

KEY TO THE SPECIES OF
ENTOMOPHTHORA SENSU LATO

by

Grace M Waterhouse and B L Brady
Commonwealth Mycological Institute

From *Bulletin of BMS* 16(2) October 1982

KEY TO THE SPECIES OF *ENTOMOPHTHORA SENSU LATO*

Grace M. Waterhouse and B.L. Brady
Commonwealth Mycological Institute

This revision of the first key (Waterhouse, 1975) has been made necessary by the description of 21 new species since then and also by the redescription of some old but important species. It remains a tabulation of characters and a diagnostic key. Although the species fall into a number of groups, these do not seek to follow several recently suggested genera and subgenera (see References) into which *Entomophthora* Fres. has been regrouped. In some sections it so happens that they do so. This serves to strengthen the divisions suggested but whether these merit generic or only subgeneric status remains a debatable point. The lack of information on hyphal bodies, pseudocystidia, nuclear content and descriptions of secondary conidia in many species would indicate that some recent placements of species have been premature.

In general the species have been arranged in each section in increasing size of primary conidia, but where it seemed of more interest to draw attention to similarity of host, e.g. those on mites, by placing these species adjacent this has been given priority.

Massospora Peck is not included. The 13 described species all attack adult cicadas. Fungal growth is confined to the abdomen, usually to the sex organs, and the spores develop in irregular cavities, the conidia and resting spores occurring in different individuals. They are set free while the insects are still moving by disintegration of the abdomen. The resting spores of all species have reticulate walls. The genus has been monographed by R.S. Soper (*Mycotaxon* 1: 13-40, 1974) and a new key provided in *ibid.* 13: 50-88, 1981.

The authors wish to thank Dr Neil Wilding of Rothamsted Experimental Station for new records and general advice.

Notes to the key. B = British records; C = Have been brought into artificial culture; all measurements in microns (μm).

References

- Ben-Ze'ev, I. & Kenneth, R.G. (1982). Features-criteria of taxonomic value in the Entomophthorales: I. A revision of the Batkoan classification. II. A revision of the genus *Erynia* Nowakowski 1881 (= *Zoophthora* Batko 1964). *Mycotaxon* 14, 393-455; 456-475.
- Humber, R.A. (1976). The systematics of the genus *Strongwellsea* (Zygomycetes: Entomophthorales). *Mycologia* 62, 1042-1060.
- Humber, R.A. (1981). An alternative view of certain taxonomic criteria used in the Entomophthorales (Zygomycetes). *Mycotaxon* 13, 191-240.
- Humber, R.A. (1981). *Erynia* (Zygomycetes: Entomophthorales): validations and new species. *Mycotaxon* 13, 471-480.
- Humber, R.A. & Ben-Ze'ev, I. (1981). *Erynia* (Zygomycetes: Entomophthorales): emendations, synonymy, and transfers. *Mycotaxon* 13, 506-516.
- King, D.S. (1976). Systematics of *Conidiobolus* (Entomophthorales) using numerical taxonomy. I. Biology and cluster analysis. II. Taxonomic considerations. III. Descriptions of recognised species. *Canadian Journal of Botany* 54, 45-65; 1285-1296; 55, 718-729.
- MacLeod, D.M. & Müller-Kögler, M. (1973). Entomogenous fungi: *Entomophthora* species with pear-shaped to almost spherical conidia (Entomophthorales: Entomophthoraceae). *Mycologia* 65, 823-893.

- MacLeod, D.M., Müller-Kögler, E. & Wilding, N. (1976). *Entomophthora* species with *E. muscae*-like conidia. *Mycologia* 68, 1-29.
- Remaudière, G. & Hennebert, G.L. (1980). Révision systématique de *Entomophthora aphidis* Hoffm. in Fres. Description de nouveaux pathogènes d'aphides. *Mycotaxon* 11, 269-321.
- Remaudière, G. & Keller, S. (1980). Révision systématique des genres d'Entomophthoraceae à potentialité entomopathogène. *Mycotaxon* 11, 323-338.

KEY TO THE SECTIONS

		Page
Conidiophores unbranched or occasionally little branched		
Conidia usually as broad as long (except <i>caroliniana</i>), single-walled, multi-nucleate		
No pseudocystidia	squat campanulate, usually with apical papilla and flat base.	
	Rhizoids present or absent	I 116
Conidia multinucleate (2-18)	spherical with papillate base or broadly pyriform.	
	Rhizoids present	II 118
	broadly or narrowly pyriform.	
	No rhizoids	III 120
Conidia usually 4-nucleate (up to 7 in <i>turbinata</i>), usually smoky coloured	secondary conidia on long capillary germ tubes.	
	No rhizoids	IV 124
Conidiophores branched: digitate, dichotomous or irregular (except <i>castrans</i> & <i>magna</i>)	secondary conidia on long capillary germ tubes.	
	Rhizoids usually present	V 128
Conidia usually longer than broad, double-walled, usually uninucleate	secondary conidia on stout germ tubes. Rhizoids present or absent.	
Pseudocystidia usually present	If on diptera pseudocystidia absent	VI 132
Rhizoids present or absent	on diptera, often in wet places secondary conidia as for VI or branched when aquatic.	
	Rhizoids & pseudocystidia present	VII 138
Conidia not reported	resting spores only present	VIII 142








LIST OF SPECIES

- 5 acaricida
 33 adjarica
 74 americana B
 71 anglica B
 48 aphidis
 8. apiculata B
 77 aquatica
 101 atrosperma B
 16 aulicae B
 14 batkoi
 104 bereschkoveana
 56 blunckii
 61 brahminae
 75 bullata B
 82 calliphorae B
 45 canadensis B
 28 caroliniana B
 67 castrans B
 94 cimbicis
 99 cleoni
 79 coleopterorum B
 23 conglomerata B
 88 conica B
 19 coronata B
 46 crassitunicata
 73 creatonoti
 58 crustosa
 6 culicis B
 91 cyrtoneurae
 69 delphacis
 55 delpiniana
 12 destruens
 84 dipterigena B
 95 dissolvens
 29 dysderci
 66 echinospora B
 54 erinacea
 3 erupta
 52 elateridiphaga
 34 floridana
 64 forficulae B
 65 forficulae var.
 major B
 60 formicae
 30 fresenii B
 36 fumosa
 97 gammae
 40 geometralis
 24 gigantea
 57 gloeospora
 56 gracilis
 13 grylli B
 105 inexpectata
 81 ithacensis
 92 jaapiana
 jaczewskii
 15 kansana
 37 lageniformis
 50 lampyridarum
 41 lanceolata
 103 lavroviae
 35 lecanii B
 76 magna
 9 major
 106 megasperma
 83 montana B
 1 muscae B
 59 myrmecophaga
 47 nebriae
 70 neoaphidis B
 53 nouryi B
 22 obscura B
 44 occidentalis B
 43 orientalis
 20 osmodes
 80 ovispora
 102 pallida
 10 papillata B
 31 parvispora
 42 patchii B
 62 phalangicida B
 49 phalloides B
 51 phytonomi Arth.
 93 phytonomi Jacz.
 7 planchoniana B
 98 porteri
 11 pseudococci
 100 punctata
 90 pustulata
 68 pyralidarum
 39 radicans B
 87 rhizospora B
 96 richteri B
 17 saccharina
 89 sepulchralis
 18 tabanivora
 25 tenthredinis B
 32 tetranychii
 27 thaxteri
 4 thripidum
 21 thromboides B
 26 tipulae Pres. B
 38 turbinata B
 85 variabilis B
 72 virescens B
 78 vomitoriae B
 2 weberi
 63 zabrii
- Synonyms
- * acaridis B
 - 16 anticae
 - 42 aphrophorae
 - 28 arrenoctona
 - 13 calopteni
 - 79 carpentieri
 - 7 chromaphidis
 - 13 colorata
 - 85 curvispora B
 - 16 egressa
 - 16 elegans
 - 53 exitialis B
 - 7 ferruginea B
 - 80 henrici
 - 67 hylemyiae B
 - 22 ignobilis
 - 96 lauxaniae
 - 82 muscivora B
 - 30 neri
 - 1 pelliculosa
 - 106 plusii
 - 21 pyriformis
 - 6 rimosa
 - 1 scatophagae
 - 66 schroeteri
 - 57 sciarae
 - 39 sphaerosperma
 - 1 syrphi
 - 22 thaxteriana B
 - 98 tipulae Porter
 - 21 virulenta
 - * zabrae
- * insufficiently described

I Hyphal bodies multinucleate, conidiophores usually unbranched, upper part enlarged point, resting spores usually azygospores with smooth walls; no pseudocystidia. Thi

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
NO RHIZOIDS 1. <i>muscae</i> incl. <i>syrrhi</i> ? <i>pelliculosa</i> <i>scatophagae</i> B C	house flies, bluebottles and other diptera	whitish felt at abdom- inal joints coalescing ventrally, attached by proboscis or legs	irregular, short, multinucleate	flask-shaped with short neck thickened apically
2. <i>weberi</i>	Neuroptera (<i>Raphidia</i>) larvae	whitish grey cushions, attached by legs	spherical to irreg- ular or amoeboid large, multinu- cleate, vacuolate	with pointed tips
3. <i>erupta</i>	Heteroptera <i>Lygus</i> and other plant bugs	white dorsal mat. Those with R.S. brown, swollen, attached by the beak	irregular, pear shape to oval	tubular to club- shaped
4. <i>thripidum</i>	<i>Thrips tabaci</i> in glasshouse	dorsal white collars on abdomen	cylindrical, simple or branched	simple
5. <i>acaricida</i>	Acarina <i>Halo- tydeus des- tructor</i>	mite yellowish brown		short stout.
WITH RHIZOIDS 6. <i>culicis</i> ? incl. <i>rimosa</i>	on gnats and other diptera in wet places	whitish or greyish, occ. greenish <i>rhizoids</i> thick uni- form	forming (a) one conidiophore (b) several conidiophores	sometimes once branched low down, binucleate
7. <i>planchoniana</i> non Thaxter incl. <i>ferrugines</i> <i>chroma- phidis</i>	Homoptera especially aphids, and ? occ. small diptera	dark coloured insects go brown, pale ones white to yellow or brick red <i>rhizoids</i> in a thick bundle or several bundles forming a platform stuck firmly	(a) spherical 9 diam. (b) oval 7.5 x 5	flask-shaped with a short neck parallel like felt


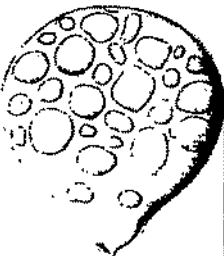
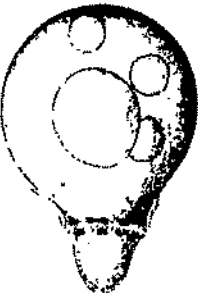

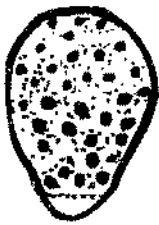
conidia usually single-walled, 2-18-nucleate, squat campanulate usually with an apical is *Entomophthora sensu stricto* if the splitting off of other genera is accepted.

Primary conidia		Secondary conidia	Resting spores
13-40 (25) x 11-30 (19.5-22), usually with one large oil globule, discharged with halo of protoplasm, double-walled		as primary but smaller or sub-ovoid with apex rounded, discharged by papilla eversion, 1 to few globules	azygospores 20-50 (34) or ellipsoid with truncate end 25-32 (28.5) x 18-25 (21.5), multinucleate, wall smooth, colourless or yellowish brown
like <i>muscae</i> 12-18 (16) x 11-16 (13)			
like <i>muscae</i> 17-23 x 15-18, pale green, protoplasm densely granular		spherical to ovoid 13.2-14.3	azygospores 33-66. external, wall smooth pale brown
like <i>muscae</i> 10-15 x 8-12, 2-4 nuclei, discharged with halo of protoplasm		as primary 9-12 x 7-9	
ovoid with truncate-convex base, 9-12 x 5-7 or subglobose 8 x 6		as primary	
like <i>muscae</i> 10-16 x 8-14, binucleate, one large oil globule, discharged with halo of protoplasm			azygospores 25-29 wall smooth, hyaline or pale brown
like <i>muscae</i> 14-23 x 12-20 (19 x 14), base slightly flared, double-walled, discharged with halo of protoplasm, 4-6 nuclei		as primary, minus apical point sometimes slightly smaller, one globule	? azygospores 25-36 (30) wall smooth, red-brown, epispore removable

II *Conidiobolus*-like with rhizoids. Hyphal bodies multinucleate, conidiophores unbranched prominent basal papilla (and sometimes a basal point) or broadly pyriform; resting

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
8. <i>apiculata</i> B C	various	yellow-pink cushions <i>rhizoids</i> few, long, conspicuous, ending in irregular disk	nearly spherical, sometimes elongated and branched multinucleate forming stroma	simple, sometimes branched
9. <i>major</i> C	various	white mat over the surface or sparse <i>rhizoids</i> few, strong, with irregular disk	spherical or ellipsoidal	sometimes digitate
10. <i>papillata</i> B	small diptera in wet places	host swollen, creamish <i>rhizoids</i> few, large, with sucker end		simple
11. <i>pseudococci</i> C	mealy bugs	inconspicuous, host chalky white, brittle <i>rhizoids</i> rope like, end branched	irregular with short branches, not breaking away	simple, rarely branched
12. <i>destruens</i> C	<i>Culex</i>	white covering <i>rhizoids</i> broad branching at tip	little branched	simple, thin




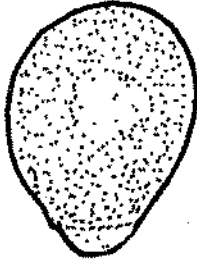

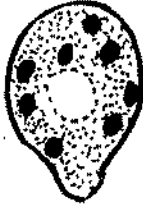

ed or rarely branched, enlarged subapically, conidia multinucleate, nearly spherical with a spores zygospores; no pseudocystidia, rhizoids present.

Primary conidia		Secondary conidia	Resting spores
spherical with large basal papilla having a point 28.5-37 x 25-30 1 or few globules discharged with a protoplasmic halo		like primary or spherical	azygo- or zygospores 28.5-45 hyaline
spherical with basal papilla proportionally smaller than preceding 45-60 x 38-55 (av. 50 x 47) many globules		similar	? azygospores 51-75 (av. 62) hyaline
spherical body separated from the very large basal papilla by a ridge 50 x 35 (up to 75 x 50) a few large globules		similar	azygospores 45-55 slightly brownish
spherical with a prominent, marked off basal papilla with a point 20-25 x 24-31.5 (papilla 7-11.5) contents granular with oil globules		similar or with 4-11 spherical smaller <i>microconidia</i> per primary conidium 7 diam.	zygospores 20-27 wall 4 hyaline, smooth
ovoid to broad pyriform with papilla and occasional basal point but no apiculus 22.5-31 x 18-24		similar	azygospores (converted conidia) 24-33 wall 2-3.5 smooth colourless superficial


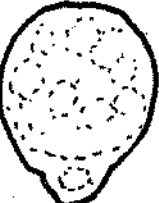
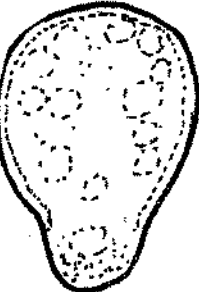


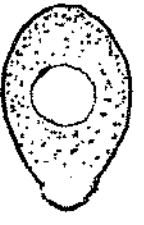

III *Conidiobolus*-like without rhizoids. Hyphal bodies multinucleate, conidiophores un- (*Entomophaga sensu* Humber, *grylli*, *kansana*, *aulicae*, *saccharina*, *batkoi*, *tabanivora*) secondary conidia like primary but smaller (except *caroliniana*), resting spores usually pseudocystidia, no rhizoids.

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
13. <i>grylli</i> incl. <i>calopteni</i> , <i>colorata</i> B C	orthoptera	host swollen attached by legs white to buff to greenish fur from the joints	short rounded, occ. amoeboid or irregular	sometimes slightly branched
14. <i>batkoi</i> C	harvest spiders <i>Oligolophus tridens</i> <i>Leiobunum</i> spp.	conidiophores emerge from the joints of the body and legs	amoeboid or irregular	unbranched, flask-shaped
15. <i>kansana</i>	Diptera various flies	white between sclerites, body disintegrates while alive, gelatinous, sticking to substrate.	subspherical to spherical	unbranched, cylindrical to clavate
16. <i>aulicae</i> incl. <i>anticae</i> , <i>egressa</i> , <i>elegans</i> B C	Lepidoptera	yellow-white, velvety	short segments, saccate	unbranched, sinuous, entwined
17. <i>saccharina</i>	moth caterpillars	covered with white conidia like grains of sugar, attached by legs		unbranched, coalescing
18. <i>tabanivora</i>	horseflies (Diptera)	cream coloured conidiophores from joints of head, thorax and abdomen	branched, coenocytic, short, thick	unbranched, clavate
19. <i>coronatus</i> (<i>Conidiobolus</i>) B C	various including aphids, soil	yellowish white	branched, segments coarsely granular	sometimes slightly branched

branched or rarely poorly branched, conidia single-walled, with either about 4 nuclei or many small nuclei, usually pyriform with a broad papillate base (except *caroliniana*), azygospores (sometimes zygosporae) with a smooth wall (?? villose in *coronatus*), no

Primary conidia		Secondary conidia	Resting spores
pyriform 25-45 x 20-37 base broadly papillate		same or smaller and more rounded	azygospores up to 40, multinucleate granular with 1 oil globule dark brown, wall smooth 4 thick
pyriform (33.3)43-52(56.9) x 30-37(41.3) base papillate 1 large oil globule		similar, smaller	28-35 smooth, wall 2.5-3 pale yellow
ovoid to pyriform 29-48 x 19-36 (av. 39 x 29) base papillate 1 central oil globule		slightly pointed apex 24-31 x 15-24 (av. 27 x 19)	
pyriform to broadly ovoid 30-40 x 18-30 papilla blunt 1 large globule		similar	azygospores 31.5-37.5 (<45) wall smooth dark yellow to brown multinucleate
pyriform 17-18 x 12-14 large papilla 1 large oil globule		similar but less regular in shape	azygospores and ? zygosporae 21 irregular spherical colourless 1 large oil globule
spherical to pyriform 33.2-40.2 x 29.2-35.6 (av. 36.7 x 32.4) base bluntly papillate 3-6 large oil globules			
nearly spherical (10)12-56(61), mostly 32-46 papillate base		similar or stalked microconidia 18 x 10	? azygospores villose, multinucleate slightly dark




Species	Hosts	Field characters	Hyphal bodies	Conidiophores
20. <i>osmodes</i> (<i>Conidiobolus</i>) C	aphids alfalfa weevil (<i>Hypera</i>) houseflies (experim.) soil	darkened larvae and pupae filled with black fluid		unbranched some- times swollen subterminally
21. <i>thromboides</i> (<i>Conidiobolus</i>) incl. <i>virulenta</i> ? <i>pyriformis</i> C	aphids, small diptera, moths	pale brown to reddish cover over entire insect host attached by proboscis	short sections more or less branched	simple <i>cystidia</i> doubtful
22. <i>obscura</i> incl. <i>ignobilis</i> <i>thaxteriana</i> <i>planohon-</i> <i>iana</i> sensu Thaxter B C	aphids	little evidence on host, aphids attached by proboscis	short to elongated branched curved or twisted	unbranched occ. ? <i>cystidia</i>
23. <i>conglomerata</i> non Thaxter B C	adult culicids (Diptera) floating	whitish in mass	amoeboid or irregular	unbranched
24. <i>gigantea</i> C	<i>Tipula palu-</i> <i>dosa</i> (Diptera) on grasses	host legs clasping grass no fungus externally	amoeboid	unbranched swollen terminally
25. <i>tenthredinis</i> ? non Thaxter ? incl. <i>cimbicis</i> B	on sawfly larvae (Hymenoptera)	velvety, turning brown		simple doubtfully occ. branched
26. <i>tipulae</i> Fres. non Porter	<i>Tipula</i> (Diptera)	single specimen on a reed	long, narrow sometimes branched, 4-celled	unbranched

Primary conidia		Secondary conidia	Resting spores
ovoid almost spherical 20.5-41.9 x 15-35 base papillate, large		similar	zygospores 13-37 (av. 25-30) spherical to elongate ellipsoid yellow- ish wall 2-6.5, rough with minute ridges
spherical 20-35 x 16-28 (av. 27 x 23) broad rounded basal papilla pyriform 15-31 x 12-25 (av. 25 x 19)		similar	zygospores 15-31 (av. 22) hyaline smooth (fine ornamentation under electron microscope) several large oil globules 12-25 (av. 15)
spherical with a papillate base 26-52 x 21-44 dense granular protoplasm many globules		similar	azygospores ? zygospores (<i>ignobilis</i>) 29-51 wall 3-6 smooth 1 - several oil globules
pyriform 25-45 x 20-34 broad papillate base 1 large oil globule discharged with protoplasm		similar 20 x 16	azygospores 34-55 (av. 46) smooth, hyaline
spherical 56-123 x 46-105 (av. 92 x 76) conical, rounded papilla many vacuoles		similar 65-88 x 57-76 (av. 76 x 66) formed at the end of a short germ tube	? azygospores 47-93 (av. 63) smooth, hyaline
broad pyriform tapering to a rounded (? or pointed) apex 40-62 x 30-52 (Petch 32-45 x 22-32) narrow papillate base 1 oil drop			azygospores 46-60 (av. 53), 27-36 (Petch) hyaline or yellowish wall smooth, 4
ovoid 33-40 x 25 short, wide, rounded papilla			



Species	Hosts	Field characters	Hyphal bodies	Conidiophores
27. <i>thaxteri</i>	aquatic flies (<i>Tipula</i>) (Diptera)	milky white flies mostly floating	simple, spherical	unbranched clavate
28. <i>caroliniana</i> incl. <i>arrenoctona</i> B C	<i>Tipula</i> (Diptera)	host, mostly males, attached by legs, shrunk, no fungus visible externally	rounded	unbranched scarcely projecting
29. <i>dysderci</i>	<i>Dysdercus</i> spp. (Homoptera)	white, velvety down on larvae and adults	irregular	simple, occ. branching

IV. Hyphal bodies 4-nucleate, conidiophores usually unbranched, conidia single-walled papillate, secondary conidia on a capillary germ tube, resting spores usually zygospores and vertical; no pseudocystidia, no rhizoids. This is the genus *Neozygites* Witlaczil and

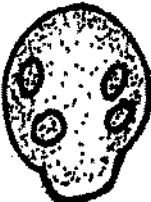

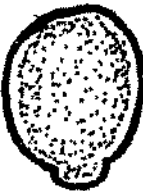
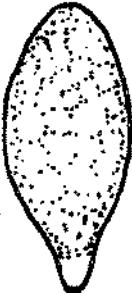


Species	Hosts	Field characters	Hyphal bodies	Conidiophores
30. <i>fresenii</i> ? incl. <i>neri</i> B	aphids	greenish- or violet- grey or grey, occ. with pinky tinges velvety, attached by proboscis body contents liquefied	yellowish globular or irregular, wall- less and unbranch- ed at first later elongating and branching	parallel like palisade
31. <i>parvispora</i>	thrips	milky when dying, then pale yellow	rectangular, 17-26.5 x 6.5-10 (21 x 8.5)	clavate

Primary conidia		Secondary conidia	Resting spores
<p>ovoid to pyriform 25-40 x 22-25 (av. 32 x 23) 1 or few large globules</p>		similar	azygospores 25-45 colourless, borne on a neck-like process
<p>ovoid or long ellipsoid 22-51 x 11-19 (av. 34 x 14) 1/d. 2.36; 26-45 x 10-15 (Thaxter) little indication of papilla</p>		<p>(1) pyriform 18-33 x 10-24 (2) fusiform 30-55 x 7-13</p>	azygospores 24-55 (av. 37) 37-55 (av. 45) (Thaxter) spherical, hyaline, smooth
<p>spherical with a large basal papilla 35-46 x 30-40 several large oil drops dis- charged with a gelatinous halo</p>		similar to primary but smaller	? zygospores 50-60 spherical, smooth, hyaline

(except *turbinata*) usually with a smoky colour, 4-7-nucleate, base flattened usually non-black or dark brown, binucleate, arising from the fusion point of spherical hyphal bodies of Remaudière & Keller and *Triplosporium* of Thaxter, Batkø, Humber, etc.

Primary conidia		Secondary conidia	Resting spores
<p>16-27 x 13-24, spherical or ovoid with a truncate base; very refractive granular with occ. two globules</p>		<p>1. like primary but smaller 2. dark smoky, almond shape, wall minute striate 29 x 13.6</p>	31 x 19-23 broad ellip- soid or sub-ovoid wall black smooth
<p>11-17.5 x 9-14.5 (13.5 x 11.5) spherical with a broad rounded base</p>		12-21 x 5-10 (17 x 7.5) almond shape with apical body	14.5 -20.5 (18) spherical. Wall black, wavy, grooved



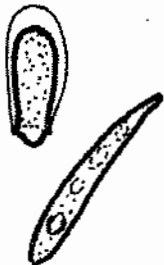

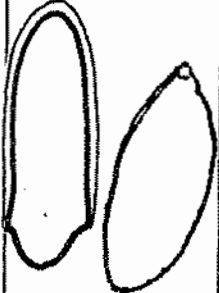
Species	Hosts	Field characters	Hyphal bodies	Conidiophores
32. <i>tetranychii</i>	mites (<i>Tetranychus</i>)	red → yellow then after death brown → grey → black	short tubular or clavate	digitate
33. <i>adjarica</i>	mites (<i>Tetranychus urticae</i>)		short, tubular, 17-27 x 5-7	single
34. <i>floridana</i>	mites	grey to grey-green	short, tubular or club-shape 2-4 nuclei	slightly broadened occ. curved columella persistent
35. <i>lecanii</i> B	scale insect	distended, white → grey → black	spherical, 4-nucleate diam. 8-10	short, stout
36. <i>fumosa</i>	mealy bugs, on citrus, ficus and hibiscus	grey woolly → black attached by proboscis	spherical c. 10 diam.	slender
37. <i>lageniformis</i>	aphids	attached by proboscis	spherical	bunched into fascicles, when young pseudodigitate
38. <i>turbinata</i> B	peach trunk aphid	glistening, reddish to black on lower sides of abdomen. Aphids hanging by proboscis	reddish, wide, long, irregular	unbranched broader just below conidium attachment

Primary conidia		Secondary conidia	Resting spores
15-17 x 12-15 hyaline, broadly pyriform, base abrupt or not, granular with small vacuoles		<ol style="list-style-type: none"> like primary uncommon almond shape, tip adhesive 25-28 x 8-11 wall brown verruculose 	azygospores 21.7 x 17.6 pyriform to oval, wall brown to black, ridged, with a hilum
12-17 x 10-4 pyriform, papilla 3-4, colourless with globules		14-24 x 7-10 clavate, brownish warty	14-25 x 14-22 spherical or subspherical, black
13-18 x 11-13 pyriform, base abrupt, refringent granules		<ol style="list-style-type: none"> like primary claviform, tip adhesive 15-20 x 10-12 wall brownish, striate 	22-26 x 20-23 spherical to ovoid, wall dark brown, smooth 2-4
18 x 9-10 pyriform		on fine hyphae pale brown	
16-28 x 8-10 fusiform tapering abruptly to base and apex occ. ellipsoid, basal papilla prominent often with apiculus		4 x 8 ellipsoid on capillary germ tubes, thick walled	? zygospores 15 diam. wall black with hyaline papilla, double, separable
30-38 (35) x 20-30 slightly smoky spherical above tapering to truncate base, contents granular		<ol style="list-style-type: none"> like primary almond shape 	
long-turbinate (obconical) 17.6-25.7 x 11.2-16 (mean 19.8 x 13.1) base blunt. 2 walls 1/b 1.2-1.86		none found	? azygospores 31.6-44.2 x 15.8-25.3 ellipsoid, smooth shiny black with small protuberance

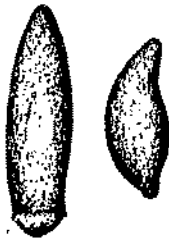

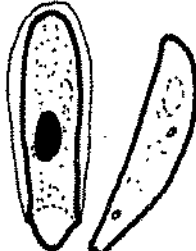

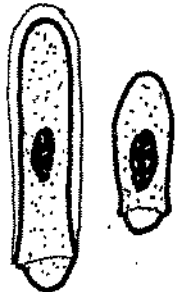

- V. Hyphal bodies multinucleate, conidiophores branched (except *crassitunicata*), digitate, cleate, wall double, base papillate with a collar, secondary conidia on a capillary germ present, rhizoids-usually present. This is part of the subgenus, later genus *Zoophthora* *Erynia* by Humber.

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
39. <i>radicans</i> (syn. <i>sphaerosperma</i>) B C	lepidopterous larvae, cicadas, diptera and aphids	colours various, white to brown-grey, occ. green, orange or black; <i>rhizoids</i> (1) numerous with expanded disk-like ends (2) monohyphal with branched ends	very variable, mycelial to spherical	much branched becoming confluent <i>cystidia</i> few, slender, tapering
40. <i>geometralis</i>	geometrid moths	<i>rhizoids</i> a strong tuft	variable, short sections, round to elongated, branched	branched, digitate, coalescing
41. <i>lanceolata</i> C	small diptera in wet places	white to greyish mycelium forming partial covering <i>rhizoids</i> present	hypha-like, branched or not	no <i>cystidia</i>
42. <i>petchii</i> = <i>aphrophorae</i> sensu Petch B	frog hopper (<i>Philaenus</i>)	bright orange stroma <i>rhizoids</i> coarse, brown in bundles, ends unexpanded		fused into orange stroma <i>cystidia</i> none
43. <i>orientalis</i>	citrus aphids	greyish brown no <i>rhizoids</i> seen	various sizes unbranched	digitate <i>cystidia</i> usually 2-celled, conical with bulbous apex

dichotomous or irregular primary conidia usually elongated and often curved, uninucleate, resting spores zygo- or azygo-; pseudocystidia (abbreviated to cystidia) sometimes Batko, also Remaudière & Keller and Ben-Ze'ev & Kenneth, but most are placed in

Primary conidia		Secondary conidia	Resting spores
<p>ellipsoid or long ellipsoid 14-25 x 5-9 (19.5 x 7.6) on larvae 22.4 x 7.2 on media base papillate with a delimiting ridge</p>		<p>(1) as primary but smaller (2) pointed and slender fusiform to almond shape 13-17 max 19</p>	<p>azygo- or zygosporos 20-37 (24-30) smooth, hyaline to pale yellow</p>
<p>short ellipsoid 15-22 x 10-12 base papillate, ridged, protoplasm finely granular</p>		<p>(1) as primary (2) long almond shape</p>	<p>azygo- or zygosporos 28-37 (30-31) smooth</p>
<p>subcylindrical, oblong or ovoid-ellipsoid 15-24 x 6-9 (17 x 7) base rounded with collar, symmetrical</p>		<p>capillary, fusiform 15-32 x 3-5 (24.4 x 3.8)</p>	<p>19-29 hyaline, smooth</p>
<p>narrow oval to ellipsoid 1/b 3.3 19.8-36.3 x 5.5-11.1 (25.2 x 8.3) papilla broad, defined by a collar mucous coat, pplasm granular with central nuclear body</p>		<p>(1) broadly oval with pointed tip 12-20 x 8-9 (2) almond shape, curved 17.5 x 7.9</p>	<p>azygosporos 23.7-34.8 wall smooth, 3 thick</p>
<p>narrow ellipsoid 23.7-34.5(27) x 6.3-10.3 (8.4) 1/b 2.8-4.3 (3.3)</p>		<p>(1) ovoid to obpyriform 19.7-26.9 x 7.1-12.6 (23 x 9) 1/b 1.7-3.2 (2.7) (2) almond-shape 24.5-29.2 x 5.5-10.3</p>	

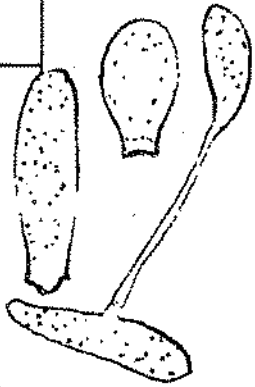

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
44. <i>occidentalis</i> B C	on aphids on <i>Betula</i> , <i>Chenopodium album</i> and potatoes	white to slightly yellow, <i>rhizoids</i> numerous in 1-3 bundles with branched tips		irregular digitate, coalescing yellow; <i>cystidia</i> scarce, slender, tapering
45. <i>canadensis</i> C = <i>aphidis</i> sensu Grobler <i>et al</i> B C	pine woolly aphid	wine red to dark red- dish brown, swollen then shrivelled. <i>rhizoids</i> cord-like	elongated 86 x 4.5	dichotomous or irregular, clustered no <i>cystidia</i>
46. <i>crassitunicata</i>	beetle (? <i>Malthodes</i> sp. Cantharidae)	white bands on head joints and abdominal joints <i>rhizoids</i> present		unbranched ?
47. <i>nebriae</i> ? = <i>radicans</i>	beetle (<i>Nebria</i> <i>brevicollis</i>)	<i>rhizoids</i> present		much branched
48. <i>aphidis</i> sensu Hoffman C	<i>Anoecia</i> aphids on <i>Cornus</i>	brown ochre, later white with conidial cushions, nodular and black with resting spores, fixed by stylets <i>rhizoids</i> black in a mat	sinuous, shortly branched 60-150	branched, grouped <i>cystidia</i> long flexu- ous, like <i>rhizoids</i> , only with R.S.
49. <i>phalloides</i> B C	aphids on <i>Urtica dioica</i> , other hosts	<i>rhizoids</i> numerous, unbranched, thin, forming pseudo- rhizomorphs		<i>cystidia</i> with round tips
50. <i>lampyridarum</i> Brit. records are misdets.	beetle	attached by man- dibles no <i>rhizoids</i>		? digitate

Primary conidia		Secondary conidia	Resting spores
<p>spindle shape, tapering to a pointed or bluntly conical apex (25-)35 x (8)-10; max 45 x 12 broad, rounded triangular base, often with apiculus, 1 large globule and smaller ones</p>		<p>(1) as primary (2) capillary, long almond shape 20-25 x 7-9 longer on agar</p>	<p>azygospores or zygo-spores 20-35 wall smooth hyaline pale yellow (20) 24-30 (32) larger on agar</p>
<p>long ellipsoid 15.5-36.5 x 6.5-14.5 (25 x 10) 1/b 2.5 several globules blunt broad papilla</p>		<p>(1) as primary but smaller (2) fusiform ellipsoid 20 x 8.5</p>	<p>azygospores (34) 29-43 light reddish or yellowish brown wall verruculose rugose</p>
<p>subcylindrical to slightly fusiform 25-36 x 8.5-12 (31.8 x 9.8) base conical with collar, symmetrical</p>		<p>capillary, fusiform to falciform, slightly curved 33-39 x 8-9</p>	<p>35-56 (43.5) wall brown, smooth at x 400 but with minute warts at higher power 2-to multi-nucleate</p>
<p>ellipsoid to fusiform often curved 28-37 x 10-13 with a globule</p>			<p>azygospores on host surface in a stroma 35-50 wall pale brown, smooth</p>
<p>sub-cylindrical to mostly fusiform (21)27-32(38) x (8)9-12(16) 1/d 2.1-3.9 basal papilla conical often pointed, with collar larger in culture</p>		<p>(1) similar on stout hyphae, projected (2) capillary (15)20-23 (30) x (8) 10-12 (16) almond-shape larger in culture</p>	<p>? azygospores, only in winged vivipares, coalescent, brown (29) 37-40 (53) wall with faint irregular ridges, separable</p>
<p>elongated cylindrical 32-48 x 11-14 (40 x 13) basal papilla hemispherical with collar constricted above, no vacuoles, (24.5) 27.5-33 (38.5) x 6-11 on another host</p>		<p>(1) broader than primary, <i>radicans</i> shape but larger (2) capillary crescentic (18) 20-25 x (7) 5-10</p>	
<p>ovoid, slightly tapering to apex 30-37 x 14-20 (35 x 15) base abrupt, broad, slightly papillate contents granular</p>		<p>long cylindrical with rounded ends on thin conidiophore</p>	





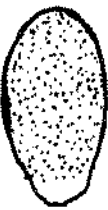
Species	Hosts	Field characters	Hyphal bodies	Conidiophores
51. <i>phytonomi</i> Arthur emend. Ben Ze'ev <i>et al.</i> C	beetle (weevil) larvae	green becoming yellow then beige <i>rhizoids</i> present	long, branched	palisade white becoming beige no <i>cystidia</i>
52. <i>elateridi- phaga</i> C	beetle (<i>Agriotes</i>)	<i>rhizoids</i> with disk		

VI. Hyphal bodies multinucleate, conidiophores branched (except *castrans* and *magna*), usually prominent, usually double-walled, uni- or multinucleate (nuclei large), resting *Erynia* of Humber and of Remaudière & Hennebert.

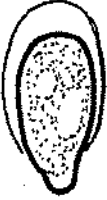
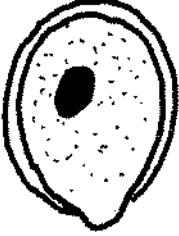
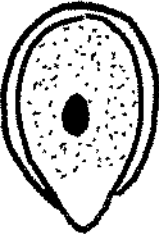




Species	Hosts	Field characters	Hyphal bodies	Conidiophores
53. <i>nouryi</i> = <i>aphidis</i> sensu Petch = <i>exitialis</i> auct. B C	root aphids	<i>rhizoids</i> single hyphae	variable, simple or branched	aggregated in clumps. <i>Cystidia</i> rare, apex obtuse, cylindrical
54. <i>ertnacea</i>	aphids	rusty brown, protrud- ing <i>cystidia</i> , attached by beak no <i>rhizoids</i>	like the conidio- phores	digitate; <i>cystidia</i> very long and thick occ. bifurcate
55. <i>delpiniana</i>	flies (<i>Polietes</i> and <i>Antho- myia</i>)	yellowish-white cover <i>rhizoids</i> not seen		digitate, coalesced <i>cystidia</i> long, occ. bifurcate
56. <i>blunckii</i> C	diamond back moth	grey to pale greenish- yellowish cover <i>rhizoids</i> numerous fine with terminal sucker	long variable	<i>cystidia</i> long slender
57. <i>gloeospora</i> ? incl. <i>sciarae</i>	gnats	<i>rhizoids</i> tapering cylindrical	spherical to slightly irregular	bifurcate

Primary conidia		Secondary conidia	Resting spores
elongated ovoid with rounded apex and broad base, similar to <i>radicans</i> but smaller 19.7-32.4 x 5.5-7.9 l/b 3-5		(1) shorter and wider than primary 18.2-23.7 x 7.1-7.9 (2) capillary, almond shape 13.4-19.7 x 5.5-7.9	azygospores internal, wall smooth 24.5-44.2
cylindrical 24-39 x 7-13 (28-35 x 8-10) papilla triangular l/b c. 3.3		(1) similar (2) capillary fusiform 31-33 x 7	22-48 (30) wall not separable




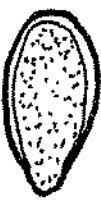




often digitate, often coalescing, conidia ovoid to pyriform or rarely fusoid, basal papilla spores zygo- or azygo-, pseudocystidia present or absent, rhizoids present or absent. Mostly

Primary conidia		Secondary conidia	Resting spores
ovoid, rarely asymmetrical, (12) 15-16.6 (20) x (7) 8-10.5 (12), basal papilla medium large, not prominent, rounded or flat		not seen	white in mass (20) 24.9-30.4 (36), wall 3-4 smooth
turbinate or obovoid 12.6-20.5 x 7.1-13.4 small papillate base and collar		similar but smaller	zygospores 27.7-37.1; wall 4-7 yellowish echinulate
obovoid 14-16 x 6-8 with truncate base		similar	azygospores, pyriform 40-46 x 23-32 wall smooth, ? hyaline
ovoid or pyriform with papillate base 13-20 x 7-11, mostly 15-18 x 7-9, in culture 16-26 x 9-14 (18-23 x 10-12) 1 or more oil drops		similar but smaller	
ovoid to pyriform, 20 x 14, papillate stout contents granular, shed with capsule		ovoid	azygospores 24-41 (35) ? uninucleate wall 4-6 hyaline ? smooth

Species	Hosts	Field characters	Hypal bodies	Conidiophores
58. <i>crustosa</i> C	<i>Malacosoma</i> spp. caterpillars	cinnamon brown tinged orange in a crust all over <i>no rhizoids</i>	oval to clavate	digitate, flask or clavate <i>no cystidia</i>
59. <i>myrmecophaga</i> sensu Humber confused in the past with the following	ants (<i>Serviformica</i>)	pinkish-white bands between segments, distended, attached by legs and mandibles ? <i>no rhizoids</i>		branched sparingly <i>no cystidia</i>
60. <i>formicae</i>	ants (<i>Formica</i>)	<i>rhizoids</i> few, stout, forming fascicle behind head with disk holdfast	irregular becoming septate and hyphal	in bands at joints dichotomous or digitate <i>cystidia</i> tapering
61. <i>brahminae</i>	defoliating beetles	attached by mouth-parts <i>rhizoids</i> with a disk		not coalescing
62. <i>phalangicida</i> B	harvest spider	pale brown waxy masses <i>rhizoids</i> ?		10 wide, coalescing rust coloured <i>cystidia</i> ?
63. <i>zabriti</i>	beetle larvae (<i>Zabrus tenebrioides</i>)	becoming dark brown <i>rhizoids</i> present	spheroidal or lobed	bifurcate <i>cystidia</i> tapering from bulbous base
64. <i>forficulae</i> var. <i>forficulae</i>	earwigs	conidiophores emerge at joints fixed by feet thorax and antennae; <i>no rhizoids</i>		sparingly branched
65. <i>forficulae</i> var. <i>major</i> B C	earwigs	conidiophores coalescing over body; <i>no rhizoids</i>		unbranched ?
66. <i>echinospora</i> incl. <i>schroeteri</i> B	diptera	flattish, swollen, brownish-grey to rust <i>rhizoids</i> coalescing		coalescing, rust-coloured <i>cystidia</i> ? absent

Primary conidia		Secondary conidia	Resting spores
ovoid tapering to a papillate base 16.5-25.3 x 6.5-12 (20.7 x 9.6) 1-3 large globules			zygodpores; 20.9-41.8 (28.9), cream to buff in mass; wall hyaline, sinuous
ovoid to pyriform, 18 x 12, slightly papillate, 1 large globule and smaller		similar but smaller no vacuole	doubtful
obovoid to pyriform, 18-25 x 10-16 papilla more or less distinct, everts on discharge		similar but smaller 16-19 x 10.5-13.5	
ovoid with papillate base 18-22 x 11-15		(1) as primary (2) small, 4-7, oval on longer germ tubes (doubtful)	zygospores, internal, 29, wall pale yellow or coloured, spiny, not separable; conj. tubes equal budded from junction
ovoid with attenuated base, 19-22 x 10 wall thin hyaline		similar	
ovoid with basal papilla 25 x 14 (max. 29 x 18) 1/d 1.8 with 2 vacuoles		not seen	internal and external 33-40 wall dark brown, smooth or verrucose
long ellipsoid 20-25 x 6-8, glutinous refringent, no globules			
ellipsoid 20-30 x 15-18, broad flattish convex papilla		smaller and rounded on short stalks	21-32.5 (27.5), yellow to pale brown wall reticulate
like <i>dipterigena</i> but not bent 20-32 x 9-14 (25 x 11), basal papilla, 1 or more large globules		similar	zygospores 10-41, external with neck, budded from junction; wall yellow to red, spiny, separable




Species	Hosts	Field characters	Hyphal bodies	Conidiophores
67. <i>castrans</i> = <i>hylemyiae</i> B	cereal fly (<i>Hylemyia</i>)	hole in ventral abdomen exudes spores; R.S. masses orange or salmon, internal; no <i>rhizoids</i>	hypha-like, branched, later short	unbranched, from vegetative hyphae <i>cystidia</i> none
placed in <i>Strongwellsea</i> by Batko, Humber etc.				
68. <i>pyralidarum</i> B now <i>neopyralidarum</i>	grass moths (<i>Pyralidae</i>)	small tufts form loose stroma chiefly over abdomen <i>rhizoids</i> numerous, terminally expanded		digitate
69. <i>delphacis</i> C	leaf and plant hoppers aphids by inoculation	<i>rhizoids</i> not seen	short, irregular hyphal sections	<i>cystidia</i> long slender
70. <i>neoaphidis</i> = <i>aphidis</i> sensu Thaxter, Nowak B C	aphids	<i>rhizoids</i> fine, numerous, with disk	very variable, branched, with large nuclei	digitate, <i>cystidia</i> narrowing to apex
71. <i>anglica</i> B	beetles and larvae (<i>Agriotes</i>)	pale or dark cream crust from joints <i>rhizoids</i> strong, coarse	? angular	coalescing <i>cystidia</i> ? long, narrow
72. <i>virescens</i> incl. <i>megasperma</i> B	lepidoptera (<i>Agrotis</i>)	greenish-yellow spore mass coating, black shrivelled larvae; <i>rhizoids</i>	spherical, germinating in	coalescing <i>cystidia</i> ? none
73. <i>creatonoti</i> C	tiger moth and army worm larvae	dark brown to yellow brown pile of buff or pink conidiophores; <i>rhizoids</i> straight, parallel, forming a tube	short irregular sections 20-24 x 8-28	coalescing over whole body <i>cystidia</i> rare
74. <i>americana</i> B	flies (<i>Muscae</i> etc.) and other insects	white to dark rust; <i>rhizoids</i> uniform threads forming mat, ends unexpanded	large, irregular, roundish	regular <i>cystidia</i> absent

Primary conidia		Secondary conidia	Resting spores
ovoid ellipsoid or obtuse conical 25-33 x 12-19, papilla 3.5 long, contents granular		spherical, forcibly discharged	spherical to ovoid 25-60 wall with short curved spines, orange, internal in females only
pyriform or ovoid 16-28 x 12-16 or globose 18-28, papilla obtuse or conical not apiculate, contents granular, large nucleus		similar but smaller	? azygospores (chlamydospores) 22-28 x 13-14 wall thick, central globule ? zygospores spherical 25-42, wall smooth, brown
ellipsoidal 26.5 x 16.1 32.7 x 14.8 (host) 30.2 x 15.5 (cult.) (Shimazu) outer wall separates readily		similar	24-28 yellow white
ovoid ellipsoid, asymmetrical, base narrow (15) 21-32 (40) x (9) 11-14 (16)		similar smaller or like <i>muscae</i>	
ovoid to subfusoid, occasionally slightly bent 22-27 x 11-13 papilla broad truncate		similar 18-21 x 10-11	
ovoid to oblong 18-32 x 16-28 (26 x 22), Petch 18-27 x 8-13, apex bluntly rounded, base irregular, multinucleate, numerous small globules		similar	? <i>megasperma</i> (Sect. VIII)
pyriform 32 x 25, base papillate cytoplasm granular			azygospores or a few zygospores 10-28 wall smooth thick
long ovoid, 28-30 (35) x 14-15, tapering to papillate base, often slightly bent numerous globules		similar	? azygospores 38-45-50 wall hyaline smooth





Species	Hosts	Field characters	Hyphal bodies	Conidiophores
75. <i>bullata</i> B C	bluebottles (<i>Sarcophaga</i> etc.)	<i>rhizoids</i> numerous, hypha-like, no ex- panded ends, coiled in bundles	variable, hypha- like	digitate, forming a continuous mat <i>cystidia</i> not seen
76. <i>magna</i> placed in <i>Strongwellsea</i>	flies (<i>Fannia</i>)	hole in ventral abdo- men exuding spores; resting spores in mass, no <i>rhizoids</i>	simple or aparing- ly branched	unbranched <i>cystidia</i> none
77. <i>aquatica</i> C	mosquito larvae and pupae	covered with white mat no <i>rhizoids</i>	irregular, long, branched	<i>cystidia</i> ? none
78. <i>vomitariae</i> B	bluebottles (<i>Calliphora</i> etc.)	<i>rhizoids</i> with tips ex- panded to star-like holdfasts	short, unequal, sacciform, branched	coalescing to thick mat; <i>cystidia</i> absent
79. <i>coleopter- orum</i> ? incl. <i>carpentieri</i> B	beetle larvae and weevils	<i>rhizoids</i> in conical tufts from thorax		coalescing, <i>cystidia</i> slender, tapering

VII. Hosts diptera and occasionally other insects often in wet places. Hyphal bodies vari-
curved, uninucleate, single or double-walled, secondary conidia broad (spherical,
rhizoids present, pseudocystidia large. All placed in *Erynia*.





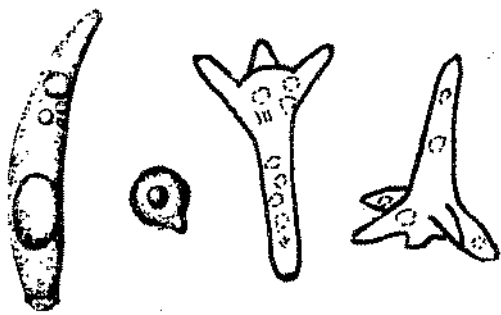

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
80. <i>ovispora</i> incl. <i>henrici</i> C	small flies in wet places	swollen, sometimes greyish, <i>rhizoids</i> present		<i>cystidia</i> large
81. <i>ithacensis</i> C	flies especially <i>Cymphoro- myia</i>	lateral white conidial masses, tawny or rusty glistening RS <i>rhizoids</i> fine numer- ous with disc or branched base		intertwined <i>cystidia</i> long slender, tapering
82. <i>calliphorae</i> incl. <i>musci- vora</i>	bluebottles (<i>Calliphora</i>)	few symptoms; occ. rusty crusts between last segments <i>rhizoids</i> present		yellowish (<i>muscivora</i>) <i>cystidia</i> slender tapering
83. <i>montana</i> B	small diptera in wet places	swollen, white to dirty white, 'hairy' <i>rhizoids</i> numerous	rounded	<i>cystidia</i> large

Primary conidia		Secondary conidia	Resting spores
like <i>americana</i> in shape 23-37.5 (29.5) x 12-16.5 (14), 1-2 globules, ejected by eversion of papilla		not seen	zygo- or azygospores 37.5-61.5 (49.7); wall pale tan, bullate (? bullae = fused hyphae) many nuclei
ovoid to ellipsoid 30-40 x 12-17			spherical or ovoid 45±7, internal; wall orange with recurved spines
pyriform 35-40 x 17, basal papilla elongated, 1 large oil drop		similar but smaller	
ovoid 28-44 x 12-19 (37 x 17) subpapillate, uninucleate			azygospores 25-52 wall smooth hyaline
ovoid 32-44 x 8-14			35-50 wall dark brown verrucose

able, conidiophores digitate often coalescing, conidia tapering to the apex or base, often ovoid or pyriform) or branched, resting spores usually zygosporangia with a smooth wall,

Primary conidia		Secondary conidia	Resting spores
ovoid tapering to papillate base 16-28 x 9-14 numerous small globules			zygosporangia 16-35 (31) hyaline
ovoid to ellipsoid 13.9-24 x 8.3-12		similar 9.3-11 x 6.5-7.4	25.9-40.7, wall yellow with deep ridges
ovoid 20-24 x 11-13 base blunt papillate			? azygosporangia (<i>Musci- vora</i>) av. 30; 1 large oil drop wall smooth, deep chestnut brown
top-shaped, apex broadly rounded tapering to a point- ed base 17-26 x 10-19 several large globules		as primary or short ovoid	

Species	Hosts	Field characters	Hyphal bodies	Conidiophores
84. <i>dipterigena</i> B C	diptera, especially small flies and gnats	white or greenish <i>rhizoids</i> few, large with terminal disks		coalescing, <i>cystidia</i> slender tapering
85. <i>variabilis</i> incl. <i>curvispora</i> B C	minute gnats in wet places	olive colour <i>rhizoids</i> numerous		<i>cystidia</i> large, tapering
86. <i>gracilis</i>	minute gnats	white <i>rhizoids</i> present		coalescing, <i>cystidia</i> rare
87. <i>rhizospora</i> B C	caddis and sm small diptera in damp places	white to grey, swollen <i>rhizoids</i> numerous, tough swollen, tapering and occ. clavate	simple or branched various sizes	coalescing luxurious <i>cystidia</i> large, tapering
88. <i>conica</i> B C	gnats and caddis (and ? flies and ? aphids) in wet places	pure white to grey, rarely green, shaggy <i>rhizoids</i> numerous, thread-like or coalescing, apex often branched	irregular, elongated, branched	coalescing, <i>cystidia</i> large, base swollen, apex tapering, sometimes branched
89. <i>sepulchralis</i>	tipulid flies in wet places	white with conspicuous halo (whited sepulchre) <i>rhizoids</i> numerous	spherical, large	coalescing, <i>cystidia</i> very large apex expanded or branched

Primary conidia		Secondary conidia	Resting spores
narrow ovoid to sub-fusiform 12-30 x 8-15 (22 x 11) rounded apex, tapering base, sometimes bent, several large globules		similar or broader	? zygospores 20-40 external clustered wall smooth, hyaline
first formed short ovoid 15 x 11, later ones elongated often curved 18-30 x 7-9 (25 x 8) apex rounded papilla narrower with collar		as the first primary rounded pear shape	30-40 (Petch) wall pale brown, smooth, zygospores 25-44 (Gustafsson) held together by brown-yellow hyphae
elongated fusiform, very curved 30-45 x 7-9 (40 x 8) apex attenuated, neck-line papillate base		as primary or nearly spherical, papillate	
tapering at both ends, often curved 30-35 (-62) x (5-) 8-10(-18) papilla rounded, base neck-line with ridge, few large oil globules discharged by columella eversion		as primary, obovoid or spherical with a prominent narrow papilla, forcibly ejected	zygospores 40-60 brownish with external hyphal network (Gustafsson 41-74 dark brown)
(1) aerial very curved, apex tapering and rounded 35-80 x 10-14, <100 x 17-22 2 large vacuoles, base papillate, discharged by columella eversion (2) aquatic; coronate (Y shape) (35-)65(-90) passive detachment single walled, uninucleate		(1) as primary (2) broadly ovoid or globose 17 (-22) (3) stellate in water from other aquatic spore forms 25-42 x 25-30, arms 7-15 single walled	zygospores 30-50 (-60) hyaline or pale brown in network of thick brown-yellow hyphae
elongated ovoid-ellipsoid or sub-fusiform, 35-48 (-55) x 10-15 base bent, narrow, papilla rounded, numerous large globules, outer wall separates easily		as primary or short ovoid	30-50, wall hyaline, smooth

VIII. Resting spores only present. Hyphal bodies need investigation. Rhizoids present or

Species	Hosts	Field characters
WALL PITTED OR RETICULATE		
90. <i>pustulata</i>	<i>Brassica</i> moth larvae (<i>Barathra</i>)	brownish going black, deformed
WALL SMOOTH (see also <i>megasperma</i>)		
91. <i>cyrtoneuræ</i>	fly	yellow crust between posterior segments and internally <i>rhizoids</i> ? present
92. <i>jaapiana</i>	leafhoppers	yellow dust between segments and internally, mummified no <i>rhizoids</i>
WALL WARTED OR VERRUCOSE		
93. <i>phytonomi</i> Jacz. non Arthur possibly the same as <i>osmodes</i>	weevil larvae	
94. <i>cimbicis</i> Petch suggests <i>tenthredinis</i>	sawfly larvae and pupae (<i>Cimbex</i>)	yellow internal powder mummified
95. <i>dissolvens</i>	night moth larvae	pale yellow mycelium and dark liquid <i>rhizoids</i> present
96. <i>richteri</i> incl. <i>lauxaniae</i> fide Bubák B	flies	reddish internal powder
97. <i>gammae</i>	moth larvae and pupae (<i>Plusia</i> and <i>Agrotis</i>)	yellowish to brown to black fixed by legs
98. <i>porteri</i> formerly <i>tipulae</i> Porter	crane flies (<i>Tipula</i>)	hyphal bodies various, mostly elongate
WALL SPINY		
99. <i>cleoni</i>	beetle larvae and pupae	orange powdery mass
100. <i>punctata</i> ? same as <i>phytonomi</i> Jacz.	beetle (weevil) larvae	pale cream turning black
101. <i>atrosperma</i> B	aphids	black powder fills dead insect; a few <i>rhizoids</i>
WALL ROUGH		
102. <i>pallida</i>	adult flies	powdery yellow to brown mass in abdomen
103. <i>lavroviae</i>	moth larvae	
104. <i>bereshkoveana</i>	moth larvae (<i>Barathra</i>)	finally black and mummified
105. <i>inexpectata</i>	moth larvae	dark brown
106. <i>megasperma</i> Cohn ? non auct. ? <i>plusii</i> ? conidial state <i>virescens</i>	moth larvae (<i>Barathra</i>)	black sluggish soft, later mummified brittle hyphal bodies spherical or oval

