Erysiphaceae of New Zealand
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Preface

In 1974 I began the study of the New Zealand Erysiphaceae to satisfy my curiosity as to whether different species of powdery mildew are more or less indistinguishable in their imperfect state, as is generally believed, or whether, as is the case in most fungi, species which can be distinguished in their perfect state also possess morphological differences in their imperfect state. I also thought it was strange that only few species had been reported on few host plants although climatic conditions were suitable for the development on a wide range of plants.

Most of this study was carried out at the Mt Albert Research Centre, Ministry of Agriculture and Fisheries, Auckland, and extensive use was made of the library of the adjoining Plant Diseases Division, Department of Scientific and Industrial Research (D. S. I. R.). Many of my new recordings have been deposited in the herbarium of the Plant Diseases Division, DSIR. At the completion of my study of living collections of powdery mildews, I examined herbarium samples collected throughout New Zealand.

Introduction

The Erysiphaceae of New Zealand have never been extensively studied or monographically treated and information on the species and their host plants is scattered throughout various annual reports and plant pathological literature. Hirata (1966), in a survey of world literature, and Blumer (1967), in his famous monograph, concluded that powdery mildews are relatively poorly represented in New Zealand. In a list of plant diseases recorded in New Zealand, Dingley (1969) listed 14 species of Erysiphaceae but expressed doubt whether one of these, Erysiphe carpophila, was a powdery mildew. The list by Dingley does not include most of the records in the national herbarium at the Mt Albert Research Centre, nor, several published species. Dingley (1969) stated that cleistothecia were rare and occurred only in the South Island. Boeseewinkel (1976a) reported the finding of cleistothecia in the North Island and compiled information on their occurrence.
by studying records in the literature and herbarium. Hammett (1977) studied Erysiphaceae on 66 host plants and found no differences between Erysiphe carpophila, E. cruciferarum, E. pisi, E. polygoni and E. ranunculi. He stated that the characteristics of mycelium, appressoria, haustoria and conidial dimensions have little diagnostic value but gave no substantiating information on their morphology.

Boesewinkel (1977) reported 34 species on 112 host plants and provided a key for their identification, based on characteristics of the imperfect state. The present work attempts to bring information together and gives 228 host records.

History

Most of the powdery mildews of New Zealand appear to have been introduced by settlers from Europe during the last two centuries. This would explain the preponderance of European species of mildew and the paucity of Asian and endemic species (Boesewinkel, 1978).

The oldest record is Erysiphe densa on Aristotelia racemosa (Berkeley, 1855). Cleistothecia of this powdery mildew have been found on several occasions in both the North and the South Island.

Other early records (conidial states only) are: Microsphaera grossulariae on Ribes uva-crispa (Kirk, 1899); Uncinula necator on Vitis vinifera (Kirk, 1901); Oidium chrysanthemi on Chrysanthemum sp. and Sphaerotheca pannosa on Rosa sp. (Kirk, 1906); Podosphaera leucotricha on Malus sylvestris (Kirk, 1908) and Blumeria graminis on Triticum aestivum (Kirk, 1909).

Several of these plants had been introduced as cuttings or plants which may have been infected.

Further interesting recordings were made during the period when the excellent plant pathologist Cunningham investigated diseases of economically important crops throughout the country. Podosphaera oxyacantha was reported on stonefruit (Cunningham, 1921) and Sphaerotheca alchemillae on Fragaria sp. (Cunningham, 1922). The first New Zealand description of cleistothecia of Podosphaera leucotricha, on shoots, leaves and petioles of apple, was given by Cunningham (1923). Sydow (1924) received from Cunningham a species which formed cleistothecia on the indigenous Weinmannia sylvicola and gave it the name Erysiphe carpophila. A related fungus, E. rubicola, was newly described from two indigenous species of Rubus (Murray, 1927). Most of these records can be verified today.

During the next 42 years, Microsphaera alphitoides (Brien and Dingley, 1951), Uncinula australiana (Dingley, 1969) and 57 host records were reported, often without description. Several host records have not been verified, such as Erysiphe cichoracearum on Begonia spp. and Kalanchoe sp. and E. polygoni on Phaseolus coccineus and Ph.
vulgaris (DINGLEY, 1965); Podosphaera leucotricha on Cydonia oblonga
(BRIEN and DINGLEY, 1951); P. oxyacanthae on Prunus persica,
Sphaerotheca alchemillae on Rubus spp. (DINGLEY, 1969) and S. pannosa
on Rubus cissoides (BRIEN and DINGLEY, 1955).

Recently the first recording of Erysiphe ranunculi and the first
finding of cleistothecia of E. cichoracearum were published (BOESE-
WINKEL, 1976a); Microsphaera begoniae was newly recorded (BOESE-
WINKEL, 1976b). During a study of powdery mildews in the Auckland
area, 19 new species were discovered and in total 34 species were
reported (BOESEWINKEL, 1977). In this monograph, 39 species are
included on 202 host plants. In the future more new host recordings
can be expected, especially for species which are known to have a wide
host range such as “Erysiphe polyphaga”, Phyllactinia guttata and
Sphaerotheca fuliginea. Several of the species which appear to be
extending their area elsewhere in the world have not yet reached
New Zealand. One of these, Leveillula taurica, can be expected to
arrive sooner or later because in recent years it has spread from Asia
to Australia and the Pacific Islands around New Zealand.

Taxonomy and Nomenclature

The delimitation of genera and species follows BLUMER
(1933; 1967), HOMMA (1937), JUNELL (1967) and SPEER (1975a). The
morphology of the imperfect states of all species is studied extensively,
as for many species no cleistothecia have been found in New Zealand.
CLEISTOTHECIA are only known to be produced by Blumeria graminis,
Erysiphe carophila, E. cichoracearum, E. cruciferarum, E. densa,
E. ranunculi, E. rubicola, Podosphaera leucotricha, Sphaerotheca
fuliginea and S. pannosa. Previous taxonomic treatments of Erysipha-
ceae do not provide adequate information on the imperfect states and
therefore a detailed study of the world literature was necessary
(BOESEWINKEL, in prep.) to establish the correlation with known
perfect states. Valuable information was obtained from De BARY
(1870), Blumer (1933), Foex (1924), Freesiuus (1852), Hirata (1942),
Neger (1902), Salmon (1905a), Tulasne (1861), Viennot-Bourgin
(1960) and Zaracovitis (1965).

Numerous measurements of conidia and conidiophores have been
carried out. In agreement with Bouwens (1924) the extreme values of
the conidial size are considered of little value and therefore the most
frequently occurring size is given with, in brackets, the extremes which
may occur rarely.

Essential characteristics are the presence or absence of con-
spicuous, welldveloped, fibrosin bodies; the production of conidia
singly or in long chains; the size, shape and position of appressoria and
haustoria; the size, shape and structure of the generally 3-celled
conidiophores, especially of their foot-cell; the size, shape and germination pattern of conidia; and the cell-size, shape, branching pattern and location of the mycelial hyphae. This is the first study which reports information on so many characteristics.

In several species a great variation occurred in the size and shape of the conidia, especially their length whereas the width showed more constant values. Variation was more obvious in species with large conidia such as *Erysiphe cruciferarum*, *E. pisi*, *E. trifolii*, *Microsphaera begoniae* and *Phyllactinia guttata*, than in species with small conidia such as *E. mougeotii*, *M. euonymi-japonici* and *Sphaerotheca pannosa*. Conspicuous variation occurred in the shape of germ tubes and the type of appressoria they produce, while the position of germ tubes, whether on the end or side of conidia, was more constant. I had previously studied the germination pattern on the host and on glass slides placed on the laboratory bench at room temperature (Boesewinkel, 1977) but during the present study conidia were also germinated in the dark at room temperature. This frequently resulted in a more uniform pattern of germination. Variation was also observed in the shape of appressoria and the foot-cells of conidiophores.

The nomenclature of Junell (1965, 1967) is followed.

**Distribution and Occurrence**

Many of the conspicuous species have been collected throughout the country and appear to have a wide distribution, such as *Erysiphe cichoracearum*, *Microsphaera euonymi-japonici*, *Podosphaera leucotricha* and *Sphaerotheca pannosa*. Less is known about the distribution of inconspicuous species such as *M. hypophylla*, *M. viburni*, *Phyllactinia guttata* and *Sawadaea bicornis*; several of these have only recently been discovered and have been collected from only few areas.

The climatic conditions in the Auckland area favour the growth of many plants and permit cultivation of all varieties of plants grown in New Zealand. Several deciduous trees and shrubs retain their leaves over a long period and diseases thrive. Many species of powdery mildew are extremely common and on a short walk through an area with gardens, eight or more species can be found. Many powdery mildews can be observed nearly all the year round for example *Blumeria graminis*, *E. aspervifoliorum*, *E. cichoracearum*, *E. mougeotii*, “*E. polyphaga*”, *M. begoniae*, *M. euonymi-japonici*, *M. polonica*, *Oidium oxalidis*, *Ph. guttata* and *S. fuliginea*. Whereas *M. viburni* and *Uncinula necator* are mainly found during the summer, *E. galeopsidis* and *M. hypophylla* have been observed during the winter months.

**Host Plants**

In many areas of the world, the sudden appearance of a powdery mildew on a previously uninfected plant species cannot be easily
explained. It is possible that either a new species arrived from another country or that a local species extended its host range. As New Zealand is well isolated by sea and air from other countries, and plant quarantine restricts the importation of plant material, new introductions of powdery mildews rarely occur. In many cases, new host records of powdery mildews can therefore be attributed to the extension of the host range of existing species rather than to the sudden appearance of new species.

Exotic host plants outnumber the indigenous hosts and include weeds of the genera Aster, Bromus, Epilobium, Erodium, Fumaria, Hypericum, Lotus, Lupinus, Melilotus, Modiola, Oxalis, Papaver, Plantago, Poa, Ranunculus, Rosa, Senecio, Solanum, Solidago, Trifolium, Valerianella, Verbena, Veronica and Urtica. As several weeds are widespread, they can function as a reservoir of infection. Economically important host plants include the genera Brassica, Cucumis, Cucurbita, Cydonia, Cyphomandra, Fragaria, Hordeum, Lycopersicon, Malus, Pastinaca, Pisum, Prunus, Pyrus, Rosa, Solanum, Trifolium and Vitis. The numerous ornamental host plants include the genera Acer, Aster, Begonia, Chrysanthemum, Cotinus, Dahlia, Eucalyptus, Euonymus, Hardenbergia, Hydrangea, Kalanchoë, Lagerstroemia, Sedum and Viburnum.

Of great interest is that several European species of powdery mildew have found host plants amongst the rich indigenous flora which is present throughout the country in gardens, parks, road sides and farmland. Indigenous host plants include the genera Alectryon, Aristotelia, Brachyglottis, Cardamine, Clematis, Coriaria, Dysoxylon, Geranium, Hebe, Hoheria, Olearia, Rubus, Solanum, Sophora, Vitex and Weinmannia. Of these hosts, Aristotelia, Rubus and Weinmannia are infected with three endemic species of powdery mildew which closely resemble European species of powdery mildew. The remaining indigenous hosts are infected with the European species E. cichoracearum, E. cruciferarum, E. galeopsidis, E. heraclei, E. pisi, E. ranunculi, E. trifolii, Ph. guttata, Sa. bicornis, S. fugax and S. fuliginea. Several of the susceptible indigenous host plants are closely related to host plants known overseas, for example, Clematis (Ranunculaceae), Geranium (Geraniaceae), Solanum (Solanaceae), Brachyglottis and Olearia (Compositae), Hoheria (Malvaceae) and Sophora (Papilionaceae). More interesting is Sa. bicornis on the indigenous host Alectryon which belongs to the same order Sapindales as the overseas host Acer. Unusual are the records on Coriaria (Coriariaceae), Hebe (Scrophulariaceae) and Vitex (Verbenaceae), on which powdery mildews have been found which occur overseas on unrelated host plants. Obviously the host range of many species of powdery mildew is still incompletely known because the literature does not yet include the hosts of the numerous unidentified species of Oidium, Oidiopsis and Ovulariopsis.

2 Sydowia, Vol. XXXII, 1979
This work is based on freshly collected living samples of the conidial state, collected in the Auckland area, and on samples collected by me on field trips throughout the country and in my large garden in Waitakere, 30 km north of Auckland. Collections have been made daily and were studied microscopically, mounted in water. I took the microphotographs with an Asahi Pentax camera which was attached to a Nikon microscope with an adapter. Germination of conidia was studied on the host or on glass slides, as reported previously (Boesewinkel, 1977) in the light or dark at room temperature and after one day incubation. Herbarium samples were examined but proved to be of little value as fibrosin bodies and the original shape of appressoria and conidia could not be observed. Cleistothecia were studied when freshly collected. They occurred on Aristotelia fruticosa, A. serrata, Aster ericoides, Delphinium ajacis, D. cultorum, Ranunculus asiaticus, R. repens, Weinmannia racemosa and W. sylvicola. In New Zealand cleistothecia have been frequently found on Aristotelia, Delphinium, Ranunculus, Weinmannia, and cereals. There are only few collections known from other hosts such as Brassica, Coriaria, Cucurbita, Malus and Rosa.

**BLUMERIA GoLOVIN ex SPEER** (1975)

Blumeria is characterised by cleistothecia with many 8-spored asci and unbranched or irregularly branched appendages. The cleistothecia possess a sub-cortical layer between the atro-sclerocortex and the hymenium.

The conidial state produces a characteristic conidiophore with a bulbous swelling of the foot cell. Conidia are produced in long chains and lack conspicuous fibrosin bodies. Appressoria are unlobed, well-developed, nipple-shaped. Conidia produce germ tubes on the side. Haustoria are characteristically multi-lobed and digitate. The genus is morphologically related to Erysiphe of which the section Euoidium produces conidia in long chains, lacks conspicuous fibrosin bodies and possesses unlobed, rarely moderately lobed, appressoria.


Type on Triticum sp.; France.

On leaves, stems and inflorescences. Mycelium thin or dense, white, occasionally ochreous or rusty brown-red late in summer. Brown sickleshaped bristles can be formed at the time of the formation of cleistothecia. Mycelial hyphae flexuous with geniculate and straight areas, branching at various angles including right angles, frequently near a septum. Hyphal cells (35—43(—53) × 3.5—5.5 μm. Appressoria unlobed, nipple-shaped, 3.5—7 μm wide, produced singly or opposite in pairs on alternating or consecutive cells. Conidiophores 60—90 × 4—7 μm producing conidia in chains. Foot-cells of conidiophores
20—40 × 5—7 μm, with a characteristic swelling of 12—15 μm wide at about half way their length and followed by cells 12.5—25 μm long. Conidia ellipsoid or lemon shaped, (20—)24—30(—35) × 8—16 μm, occasionally up to 2 μm wider at one end or slightly constricted at the centre. No well-developed conspicuous fibrosin bodies present. Germ tubes on side or end of conidia, simple, straight or occasionally flexuous, about 12—50 × 2.5—4 μm and terminating in an unlobed appressorium 4—5 μm wide. Haustoria characteristically digitate. Cleistothecia have been found on cereal crops but were not studied by me.

The typical shape of the conidiophores and haustoria separate *Bl. graminis* from other species which produce conidia in long chains. This is the only species known to occur on Gramineae. Serious attack occurs on grasses richly supplied with nitrogen and/or growing in the shade. So far this mildew has not been found on any of the numerous indigenous grasses.

*ERYSIPHE* DC. ex Fr. (1821)

*Erysiphe* is characterised by cleistothecia with many asci and unbranched or irregularly branched appendages. In species of the section Euoidium the asci contain generally 2 spores. In the Pseudoidium section the asci contain 3—6 or 6—8 spores.

The conidial state produces no conspicuous fibrosin bodies and can be divided into the Euoidium section, where conidia are produced in long chains and appressoria are generally unlobed, and the Pseudoidium section where conidia are formed singly and appressoria are generally lobed. The haustoria are globose or pear shaped and unlobed, rarely moderately lobed.

1. Conidiophores producing conidia in chains
   A. Appressoria moderately lobed; germ tubes on side of conidia
      on Geraniaceae: *Geranium*                           *E. galeopsidis*
      on Labiatae: *Rosmarinus*                          *E. galeopsidis*
B. Appressoria unlobed

I. Appressoria well-developed, nipple-shaped; germ tubes generally produced on the end of conidia
   on Compositae: Aster and many other genera
   on Cruciferae: Cardamine
   on Cucurbitaceae: Cucumis, Cucurbita
   on Gesneriaceae: Sinningia
   on Malvaceae: Hibiscus
   on Myrtaceae: Eucalyptus
   on Plantaginaceae: Plantago
   on Scrophulariaceae: Penstemon
   on Solanaceae: Nicotiana, Petunia, Solanum

II. Appressoria nipple-shaped, often poorly developed and nearly inconspicuous; germ tubes frequently on side of conidia
   on Compositae: Helianthus
   on Cucurbitaceae: Cucurbita, Cucumis
   on Malvaceae: Hibiscus, Modiola
   on Myrtaceae: Eucalyptus
   on Solanaceae: Lycopersicon, Nicotiana, Petunia, Solanum

III. Appressoria nipple-shaped, poorly developed; germ tubes on end of conidia
   on Labiatae: Thymus

2. Conidiophores producing conidia singly

A. Appressoria moderately lobed
   on Papilionaceae: Lathyrus, Lupinus, Melilotus, Pisum
   on Scrophulariaceae: Hebe

B. Appressoria multi-lobed or moderately lobed

I. Conidiophore straight; germ tubes simple
   on Umbelliferae: Pastinaca
   on Meliaceae: Dysoxylum

II. Conidiophores straight or with a foot-cell which is slightly bent or decreases in width from the base upwards; germ tubes simple, rarely slightly branched
   on Cruciferae: Brassica, Cardamine, Iberis, Raphanus
   on Papaveraceae: Papaver
   on Capparidaceae: Cleome
on Fumariaceae: *Fumaria E. cruciferarum*

on Geraniaceae: *Erodium, Geranium E. cruciferarum*

C. Appressoria multi-lobed

I. Conidiophores moderately long, flexuous at the base; conidia ellipsoid-cylindric

on Papilionaceae: *Brachysema, Lathyrus, Lotus, Trifolium, Wistaria E. trifolii*

II. Conidiophores moderately long, flexuous at the base; conidia cylindric-ovoid; germ tubes simple or branched or forked

on Cunoniaceae: *Weinmannia E. carpophila*

III. Conidiophores moderately long, straight; conidia cylindric

on Elaeocarpaceae: *Aristotelia E. densa*

IV. Conidiophores short or moderately long, straight; conidia ovoid; germ tubes simple or branched

on Ranunculaceae: *Anemone, Aquilegia, Clematis, Delphinium, Nigella, Ranunculus E. ranunculi*

2. *Erysiphe asperifoliorum* GREV. 1824. — *Fl. Edin.: 461*

Type on *Symphytum* sp.; Scotland.

On leaves, stalks and inflorescences. Mycelium thin or moderately dense. Hyphae moderately flexuous, branching at right angles, often near a septum. Hyphal cells (60—)67—75(—80) x 5—7.5 μm. Appressoria unlobed nipple-shaped or poorly developed. Conidiophores 105—200(—440) x 10—12.5 μm, simple or occasionally branched at the base, producing conidia in chains. Foot-cells of conidiophores either straight and occasionally constricted at the base or, rarely, branched near the top, (17—)30—63(—400) x 10—12.5 μm, followed by two cells of 14—20(—100) μm long. Conidia ovoid-cylindric, 32—35(—42) x (15—)16—18(—23) μm. No well developed fibrosin bodies present. Germ tubes on side or end of conidia, simple, short, occasionally bent or helicoid, often broadened, 10—15 x 5—10 μm. Haustoria globose, 17.5—20 μm.

The often poorly developed appressoria distinguish this species from *E. cichoracearum*. The characteristic germ tubes have been illustrated by ZARACOVITIS (1964, 1965).

on *Veronica arvensis* L. (new record).


Type on *Lycopus europaeus* L., Germany.

On leaves. Mycelium thin, white. Hyphae moderately flexuous, branching at right angles with cells 50—75 x 5—7.5 μm. Appressoria
poorly developed, nipple-shaped or nearly inconspicuous. Conidiophores 160—220 x 12.5 \(\mu\text{m}\), producing conidia in long chains. Foot-cells straight but often attenuated at the base where there is an area of 5—10 \(\mu\text{m}\) wide which frequently collapses when examined in water. Foot-cells measure (30—)62(—70) x (5—)7.5—12.5 \(\mu\text{m}\) and are followed by one or two cells (12—)25—35 x 12—13 \(\mu\text{m}\). Conidia ovoid-cylindric, (0—)35—37(—45) x (15—)18—20(—22.5) \(\mu\text{m}\). No well-developed fibrosin bodies formed. Germ tubes on end of conidia, simple, moderately long, 5 \(\mu\text{m}\) wide and terminating in a long appressorium about 30 x 7.5 \(\mu\text{m}\).

This species occurs frequently in herb gardens and causes slight to moderate damage.

on *Thymus aureus* Hort. ex E. Morr. (new record)
on *Thymus serpyllum* L. (BoeseWinkel, 1977).


Type on *Weinmannia sylvicola*; New Zealand.

On leaves, stems and inflorescences. Mycelium thin, white. Hyphae flexuous or irregularly shaped, (3—)4—5 \(\mu\text{m}\) wide. Appressoria multilobed, 6—7.5 \(\mu\text{m}\) wide. Conidiophores (50—)94—127 x 7—9 \(\mu\text{m}\), producing conidia singly. Foot-cells of conidiophores flexuous, 35—42 x 7—9 \(\mu\text{m}\), followed by a second cell of 27—35 x 7.5 \(\mu\text{m}\) and a third cell of 32.5—50 x 8—8.7 \(\mu\text{m}\). Conidia cylindric-ovoid, (25—)30—32.5(—52.5) x (12.5—)15—16.5 \(\mu\text{m}\). No well-developed fibrosin bodies produced. Germ tubes on end, occasionally on side of conidia, simple, branched or forked, straight or flexuous, moderately long and 5—7.5 \(\mu\text{m}\) wide, terminating in a club-shaped or lobed appressorium about 17.5 \(\mu\text{m}\) wide (Pl. 1, fig. 1).

Cleistothecia (100—)140—200 \(\mu\text{m}\) diam. with numerous appendages 3—4.5 \(\mu\text{m}\) wide and 1.5—4 times as long as the diameter of the cleistothecia, usually unbranched, rarely branched near the tip. Asci 6—22 with 8 spores.

The numerous asci which frequently number 20—22 and contain 8 ascospores clearly distinguish this species from *E. polygoni* s. lat. None of the species related to *E. polygoni* s. lat. in New Zealand resemble *E. carpophila* in the perfect state. Sydow (1924) remarked that *E. carpophila* is very close to *E. aggregata* (Peck) Farlow but differs in having smaller and fewer asci. Both species had at that time not been found on leaves but only on inflorescences and no conidial state had been found. Recently the conidial state of *E. carpophila* was recorded and both the conidial state and the cleistothecia occurred on inflorescences and on leaves of two species of *Weinmannia* (BoeseWinkel, 1977). It is a harmless disease and occurs periodically throughout the year.
on *Weinmannia racemosa* L. f. (Boesewinkel, 1977). On this host the cleistothecia are frequently smaller, 100—170 μm and contain fewer asci, 10—12 in number. Also the conidia can be slightly smaller than on the other host.

on *Weinmannia sylvicola* Sol. ex A. Cunn. (Sydow, 1924).


Type on *Scorzonera hispanica*; France.

On leaves, stalks and inflorescences. Mycelium moderately dense or dense, white. Hyphae moderately flexuous, occasionally geniculate, branching at tight angles near a septum. Hyphal cells (57—)60—70 (—90) × 5—7.5 μm. Appressoria unlobed, nipple-shaped, smooth, rarely with slightly crenulated surface, one per cell or several in series or opposite. Conidiophores 75—160(—230) × 10—12.5 μm, producing conidia in long chains. Foot-cells of conidiophores straight, occasionally slightly swollen at the base, 55—80 × (7.5—)10—11 μm, followed by two cells of 22—27.5 × 11—12.5 μm. Conidia cylindric-barrel shaped (25—)35(—42) × (14—)18—19 μm. No well-developed fibrosis bodies formed. Germ tubes on end, rarely the side of conidia, simple or rarely forked, straight or occasionally flexuous, moderately long and 5 μm wide terminating in an unlobed club-shaped appressorium 5—8 μm wide.

Since 1900 this species has been reported from many host plants but the first cleistothecia were only recently found on *Aster ericoides* (Boesewinkel, 1976a) and, during the present study, on *Plantago major*. Many hosts in the following list are likely to be infected with "*E. polyphaga*".

on *Aster ericoides* L. (Brien and Dingley, 1955)
on *Aster laevis* L. (Brien and Dingley, 1955)
on *Aster novae-angliae* L. (Brien and Dingley, 1955)
on *Aster novi-belgii* L. (Brien and Dingley, 1955)
on *Aster subulatus* Michx. (Boesewinkel, 1977)
on *Buphthalmum speciosum* Schreb. (Hammett, 1977)
on *Callistephus chinensis* Nees (Brien and Dingley, 1955)
on *Cardamine hirsuta* L. (Hammett, 1977)
on *Coreopsis grandiflora* Nutt. (Boesewinkel, 1977)
on *Cosmos bipinnatus* Cav. (Boesewinkel, 1977)
on *Cucumis sativus* L. (Kirk, 1901)
on *Cucumis melo* var. *cantalupensis* Naud. (Brien and Dingley 1951)
on *Cucurbita maxima* Duch. ex Poir. (Gillard, 1951)
on *Cucurbita pepo* L. (Brien, 1946)
on *Cyphomandra betacea* (Cav.) Sendt. (Boesewinkel, 1977)
on *Dahlia* sp. cult. (Boesewinkel, 1977)
on *Eucalyptus leucoxylon* var. *rosea* Hort. (Boeseewinkel, 1977)
on *Gerbera jamesonii* Bolus (Boeseewinkel, 1977)
on *Helianthus annuus* L. (Boeseewinkel, 1977)
on *Hibiscus mutabilis* L. (Boeseewinkel, 1977)
on *Nicotiana tabacum* L. (Boeseewinkel, 1977)
on *Olearia rani* (A. Cunn.) Druce (Boeseewinkel, 1977)
on *Penstemon hartwegii* Benth. (Dingley, 1960)
on *Petunia hybrida* Villem. (Boeseewinkel, 1977)
on *Plantago major* L. (Boeseewinkel, 1977).

The species present on this host is variously reported in the literature as *E. cichoracearum*, "*E. polyphaga*" and *E. sordida* Junell. Laundon (1973) reported *E. sordida* from New Zealand but stressed that this was only on a host basis as no cleistothecia were found and the conidial state lacked diagnostic features. Neger (1902) reported that the germ tubes of *E. sordida* are simple, straight or flexuous, or branched and Blumer (1933) mentioned long and narrow conidia produced by *E. sordida*. The New Zealand species, however, does not differ in conidial size, shape and germ tubes from *E. cichoracearum*. Sawada (1914) reported that the conidiophores of *E. sordida* are bent and produced from the side of mycelial hyphae. This has not been observed in New Zealand collections. Recently I found a small number of cleistothecia on the inflorescences only and with characteristics of *E. cichoracearum*.

on *Sanvitalia procumbens* Lam. (Boeseewinkel, 1977)
on *Sinningia speciosa* (Lodd.) Bent. et Hook. (new record)
on *Solanum aviculare* Forst. f. (Boeseewinkel, 1977)
on *Solanum laciniatum* Ait. (Boeseewinkel, 1977)
on *Solanum mauritianum* Scop. (Boeseewinkel, 1977)
on *Solanum tuberosum* L. (Dingley, 1960)
on *Solidago altissima* L. (Boeseewinkel, 1977)
on *Solidago canadensis* L. (Boeseewinkel, 1977)
on *Tragopogon porrifolius* L. (new record)
on *Veronica arvensis* L. (Boeseewinkel, 1977)
on *Viola tricolor* var. *hortensis* DC. (Boeseewinkel, 1977)
on *Viola sp. cult.* (Boeseewinkel, 1977)


Type on *Alyssum alyssoides*; Czechoslovakia.

On leaves, stems and pods. Mycelium dense or thin, white. Hyphae not very flexuous, occasionally geniculate, branched at right angles near a septum. Hyphal cells 45—75×(2.5—)5(—10) μm. Appressoria moderately to strongly lobed, 5—7 μm wide, single or opposite in pairs. Conidiophores (60—)70—85(—150) × 7.5—8.7 μm, producing conidia singly. Foot-cells of conidiophores straight or rarely slightly bent,
occasionally decreasing in width from 8—8.3 μm at the base to 7.5 μm at the top, 20—35 × 7.5—8.5 μm, followed by one, two or occasionally four straight walled cells of (7.5—)25—27(—40) × 8.7 μm. Conidia cylindric or ellipsoid cylindric, (27—)38(—55) × (11—)15—17.5 (—20) μm. On Cruciferae a large number of conidia of 47 × 17.5 μm and a few of 52 × 12.5 μm have been observed. No well developed fibrosin bodies produced. Germ tubes on end of conidia, simple or rarely slightly branched, short or long and terminating in a strongly to moderately lobed appressorium 7.5—20 × 7.5 μm.

Cleistothecia have been observed on the midrib of a leaf of Brassica rapa, but the contents were not studied. Bouwens (1924) noticed that the species on Cruciferae could be distinguished by the relatively long and narrow conidia. It is rarely harmful to the plants.

on Brassica campestris L. (new record)
on Brassica napo-brassica (L.) MILL. (BOESEWINKEL, 1977)
on Brassica napus L. (BOESEWINKEL, 1977)
on Brassica napus var. napo-brassica (L.) REICHENB. (new record)
on Brassica oleracea var. botrytis L. (BOESEWINKEL, 1977)
on Brassica oleracea var. racemosa ALEF. (new record)
on Brassica rapa L. (new record)
on Cardamine debilis BANKS ex DC. (BOESEWINKEL, 1977)
on Cardamine hirsuta L. (new record)
on Cleome spinosa JACQ. (new record)
on Erodium moschatum (L.) L'HÉRIT (BOESEWINKEL, 1977)
on Fumaria officinalis L. (BOESEWINKEL, 1977)
on Geranium homeanum TURCZ. (BOESEWINKEL, 1977)
on Iberis umbellata L. (new record)
on Papaver nudicaule L. (BOESEWINKEL, 1977)
on Papaver rhoeas L. (BOESEWINKEL, 1977)
on Papaver somniferum L. (BOESEWINKEL, 1977)
on Raphanus maritimus Sm. (new record)


Type on Aristotelia serrata; England.

On leaves, stalks and inflorescences. Mycelium white, thin to dense. Hyphal cells 50—60 × 4—5 μm. Appressoria strongly lobed. Conidiophores (60—)75—110(—115) × 7.5—12.5 μm, producing conidia singly. Basal septum 0—12.5(—30) μm from the branching point of the mycelium. Foot-cells of the conidiophores straight or swollen up to 10 μm at the base and about 7.5 μm wide towards the apex, 37—42.5 × 7.5—10 μm, followed by two slightly shorter cells. Conidia long cylindric (25—)35—38(—45) × (13—)16.2—17.5 (—19.2)μm, occasionally up to 2.5 μm wider at one end. No well developed fibrosin bodies produced.
Cleistothecia (90—)100—130(—140) μm with transparent outer cells of about 13×17.5 μm. Appendages straight or slightly geniculate or flexuose, hyaline, simple 100—180(—300)×3—5 μm, forming a dense web. Asci (2—)8—18 in number, with (5—)7—8 ascospores (pl. 1, fig. 2).

The cleistothecia of the type collection from the Wairarapa in the North Island were described containing six asci with about eight ascospores. Over the last sixty years several unreported collections with cleistothecia have been made from various areas. SALMON (1900) included the species in E. polygoni. E. polygoni DC. ex St. Am., the species on Polygonum aviculare L., has not been recorded in New Zealand and this species differs in having (2—)3—4-spored asci which number 3—12. The large number of ascospores of E. densa is a feature which has been reported for only few species of Erysiphe such as E. aggregata, E. carpophila, E. majorii Blumer, E. rubicola, E. ulmariæ Desm. and E. vernalis Karst. The species on Aristotelia is occasionally serious on young growing tips.

on Aristotelia fruticosa Hook. f. (new record)
on Aristotelia serrata (J. R. & G. Forst.) W.R.B. Oliver (SALMON, 1900)


Type on Galeopsis tetrakht; France.

On leaves. Mycelium white, thin. Hyphae moderately flexuous and geniculate, branched at right angles near a septum. Hyphal cells (50—)60(—75)×5—7.5 μm. Appressoria moderately lobed or multilobed, well-developed, 2—8.5×2—5 μm and provided singly or opposite in pairs. Conidiophores 77(—110)×10—12.5 μm, producing conidia in long chains. Foot-cells of conidiophores straight or decreasing in width from 12.5 μm at the lower half to 10—11 μm at the apex, followed by two straight walled cells of 12—20(—50) μm long. Conidia cylindric-ovoid, (25—)35—45(—57)×(15—)17—20 μm No well-developed fibrosin bodies formed. Germ tubes on side or end of conidia, simple or forked, straight or flexuous, short or moderately long 3—7.5 μm wide and terminating in a moderately lobed or multi-lobed appressorium.

This species is similar to E. cichoracearum but can be distinguished by the lobed appressoria (SALMON, 1900). Also characteristic are the position and shape of the germ tubes which resemble, when short and more or less forked, those of S. epilobii (WALLR. ex LINK) SACC. and S. fuliginea. It is mainly found during the winter and can occur on the same geranium plants which during the summer become infected with S. fugax. Of interest is the fact that the unusual host genus Geranium
has also been recorded in Japan by Homma (1937). The disease is mainly hypophyllous and produces only slight reddening of the leaves.

on Geranium molle L. (new record)
on Geranium homeanum Turcz. (new record)
on Rosmarinus officinalis L. (Boesewinkel, 1977)


Type on Heracleum spodmontium; France.
On leaves, stalks and inflorescences. Mycelium dense, white. Hyphal cells (50—)62—65(—80) × (2.5—)4—5(—10) μm, branching at right angles near the ends of the cells. Appressoria moderately or multi-lobed, produced singly or opposite in pairs. Conidiophores 60—140 × 7.5—10 μm, producing conidia singly. Foot-cells (20—)32—35(—45) × 9—10 μm, straight or decreasing in diameter towards the top to 7.5 μm wide, followed by one, two or three cells of 17.5—50 (—105) × 7.5 μm. Although conidiophores are usually 3-celled, one of four cells and 130 μm long was observed on the underside of a leaf. Conidia cylindric-ovoid, (35—)42.5—45(—47.5) × (12.5—)17—18 (—21.2) μm. No well-developed fibrosin bodies produced. Germ tubes on the ends of conidia, simple or moderately branched, straight of flexuous, very short or up to 60 μm long and terminating in a clubshaped or moderately lobed appressorium 8—10 μm wide. This species resembles E. cruciferarum but can be distinguished by the more regular shape of the conidia which in E. cruciferarum are frequently wider on one end. Furthermore no 5-celled conidiophores have been observed for E. heraclei. Serious infection can cause reduction in growth.

on Dysoxylum spectabile (Forst. f.) Hook. f. (new record)
on Pastinaca sativa L. (Boesewinkel 1977)


Type on Lycium barbarum; France.
On leaves, stalks and inflorescences. Mycelium well-developed, white. Hyphae flexuous, occasionally geniculate, branching at various angles including right angles, frequently near a septum. Hyphal cells (40—)42—45(—112) × (3—)5(—9) μm. Appressoria unlobed, nipple-shaped, well-developed and numerous, 4—7 μm wide. Conidiophores simple, rarely branched near the base, 75—120 × (7.5—)9—10(—12.5) μm, producing conidia in chains. Foot-cells of conidiophores (30—)37—50(—60) × (7.5—)10 μm, followed by two or three straight cells of about 17—25 × 9—10(—12.5) μm. Conidia oblong-cylindric with nearly flattened ends, occasionally ovoid or barrel-shaped, (20—)27.5(—38) × (10—)13.7(—19) μm. No well-developed fibrosin
bodies formed. Conidia show a conspicuous papilla at the place where they have been attached. Germ tubes on end, rarely the side of conidia, simple short or long, 4—5 μm wide and terminating in an unlobed appressorium 5—6 μm wide. Haustoria globose, about 17.5 μm diameter (pl. 2, fig. 3).

According to de Bary (1870) this species can even in the conidial state be easily identified by the small and typically cylindric conidia. These characteristics of the conidia on Lycium species in Europe have also been reported from other areas of the world such as Japan (Homma, 1937), the Canary Islands (Jöresstad, 1962), Formosa (Yen and Wang, 1973) and New Zealand (Boeseewinkel, 1977). Although this species on Lycium has no typical characteristics of the genus Microsphaera and lacks the multi-lobed appressoria, it is frequently referred to as M. mougeotii Lév. because of the branching of the appendages, characteristics which appear to vary according to the different descriptions in the literature. In the genus Microsphaera, M. mougeotii would be the only species with 2-spored asci. Blumer (1967) thinks it possible that M. mougeotii forms a transition between the genera Microsphaera and Uncinula and several authors have suggested creating a new genus, such as Arthrocladiella Vasil’kov, to accommodate this species. However, the important characteristics of 2-spored asci, unlobed and nipple-shaped appressoria, conidia which lack fibrosin bodies and are produced in a chain, are typical of the Euoidium section of the genus Erysiphe. The disease occurs throughout the year.

   Type on Pisum sp.; France.

   On flowers, pods and leaves. Mycelium dense or thin, white. Hyphae moderately flexuous, branching at right angles near a septum, occasionally forming two branches which are nearly opposite. Hyphal cells (50—)65—88 X 5—7.5(—10) μm. Appressoria moderately lobed, occasionally unlobed with a crenulated surface of forming many very small lobes, generally produced singly, 5—10 μm wide. Conidiophores more or less straight, rarely slightly flexuous at the base, simple, 62—105(—178) X 7—10 μm producing conidia singly. Foot-cells (22—)38—50(—75) X 7—10 μm, followed by a slightly longer or shorter second cell of 20—55 μm and a third cell of 20—42 μm. Foot-cells 7.2—8.5 μm wide at the base and tapering to 6.2—7 μm wide at the top. Conidia ellipsoid-cylindric, (32—)40—47(—100) X 15—17(—20) μm. No well-developed fibrosin produced. Germ tubes formed on the ends or sides of conidia, simple, short or up to 50 μm long, 2.5—3.7 μm wide and terminating in an unlobed or moderately lobed appressorium 5—10 μm wide. Haustoria (17—)20(—25) μm diameter.

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It differs from *E. trifolii* in the shape of the foot-cells of the conidiophores, the appressoria and the germ tubes of the conidia. This species occurs throughout the year but is apparently harmless. 

on *Hebe speciosa* (A. Cunn.) Ckn. & Allan (new record)

on *Lathyrus odoratus* L. (Boesewinkel, 1977)

on *Lathyrus pubescens* Hook. & Arn. (new record)

on *Lupinus angustifolius* L. (new record)

on *Lupinus argentatus* Pursh. (new record)

on *Lupinus polyphyllus* Lindl. (new record)

on *Melilotus indica* L. (new record)

on *Pisum sativum* L. (Boesewinkel, 1977)


On flowers, stems and leaves of many unrelated plants. The morphological characteristics are similar to those of *E. asperifoliorum* and *E. cichoracearum* but a few differences may be observed. The unlobed nipple-shaped appressoria are frequently poorly developed and occasionally inconspicuous. In several collections conidiophores have been observed which were branched near the apex or, less frequently, the middle of their foot-cell. The germ tubes of conidia are more frequently produced on the side than occurs in *E. cichoracearum* and they are often short, terminating in a conspicuous appressorium (pl. 2, fig. 4). Whereas *E. cichoracearum* generally produces 2-spored asci and is thought to occur mainly on Compositae, Hammarlund (1945) distinguished "*E. polyphaga*" by the presence of 2—4-spored asci, which he observed in cleistothecia on *Begonia, Cucumis, Dahlia* and *Veronica*, and by the ability to infect plants of many unrelated families. Junell (1967) remarked that in *E. cichoracearum* 2—4-spored asci can also occur but used "*E. polyphaga*" because of the wide host range. Hammarlund (1945) was able to infect *Kalanchoë blossfeldiana* with conidia from *Begonia cv. Gloire de Lorraine* and subsequently inoculated 100 different plant species belonging to 11 families. On 62 different species a positive reaction was obtained but unfortunately no descriptions of the morphology of the mildews on the different hosts were provided and it cannot be ascertained whether in all cases the same "*E. polyphaga*" developed. Although some infection may have been accidental, due to airborne conidia or the build up of latent infection it is unlikely that all 62 plant species became infected accidentally. Blumer (1952) suggested that "*E. polyphaga*" might be a synonym of *E. asperifoliorum*. A study of the New Zealand collections is being carried out and, while I at present agree with Blumer's opinion, "*E. polyphaga*" is in the meantime retained for those host plants on which a species resembling *E. cichoracearum* and *E. asperi-
foliorum was found which could be transmitted to plants of unrelated families such as Cucurbitaceae and Solanaceae. "E. polyphaga" occurs throughout the year.

- on *Chrysanthemum hortorum* Bailey (new record)
- on *Chrysanthemum morifolium* Ramat (new record)
- on *Cucumis angurica* L. (new record)
- on *Cucumis melo* var. *cantalupensis* Naud. (new record)
- on *Cucumis sativus* L. (new record). Infection occurs in early spring and before it disappears, the same infected plants can become infected simultaneously with *Sphaerotheca fuliginea*.
- on *Eucalyptus leucoxylon* var. *rosea* Hort. (new record)
- on *Helianthus annuus* L. (new record)
- on *Helichrysum bracteatum* Andr. (new record)
- on *Hibiscus mutabilis* L. (new record)
- on *Lycopersicon esculentum* Mill. (new record)
- on *Modiola caroliana* G. Don (new record)
- on *Nicotiana tabacum* L. (new record)
- on *Petunia hybrida* Vil. (new record)
- on *Solanum integrifolium* Poir. (new record)
- on *Solanum mauritianum* Scop. (new record)


Type on *Ranunculus muricatus*; Scotland.

On stalks, inflorescences and leaves. Mycelium dense, white. Hyphae moderately flexuous and branched at right angles. Hyphal cells 45—66(—87) × 5—7 μm. Appressoria multi-lobed, single or opposite in pairs, sometimes sparingly produced. Conidiophores 50—74(—95) × 7.8—8(—10) μm, straight, simple, producing conidia singly. Foot-cells of conidiophores straight, (15—)25(—30) × 7.5—10 μm, slightly shorter or longer than the second cell which is 10—35 μm long. Conidia ovoid, (30—)37.5(—40) × (17.5—)20—22.5 μm. On one occasion an unusually large conidiuim of 62.5 × 20 μm occurred. No well-developed fibrosin bodies present. Germ tubes produced on the end of conidia, branched or simple, either moderately long and terminating in an inconspicuous or lobed appressorium or short, up to 20 μm long, and terminating in a multi-lobed appressorium about 22 × 12 μm.

Cleistothecia globose, 88—130 μm. Appendages basally inserted, mycelioid, hyaline to dark brown, 2—5 times as long as the diameter of the cleistothecia, up to 5 μm wide, simple or rarely branched near the end, up to 35 in number. Ascii 5—8, subovate, 40—70 × 25—40 μm. Ascospores 4—6 per ascus, 17.5—22.5 × 10—12.5 μm. Cleistothecia have been found on several species of *Delphinium* and *Ranunculus*.

*E. ranunculi* can in New Zealand be separated from other recorded
species of the *E. polygoni* complex by the relatively short, straight conidiophores, the moderately large ovoid conidia, the branching of germ tubes and the multi-lobed appressoria. The form on *Aquilegia vulgaris*, which occurs only occasionally, is overseas frequently identified as *E. aquilegiae* DC. ex Mérat. Although slightly larger conidia were produced on this host, it could not be distinguished from *E. ranunculi*. No diagnostic characteristics of the imperfect state on *Aquilegia* could be found in the literature and it is included in *E. ranunculi* until cleistothecia are found.

on *Anemone coronaria* L. (new record)

on *Aquilegia vulgaris* L. (Boeseewinkel, 1977)

on *Clematis australis* var. *rutijolia* (Hook. f.) *Allan* (Boeseewinkel, 1977)

on *Clematis jackmanii* Moore (new record)

on *Clematis paniculata* Gmel. (Boeseewinkel, 1977)

on *Delphinium ajacis* L. (Boeseewinkel, 1977)

on *Delphinium cultorum* Voss (Boeseewinkel, 1977)

on *Nigella damascena* L. (new record)

on *Ranunculus acris* L. (new record)

on *Ranunculus asiaticus* L. (Boeseewinkel, 1977)

on *Ranunculus parviflorus* L. (new record)

on *Ranunculus repens* L. (Boeseewinkel, 1976a)

on *Ranunculus sardous* Crantz. (Boeseewinkel, 1977)

on *Ranunculus sceieratus* L. (Boeseewinkel, 1977)


Type on *Rubus australis*; New Zealand.


Cleistothecia 90—140 μm diameter. Appendages sparse or numerous mycelioid, hyaline or faintly fuliginous, 25—100(—210)×3—5 μm. Asci 4—17 with 8 ascospores.

This species was first described by Murray (1927) from Nelson in the South Island and has been observed on a few occasions in several areas of the North Island.

on *Rubus australis* Forst. f. (Murray, 1927)

on *Rubus cissoides* A. Cunn. (Boeseewinkel, 1976a)

on *Rubus squarrosus* Frtsch (Boeseewinkel, 1976a)

Type on *Trifolium medium* L.; Scotland.

On leaves. Mycelium thin, white. Hyphae moderately flexuous, branching at right angles. Hyphal cells 45—68 x 2.5—7.5 μm. Appressoria multi-lobed, 5 x 10 μm, single or in pairs. Conidiophores (50—) 75—110 x 6.5—7.5 (—10) μm, generally (1—) 2—3-celled but occasionally 4-celled and about 120 μm long, producing conidia singly. FOOT-cells moderately to strongly flexuous near the base, occasionally straight, (18—) 37.5 (—55) x 6.5—7.5 μm and followed by two straight walled cells of (18—) 20—30 (—43) μm long. Conidia ellipsoid-cylindric, (30—) 32.5—42.5 (—50) x 16.5—17.5 (—20) μm. No well-developed fibrosin bodies present. Germ tubes produced on ends of conidia, simple or occasionally branched, short or up to 140 μm long and 3—4 μm wide, terminating in an unlobed appressorium 4—7.5 μm diameter.

In the literature this species is frequently confused with *E. pisi* but it was discovered that the conidial state can be distinguished easily by the foot-cell of the conidiophores, the appressoria and the germ tubes. It is also very similar to *O. hardenbergiae* but can be distinguished by the germination pattern of the conidia. It is generally of little consequence. On some hosts such as *Sophora* and *Trifolium* spp. it is present throughout the year.

It is interesting that Homma (1937), who did not differentiate between *E. pisi* and *E. trifolii*, reported the host *Sophora angustijolia* Sieb. & Zucc. from Japan.

on *Brachysema lanceolata* Meissn. (new record)
on *Lathyrus odoratus* L. (new record)
on *Lotus corniculatus* L. (Boesewinkel, 1977)
on *Sophora microphylla* Ait. (new record)
on *Trifolium dubium* Sibth. (Boesewinkel, 1977)
on *Trifolium micranthum* Viv. (new record)
on *Trifolium pratense* L. (new record)
on *Trifolium striatum* L. (new record)
on *Trifolium subterrancum* L. (new record)
on *Wistaria floribunda* DC. (new record)


Type on *Verbascum* sp.; Russia.

On leaves. Mycelium dense, white. Hyphae with cells about 57 x 4—7 μm. Appressoria unlobed, nipple-shaped, 5—10 μm wide. Conidiophores 164—250 x 11—15 μm, producing conidia in chains. Foot-cells 140—150 x 11—15 μm, increasing in diameter from 11—12 μm at the base to 15 μm at the top. Conidia cylindric-ovoid,
im. No conspicuous fibrosin bodies produced. Germ tubes on end, rarely the side of conidia, about 150 μm long or longer, straight or occasionally flexuous and terminating in an unlobed appressorium 9—10 μm wide.

This species can be distinguished from *E. cichoracearum* by the large conidiophores and conidia, and by the long germ tubes which Neger (1902) first mentioned. It occurs throughout the summer but is inconspicuous due to the hairy surface of the host and apparently causes little damage.

on *Verbascum thapsus* L. (Boekewinkel, 1977)

**MICROSPHAERA** Lév. (1851)

The genus *Microsphaera* is characterised by cleistothecia with several asci usually up to 12 containing 3—8 ascospores and with appendages which are dichotomously branched near their apex. The imperfect state differs from *Podosphaera*, *Sawadaea* and *Sphaerotheca* by the absence of conspicuous fibrosin bodies and by singly produced conidia. The appressoria are multi-lobed, frequently opposite in pairs, and more numerous than in many species of the morphologically related *Pseudoidium* section of *Erysiphe*.

1. Conidiophores flexuous at the base; conidia cylindric
   - on *Celastraceae*: *Euonymus* M. *euonymi-japonici*
   - on *Rutaceae*: *Severinia* M. *euonymi-japonici*
   - on *Fagaceae*: *Quercus* M. *hypophylla*

2. Conidiophores more or less straight
   A. Conidia cylindric
      - on *Caprifoliaceae*: *Viburnum* M. *viburni*
   B. Conidia cylindric-ovoid
      - on *Begoniaceae*: *Begonia* M. *begoniae*
   C. Conidia ellipsoid-cylindric
      - on *Saxifragaceae*: *Ribes* M. *grossulariae*
   D. Conidia ellipsoid-ovoid; foot-cells of conidiophores relatively short and not slender
      - on *Fagaceae*: *Castanea*, *Quercus* M. *alphitoides*
      - on *Sapindaceae*: *Cotinus* M. *alphitoides*
   E. Conidia ellipsoid-ovoid, foot-cells of conidiophores relatively long and slender
      - on *Crassulaceae*: *Kalanchoë*, *Sedum* M. *polonica*
      - on *Saxifragaceae*: *Hydrangea* M. *polonica*
      - on *Scrophulariaceae*: *Acanthus* M. *polonica*

Type on *Quercus robur*; France.

On leaves and inflorescences. Mycelium moderately dense to dense, white. Hyphae branching at nearly right angles, frequently near a septum, occasionally two opposite branches are formed. Hyphal cells (20—)50(—58) × 3—7 μm. Appressoria multi-lobed, single or opposite in pairs. Conidiophores 42.5—60(—105) × 6.5—10 μm, producing conidia singly. Occasionally 4—5-celled conidiophores occur on the underside of leaves. Foot-cells of conidiophores straight, (15—)20—22 (—60) × (6.5—)7.2—7.5(—8.7) μm, followed by one or two cells of 10—27 × 7.5—10 μm, the apex of the last cell often broadened up to 10 μm. Conidia ellipsoid-ovoid, occasionally cylindric-ovoid, 35—37.5 (—45) × (15—)17.5—21.2(—22) μm. No well-developed fibrosin bodies produced. Germ tubes on end, simple or forked, short or moderately long about 5 μm wide and frequently ending in a lobed appressorium 10 × 15 μm. Haustoria about 32 μm wide (pl. 1, fig. 2).

This species is characterised by the shape of the conidia, germ tubes and conidiophores, the latter including short 3-celled and long 5-celled ones. The disease is very common during the growing season on species of *Castanea* and *Quercus* where it can seriously injure the growing tips. On *Castanea* spp. it also infects the fruit. On *Cotinus* it was observed only once, sporulating on the inflorescences of a shrub under an infected tree of *Quercus robur*. No cleistothecia have been reported from New Zealand.

on *Castanea dentata* Borkh. (Boesewinkel, 1977). The conidia on this host are frequently ellipsoid-cylindric and measure most frequently 38 × 17.5 μm.

on *Castanea sativa* Mill. (Boesewinkel, 1977)

on *Cotinus coggygria* Scop. (Boesewinkel, 1977)

on *Quercus lusitanica* Lam. (new record)

on *Quercus robur* L. (Brien and Dingley, 1951)

This first-record lacks a description.

on *Quercus sessiliflora* Salisb. (Boesewinkel, 1977)

This host retains its leaves during the winter months but the mildew ceases its activity until spring.


Type on *Begonia* sp.; England.

On leaves, stalks and inflorescences. Mycelium dense or thin, white. Hyphae not very flexuous, sparingly branched at about the centre of hyphal cells and at about right angles, with a septum near the base of the new branch. Hyphal cells (62—)87.5(—130) × 5—6.5 μm, Appres-
soria multi-lobed, in pairs, one or several pairs can be present on a hyphal cell. Conidiophores 75—120×7.5—10 μm, straight simple or rarely branched at the base, producing conidia singly. Conidiophores generally 3- occasionally 2- or 5-celled. Foot-cells of conidiophores straight, occasionally slightly swollen up to 12.5 μm at the base, (37—)40(--52)×8.7—11.5 μm, followed by two shorter cells of 15—42×8.7—10 μm. Conidia ovoid to long-cylindrical, extremely variable in size, (25—)55—62.5(--72.5)×(12.5—)17.5—18.7(--25) μm. Long conidia often of uneven width, up to 1 μm wider at one end and slightly attenuated at the centre. They collapse easily when placed in water. No well-developed fibrosin bodies present. Germ tubes on end, multibranched or single, straight or flexuous, short or moderately long, with or without a multi-lobed appressorium 15×22 μm. Haustoria uninucleate, globose, 30—32 μm wide in large epidermal cells and 20—25 μm wide in smaller epidermal cells.

The presence of huge conidia and large haustoria are a characteristic feature which distinguish this species from Oidium begoniae Puttem. and “Erysiphe polyphaga”. Moreover in “E. polyphaga” the appressoria are unlobed and the conidia are produced in long chains. Cleistothecia have not been found in New Zealand. The disease is generally harmless.

on Begonia masoniana Irmsch. (Boeseewinkel, 1976b)
on Begonia rex-cultorum Bailey (Boeseewinkel, 1976b)
on Begonia semperfloreus Link & Otto (Boeseewinkel, 1976b)
on Begonia tuberhybrida Voss (Boeseewinkel, 1976b)
on Begonia cv. Gloire de Lorraine (Boeseewinkel, 1976b)


Type on Euonymus japonicus; Uruguay.

On leaves, stalks and inflorescences. Mycelium dense, white. Hyphae rather straight, occasionally flexuous, or geniculate, sparingly branched at various angles or at right angles, with a septum near the base of the new branch. Hyphal cells (40—)55—75(--85)×4—5 μm. Appressoria multi-lobed, 8—12.5 μm wide, opposite in pairs, one to several per cell generally on alternating hyphal cells. Conidiophores 50—80×7—8 μm, simple or rarely branched near the centre of the third cell, more or less straight except for the basal part, producing conidia singly. Foot-cells slightly flexuous at the base, (10—)20—30 (--50)×7.5—8.7 μm, followed by two shorter cells of (10—)20—22 μm long. Conidia cylindric or ellipsoid cylindric, (30—)32.5(--45)×(12—) 17 μm. No conspicuous fibrosin bodies present. Germ tubes produced on the end of conidia, short and terminating in a multi-lobed appressorium 10—12.5 μm wide.
Cleistothecia are not present in the New Zealand collections, and, following the description from Uruguay, cleistothecia have only been reported from France and Yugoslavia (VIENNOT—BOURGIN, 1966). The conidial state is distinct due to the rather cylindrical, small and narrow conidia and the slightly flexuous base of the conidiophores. This species occurs wherever susceptible species of *Euonymus* are grown and is active throughout the year, especially on new growing tips and young fruit.

- *Microsphaera japonica* L. (BOESEWINKEL, 1977)
- *Microsphaera japonica* var. *aureo-marginatus* REHD. (new record)
- *Severinia buxifolia* (Poir.) TEN. (BOESEWINKEL, 1979)


Type on *Ribes uva-crispa* L.; Germany.

On leaves. Mycelium thin or dense, white. Hyphae flexuous. Appressoria lobed. Conidiophores 40—90 × 6.5—8.7 μm, producing conidia singly. Conidia cylindric or ellipsoid cylindric, (21—)30 × (11—)17 μm. No well-developed fibrosin bodies produced. Only one sample in poor condition was collected. This species can be distinguished from the American gooseberry powdery mildew, which has not been found in New Zealand, by the absence of conspicuous fibrosin bodies and the singly produced conidia. It is apparently harmless.


Type on *Quercus robur* L.; USSR.

On leaves. Mycelium evanescent, white or grey white. Hyphae moderately flexuous and moderately geniculate, branching at more or less right angles and frequently near a septum. Hyphal cells (27—)45—50 (−62) × (3—)5—6 μm. Appressoria multi-lobed, 5—7.5 μm wide, frequently opposite in pairs. Conidiophores about 90—100 × 7.5—10 μm, producing conidia singly. Foot-cells of conidiophores about 20—28 × 7.5 μm, flexuous, followed by one or two straight walled cells of 10—35 × 8.7—10 μm. Conidia cylindric with rounded ends, (32—)40—45 (−55) × (12—)16.2—17.5 (−18.5) μm. No conspicuous fibrosin bodies produced. Germ tubes on end of conidia, simple, short, about 3—5 μm wide and with or without lobed appressoria on their ends.

By the shape and size of the conidiophores, conidia and germ tubes this species can be distinguished from *M. alphitoides*. Furthermore *M. hypophylla* produces evanescent mycelium, especially on the
underside of leaves and attacks the areas around the mid ribs and veins, whereas, *M. alphitoides* produces conspicuous white areas all over the leaves, especially on the upperside. *M. hypophylla* was found sporulating in July at a time when *M. alphitoides* had disappeared. The conidia of *M. hypophylla* have been photographed by CRUCET (1962) and further characteristics of the imperfect state are given by BLUMER (1967) and JUNELL (1967). Not reported before however are the hyphal cells, the type of appressoria and the flexuous shape of the foot-cells of the conidiophores. SPEER (1975b) suggested that *M. hypophylla* was a synonym of *M. alphitoides* but he apparently only studied material of *M. alphitoides*.

on Quercus sessiliflora SALISB. (new record)


Type on Hydrangea hortensis (cult.); Poland.

On leaves, stems and flowers. Mycelium dense or evanescent, white. Hyphae moderately flexuous, branching more or less at right angles with a septum near the base of a new branch. Hyphal cells 40—50×5—7 μm, often of irregular diameter. Appressoria multilobed, 5—25 μm wide, often opposite in pairs, series of three pairs can occur on one hyphal cell. Conidiophores (57—)70—90(—175)×7.5—8.7 μm, producing conidia singly. A few 5-celled conidiophores occur on both sides of the leaves. Foot-cells of conidiophores (10—)17—37.5 (—50)×7.5—10 μm, followed by a longer cell of about 27—31 μm long. Conidia ovoid or ellipsoid-ovoid, (27.5—)37.5(—45)×(14—)17.5 (—20) μm. No conspicuous fibrosin bodies produced. Germ tubes on ends of conidia, simple, often rather short and terminating in a multilobed appressorium 8—12 μm wide. Haustoria globose, about 17.5—18.7 μm diameter (pl. 1, fig. 6, 7, 8). Cleistothecia have only been described from Poland in the original description.

This species is active on susceptible Hydrangea species throughout the year and generally harmless.

on Acanthus mollis L. (BOESEWINKEL, 1977). This unusual record is rare and was found on plants close to infected Hydrangea plants.

on Hydrangea macrophylla (THUNB.) SER. (BOESEWINKEL, 1977)

on Kalanchoe tubiflora (HARV.) HAMET (new record). This occurs occasionally.

on Sedum praecatum DC. (new record). This is a very common disease but due to the generally evanescent mycelium it is difficult to detect.

*Type on Viburnum opulus*; France.

On leaves. Mycelium evanescent, rarely dense, white. Hyphae moderately flexuous, sparingly branched at right angles near a septum. Hyphal cells (50—)57—75 \( \times \) (3.5—)4—5(—10) \( \mu m \). Appressoria multilobed, opposite in pairs or single, 3—12 \( \mu m \) wide. Conidiophores (50—)75—120(—130) \( \times \) 5—7.5 \( \mu m \), producing conidia singly. Foot-cells 30—85 \( \mu m \) long, decreasing in width from 5.5—7.5 \( \mu m \) at the base to 5 \( \mu m \) at the top, straight or occasionally slightly flexuous at the base, followed by one or two cells of 15—20(—40) \( \times \) 7.5 \( \mu m \). Conidia cylindric, (32—)35—37(—47.5) \( \times \) (11—)15—17(—17.5) \( \mu m \), occasionally abruptly narrowed at the base up to 7.5 \( \mu m \) wide, over a distance of 7.5 \( \mu m \). No conspicuous fibrosin bodies produced. Germ tubes on the ends of conidia, simple, short or moderately long and terminating in a multi-lobed appresorium. In contrast to *M. hedwigii* Lév., which does not occur in New Zealand, this species is mainly hypophyllous and produces mainly inconspicuous mycelium.

The disease occurs during the summer and is often difficult to detect. It is harmless.

*on Viburnum opulus* L. (new record)

*on Viburnum trilobum* Marsh. (Boesewinkel, 1977)

**OIDIUM** Link 1824

This form genus includes the conidial states of those species of *Blumeria*, *Brasiliomyces*, *Cystotheca*, *Erysiphe*, *Microsphaera*, *Podosphaera*, *Sawadaea*, *Sphaerotheca* and *Uncinula* for which no connection with cleistothecia is known.


*Type on Chrysanthemum indicum*; Germany.

On leaves, stalks and inflorescences. Mycelium dense or thin, white. Hyphae flexuous, branching at right angles near a septum. Hyphal cells (62—)80—100(—105) \( \times \) (5—)6.5—7.5(—8) \( \mu m \). Appressoria unlobed, inconspicuous, occasionally nearly nipple-shaped, 5—12 \( \mu m \) wide. Conidiophores (62—)105—190(—230) \( \times \) 10—12.5 \( \mu m \), producing conidia in long chains. Foot-cells 75—130(—140) \( \times \) 12.5(—15) \( \mu m \), followed by one or two straight walled cells of 20—35 \( \mu m \) long. Basal septum of the conidiophore about 10.5 \( \mu m \) wide whereas the septa higher up the conidiophore measure about 12.5 \( \mu m \). Conidia variable in shape, ellipsoid, occasionally cylindric or barrel-shaped with rounded ends, (35—)52.5(—80) \( \times \) (16.2—)22.5(—30) \( \mu m \). No conspicuous fibrosin bodies formed. Germ tubes on side or end of conidia, simple or, rarely, branched, short or long and terminating in an unlobed or slightly
lobed appressorium 22×7—10 μm. Haustoria globose, 17.5—22.5 μm wide. This species can be distinguished from *Erysiphe cichoracearum* and "*E. polyphaga*" by the large conidia and inconspicuous appressoria. It is present throughout the year and moderately harmful.

on *Chrysanthemum hortorum* Baily (Boesewinkel, 1977)
on *Chrysanthemum indicum* L. (new record)
on *Chrysanthemum morifolium* Ramat (Boesewinkel, 1977)


Type on *Hardenbergia monophylla*; New Zealand.

On leaves. Mycelium evanescent, white. Hyphae flexuous, branching at right angles near a septum, with a septum near the base of the new branch. Hyphal cells (40—)45—55(—70)×3.5—7 μm. Appressoria multi-lobed, 5—12.5 μm wide, single or opposite in pairs. Conidiophores (68—)87—92(—125)×6.5—8 μm, producing conidia singly. Foot-cells flexuous or nearly straight at the base, 35—45×6.5—8.8 μm, followed by cells about 20—35 μm long. Conidia cylindric-ellipsoid, (32—)40—55×(12.5—)17—21 μm, occasionally up to 2.5 μm wider at one end. No conspicuous fibrosin bodies produced. Germ tubes on end of conidia, simple and straight or branched, occasionally coralloid, either short with a moderately lobed or multilobed appressorium or long, 4.5 μm wide and terminating in an unlobed or moderately lobed appressorium (pl. 1, fig. 10; pl. 2, fig. 9). This species is very similar to *E. trifolii* and differs mainly in the germ tubes. It occurs on both sides of leaves throughout the year, and is harmful to the young growth.

on *Hardenbergia monophylla* Benth. (Boesewinkel, 1977)


Type on *Helichrysum bracteatum*; New Zealand.

On leaves. Mycelium evanescent, white. Hyphae 6.2—7.5 μm diam. Appressoria unlobed, inconspicuous. Conidiophores 210—330×10—15 μm, producing conidia in long chains. Foot-cells straight, about 150—250 μm long, with basal septum 15—85 μm away from the branching point of the mycelium, followed by two straight walled cells about 30—40 μm long. Conidia ovoid-cylindric or ellipsoid, (35—)40—45(—72)×(17.5—)20—22(—25) μm. No conspicuous fibrosin bodies produced. Germ tubes on end or side of conidia, simple, straight, moderately long and 6—7.5 μm wide, terminating in a club-shaped appressorium. Haustoria (17.5—)20—25(—30) μm diameter.

This species resembles *O. chrysanthemi* but differs in the shape and size of the conidia, the size of the haustoria and the placement of the basal septum of the conidiophores. Apparently a harmless disease.

on *Helichrysum bracteatum* Andr. (Boesewinkel, 1977). This
species was collected during the winter in Waitakere in my garden where so far no *O. chrysanthemi* has been found in spite of the presence of several species of *Chrysanthemum*.


Type on *Oxalis corniculata*; Australia.

On leaves and inflorescences. Mycelium thin to dense, white. Hyphae geniculate with many straight areas, branching at right angles near a septum. Hyphal cells (37—)65—67(—70) × 2.5—5 μm. Appressoria multi-lobed, single or opposite in pairs, 2.5—5 μm wide. Conidiophores (67—)92(—150) × 5 μm, producing conidia singly. Foot-cells of conidiophores (8—)18—22(—33) μm long and often decreasing in width from 5.5 μm at the base to 4—4.5 μm at the top. The relatively short foot cells are followed by longer cells (19—)32—50(—115) μm. Conidia ellipsoid — lemon-shaped, (20—)35(—43) × (10—)13.7 (—15) μm, without conspicuous fibrosin bodies. Germ tubes on end, occasionally on side, simple or occasionally branched, straight, 37—50 × 2.5—3 μm and terminating in an unlobed or moderately to multi-lobed appressorium.

This species is characterised by the small ellipsoid conidia, the narrow mycelium and conidiophores, and the relative length of the conidiophore cells.

Sawada (1914) and Homma (1937) found only the imperfect state on *Oxalis* in Japan but regarded *O. oxalidis* as a synonym of *M. russellii* Clint., although the correlation has not yet been proven. The disease occurs throughout the year in glasshouses and gardens.

on *Oxalis corniculata* L. var. microphylla Hook. (Boese winkel, 1977)

*Phyllactinia* Lév. (1851)

The genus *Phyllactinia* is characterised by cleistothecia with numerous 2-spored asci and characteristic appendages which have a bulbous area at the base. The conidial state differs markedly from that of the other genera in New Zealand and belongs to the genus *Ovulariopsis*. Both epiphytic and endophytic mycelium occur, the latter producing haustoria. The conidiophores are long and slender and produce conidia singly. The conidia of many species are characteristically clavate and large. Conspicuous fibrosin bodies are generally absent.


Type on *Corylus avellana*; Germany.

On leaves. Mycelium thin, evanescent, greyish. Hyphae flexuous, and moderately geniculate, branched at right angles, often with a
septum at the base of the new branch. Hyphal cells (50—)67—80
(—150)×4—5(—10) μm. Appressoria generally unlobed, nipple or
hook-shaped, occasionally branched to moderately lobed, 7.5—12.5 μm
wide, single or frequently opposite in pairs. Conidiophores (100—)
150—330(—570)×7.5—8.7 μm, producing conidia singly. Conidi-
ophores generally 3-celled but occasionally 2 or 4—5-celled. Foot-cells
(20—)55—200 μm long, with the basal septum (10—)17.5—37 μm,
away from the branching point of the mycelium, followed by cells of
15—40 μm long. Conidia clavate or rhomboid in outline, often with a
protrusion at the apex and a narrow area of about 7—5 μm long at
the base, (50—)75(—125)×(22.5—)26(—35) μm. No conspicuous
fibrosin bodies produced. Germ tubes on side of conidia, simple, about
20—30×5(—7) μm and ending in an unlobed appressorium (pl. 2,
fig. 11). Several of these characteristics were depicted by TULASNE
(1861) and SALMON (1905b).

This species is hypophyllous and inconspicuous. Leaf symptoms
are frequently absent and the fungus can be detected only by holding
leaves obliquely to the light. It occurs throughout the year in gardens,
streets and forests.

on Vitex lucens KirK (Boesewinkel, 1977)

**PODOSPHAERA** Kunze (1823)

The genus Podosphaera is characterised by cleistothecia with one
ascus containing 6—8 spores and by appendages dichotomously
branched near the apex. The branching of the appendages and the
absence of secondary brown mycelium help to distinguish this genus
from Sphaerotheca. The conidial state is of the Euoidium type and
produces slender or broad conidiophores which form conidia in long
chains. The conidia contain well-developed conspicuous fibrosin bodies.
Germ tubes are frequently produced on the side and are simple.

1. Conidiophores plump, not slender, 75—112×9—10 μm
   on Rosaceae: Malus, Photinia, Pyrus
   P. leucotricha

2. Conidiophores moderately slender, 70—120×7.5 μm
   on Rosaceae: Prunus
   P. tridactyla

3. Conidiophores long and slender, 125—275×7.5 μm
   on Rosaceae: Crataegus, Cydonia
   P. clandestina

   Nat. bot., 3 sér., 15: 136

   Type on Crataegus oxyacantha; Germany.

   On leaves. Mycelium thin, evanescent. Hyphae flexuous, occasion-
   ally geniculate, branching at right angles with a septum at the base,
   sometimes producing two opposite branches. Hyphal cells (50—)52.5
   (—75)×3.5(—5) μm. Appressoria unlobed, nipple-shaped, well-
developed or occasionally poorly developed, single or in sequence. Conidiophores long and slender, 125—275×7.5 μm, producing conidia in long chains. Foot cells (36—)55—87(—125)×7.5 μm with basal septum (7—)15—30 μm away from the branching point of the mycelium, followed by two to five straight-walled cells of 20—25×7.5 μm after which bulging cells of 10—12 μm wide occur. Conidia ellipsoid-cylindric, 25—27.5(—32.5)×11—12.5(—15) μm. Well-developed conspicuous fibrosin bodies are present, about 2—3(—6) μm diameter. Germ tubes on side or end of conidia.

This species can be distinguished from *P. leucotricha* by the remarkably slender conidiophores and conidia and the position of the basal septum of the conidiophores. It is generally inconspicuous on both sides of leaves and appears to cause little damage.

on *Crataegus monogyna* JACQ. (new record)

on *Cydonia oblonga* MILL. (new record)

BRIEN and DINGLEY (1951) listed *P. leucotricha* on this host but this species cannot be found on herbarium material and all New Zealand samples show the characteristically slender conidiophores. DINGLEY (1969) reported *P. clandestina* (instead of *P. tridactyla*) on *Prunus domestica* without description or herbarium sample and this unusual record cannot be verified.


Type on “living twigs”; America.

On leaves, stalks, inflorescences and fruit. Mycelium moderately dense to dense, white. Hyphae moderately flexuous, branching at right angles and 3.5—5 μm diameter.

Appressoria unlobed, nipple-shaped and well-developed. Conidiophores (57—)75—112(—115)×9—10 μm, producing conidia in long chains. Foot-cells (35—)37(—77)×9—12.5 μm, straight but often slightly swollen at the base, followed by one or two straight walled cells of 20—35 μm long. Conidia ovoid, 27.5—30×17.5—18 μm. Well-developed conspicuous fibrosin bodies of 2.5—5 μm diameter produced. Germ tubes on sides or near ends of conidia, simple, straight, long or short and ending in an unlobed appressorium (pl. 1, fig. 12).

Cleistothecia, containing a single, 8-spored ascus and with 5—6 long apical appendages, have been collected on several occasions and they were first described by CUNNINGHAM (1923). The broad, plump, conidiophores distinguish this mildew from other species in New Zealand. It is common on many varieties and cultivated rootstocks of apple throughout the year. Serious damage can occur when in spring the flowers, leaves and young twigs are attacked.

on *Malus sylvestris* (L.) MILL. (KIRK, 1908). Until 1908, powdery mildew of apple had been reported from New Zealand as *P. oxyacanthae*. CUNNINGHAM (1921) pointed out that two
species, *P. leucotricha* and *P. oxyacanthae*, occurred on pip fruit but that these could not be identified from the conidial state alone. In 1925, Cunningham made it clear that *P. leucotricha* had only been recorded on apple.

on *Photinia serrulata* Lindl. (Boesewinkel, 1977). This is a very common mildew in the Auckland area and causes malformation of the spring growth.

on *Pyrus communis* L. (Brien and Dingley, 1951)


Type on *Prunus padus* L.; Germany.


Only one sample was studied in January 1968 and no further information was obtained. Unfortunately the characteristics of this fungus have not previously been described from New Zealand.

on *Prunus avium* L. (Cunningham, 1921)

on *Prunus domestica* L. (new record). This disease is very inconspicuous and was only observed once.

on *Prunus lusitanica* L. (Dingley, 1969)

SAWADAEEA Miyabe (1914)

The genus *Sawadaea* is characterised by large cleistothecia which contain many 8-spored asci and have many apically coiled, simple or branched appendages. The imperfect state is characterised by the production of both micro and macroconidiophores and micro and macroconidia, which produce conspicuous fibrosin bodies.


Type on *Acer pseudoplatanus*; Germany.

On leaves and inflorescences. Mycelium evanescent, white. Hyphal cells (45—)50(—65)×(2.5—)4—5(—6) μm. Appressoria unlobed, either poorly developed and inconspicuous or occasionally well-developed, nipple-shaped, 5—6 μm wide. Conidiophores straight, simple, rarely branched, producing conidia in chains. Macroconidiophores 57—95 (—125)×4—8(—10.5) μm, with basal septum 0—15 μm from the branching point of the mycelium. Foot-cells 17—50×6.2—10.5 μm, occasionally tapering from 7.5 μm at the base to 5.2 μm at the top. Microconidiophores 20—190×5—7.5 μm. Foot-cells 20—40(—100)×5—7.5 μm, often tapering to 5 μm at the top. Conidia cylindrical with characteristic angular outline, occasionally ellipsoid-ovoid. Macroconidia (23—)27(—37.5)×(13—)15(—20) μm, microconidia 12.5
Well-developed conspicuous fibrosin bodies present in both micro and macroconidia and in conidiophore cells. Germ tube on sides or ends of conidia, short or moderately long, 5—40 x 2.5 μm and terminating in an unlobed or rarely in a moderately lobed appressorium 25 x 5(—12) μm. On rare occasions branching of the base of foot cells and the base of the second conidiophore cells occurred (pl. 1, fig. 13). The shape of the conidia and the evanescent, hypophyllous mycelium distinguish this species from Sa. tulasnei (FUCK.) Homma which occurs overseas. Sa. bicornis is found from late spring until winter, but is easily overlooked as the symptoms are slight.

on *Acer negundo* L. (Boese winkel, 1977)
on *Acer pseudoplatanus* L. (Boese winkel, 1977)
on *Alectryon excelsus* Gaertn. (Boese winkel, 1979)
on *Dodonaea viscosa* Jacquin (new record)

**Sphaeroteca** Lév. (1851)

The genus *Sphaeroteca* is characterised by cleistothecia containing one ascus with (6—7—)8 ascospores and with unbranched or irregularly branched appendages. The conidiophores produce conidia in long chains. Conspicuous fibrosin bodies are produced. Several species form a secondary, brown and straight walled mycelium. The germ tubes are frequently produced on the side of conidia and are either bent or straight or simple or broadly forked.

1. Conidiophores long with basal septum 20—45 μm from branching point of mycelium. Chains of immature conidia moderately long or long.
   on Rosaceae: *Fragaria*  
   on Myrtaceae: *Eucalyptus*  
   **S. alchemillae**

2. Conidiophores moderately long, 100—140 x 8—9.5 μm, and basal septum 0—85 μm from branching point of mycelium. Chains of immature conidia long.

3. Conidiophores moderately long, slender, 75—80 x 7.5—8.7 μm, basal septum at branching point of mycelium. Chains of immature conidia long.
   on Rosaceae: *Rosa*  
   **S. pannosa**

4. Conidiophores moderately long, not slender, 80—100 x 10—12.5 μm, basal septum at branching point of mycelium. Germ tubes occasionally short and broadly forked.
   on Compositae: *Calendula*, *Gaillardia*,  
   *Helianthus*, *Olearia*,  
   *Petasites*, *Senecio*  
   **S. fuliginea**
   on Coriariaceae: *Coriaria*  
   **S. fuliginea**
   on Cucurbitaceae: *Citrullus*, *Cucumis*,  
   *Cucurbita*, *Lagenaria*  
   **S. fuliginea**
on Gesneriaceae: *Saintpaulia*  
S. *fuliginea*

on Malvaceae: *Hibiscus, Hoheria*  
S. *fuliginea*

on Papilionaceae: *Phaseolus*  
S. *fuliginea*

on Acanthaceae: *Acanthus*  
S. *fuliginea*

5. Conidiophores moderately long, not slender, 70—140 × 10—12.5 μm. Chains of immature conidia long or moderately long. Germ tubes occasionally short and forked.

on Verbenaceae: *Verbena*  
S. *verbenae*


Type on *Alchemilla vulgaris*; Scotland.

On leaves and fruit. Mycelium evanescent, occasionally dense. Hyphal cells about 50—70 × 3—5 μm. Appressoria unlobed, well-developed nipple-shaped, 5 × 7.5 μm. Conidiophores (88—)250—350 × 7.5—12.5 μm, producing conidia in long or moderately long chains with about (2—)3—8 immature conidia. Foot-cells (80—)110—170 μm long, straight or increasing in diameter from 7—10 μm at the base to 12.5 μm at the top. Basal septum of conidiophores (8—)20—45 μm away from the branching point of the mycelium. Conidia ovoid or subspherical, (22—)26—33(—38) × 16—22(—25) μm with well-developed fibrosin bodies. Germ tubes on side of conidia, simple, straight, very long and about 6.2 μm wide, ending in an unlobed appressorium.

Of interest, is, that the host range includes *Eucalyptus*, a genus on which this mildew has also been reported by BRANDENBURGER (1961) from Germany.

on *Eucalyptus cinerea* F. J. MUELL. ex BENTH. (new record)

on *Eucalyptus diversicolor* F. J. MUELL. (new record). Affected areas of the leaves become purple.

on *Eucalyptus grossa* F. J. MUELL. (new record)

on *Eucalyptus megacarpa* F. J. MUELL. (new record)

on *Eucalyptus nutans* F. J. MUELL. (new record)

on *Eucalyptus torquata* LUEHM. (new record)

on *Fragaria* sp. cult. (Cunningham, 1922). This disease is probably more common than is generally thought, but frequently the mildew is hypophyllous and too inconspicuous to be detected easily. Occasionally fruits have a "hairy" appearance due to the presence of numerous conidiophores.

34. *Sphaerotheca fugax* PENZ. & SACC. 1884. — Atti r. Ist. Ven. sci. 6: 2, 586

Type on *Geranium silvaticum*.

On leaves, stems and inflorescences. Mycelium sparse to dense, hyphae flexuous and geniculate. Hyphal cells 40—55 × 5—7.5 μm.
Appressoria unlobed, inconspicuous, up to 8.2 μm wide. Conidiophores 100—140 × 8—9.5 μm, producing conidia in chains with about 3—7 (—9), immature conidia. Foot-cells of conidiophores 65—90 × 8.7—9.5 μm and followed by cells 12—10 μm long. Basal septum of conidiophores 0—85 μm away from the branching point of the mycelium. Conidia ovoid or nearly globose, (21.2—)22.5—25(—40) × (15—)17.5—18.7(—21) μm. Well-developed fibrosin bodies present, often 6—8 in number. Germ tubes produced on the side, less frequently the end of conidia, simple, either short and broadly swollen, about 22.5 × 6—9 μm, or moderately long. Haustoria 15 × 18—23 μm.

This species is easily distinguished by the shape and small size of the conidia and by the placement of the basal septum of the conidiophores. It is common during the summer when in sheltered areas affected plants can become conspicuously white.

on Erodium moschatum (L.) L’HÉR. (BOESEWINKEL, 1977)
on Geranium homeanum TURCZ. (BOESEWINKEL, 1977)
on Geranium molle L. (new record)

35. Sphaerotheca fuliginea (SCHLECHT. ex FR.) POLL. 1905. — Atti r. Ist. bot. Univ. Pavia 2: 9, 8

Type on Veronica longifolia; Germany.

On leaves, stalks and inflorescences. Mycelium dense. Hyphae flexuous with straight and irregular areas, occasionally slightly geniculate, branching at various angles, including right angles, near a septum and sometimes producing two opposite branches. Hyphal cells (37—)62—67(—80) × 3—8.7 μm. Appressoria unlobed and inconspicuous. Conidiophores (32—)80—100 × 10—12.5 μm, producing conidia in chains with 1—4 immature conidia. Foot-cells of conidiophores (15—)35—50 × 10—12.5 μm followed by one or two straight walled cells of 15—22(—30) × 12.5 μm. The foot-cells can be slightly swollen at the base, measuring about 7.5 μm at the basal septum and increasing to 12.5 μm wide at the base after which the diameter decreases to 11—12.5 μm. Conidia ovoid, 27.5—31(—58.2) × 15—17.5 (—22.5) μm, with well-developed fibrosin bodies which are 2—7.5 μm wide and number up to 24 per conidium. Germ tubes on side of conidia, simple or forked, short or moderately long, frequently characteristically short, broadened and forked. Haustoria about 20—27.5 μm diameter (pl. 2, fig. 14). Cleistothecia have been reported from Coriaria (DINGLEY and BRIEN, 1956) and Cucurbita (DINGLEY, 1959).

This species is common throughout the year on Calendula, Coriaria, Cucumis and Cucurbita. During the summer it is also common on Hibiscus and Phaseolus.

So far no characteristies have been reported by which the conidial state can be split up into the different species used by JUNELL (1967).
Until cleistothecia are found on a wider range of plants and their characteristics are compared, it is best to accommodate all records in *S. fuliginea*.

- on *Acanthus mollis* L. (new record)
- on *Calendula officinalis* L. (DINGLEY, 1960)
- on *Citrullus lanatus* (THUNB.) MATSUM & NAKAI (HAMMETT, 1977)
- on *Coriaria angustissima* HOOK. (DINGLEY and BRIEN, 1956)
- on *Coriaria arborea* LINDSAY (BOESEWINKEL, 1977)
- on *Coriaria lurida* KIRK (DINGLEY and BRIEN, 1956)
- on *Cucumis angorica* L. (BOESEWINKEL, 1977)
- on *Cucumis melo* var. *cantalupensis* NAUD. (BOESEWINKEL, 1977)
- on *Cucumis sativus* L. (LAUNDON, 1971)
- on *Cucurbita maxima* DUCH. (LAUNDON, 1971)
- on *Cucurbita moschata* DUCH. ex POIR (DINGLEY, 1969)
- on *Cucurbita pepo* L. (DINGLEY, 1959)
- on *Gaillardia lanceolata* MICHX. (new record)
- on *Helianthus annuus* L. (BOESEWINKEL, 1977)
- on *Hibiscus syriacus* L. (BOESEWINKEL, 1977)
- on *Hoheria populnea* A. CUNN. (BOESEWINKEL, 1977)
- on *Hoheria lyallii* HOOK. (BOESEWINKEL, 1977)
- on *Lagenaria siceraria* (MOL.) STANDL. (BOESEWINKEL, 1977)
- on *Olearia furfuracea* (A. RICH.) HOOK. f. (BOESEWINKEL, 1979)
- on *Petasites fragrans* PRESL. (BOESEWINKEL, 1977)
- on *Phaseolus coccineus* L. (BOESEWINKEL, 1977)
- on *Phaseolus mungo* L. (new record)
- on *Phaseolus vulgaris* L. (new record)
- on *Saintpaulia ionantha* WENDL. (new record)
- on *Senecio cruentus* DC. (DINGLEY, 1969)


Type on *Rosa villosa* L.; Germany.

On leaves, stalks and inflorescences. Mycelium moderately dense to dense, primary mycelium white, secondary mycelium brown. Hyphae of primary mycelium moderately flexuous, branched at right angles, occasionally near a septum. Hyphae of secondary mycelium straight. Hyphal cells (12—)25—40(—120)×(3—)5—6(—7) μm. Appressoria unlobed, well-developed nippleshaped. Conidiophores 70—80(—200)×7.5—8.7(—10) μm, producing conidia in long chains with about 3—7(—9) immature conidia. Foot-cells of conidiophores 45—75(—120)×7.5—11 μm, often slightly swollen at the base where they are up to 11 μm wide with a basal septum about 7.5 μm wide. Foot-cells are followed by two straight-walled cells of about 12—16×10 μm. Conidia ovoid, 25—30×13.5—17.5 μm, producing conspicuous,
well-developed fibrosin bodies about 3—5 \( \mu \text{m} \) wide. Germ tubes on side or end of conidia, simple, about 4—5 \( \mu \text{m} \) wide. Cleistothecia containing single 8-spored asci have been collected on \( \text{Rosa rubiginosa} \) and \( \text{Rosa sp. cult.} \), but they have not been described.

This mildew is very serious on \( \text{Rosa multiflora} \) on which it frequently forms cleistothecia on the killed flowers. It damages fruit of \( \text{Prunus persica} \).

on \( \text{Prunus persica} \) (L.) \( \text{Batsch} \) (Cunningham, 1925)
on \( \text{Rosa multiflora} \) \( \text{Thumb.} \) (Hammett, 1977)
on \( \text{Rosa rubiginosa} \) L. (Brien and Dingley, 1953)
on \( \text{Rosa sp. cult.} \) (Kirk, 1906)

37. \( \text{Sphaerotheca verbenae} \) Savulescu & Negru 1953. — Bull. stiint. Acad. române 5: 415

Type on \( \text{Verbena hybrida} \); Rumania.

On leaves and inflorescences. Mycelium sparse to dense, white or grey. Hyphae very flexuous or geniculate, occasionally moderately flexuous, branching at right angles, often near a septum. Hyphal cells (35—)67(—95) \( \times \) (5—)7.5(—10) \( \mu \text{m} \). Appressoria unlobed, inconspicuous, about 8—10 \( \mu \text{m} \) wide. Conidiophores 70—140 \( \times \) 10—12.5 \( \mu \text{m} \), producing conidia in long chains, with 2—6(—9) immature conidia. Foot-cells of conidiophores 35—100 \( \times \) 11—12.5 \( \mu \text{m} \), occasionally 10 \( \mu \text{m} \) wide at basal septum, followed by one or two straight-walled cells 15—27.5 \( \times \) 11 \( \mu \text{m} \). Conidia ellipsoid to ovoid-cylindric, 32—35 \( (-47.5) \times (15-17.5-20 \mu \text{m} \) on \( \text{V. hybrida} \) and 35—42(—57) \( \times \) 15.5—16.2(—21) \( \mu \text{m} \) on \( \text{V. bonariensis} \). Conspicuous fibrosin bodies present, about 2.5—5 \( \mu \text{m} \) wide and about ten per conidium. Germ tubes on side of conidia, simple or occasionally forked, often short, about 17 \( \mu \text{m} \) long, more or less similar to those of \( \text{S. fuliginea} \) but often less broad, about 13 \( \mu \text{m} \) wide, and when forking occurs this is often more pronounced. This is a very common mildew. It is mainly hypophyllous.

on \( \text{Verbena bonariensis} \) L. (Boesewinkel, 1977)
on \( \text{Verbena hybrida} \) Voss (Boesewinkel, 1977)

**UNCINULA** Lév. (1851)

The genus \( \text{Uncinula} \) is characterised by cleistothecia containing several or many asci with 2—8 ascospores. The appendages are often numerous and are characteristically coiled at the apex.

1. Conidiophores straight, not slender or long
   on \( \text{Lythraceae: Lagerstroemia} \) \( \text{U. australiana} \)

2. Conidiophores frequently flexuous at the base, short or slender and long
   on \( \text{Vitaceae: Vitis} \) \( \text{U. necator} \)

Type on *Lagerstroemia indica*; Australia.

On leaves and stalks. Mycelium thin or dense, white. Hyphae sparsely branched at right angles, with or without a septum at the point of branching. Hyphal cells (38—)45—65 × (3—)5 μm. Appressoria multi-lobed, 5—6 μm wide, single or in pairs, often several pairs formed per hyphal cell. Conidiophores 55—80 × 5—8.7 μm, producing conidia singly. Foot-cells of conidiophores straight, occasionally narrowed up to 5 μm near the centre, or, rarely, slightly flexuous at the base, 27—30 (—55) × (5—)6—7 μm, occasionally only 5 μm wide at the insertion point, followed by two slightly shorter cells of 20—25 (—30) × 6.5—8.7 μm. Conidia ovoid or cylindric-ellipsoid, (27—)30—35 (—47) × (12.5—)13—15 (—20) μm. No well-developed fibrosin bodies produced. Germ tubes formed on the end of conidia, straight or flexuous, either very short and immediately producing one or two multi-lobed appressoria, or, moderately long, ending in a multi-lobed or unlobed appressorium.

HIRATA (1942) and VIENNOT-BOURGIN (1971) reported the formation of two multi-lobed appressoria upon germination, which distinguishes this species from species of *Microsphaera* for which this characteristic has not been observed. This species is common on its host in the Auckland area and occurs throughout the year. It seriously affects the young growth.

on *Lagerstroemia indica* L. (DINGLEY, 1969)


Type on *Vitis labrusca* L.; North America.

On leaves, stalks and fruit. Mycelium thin or dense, white. Hyphae flexuous, with cells 45—75 × 5 μm. Appressoria multi-lobed, 7—8 μm wide, single or opposite in 1, 2 or 3 pairs. Epiphyllous conidiophores 1, 2 or 3-celled, 70—100 × 5—7.5 μm, with foot-cells 25—60 × 5—7.5 μm. Hypophyllous conidiophores 1, 2, 3, or 4-celled, 220—400 × 5—7.5 μm with foot-cells 80—160 × 5—7.5 μm, followed by one long and one or two shorter cells. Foot-cells are moderately to extremely flexuous at the base. Conidia ovoid (27—)32.5—35 (—47) × (15—)17.5—18 (—19.5) μm, without conspicuous fibrosin bodies. Germ tubes on end, rarely on side of conidia, simple, irregularly branched or forked, short or moderately long and terminating in an unlobed or multi-lobed appressorium (pl. 2, fig. 15). A special feature of this species is the extremely flexuous base of the conidiophore which was first drawn by FRESENTIUS (1852) and which occurs to a lesser degree in a few other species. The difference in length of the conidiophores on
upper- and under-side of the leaves could be due to the presence of numerous hairs on the underside of the leaves. This powdery mildew is common during the summer and can cause serious damage.

on *Vitis vinifera* L. (Kirk, 1901)

40. Unidentified species of *Oidium* occur on *Brachyglottis repanda* J. R. & G. Forst., *Epilobium pubens* A. Rich., *Erica* sp., *Hypericum gramineum* Forst. f., *Limosella lineata* Glück, *Magnolia* sp., *Nasturtium* sp., *Olearia nummularifolia* Hook. f., *Salvia officinalis* L., *Senecio jacobaea* L., *Urtica ferox* Forst. f., *U. incisa* Poir., *Valerianella locusta* (L.) Betsche and *Zinnia elegans* L. Of these I have not been able to find a good collection to make identification possible. Lucas and Sheridan (1977) recorded *Oidium* sp. on a number of *Eucalyptus* species. Examination of their herbarium collections showed that several are *S. alchemillae*.

**Bibliography**


— (1905b). On the variation shown by the conidial stage of Phyllactinia corylea (Pers.) Karst. — Ibid. 3: 493—505.


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Host Index

Bl. = Blumeria; E. = Erysiphe; M. = Microsphaera; O. = Oidium;
Ph. = Phyllactinia; P. = Podosphaera; Sa. = Sawadaea; S. = Sphaerotheca;
U. = Uncinula.

Acanthus mollis ........... M. polonica
Acer negundo ........... Sa. bicornis
Agropyron scabrum ........... Bl. graminis
Alectryon excelus ........... Sa. bicornis
Alopecurus pratensis ........... Bl. graminis
Anemone coronaria ........... E. ranunculi
Aquilegia vulgaris ........... E. ranunculi
Aristotleia fruticosa ........... E. densa
Aster ericoides ........... E. cichoracearum
Avena sativa ........... Bl. graminis
Begonia masoniana ........... M. begoniae
Brachyglottis repanda ........... Oidium sp.
Brachylytis lanceolata ........... E. trifolii
Brassica campestris ........... E. cruciferarum
napo-brassica ........... E. cruciferarum
napus ........... E. cruciferarum
napus var.
napo-brassica ........... E. cruciferarum
oleracea
var. botrytis ........... E. cruciferarum
oleracea
var. ramosa ........... E. cruciferarum
rapa ........... E. cruciferarum
Bromus spp. ........... Bl. graminis

Buphthalmum speciosum ........... E. cichoracearum
Calendula officinalis ........... S. fuliginea
Callistephus chinensis ........... E. cichoracearum
Cardamine debilis ........... E. cruciferarum
hirsuta ........... E. cichoracearum
Castanea dentata ........... M. alphitoides
sativa ........... M. alphitoides
Chrysanthemum hortorum ........... "E. polyphaga"
indicum ........... O. chrysanthemi
morifolium ........... "E. polyphaga"
Citrullus lanatus ........... S. fuliginea
Clematis australis var.
rutifolia ........... E. ranunculi
jackmanii ........... E. ranunculi
paniculata ........... E. ranunculi
Cleome spinosa ........... E. cruciferarum
Coriaria angustissima ........... S. fuliginea
arborea ........... S. fuliginea
lurida ........... S. fuliginea
Coreopsis grandiflora ........... E. cichoracearum
Cosmos bipinnatus ........... E. cichoracearum
Cotinus coggygria ........... M. alphitoides
Crataegus monogyna ........... P. clandestina
Cucumis angurica ........... "E. polyphaga"
S. fuliginea
melon var.
cantalupensis ........... E. cichoracearum
"E. polyphaga"
S. fuliginea
raesanica ........... E. cichoracearum
"E. polyphaga"
S. fuliginea

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Cucurbita
maxima ........ E. cichoracearum
moschata ....... S. fuliginea
pepo .......... E. cichoracearum
S. fuliginea
Cydonia
oblonga ........ P. clandestina
Cyphomandra
betaceae ...... E. cichoracearum
Dactylis
glomerata ...... Bl. graminis
Dahlia
sp. cult. ........ E. cichoracearum
Delphinium
ajacis ........ E. ranunculi
culturorum .... E. ranunculi
Dodonaea
viscosa .......... S. bicornis
Dyssoxyllum
spectabile ..... E. heraclei
Epilobium
pubens .......... Oidium sp.
Erica
sp. ............ Oidium sp.
Erodium
moschatum ...... E. cruciferarum
S. fugax
Eucalyptus
cinerea .......... S. alchemillae
diversicolor .... S. alchemillae
grossa ........ S. alchemillae
leucoxylon var.
rosea .......... E. cichoracearum
S. alchemillae
 „E. polyphaga”
megacarpa .... S. alchemillae
nutans .......... S. alchemillae
torquata ...... S. alchemillae
Euonymus
japonicus ...... M. euonymi-japonici
japonicus var.
aureomarginatus .. M. euonymi-japonici
Fragaria
sp. cult. ........ S. alchemillae
Fumaria
officinalis ...... E. cruciferarum
Gaillardia
lanceolata ..... S. fuliginea
Geranium
homeanum ...... E. cruciferarum
S. alchemillae
galeopsidis
molle .......... E. galeopsidis
S. fugax
Gerbera
jamesonii ...... E. cichoracearum
Hardenbergia
monophylla .... O. hardenbergiae
Hebe
speciosa ...... E. pisi
Helianthus
annuus ........ E. cichoracearum
„E. polyphaga”
S. fuliginea
Helichrysum
bracteatum .... „E. polyphaga”
O. helichrysi
Hibiscus
mutabilis ...... E. cichoracearum
„E. polyphaga”
syriacus ...... S. fuliginea
Hoheria
lyallii ....... S. fuliginea
populnea ...... S. fuliginea
Hordeum
vulgare ...... Bl. graminis
Hydrangea
macrophylla ... M. polonica
Hypericum
gramineum .... Oidium sp.
Iberis
umbellata ...... E. cruciferarum
Kalanchoë
tubiflora ...... M. polonica
Lagenaria
siceraria ...... S. fuliginea
Lagerstroemia
indica .......... U. australiana
Lathyrus
odoratus ...... E. pisi
E. trifolii
pubescent ..... E. pisi
Limosella
lineata ........ Oidium sp.
Lotus
corniculatus ... E. trifolii
Lupinus
angustifolius .... E. pisi
argenteus ...... E. pisi
polyphyllus ..... E. pisi
Lycium
chinense ...... E. mougeotii
Lycopersicon
esculentum ..... „E. polyphaga”
Magnolia
sp. ........... Oidium sp.
Malus
sylvestris .... P. leucotricha

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Melilotus indica ........... E. pisi
Modiola caroliniana ...... E. polyphaga
Nasturtium sp. ............ Oidium sp.
Nicotiana tabacum ........ E. cichoracearum
Nigella damascena .......... E. ranunculi
Olearia furfuracea .......... S. fuliginea
Penstemon hartwegii X .......... E. cichoracearum
Phalaris tuberosa .......... Bl. graminis
Phaseolus coccineus .......... S. fuliginea
Petasites fragrans .......... S. fuliginea
Petunia hybrida ........... E. cichoracearum
Phalacris sessiliflora ........ M. alphioides
Pisum sativum ............ E. pisi
Phlox subulata .......... P. leucotricha
Plantago major ........... E. cichoracearum
Poaceae trivialis .......... Bl. graminis
Prunus avium ............ P. tridactyla
domestica ........... P. tridactyla
luisitanica .......... P. tridactyla
Pyrus communis .......... P. leucotricha
Quercus luisitanica ........ M. alphioides
Sessiliflora ........... M. hypophylla
Ranunculus acris ........... E. ranunculi
asiaticus ........... E. ranunculi
parviflorus ........... E. ranunculi
repens .......... E. ranunculi
sardous .......... E. ranunculi
sceletatus ........ E. ranunculi
Raphanus maritimus .......... E. cruciferarum
Ribes nigrum ........... M. grossularia
sylvestre .......... M. grossularia
uva-cripa var.
sativum .......... M. grossularia
Rosa multiflora ........... S. pannosa
rubiginosa .......... S. pannosa
sp. cult .......... S. pannosa
Rosmarinus officinalis .......... E. galeopsidis
Rubus australis .......... E. rubicola
cissoides .......... E. rubicola
squarrosus .......... E. rubicola
Saintpaulia ionantha .......... S. fuliginea
Salvia officinalis .......... Oidium sp.
Sanvitalia procumbens .......... E. cichoracearum
Sedum praetalmum .......... M. polonica
Senecio cruentus .......... S. fuliginea
jacobaea .......... Oidium sp.
Severinia buxifolia .......... M. euonymi-japonici
Sinningia speciosa .......... E. cichoracearum
Solanum aviculare .......... E. cichoracearum
integriflorum .......... E. polyphaga
laciniatum .......... E. cichoracearum
mauritianum .......... E. cichoracearum
S. pannosa
Solidago altissima .......... E. cichoracearum
canadensis .......... E. cichoracearum
Sophora microphylla .......... E. trifolii
Plate 1

Fig. 1. *Erysiphe carpophila*. Conidiophore with a flexuous footcell, ×670.

Fig. 2. *Erysiphe densa*. Dark cleistothecia on a part of a leaf of *Aristotelia fruticosa*, ×10.

Fig. 5. *Microsphaera alphitoides*. Conidiophore producing conidia singly, ×670.

Fig. 6. *Microsphaera polonica*. Conidiophore producing conidia singly, ×670.

Fig. 7. *Microsphaera polonica*. Mycelium with multi-lobed appressoria which are either single (a) or in pairs (b), ×670.

Fig. 8. *Microsphaera polonica*. Conidium and a 5-celled conidiophore, ×670.

Fig. 9. *Oidium hardenbergiae*. Conidium with coralloid germ tube, ×670.

Fig. 10. *Oidium hardenbergiae*. Conidiophore with a long flexuous foot-cell, ×670.

Plate 2

Fig. 3. *Erysiphe mougeotii*. Conidiophore producing cylindric conidia in a chain, ×670.

Fig. 4. "*Erysiphe polyphaga*". Conidium with short germ tube produced on the side, ×670.

Fig. 9. *Oidium hardenbergiae*. Conidium with coralloid germ tube, ×670.

Fig. 11. *Phyllactinia guttata*. Artificially bent conidiophore showing a basal septum (a) far away from the branching point of the mycelium, ×670.

Fig. 14. *Sphaerotheca fuliginea*. Conidium with broadly forked germ tube, ×670.

Fig. 15. *Uncinula necator*. Conidiophore with a long flexuous foot-cell, ×670.