).

Examination of Specimens on *Peltophorum pterocarpum* (DC.), MUMH 4721.

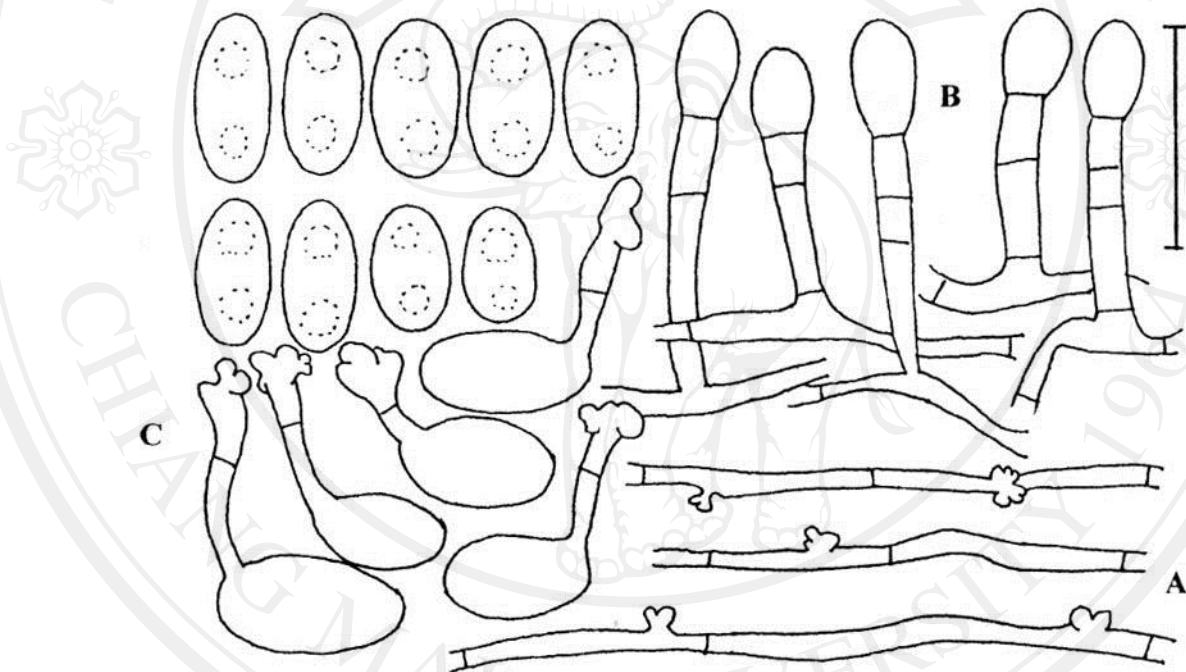


Fig. 57 *Oidium* subgenus *Pseudoidium* MUMH 4721 on *Peltophorum pterocarpum*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

52. *Pseudoidium* on *Pilea trinervia* Weight., Urticaceae; (ชมหินสามทาง)

Colonies: Mycelium is amphigenous, ectophytic, white superficial, covers the upper leaf surface, profusely branched and branching at right or narrow angles, 3.69-4.92 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (66.42–)78.72–103.32(–127.92) \times 9.84–17.22 μm (average 90.04 \times 14.02 μm); foot-cells are cylindric (17.22–)27.06–56.58(–66.42) \times 6.15–7.38(–8.61) μm (average 36.97 \times 6.96 μm), flexuous or slightly curved at the base, producing conidia followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid, 31.98–41.82(–44.28) \times 14.76–18.45 μm (average 37.88 \times 16.65 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type) (Fig. 58).

Specimens examined : on *Pilea trinervia* Weight., MUMH 4722.

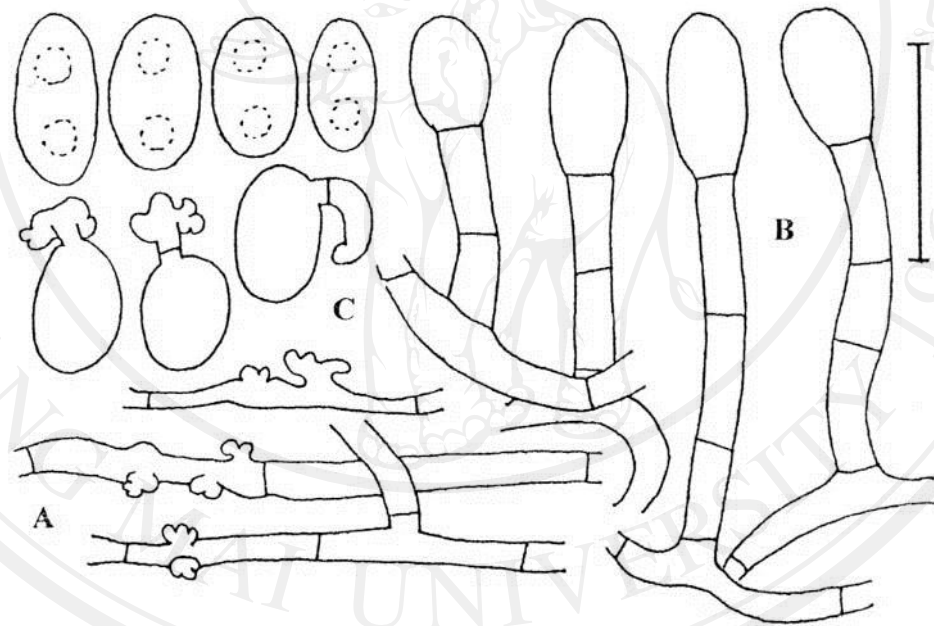


Fig. 58 *Oidium* subgenus *Pseudoidium* MUMH 4722 on *Pilea trinervia*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μm).

53. *Pseudoidium* on *Pisum sativum*, Fabaceae; (ถั่วลันเตา)

Colonies: Mycelium is on stems, leaves, pods and young shoots, amphigenous, evanescent to persistent, often covering the whole leaf surfaces, evanescent on stems and pods; appressoria are well-developed, variable in shape, multilobed to moderately lobed, opposite in pairs or single. Conidiophores are erect, single or two on a hyphal cell, (75–)82.5–120(–125)×7.5–10 μm (average 97.8×7.8 μm); foot-cells are cylindrical, (22.5–)25–35(–42.5)×7.5–10 μm (average 30.1×7.8 μm), flexuous, producing conidia followed by 3–4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric, (30–)32.5–42.5(–45)×15–17.5 μm (average 39×16.91 μm), without conspicuous fibrosin bodies, producing germ tubes on an end or on the shoulder (Polygoni-type), terminating in unlobed or moderately lobed appressoria.

Examination of Specimens on *Pisum sativum* L., MUMH 1850.

Four powdery mildews were recorded on four species of *Pisum* spp. in the world (Amano, 1986). They are *E.pisi*, *E.communis*, *L.taurica* and *Oidium* sp. Previously, *E.pisi* have been recorded on *Pisum sativum* in Thailand. *Erysiphe pisi* was reported on various host species of Fabaceae including *Pisum* sp. (Shin, 2000). Falloon *et al.* (1989) studied anamorphic characteristics of *E.pisi* on *Pisum sativum* by scanning electron microscopy. The anamorphic characteristics of the present work are in good agreement with *E.pisi*. To clarify the identification, *Oidium* subgenus *Pseudoidium* on *Pisum sativum* was sequenced, and a phylogenetic tree (NJ tree) constructed by the sequence is shown in Fig. 73. The ITS sequence of *Oidium* subgenus *Pseudoidium* on *Pisum sativum* has identical sequence with *E.pisi* on *Pisum sativum* collected in Japan. **Therefore, based on the morphological characteristics and molecular analysis, powdery mildew on *Pisum sativum* may be identified as *Erysiphe pisi*.**

54. *Pseudoidium* on *Pogostemon* sp. Labiatae; (พิมเสนต้น)

Colonies: Mycelium is amphigenous, ectophytic and epiphyllous, white superficial, profusely branched and branching at right or narrow angles, 4.92-5.04 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position,

(36.96–)68.88–86.1(–95.94)×(11.07–)14.76–19.68 μm (average 78.72×16.68 μm);

foot-cells are cylindric (14.76–)19.68–29.52(–36.9)×(6.15–)7.38–9.84(–11.07) μm

(average 24.23×8.04 μm), flexuous or slightly curved at the base, producing conidia

followed by 2–3 shorter cells, with a basal septum at the branching point of the

mycelium. Conidia are formed singly, ellipsoid-ovoid (24.6–)27.06–34.44

(–36.9)×(12.3–)15.99–19.68 μm (average 30.7×16.97 μm), without conspicuous

fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-

type), terminating in lobed appressoria (Fig. 59).

Examination of Specimens on *Pogostemon* sp., MUMH 4723.

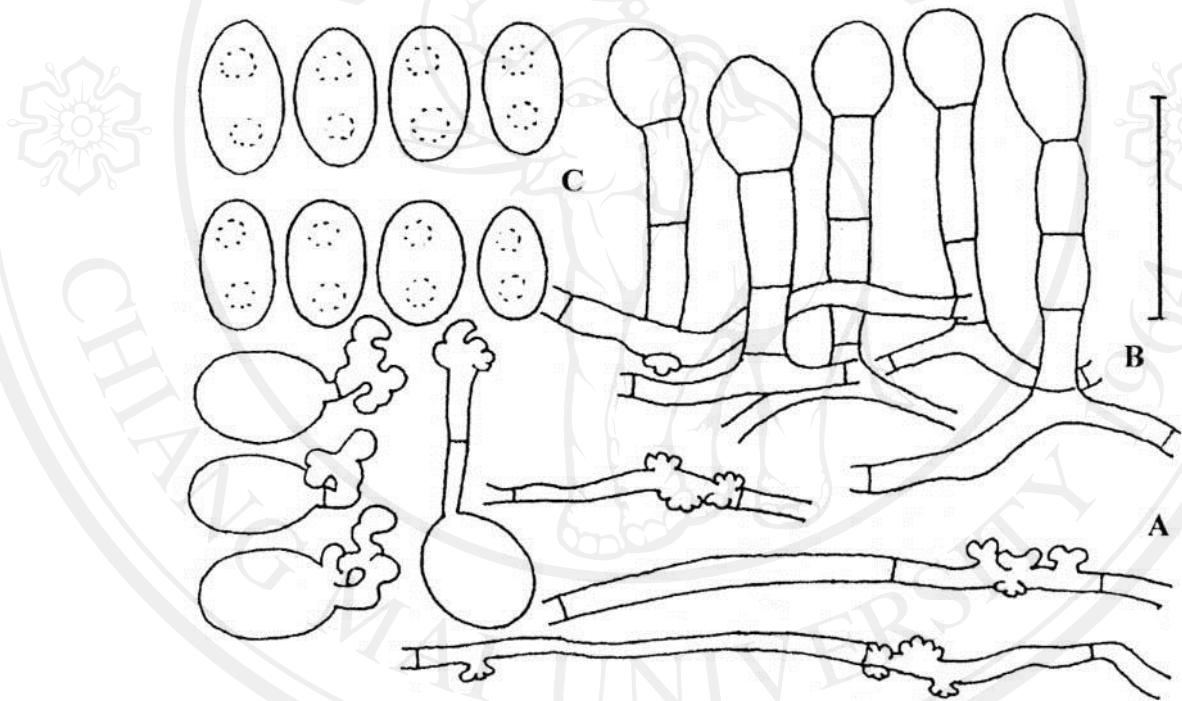


Fig. 59 *Oidium* subgenus *Pseudoidium* MUMH 4723 on *Pogostemon* sp.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

55. *Pseudoidium* on *Polygonum odoratum* Lour., Polygonaceae; (ผักไผ่)

Colonies: Mycelium is mostly epiphyllous, amphigenous, ectophytic, white superficial, profusely branched and branching at right or narrow angles, 4.92-5.73 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, single or two on a hyphal cell, arising from the upper part of mother cells, position mostly central, (95.94-)110.7-159.9(-196.8) \times 9.84-14.76 (-17.22) μm (average 133.9 \times 11.93 μm), straight or mildly flexuous at the base; foot-cells are cylindrical (14.76-)27.06-41.82(-73.8) \times (6.15-)7.38-8.61(-9.84) μm (average 34.02 \times 7.63 μm), flexuous or slightly curved at the base, producing conidia followed by 2-3 shorter cells, with a basal septum at the branching point of the mycelium.

Conidia are formed singly, ellipsoid-cylindrical (31.98-)34.44-43.05(-73.8) \times (12.3-14.76-17.22(-18.45) μm (average 38.94 \times 16.43 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type) terminating in lobed appressoria (Fig. 60).

Examination of Specimens on *Polygonum odoratum* Lour., MUMH 2920.



Fig. 60 *Oidium* subgenus *Pseudoidium* MUMH 2920 on *Polygonum odoratum*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

56. *Pseudoidium* on *Quercus vestitus*, Fagaceae; (ก่อแอบ)

Colonies: Mycelium is amphigenous, ectophytic, white superficial cover the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy.

Appressoria are well-developed, coral-like, single or occasionally opposite in pairs.

Conidiophores are erect, single on a hyphal cell, arise from the side of hyphae to bend at the base, $68-86 \times 11-14 \mu\text{m}$ and produce conidia. Conidia are formed singly, ellipsoid-cylindric, $32-36 \times 17-20 \mu\text{m}$, without conspicuous fibrosin bodies, and produce germ tubed with lobed appressoria (Polygoni-type) (Fig. 61).

Examination of Specimens on *Quercus vestitus*, MUMH 4994.

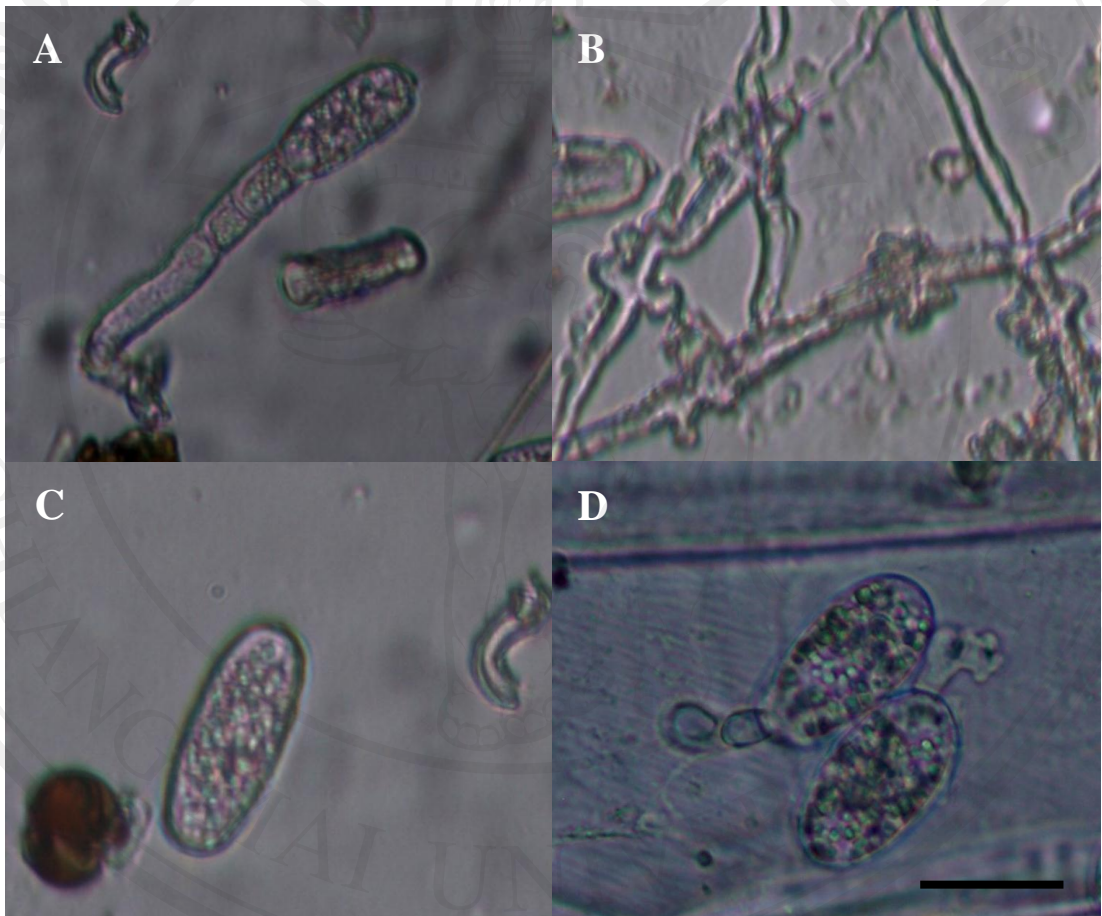


Fig. 61 *Erysiphe* MUMH 4994 on leaves of *Quercus vestitus*.

A : Conidiophore. B : Hyphae with appressoria.

C : Conidium. D : Conidia with germ tubes (bar =50 μ m).

57. *Pseudoidium* on *Quercus kingiana*, Fagaceae; (ก้อแดง)

Colonies: Mycelium is amphigenous, ectophytic, white superficial cover the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy.

Appressoria are well-developed, coral-like, single or occasionally opposite in pairs.

Conidiophore are erect, single on a hyphal cell, arise from the side of hyphae to bend at the base, and produce conidia. Conidia are formed singly, ellipsoid-cylindric,

(27.5–)28.75–37.5×(10–)12.5–15(–16.25) μm (average 32.58×13.79 μm), without

conspicuous fibrosin bodies, and produce germ tubes with lobed appressoria

(Polygoni-type) (Fig. 62).

Examination of Specimens on *Quercus kingiana*, MUMH 4995.

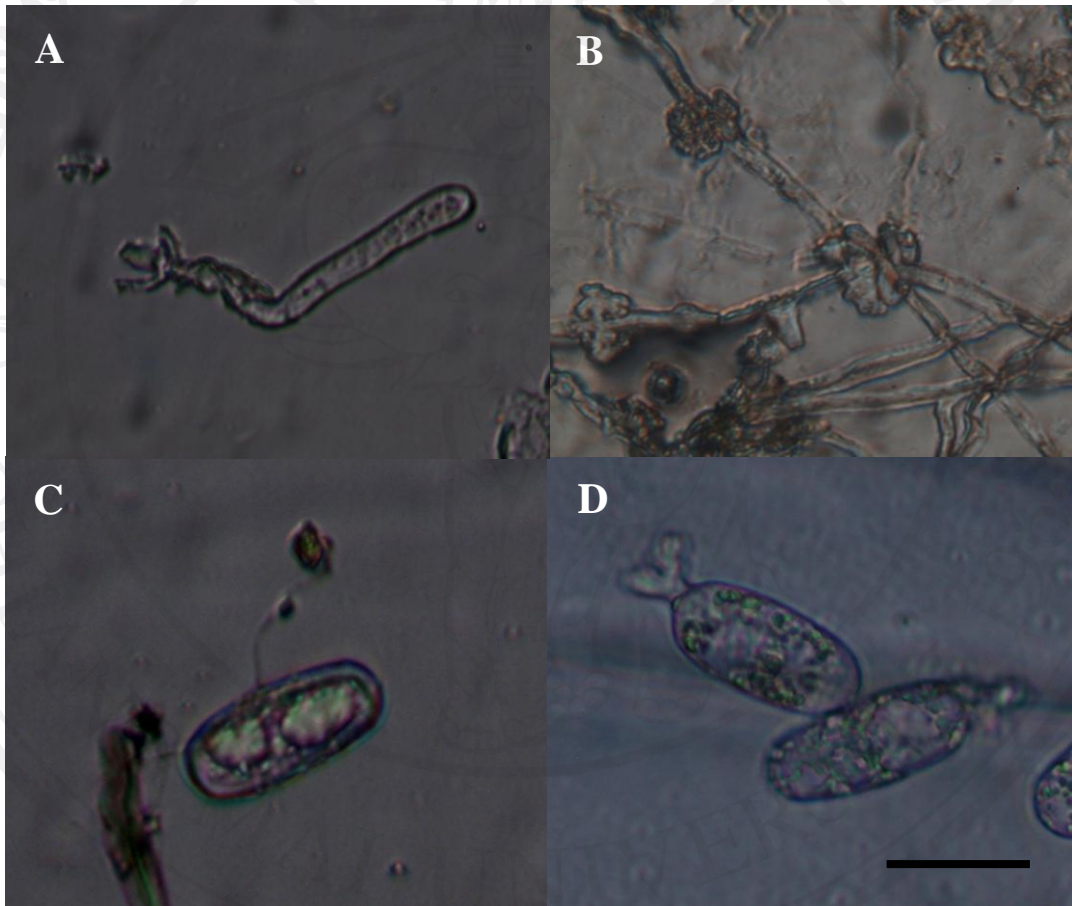


Fig. 62 *Erysiphe* MUMH 4995 on *Quercus kingiana*, Fagaceae.

A : Conidiophore. B : Hyphae with appressoria.

C : Conidium. D: Conidia with germ tubes (bar =50 μ m).

58. *Pseudoidium* on *Rhododendron* sp., Ericaceae; (กุหลาบพันปี)

Colonies: Mycelium is found on both sides of the leaves, amphigenous, ectophytic, white, superficial, covers the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy, 2.94–4.05 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, 64.7–82.35 (–85.29) \times (7.35–)8.09–10.29 μm (average 78.31 \times 8.63 μm); foot-cells are cylindrical (17.65–)20.59–27.94(–36.76) \times (5.88–)6.62–8.82(–10.29) μm (average 25.59 \times 7.9 μm), flexuous or slightly curved at the base, producing conidia followed by 2–4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric, (34.44–)35.29–38.23 \times 16.17–17.65 μm (average 36.18 \times 16.91 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 63).

Examination of Specimens on *Rhododendron* sp., MUMH 4724.

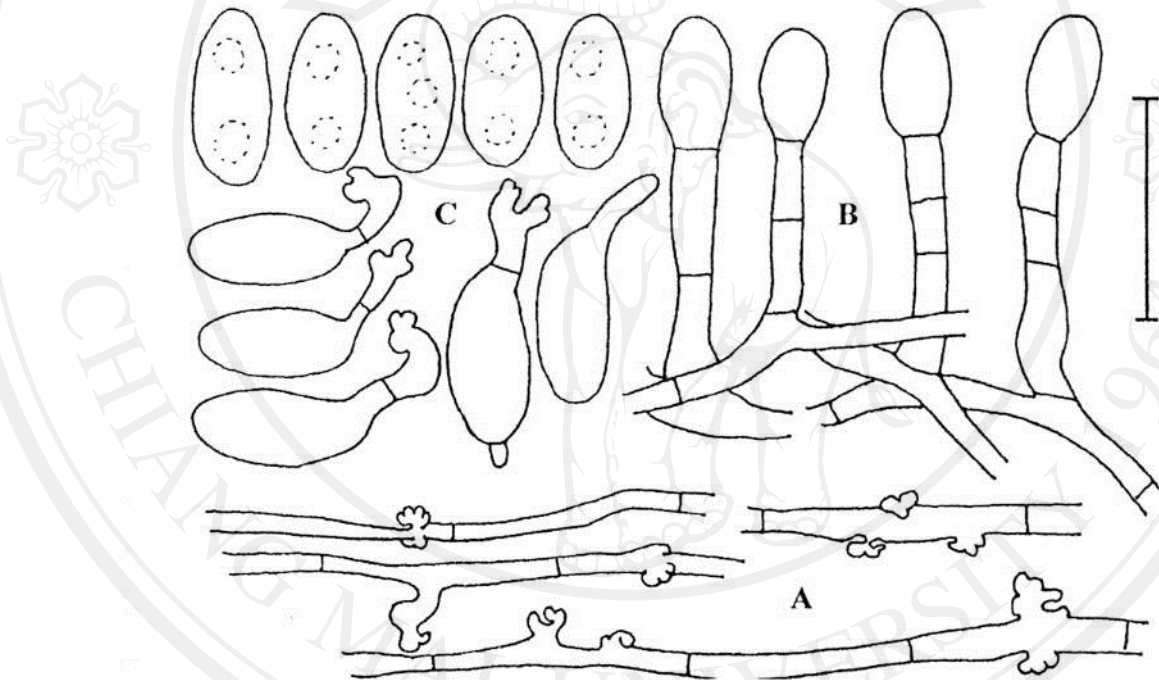


Fig. 63 *Oidium* subgenus *Pseudoidium* MUMH 4724 on *Rhododendron* sp.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

59. *Pseudoidium* on *Sesbania grandiflora*, Leguminosae; (เสถ)

Colonies: Mycelium is epiphyllous, mostly epiphyllous, white patches on the upper leaf surface, persistent to subevanescent; appressoria are well-developed, lobed to multilobed, single. Conidiophores are erect, arising from the side of mother cells, mostly central position, $(72.5-100-105(-117.5)) \times 7.5-10 \mu\text{m}$ (average $90.2 \times 8.3 \mu\text{m}$); foot-cells are cylindric, $(27.5-30-47.5(-50)) \times 7.5-10 \mu\text{m}$ (average $37 \times 8.35 \mu\text{m}$), flexuous or slightly curved at the base, producing conidia followed by 3–4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, $(32.5-35-42.5(-45)) \times 15-20 \mu\text{m}$ (average $38.08 \times 17.7 \mu\text{m}$), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 64).

Examination of Specimens on *Sesbania grandiflora* (L.) Poir., MUMH 1779,

MUMH 1788, MUMH 1808, MUMH 1828.

Five powdery mildews, e.g., *Erysiphe communis*, *E.pisi*, *Erysiphe* sp., *Leveillula turica*, and *Oidium* sp., on six species of *Sesbania* have been recorded throughout the world (Amano, 1986). *Oidium* sp. has been recorded on *Sesbania grandiflora* in Thailand, Srilanga and Vietnam. Arnaud (1921) reported on finding *L.taurica* as pathogen on *Sesbania* sp. around the world. *Oidiopsis*, anamorph of *Leveillula* is different from the fungus *Oidium* subgenus *Pseudoidium*. A phylogenetic tree (Fig. 73) constructed by the neighbor-joining method shows that the nucleotide sequence of the powdery mildew on *Sesbania grandiflora* has an identical sequence with *Oidium* subgenus *Pseudoidium* on *Tamarindus indica* collected in Thailand. Based on the morphological and molecular characteristics, this fungus should be identified as *Oidium* subgenus *Pseudoidium* due to having the teleomorph of *Erysiphe* sp.



Fig. 64 *Oidium* subgenus *Pseudoidium* MUMH 1828 on *Sesbania grandiflora*.

A : Hyphae and appressorium, B : Conidiophores,

C : Conidia and conidia with germ tubes (bar =50 μ m).

60. *Pseudoidium* on *Stachytarpheta indica*, Verbenaceae; (พืชมูกีเขี้ยว)

Colonies: Mycelium is amphigenous, patches, persistent to subevanescent; hyphae are substraight to wavy, branching at right angle, with a septum at the branching point; appressoria are lobed to multilobed, single or opposite in pairs. Conidiophores are erect, single on a hyphal cell, arising from the upper part of mother cells, central position to non-central, (78–)82–98(–102)×8 μm; foot-cells are cylindric, (10–)16–30(–46)×8 μm, slightly constricted at the branching point, producing conidia in single, with a basal septum at the branching point of the mycelium. Conidia are mostly oval, 34–42×(14–)15–17(–18) μm, without conspicuous fibrosin bodies, producing germ Polygoni-type.

Examination of Specimens on *Stachytarpheta indica* Vahl., MUMH 1843.

Two powdery mildews, i.e., *Oidium verbena* and *Oidium* sp., were recorded as pathogen on four species of *Stachytarpheta* throughout the world (Amano, 1986). They are *Stachytarpheta cayanensis*, *Stachytarpheta dichotoma*, *Stachytarpheta indica* and *Stachytarpheta jamaicensis*. Narayanaswamy and Ramakrishnan (1969) reported that *Oidium clitoria* on *Clitoria ternate* infected *Ipomoea obscura* and *Stachytarpheta indica*. To clarify the identification, sequence *Oidium* subgenus *Pseudoidium* on *Stachytarpheta indica* is combined with the data matrix of *Erysiphe* species to construct a phylogenetic tree. The sequence shows highest similarity with the sequence of *Oidium* subgenus *Pseudoidium* on *Zizyphus nammuralia* (99.1%). A phylogenetic tree (NJ tree) showed (Fig. 73) that *Oidium* subgenus *Pseudoidium* on *Stachytarpheta indica* forms a large clade with *Oidium* subgen. *Pseudoidium* on *Nicotiana tabaci*, *Glycine max*, *Boronia megastigma*, *Sedum bulbifrum*, *Ludwigia hyssopifolia* and *Zizyphus nummularia* and *Oidium neolycopersici* on *Lycopersicon esculentum* with 100% bootstrap value. They form clade at the base of phylogenetic tree. **This is the first report of powdery mildew on *Stachytarpheta indica* in Thailand and also in the world.**

61. *Pseudoidium* on *Stephania venosa* (Blume) Spreng, Menispermaceae;

(สมุนไพร)

Colonies: Mycelium is white superficial cover the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy, 3.69–4.92 μm wide; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, position mostly central, (41.82–)54.12–78.72(–83.64) \times 4.92–6.15 μm (average 53.38 \times 5.29 μm); foot-cells are cylindric (24.6–)27.06–41.82(–51.66) \times 6.15–7.38 μm (average 33.28 \times 7.08 μm), flexuous or slightly curved at the base, producing conidia followed by 3-4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid, (29.52–)31.98–44.28(–49.2) \times (14.76–)17.22–19.68 μm (average 38.25 \times 18.52 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 65).

Examination of Specimens on *Stephania venosa* (Blume) Spreng., MUMH 4725.

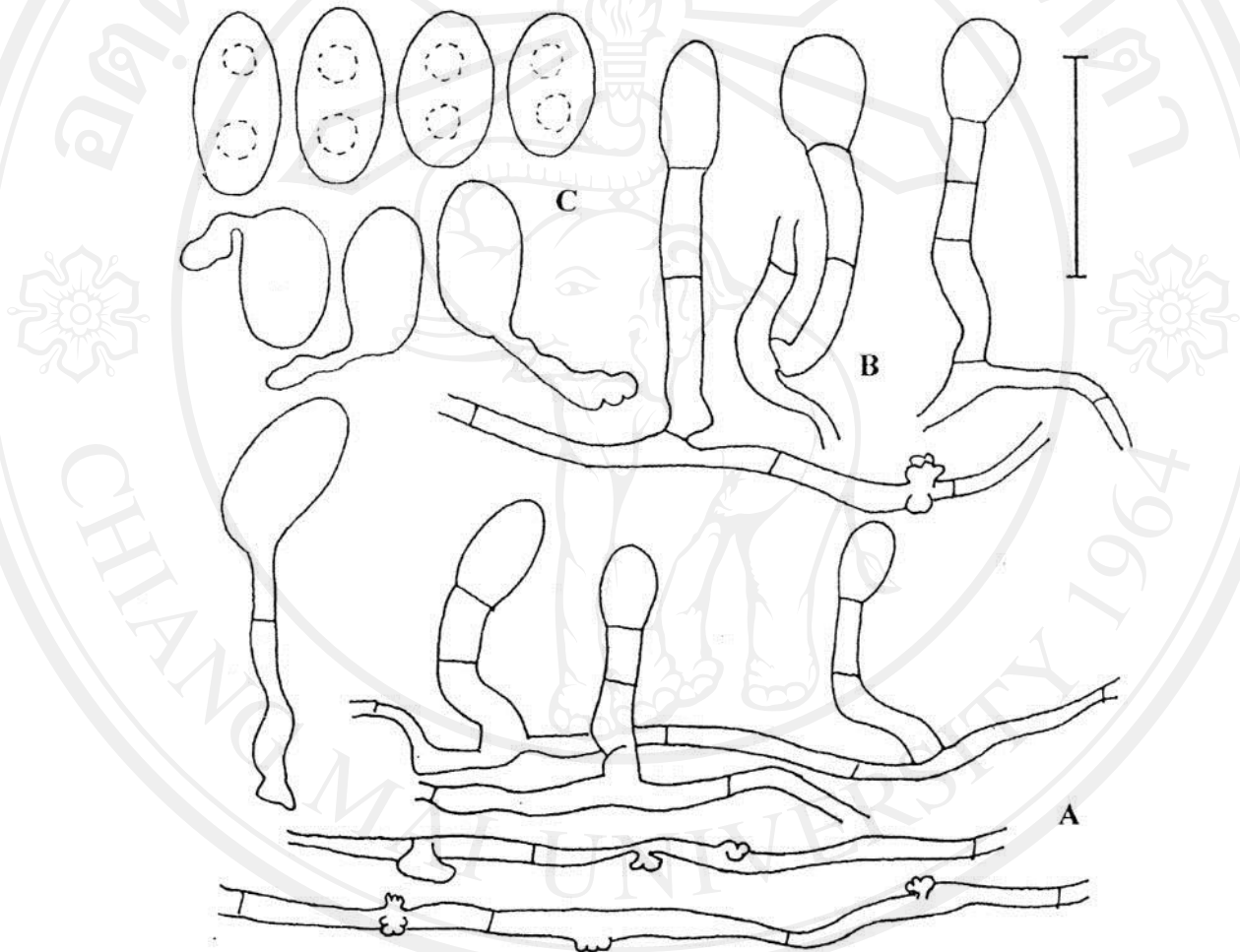


Fig. 65 *Oidium* subgenus *Pseudoidium* MUMH 4725 on *Stephania venosa*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

62. *Pseudoidium* on *Tamarindus indica*, Fabaceae; (มะขาม)

Colonies: Mycelium is abundantly epiphyllous, usually forming thin to moderately thick white film or circular to subcircular white patches on the upper leaf surface; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the upper part of mother cells, mostly central position, $(82.5-85-107.5(-112.5) \times 5-7.5 \mu\text{m})$ (average $95.75 \times 6 \mu\text{m}$); foot-cells are cylindric, $(27.5-32.5-37.5(-42.5) \times 5-7.5 \mu\text{m})$ (average $34.7 \times 6.2 \mu\text{m}$), flexuous or slightly curved at the base, producing conidia singly, followed by 2–4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, $(27.5-32.5-37.5(-45) \times 12.5-17.5 \mu\text{m})$, without conspicuous fibrosin bodies (Fig. 66).

Examination of Specimens on *Tamarindus indica* L., MUMH 1750, MUMH 1775.

Previously, Yen (1966a) claimed that the powdery mildew fungus found on *Tamarindus indica* was a new variety; *Oidium erysiphoides* f. *tamarindi*. Later, Braun (1982b) revised the name to be *Oidium tamarindi*. This fungus distributes in Asia (Ceylon, Java, Singapore, Taiwan) and Africa (Ghana, South Africa). The fungus recorded by Yen is identical to the fungus in this study. To clarify the identification, sequence the ITS region of this fungus is combined with the data matrix of *Erysiphe* species, and constructed a phylogenetic tree by the neighbor-joining method (NJ tree, Fig. 73). The result shows that ITS sequence of the powdery mildew on *Tamarindus indica* has an identical sequence with *Oidium* subgenus *Pseudoidium* on *Tamarindus indica* collected in Thailand.

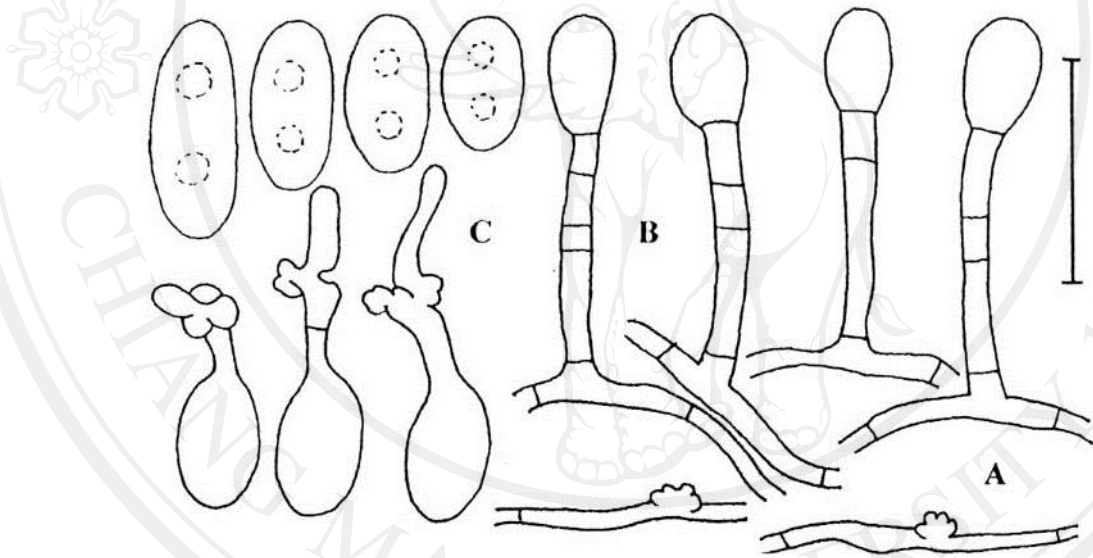


Fig. 66 *Oidium* subgenus *Pseudoidium* MUMH 1750 on *Tamarindus indica*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

63. *Pseudoidium* on *Tectona grandis*, Verbenaceae; (ถ้ำก)

Colonies: Mycelium is amphigenous, epiphyllous, white superficial cover the upper leaf surface, persistent to subevanescent; hyphae are substraight to somewhat wavy, 3.69 μm wide, appressoria coral-like single or opposite in pairs. Conidiophore are erect, single on a hyphal cell, arise from the side of hyphae to bend at the base, (48.1–)52–70.2(–80.6) \times 13–16.9(–20.8) μm (average 60.02 \times 14.43 μm); foot-cells are cylindric, 13–20.8(–26) \times 7.8–10.4(–11.7) μm (average 16.94 \times 8.84 μm), flexuous or slightly curved at the base, producing conidia singly, followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are ellipsoid-ovoid, (31.2–)32.5–36.4(–39) \times (16.9–)19.5–23.4 μm (average 34.32 \times 21.07 μm), without fibrosin conspicuous fibrosin bodies, and producing germ tubes on the shoulder (Polygoni-type), (Fig. 67). Chasmothecia are globose to subglobose, 120–180 μm in diameter ; appendages are numerous, 26–63 per ascoma ; straight to curved, hyaline, aseptate, apex, loosely to closely uncinat-circinate ; asci are 55–73 \times 35–53 μm , 2–7 per ascomata; ascospores are ellipsoid-ovoid, 22–28 \times 14–17 μm , 2–6 ascospores per ascus (Fig. 68).

Examination of Specimens on *Tectona grandis* L. f., MUMH 1489.

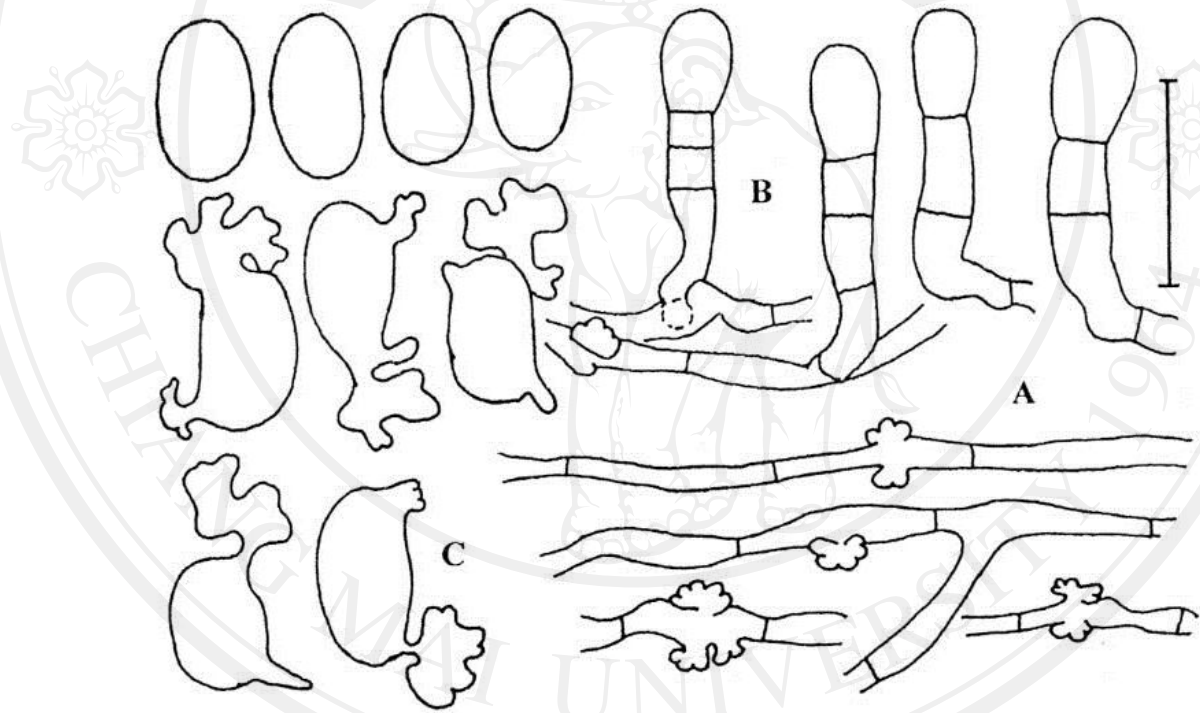


Fig. 67 *Oidium* subgenus *Pseudoidium* MUMH 1489 on *Tectona grandis*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubed (bar =50 μ m).

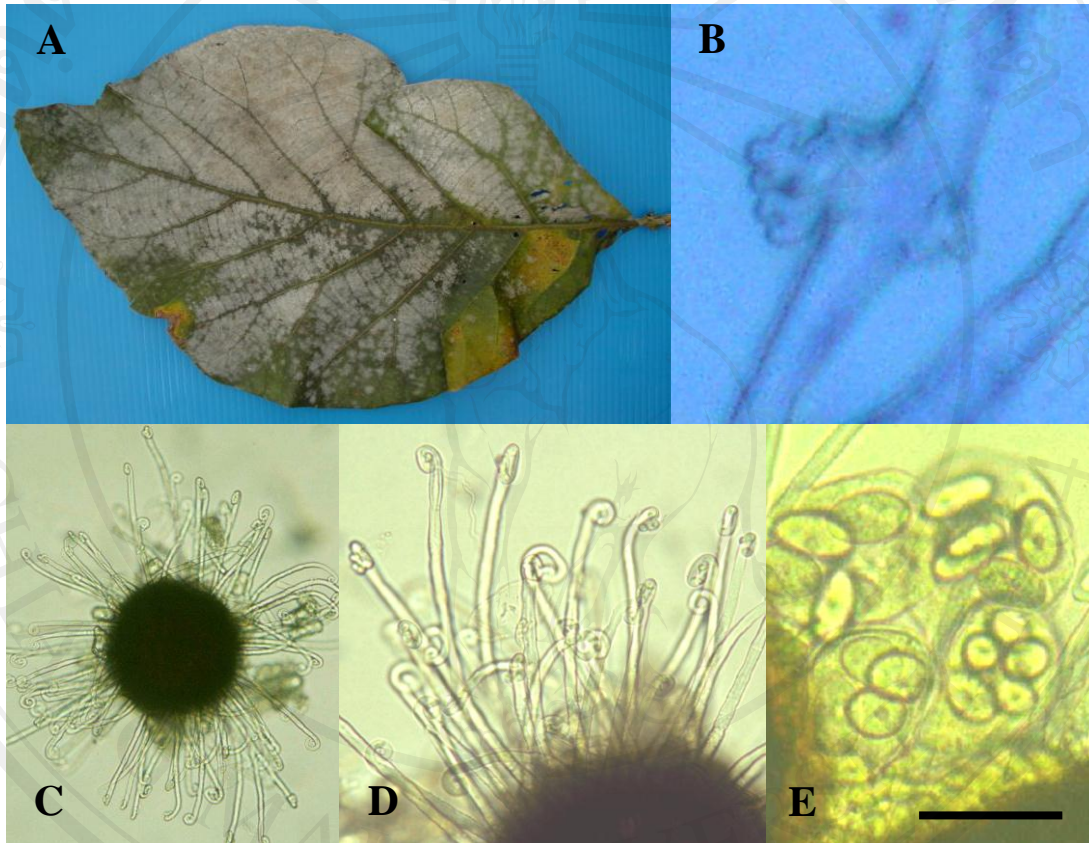


Fig. 68 *Erysiphe tectonae* MUMH 1489 on *Tectona grandis*.

A : Symptoms and colonies of *Pseudoidium*. B : appressoria.

C : Chasmothecium. D : Appendages.

E : Asci containing ascospores (bar =50 µm).

Salmon (1907) found *Erysiphe tectonae* on *Tectona grandis* in Asia (India and Burma). Both anamorphic and teleomorphic characteristics of the powdery mildew in the present study are similar to the previous record. Based on the morphological characteristics, powdery mildew on teak in Thailand should be identified as *E.tectonae*. To confirm the morphological identification, the sequence of powdery mildew on *T.grandis* is used to construct a phylogenetic tree (Fig. 72). The phylogenetic tree placed *E.tectonae* in the group consisting of *E.sengokui* and *E.tagashina* with 96% of bootstrap, although their sequence similarities were less than 90%. The phylogenetic tree also represents that *E.tectonae* is a unique species and distinct from other species. **Based on the morphology and sequence analysis, powdery mildew on *T.grandis* can be identified as *E.tectonae*. This is the first record of powdery mildew on *T.grandis* in Thailand.**

64. *Pseudoidium* on *Tiliacora triandra*, Menispermaceae; (ผักข่านาง)

Colonies: Mycelium is amphigenous, ectophytic and hypophyllous, white superficial, profusely branched and branching at right or narrow angles, 4.88-5.28 μm wide ; appressoria are well-developed, lobed to multilobed, opposite in pairs or single.

Conidiophores are erect, arising from the side of mother cells, mostly central position, 102.44(-109.76) \times 7.32-9.76 μm (average 96.02 \times 9.11 μm); foot-cells are cylindrical (26.83-29.27-39.02(-41.46) \times 7.32-8.54 μm (average 34.31 \times 7.6 μm), flexuous or slightly curved at the base, producing conidia singly, followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-ovoid (36.59-41.46(-43.9) \times 17.07-19.51 μm (average 38.29 \times 19.02 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 69).

Examination of Specimens on *Tiliacora triandra*, MUMH 4726.

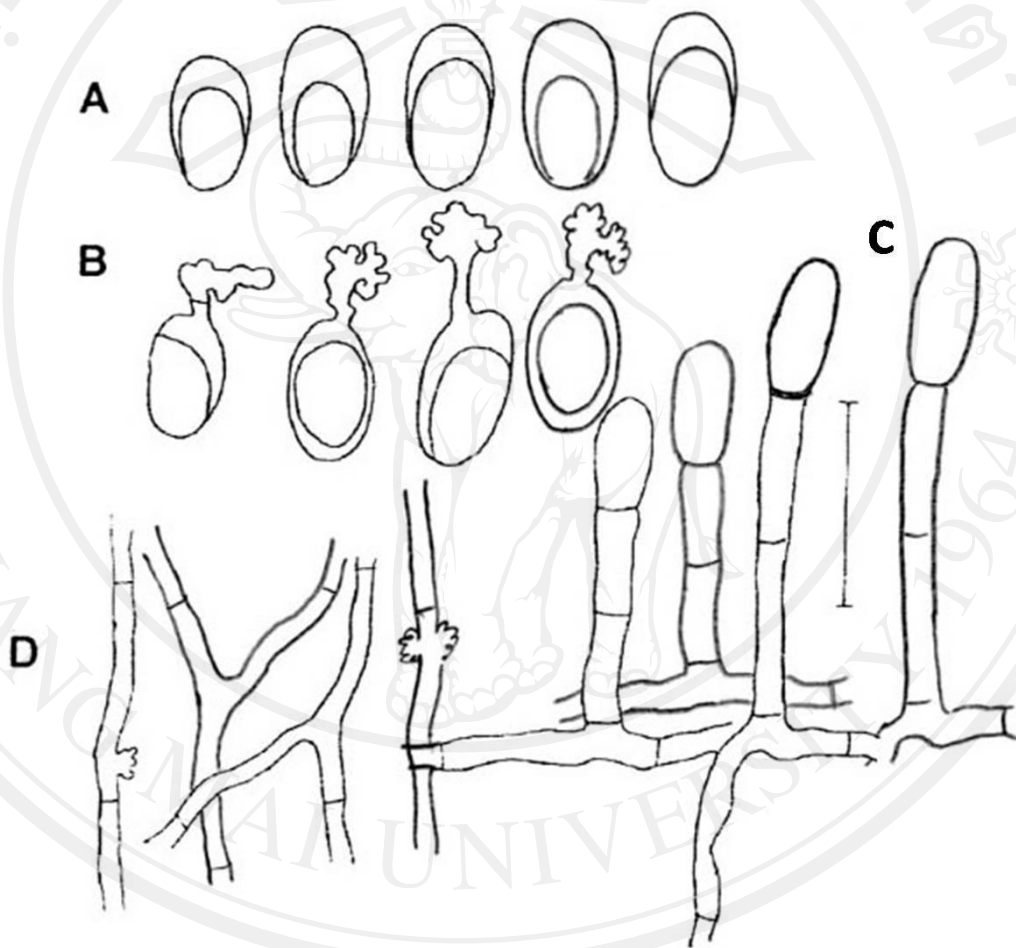


Fig. 69 *Oidium* subgenus *Pseudoidium* MUMH 4726 on *Tiliacora triandra*.

A : Conidia. B : Conidia with germ tubes. C : Conidiophores.

D : Hyphae and appressoria (bar =50 μ m).

65. *Pseudoidium* on *Urena lobata*, Malvaceae

Colonies: Mycelium is amphigenous, effuse or patchy, persistent to evanescent; hyphae are tortuose, substraight to somewhat wavy, 4–6 μm wide, branching at right or narrow angle, with a septum near the branching point. Conidiophores are erect, single or two on a hyphal cell, arising from the upper part of mother cells, mostly central position, 80–210 \times 7.5–10 μm , straight or mildly flexuous at the base; foot-cells are cylindric, 37.5–87.5 \times 7.5–10 μm , constricted at the branching point, producing conidia followed by 1–3 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ovoid-doliform, (27.5–)33–40(–47.5) \times (17.5–)19–23(–24) μm , without conspicuous fibrosin bodies, producing germ tubes at an end of the spore or on the shoulder (Polygoni-type), terminating in lobed appressoria.

Examination of Specimens on *Urena lobata* (Burm. f.) W. ETA., MUMH 1851.

Previously, Yen (1967) found *Oidium urenae* on *Urena lobata* in Taiwan. Later, Braun (1986) found *Oidium schmiedeknechtii* on the same host in Cuba and Taiwan. *Oidium urenae* differs from *Oidium schmiedeknechtii* by its very long foot-cells. Anamorphic features of the fungus in this study are similar to *O.schmiedeknechtii* (Braun, 1986). Owing to the specimen was contaminated with other fungi, it is unable to obtain the sequence of the powdery mildew of this plant. However, having the non-catenate conidia without fibrosin bodies, the powdery mildew fungus on *Urena lobata* may be identified as *Oidium* subgenus *Pseudoidium*.

66. *Pseudoidium* on *Viburnum inopinatum*, Capritoliaceae; (อุณ)

Colonies: Mycelium found on the lower of leaves is amphigenous, ectophytic and hypophyllous, white superficial, profusely branched and branching at right or narrow angles, 3.69-4.92 μm wide ; appressoria are well-developed, lobed to multilobed, opposite in pairs or single. Conidiophores are erect, arising from the side of mother cells, mostly central position, (86.1-)91.02-120.54(-147.6) \times (9.84-)11.07-14.76(-17.22) μm (average 119.97 \times 13.6 μm); foot-cells are cylindric (19.68-)22.14-31.98(-41.82) \times (4.92-)6.15-8.61 μm (average 27.55 \times 7.7 μm), flexuous or slightly curved at the base, producing conidia followed by 1-2 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, ellipsoid-cylindric (31.98-)34.44-41.82(-55.35) \times 14.76-17.22(-18.45) μm (average 38.13 \times 15.67 μm), without conspicuous fibrosin bodies, containing oil drop, producing germ tubes on the shoulder (Polygoni-type), terminating in lobed appressoria (Fig. 70).

Examination of Specimens on *Viburnum inopinatum*, MUMH 4728.

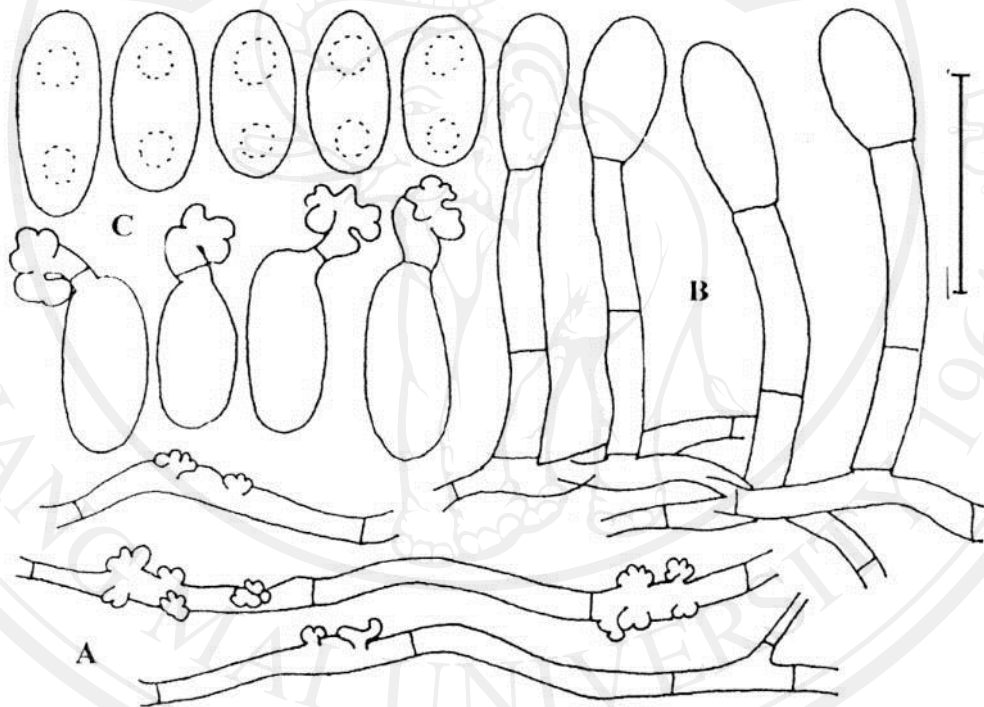


Fig. 70 *Oidium* subgenus *Pseudoidium* MUMH 4728 on *Viburnum inopinatum*.

A : Hyphae and appressorium. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

67. *Pseudoidium* on *Vitis vinifera*, Vitaceae; (อู่หม)

Colonies: Mycelium amphigenous, mostly epiphyllous, persistent to subevanescent, appressoria are well developed, multilobed to moderately lobed, opposite in pairs or single. Conidiophores are single (52.5–)72.5–115(–127.5)×7.5–8 μm (average 95×7.6 μm); foot-cells are cylindric, (20–)22.5–37.5(–67.5)×7.5 μm (average 33.26×7.6 μm), broader upwards, moderately to flexuous or twisted at the base of foot-cells, producing conidia followed by 2–4 cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, (30–)32.5–40(–42.5)×(–12.5)15–17.5 μm (average 36.3×15.2 μm), without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), long to moderately long, terminating in lobed appressoria.

Examination of Specimens on *Vitis vinifera* L., MUMH 1835.

68. *Pseudoidium* on *Zizyphus nummularia*, Rhamnaceae; (พุทธา)

Colonies: Mycelium is amphigenous, abundantly epiphyllous, usually forming thin to moderately thick white film or circular to subcircular white patches on the upper leaf surface; hyphae are substraight to somewhat wavy, 5–7 μm wide, branching at right or narrow angle, with a septum near the branching point; appressoria are well-developed, lobed to multilobed, single. Conidiophores are erect, arising from the upper part of mother cells, mostly central position, 129–253 \times 7–8 μm ; foot-cells are cylindric, 23–103 \times 7–8 μm , flexuous or slightly curved at the base, producing conidia followed by 2–4 shorter cells, with a basal septum at the branching point of the mycelium. Conidia are formed singly, cylindric oval, (31–)33–44(–49) \times (15–)18–23(–26) μm , without conspicuous fibrosin bodies, producing germ tubes on the shoulder (Polygoni-type), long to moderately long, terminating in lobed appressoria (Fig. 71).

Examination of Specimens on *Zizyphus nummularia* (Burm.f.)Wight. & Arn.,

MUMH 1799.



Fig. 71 *Oidium* subgenus *Pseudoidium* MUMH 1799 on *Zizyphus nummularia*.

A : Hyphae and appressoria. B : Conidiophores.

C : Conidia and conidia with germ tubes (bar =50 μ m).

Two species of *Zizyphus* i.e., *Zizyphus nummularia* and *Zizyphus mauritiana* have been recorded as host plants of *E.acacia*, *Oidium* sp. and *Leveillula* sp. throughout the world (Amano, 1986). Braun (1982c) described *Oidium zizyphi* on *Zizyphus mauritiana* in India, Thailand and Taiwan. The fungus in this study somewhat differs from *Oidium zizyphi* in its larger conidial size and longer-conidiophores. The teleomorph of this fungus has not been found in Thailand. So, only the anamorphic state is described in details. To clarify the identification, sequence *Oidium* subgenus *Pseudoidium* on *Zizyphus mauritiana* is combined with the data matrix of *Erysiphe* species to construct a phylogenetic tree. A phylogenetic tree (NJ tree, Fig. 73) shows that *Oidium* subgenus *Pseudoidium* on *Zizyphus mauritiana* forms a large clade with *Oidium* subgen. *Pseudoidium* on *Nicotiana tabaci*, *Glycine max*, *Boronia megastigma*, *Sedum bulbifrum*, *Stachytarpheta indica* and *Ludwigia hyssopifolia* and *Oidium neolycopersici* on *Lycopersicon esculentum* with 100% bootstrap value and places at the basal position of the phylogenetic tree.

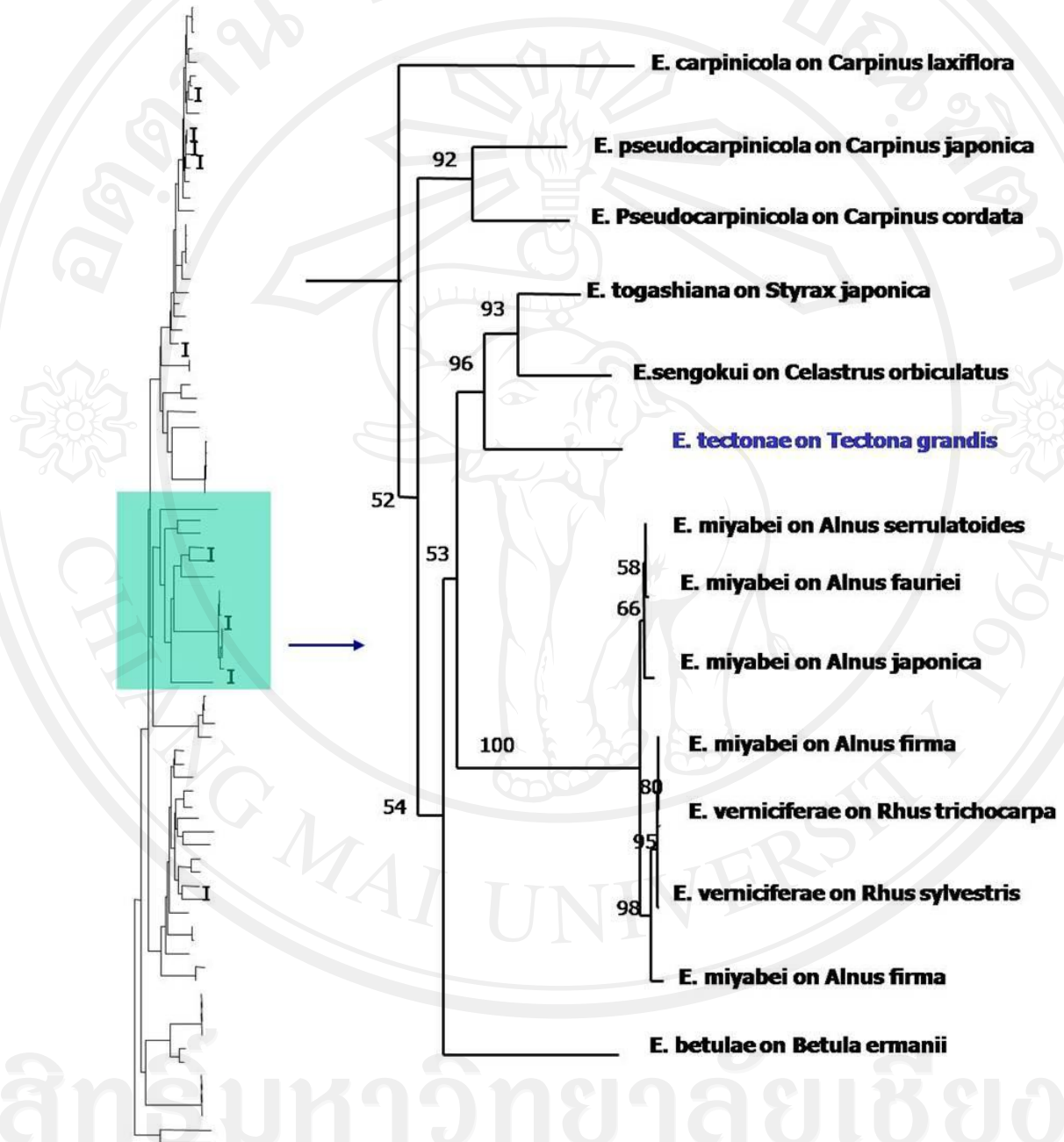


Fig. 72 NJ tree derived from sequence of ITS1, ITS2, and the 5.8S rRNA gene from *Erysiphe* plus *Erysiphe tectonae* on *Tectona grandis*. The number above the branches represent the proportion (percent) of bootstrap replications.

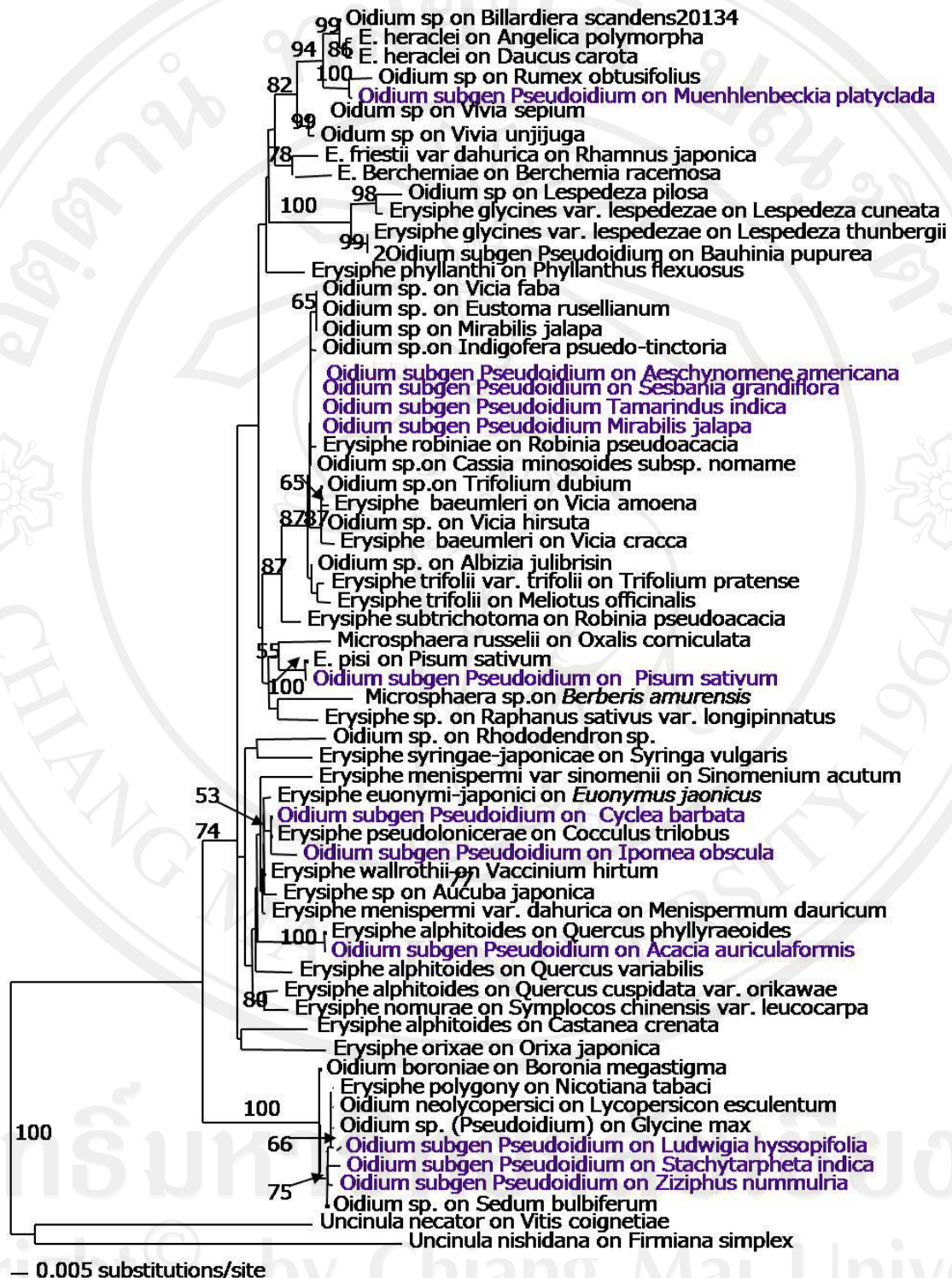


Fig. 73 NJ tree inferred from sequences of ITS1, ITS2, and the 5.8S rDNA gene from *Erysiphe* section *Erysiphe* plus *Oidium* subgenus *Pseudoidium* (indicated in blue). The bootstrap values of 1000 replications are shown above the branches.

Oidium subgenus *Pseudoidium* occurred on 59 host plant species covering 34 host plant families. Of these host plants, there is only one species of powdery mildew producing both anamorphic and teleomorphic states occurred on *Tectona grandis*. Salmon (1907) firstly reported on powdery mildew of *Tectona grandis* in India. He erected *Uncinula tectonae* as the powdery mildew on this plant. Unfortunately, he did not describe the anamorphic state of this species. Later in 1965 Kothari *et al.* examined powdery mildew on *Tectona grandis* from Rajasthan, Pakisathan. Luckily, they observed both anamorphic and teleomorphic states of this fungus. They compared those characters with *U.tectonae* observed by Salmon (1907). Although there are some differences in teleomorphic state and the presence of anamorphic state in the report of Kothari *et al.*, (1965) they did not name a new species. They considered that Salmon did not report anamorphic state because he did not find anamorph and teleomorph state simultaneously. So *U. tectonae* is still the only one species of powdery mildew of *Tectona grandis*. Braun (1987) observed and described powdery midew of *Tectona grandis*. He made a good description of anamorphic and teleomorphic states of this species.