

Host range and geographic distribution of Erysiphaceae as viewed from the families of Angiosperms, and comparison with Meliolineae

By K. Hirata

(Faculty of Agriculture, Niigata University, Niigata, Japan)

Table 1 was prepared for the purpose of reviewing the host range and geographic distribution of the Erysiphaceae (powdery mildew fungi) and the Meliolineae in connection with the families of the Angiosperms, especially the Dicotyledons. The numbers of host species of the Erysiphaceae and the Meliolineae in the table are due to my publication⁷⁾ and Hansford's⁸⁾.

The powdery mildew fungi are parasites of the Angiosperms, especially the Dicotyledons. They have many or few host species in 146 families among the total 291 families of the Dicotyledons^{*)}, and the host species in the Dicotyledons add up to more than 6500. In the Monocotyledons which are composed of 53 families^{*)}, only eight families have few host species with an exception of the family Gramineae which has many host species. The host range of the powdery mildew fungi is therefore recognized to be mainly in the Dicotyledons.

The Meliolineae has 2971 and 246 host species respectively in 125 families of the Dicotyledons and 14 families of the Monocotyledons, and in addition it has small host ranges in the Gymnosperms and Pteridophytes.

I have long noticed that there is a distinct difference between Formosa and Japan concerning the host range of the Erysiphaceae and the Meliolineae. The Meliolineae has considerably many host species in Formosa⁹⁾ which is situated in the subtropical zone, while it has only a few host species in Japan which are trees, such *Aucuba japonica*, *Camellia japonica*, *Clerodendron dichotoma*, etc.⁹⁾: Japan is generally speaking located in the temperate zone. On the other hand, the Erysiphaceae has far more host species in Japan (more than 800) than in Formosa and about 70% on the host species are herbs. It is noteworthy that both the Erysiphaceae and the Meliolineae are closely related to each other, being placed in the same order or in the neighboring orders^{1, 2, 3, 4)}. Furthermore the two fungi coincide in that they are obligate parasites

*) The numbers of families composing the Dicotyledons and the Monocotyledons come from A. Engler's „Syllabus der Pflanzenfamilien“, 12th ed. (1964).

and mostly ectoparasitic. So far as the two fungi in Formosa and Japan are concerned, they seem to have taken quite different courses in the host range and geographic distribution. Thus I have wanted to know if such a relation between the two fungi as found in Formosa and Japan can also be found in the other parts of the world. Comparison of the host range and geographic distribution between the two fungi may be helpful in understanding either one of the fungi, by contrasting it with the other.

The first part of this paper concerns the dicotyledonous families which have no or few host species of the powdery mildew fungi in connection with the geographic distribution of the families. The second part deals with the dicotyledonous families which have many host species. In the third part a comparison is tried between the powdery mildew fungi and the Meliolineae regarding their host range and geographic distribution.

I. Families which have no or few host species of powdery mildew fungi.

While preparing and looking through Table 1, it was noticed that the dicotyledonous families which belong to the following five groups generally have no or few host species of powdery mildew fungi.

- (1) Families composed of a small number of species
- (2) Families distributed exclusively or almost exclusively in the tropics
- (3) Families distributed exclusively in the Southern Hemisphere
- (4) Families distributed in both the tropics and the Southern Hemisphere

(5) Families of special nutrition or special ecological type.

(1) Families composed of a small number of species. Small families which are composed of less than 30 species count 110 among the total 291 dicotyledonous families. Among the 110 families 93 families have no host species of powdery mildew fungi; 12 families have each a single host species and the remaining five families, that is, Platanaceae (102*), Coriariaceae (144 *), Hippocastanaceae (149 *), Alangiaceae (221 *), and Nyssaceae (222 *), have a few host species.

(2) Families distributed exclusively or almost exclusively in the tropics. Families distributed exclusively or almost exclusively in the tropics are 103 in number. Among them 76 families have no host species and the remaining 27 families, for example, Annonaceae (44), Lauraceae (56), Piperaceae (70), Zygophyllaceae (127) and Flacourtiaceae (183), generally have few host species or small ratios of host species to the total species composing respective families. (Refer to the fifth column of Table 1).

*) Family number which is given at the top of each family in the first column of Table 1.

(3) Families distributed exclusively in the Southern Hemisphere. The families with restricted distribution in the Southern Hemisphere count 26. They have no host species, excepting two families, Proteaceae (15) and Goodeniaceae (287), each of which has a single host species.

(4) Families distributed in both the tropics and the Southern Hemisphere. Ten families belong to this groups. Five families among them have no host species, and each of the remaining five families, namely, Cunoniaceae (109), Byblidaceae (112), Tropaeolaceae (126), Myoporaceae (277) and Calyceraceae (290), have one or few host species.

(5) Families of special nutrition or special ecological type. All of the following 20 families of special nutrition or special ecological type have no host species.

Parasitic families: Loranthaceae (22), Balanophoraceae (23), Rafflesiaceae (74), Orobanchaceae (275) and three other families.

Insect-trapping families: Sarraceniaceae (92), Nepenthaceae (93), Droseraceae (94) and Lentibulariaceae (276).

Aquatic families: Nymphaeaceae (67), Podostemaceae (122), Menyanthaceae (249), Callitrichaceae (260) and four other families.

Desert-living and with greatly reduced leaves: Castaceae (39).

From the above statement it is clear that the families which are exclusively distributed in the tropics or the Southern Hemisphere or in both of these zones have no or few host species. In this connection it may be noteworthy that the host species in Lauraceae and Zygophyllaceae belonging to the second group, and also in Platanaceae and Hippocastanaceae belonging to the first group, are mostly recorded in temperate regions of the Northern Hemisphere.

II. Families which have many host species of powdery mildew fungi.

When the families belonging to the above mentioned five groups are excluded from the total 291 families of the Dicotyledons, 103 families remain. These families are distributed, some exclusively and some not, in the extratropical Northern Hemisphere. Among them there are considerably many families which have many host species of powdery mildew fungi or high ratios of host species. It is remarkable that all of the 13 families, which are distributed only in the extratropical Northern Hemisphere, have very many host species; for example, Salicaceae (7), Betulaceae (8), Cruciferae (97), Geraniaceae (125) and Aceraceae (146). (These families are designated by N in the column of distribution of Table 2, A). Among the families which are distributed not only in the Northern Hemisphere but also in the tropics and the Southern Hemisphere (designated by T N S in Table 2), there are 30 families which have many host species or high ratios of host species (more than 6%); for example, Polygonaceae (25), Rosaceae (115), Labiatae (261)

and Plantaginaceae (279). Whereas, there are 22 families which are not restricted to the Northern Hemisphere and have no or few host species or low ratios of host species (1% or less) (Table 2, B). However, about one half of these families are more tropical than Northern or Southern Hemispheric (as designated by T N S), while many of the families with many host species are not particularly tropical or Northern or Southern Hemispheric (as designated by T N S).

The above statement including what mentioned in the first part may be summarized as follows: the families distributed, either exclusively or not, in the extratropical Northern Hemisphere have the most abundant host species, as compared with the families distributed, either exclusively or dominantly, in the tropics and the Southern Hemisphere. It may further be presumed that the Northern Hemisphere is the most favorable for the powdery mildew fungi.

In regards to the reason why the tropical families have no or few host species, the environment conditions in the tropics may be responsible. Or else, the reason may not be found in the external conditions but may be sought for in tropical plants themselves which may have acquired an insusceptible quality to powdery mildew fungi while repeating their generations in the tropics.

The extratropical Northern Hemisphere is composed of three continents, namely Asia, Europe and North America. Which continent has the most abundant host species of powdery mildew fungi? Or, which continent is the most favorable for the fungi? This is an inquiry which appears interesting but it is quite premature for me to discuss this. At present I can only point out some fragmentary facts or relations, as follows, which I have noticed as interesting in connection with the distribution of the fungi in the Northern Hemisphere. When more facts and relations are accumulated, they may help to reveal important underlying relations between the fungi, the plants and the three continents.

(1) Boraginaceae (257) has many host species in Europe and North America. The family is composed of many species in Japan and probably also in China, but has no host species in Japan and only two in China. It may be worthy of mentioning that the family has many host species in Kazakh and Armenia which are located between the Far East and Europe. The family Gramineae also requires attention, since the family has a comparatively smaller number of host species in Japan and China, while it has many host species in Europe and North America^{7, 8)}.

(2) Caryophyllaceae (34), Cruciferae (97) and Umbelliferae (227), which have many species in the three continents, have many host species in Europe, while they have no or few host species in Japan, China and North America. These families also have many host species in Kazakh and Armenia^{7, 8)}.

(3) Nyctaginaceae (29), Portulacaceae (32), Cactaceae (39), Loasaceae (200), Pyrolaceae (230) and Hydrophyllaceae (257) are distributed only in North America. These families, except Hydrophyllaceae, have no or few host species^{7, 8)}. So far as these families are concerned, the North American families may generally be recognized, although not conclusively, to be incompatible with powdery mildew fungi. In this connection I want to know but cannot yet ascertain whether there are families which are distributed exclusively or dominantly in Asia or Europe, and whether such families, if present, have many host species or few ones.

(4) Amaranthaceae (37), Primulaceae (236) and Gentianaceae (248) may be remarkable families in the point they are large families composed of 900, 800 and 1100 species, respectively, and seem to be widely distributed in the Northern Hemisphere, but have no or very few host species in any of the three continents^{7, 8)}.

III. Comparison of Erysiphaceae with Meliolineae in regards to their host range and geographic distribution.

When Table 1 is looked through, it indicates that the host range and geographic distribution of the Erysiphaceae and the Meliolineae are quite different. In order to make it easier to understand the difference, Table 3 was prepared by picking up (A) the families with many host species of the Erysiphaceae but no or few host species of the Meliolineae; (B) the families, inversely to (A), with many host species of the Meliolineae but no or few host species of the Erysiphaceae, and (C) the families with many host species of the two fungi. According to this table the families with many host species of the Erysiphaceae (A) are distributed, either exclusively or not, in the extratropical Northern Hemisphere and include many herbaceous families. On the other hand, the families with many host species of the Meliolineae (B) are generally distributed in the tropics and most of them are arboreal and shrubby families. Only Piperaceae (70) and Convolvulaceae (255) are herbaceous families with many host species of the Meliolineae. As compared with the families with many host species of either the Erysiphaceae or the Meliolineae, those families which have many host species of both fungi are rather smaller in number counting only six (C). This fact may be related to the discrepancy in the host range and geographic distribution between the two fungi.

Table 4 lists the countries where the host species of the Erysiphaceae and the Meliolineae parasitic on Rhamnaceae (168) are recorded: this family has 26 host species of the Erysiphaceae and 24 of the Meliolineae in the world. The table helps to understand the difference between the two fungi in their geographic distribution. As seen in the table, the Erysiphaceae is mostly recorded in the temperate regions of the Northern Hemisphere, while the Meliolineae is recorded from the tropics and the subtropics. Such an aspect found in the Rhamnaceae is not special to this family, but is recognized also in the other families.

The above mentioned difference between the two fungi in the host range and geographic distribution is the more interesting when we consider that the two fungi are genealogically close to each other and that both of them are obligate parasites, mostly inhabiting the epidermal tissue. Such a consideration leads me to the following inquiries. Why have the two closely related fungi such a striking contrast in their host range and geographic distribution? Where were the native places of the two fungi? Were the powdery mildew fungi born in the extratropical Northern Hemisphere where they flourish now? Is it entirely impossible that the powdery mildew fungi were born in the tropics and have gradually moved to the warm and temperate Northern Hemisphere?

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Table 1. Number of host species of Erysiphaceae and Meliolineae in respective families of Angiosperms

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Erysiphaceae	Meliolineae	Remarks ⁷⁾
ANGIOSPERMAE DICOTYLEDONEAE (ARCHICHLAMYDEAE)							
<i>Casuarinales</i>							
1. Casuarinaceae	50	T			1	2	
<i>Juglandales</i>							
2. Myricaceae	56	T N S			1	2	3
3. Juglandaceae	58	N	21	36			1
<i>Balanopales</i>							
4. Balanopaceae	9	T					
<i>Leitneriales</i>							
5. Leitneriaceae	1	N					
6. Didymelaceae	2		S				
<i>Salicales</i>							
7. Salicaceae	350	N	151	43			
<i>Fagales</i>							
8. Betulaceae	100	N	155	100			
9. Fagaceae	600	T N S	266	44		28	

¹⁾ Sequence of orders and families is owing to A. Engler's "Syllabus der Pflanzenfamilien", 12th edition (1964).

²⁾ Number of species which compose respective families, owing to "Syllabus der Pflanzenfamilien".

³⁾ Distribution of respective families, owing to "Syllabus der Pflanzenfamilien" and J. Hutchinson's "The families of flowering plants", 2nd edition (1959).

⁴⁾ Owing to K. Hirata's "Host range and geographical distribution of the powdery mildews" (1966⁷).

⁵⁾ Ratio of the number of host species to the number of species which compose respective families.

⁶⁾ Owing to H. C. Hansford's "The Meliolineae" (1961)⁵.

⁷⁾ Remarks regarding the nutritional or ecological type and the distribution of respective families.

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Ery- siphaceae	Melio- lineae	Remarks ⁷⁾
			Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Number of host species ⁶⁾
<i>Urticales</i>					
10. Rhoipteleaceae	1	T			
11. Ulmaceae	150	N	68	45	13
12. Eucommiaceae	1	N			
13. Moraceae	1.550	T N S	40	3	53
14. Urticaceae	700	T N S	31	4	11
<i>Proteales</i>					
15. Proteaceae	1.400	S	1	+ *)	17
<i>Santalales</i>					
16. Olacaceae	230	T			8
17. Dipentodontaceae	1	T			
18. Opiliaceae	60	T			6
19. Grubbiaceae	5	T			
20. Santalaceae	400	T N S	22	6	8 Sometimes parasitic
21. Misodendraceae	11	S			
22. Loranthaceae	1.400	T			15 parasitic
<i>Balanophorales</i>					
23. Balanophoraceae	100	T			Parasitic
<i>Medusandrales</i>					
24. Medusandraceae	6	T			
<i>Polygonales</i>					
25. Polygonaceae	800	T N S	85	11	21
<i>Centrospermae</i>					
26. Phytolaccaceae	120	T	2	2	7
27. Gyrostemonaceae	16	S			
28. Achatocarpaceae	8	T S			
29. Nyctaginaceae	300	T N S	2	1	2 American
30. Molluginaceae	95	T			
31. Aizoaceae	2.500	T S			
32. Portulacaceae	500	T N S			American
33. Basellaceae	20	T	1	5	
34. Caryophyllaceae	2.000	N	58	3	
35. Dysphaniaceae	6	S			
36. Chenopodiaceae	1.500	T N S	47	3	
37. Amaranthaceae	900	T N S	7	1	1
38. Didiereaceae	11	S			

*) Ratio smaller than 0,5%.

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Ery- siphaceae		Melio- lineae	Remarks ⁷⁾
			Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Number of host species ⁶⁾	
<i>Cactales</i>						
39. Cactaceae	2.000	T N S			1	Leaves reduced, American
<i>Magnoliales</i>						
40. Magnoliaceae	215	T N S	18	8	13	
41. Degeneriaceae	1	T				
42. Himantandraceae	3	T				
43. Winteraceae	95	T				
44. Annonaceae	2.100	T	2	+	38	
45. Eupomatiaceae	2	T				
46. Myristicaceae	250	T			4	
47. Canellaceae	20	T			3	
48. Schisandraceae	47	T N	2	4	1	
49. Illiciaceae	42	T N S				
50. Austrobaileyaceae	2	T				
51. Trimeniaceae	7	T				
52. Amborellaceae	1	T				
53. Monimiaceae	450	T			11	
54. Calycanthaceae	9	N	1	11		
55. Gomortegaceae	1	T				
56. Lauraceae	2.250	T	19	1	76	
57. Hernandiaceae	65	T			3	
58. Tetracentraceae	1	N				
59. Trochodendraceae	1	N				
60. Eupteleaceae	2	N	1	50		
61. Cercidiphyllaceae	2	N	1	50		
<i>Ranunculales</i>						
62. Ranunculaceae	2.000	T N S	274	14	4	
63. Berberidaceae	650	N	32	5		
64. Sargentodoxaceae	1	T N				
65. Lardizabalaceae	30	N S	3	10		
66. Menispermaceae	425	T N S	10	4	13	
67. Nymphaeaceae	80	T N S				Aquatic
68. Ceratophyllaceae	6	T N S				Aquatic
<i>Piperales</i>						
69. Saururaceae	5	T N				
70. Piperaceae	1.400	T	2	+	43	
71. Chloranthaceae	70	T	2	3	1	
72. Lactoridaceae	1	S				

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Number of host species ⁴⁾	Ery- siphaceae Ratio ⁵⁾ (%)	Melio- lineae Number of host species ⁶⁾	Remarks ⁷⁾
<i>Aristolochiales</i>						
73. Aristolochiaceae	600	T N S	4	1	9	
74. Rafflesiaceae	55	T N S				Parasitic
75. Hydnoraceae	18	T N S				Parasitic
<i>Guttiferales</i>						
76. Dilleniaceae	350	T			10	
77. Paeciniaceae	33	N	10	30		
78. Crossosomataceae	4	N				
79. Eucryphiaceae	5	S				
80. Medusagynaceae	1	T				
81. Actinidiaceae	320	T N	9	3	6	Asian
82. Ochnaceae	400	T			7	
83. Dioncophyllaceae	3	T				
84. Strasburgeriaceae	1	T				
85. Dipterocarpaceae	400	T			1	
86. Theaceae	600	T N			7	Asian
87. Caryocaraceae	25	T				
88. Maroegraviaceae	120	T			4	
89. Quiniaceae	37	T				
90. Guttiferae	900	T N S	43	5	22	
91. Ancistrocladaceae	16	T				
<i>Sarraceniales</i>						
92. Sarraceniaceae	16	T N S				Insect- trapping, American
93. Nepenthaceae	79	T				Insect- trapping
94. Droseraceae	93	T N S				Insect- trapping
<i>Papaverales</i>						
95. Papaveraceae	700	T N	45	6		
96. Capparaceae	800	T N	9	1	11	
97. Cruciferae	3.000	N	233	8	1	
98. Tovariaceae	2	T				
99. Resedaceae	70	N	4	6		
100. Moringaceae	10	T				
<i>Batales</i>						
101. Bataceae	2	T				
<i>Rosales</i>						
102. Platanaceae	7	N	7	100		
103. Hamamelidaceae	115	T N	13	11	2	

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Ery- siphaceae Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Melio- lineae Number of host species ⁶⁾	Remarks ⁷⁾
104. Myrothamnaceae	2	T				
105. Crassulaceae	1.400	T N S	67	5		
106. Cephalotaceae	1	S				
107. Saxifragaceae	1.200	N S	131	11	6	
108. Brunelliaceae	35	T				
109. Cunoniaceae	350	T S	1	+	3	
110. Davidsoniaceae	1	S				
111. Pittosporaceae	240	T S	1	+	9	
112. Byblidaceae	2	T S				
113. Roridulaceae	2	S				
114. Bruniaceae	75	S				
115. Rosaceae	3.000	T N S	581	19	29	
116. Neuradaceae	10	S				
117. Chrysobalanaceae	300	T				
118. Connaraceae	400	T			17	
119. Leguminosae	13.000	T N S	866	7	315	
120. Krameriaceae	20	T N S				
<i>Hydrostachyales</i>						
121. Hydrostachyaceae	30	S				Aquatic
<i>Podostemales</i>						
122. Podostemaceae	200	T				Aquatic
<i>Geraniales</i>						
123. Limnanthaceae	8	N				
124. Oxalidaceae	950	T N S	14	1		
125. Geraniaceae	780	N	69	9		
126. Tropaeolaceae	80	T S	7	9		
127. Zygophyllaceae	250	T	9	4	1	
128. Linaceae	500	T N S	16	3	3	
129. Erythroxylaceae	2	T			3	
130. Euphorbiaceae	7.500	T N S	146	2	130	
131. Daphniphyllaceae	35	T N	1	3		Asian
<i>Rutales</i>						
132. Rutaceae	1.600	T N S	29	2	93	
133. Cneoraceae	3	N				
134. Simaroubaceae	100	T N S	6	6	10	
135. Pierodendraceae	3	T				
136. Burseraceae	600	T	1	+	17	
137. Meliaceae	1.400	T N S	9	1	72	
138. Akaniaceae	1	S				
139. Malpighiaceae	800	T			34	
140. Trigoniaceae	35	T			1	

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Ery-siphaceae		Melio-lineae		Remarks ⁷⁾
			Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Number of host species ⁶⁾		
141. Vochysiaceae	200	T					
142. Tremandraceae	30	S					
143. Polygalaceae	800	T N S	1	+	7		
<i>Sapindales</i>							
144. Coriariaceae	10	T N S	3	30			
145. Anacardiaceae	600	T N S	34	6	71		
146. Aceraceae	150	N	65	44	1		
147. Bretschneideraceae	1	T					
148. Sapindaceae	1.500	T	11	1	125		
149. Hippocastanaceae	15	T N	12	80			
150. Sabiaceae	90	T	1	1			
151. Melianthaceae	38	T			3		
152. Aextoxicaceae	1	T					
153. Balsaminaceae	450	T N S	11	2	2		
<i>Julianiales</i>							
154. Julianiaceae	5	T	1	20			
<i>Celastrales</i>							
155. Cyrillaceae	14	T N					
156. Pentaphyllaceae	4	T					
157. Aquifoliaceae	450	T N S	17	4	8		
158. Corynocarpaceae	5	T S					
159. Pandaceae	15	T S					
160. Celastraceae	850	T N S	26	3	23		
161. Staphyleaceae	50	T N S	1	2	3		
162. Hippocrateaceae	300	T			14		
163. Stackhousiaceae	22	S					
164. Salvadoraceae	12	T	1	8	1		
165. Buxaceae	60	T N S	4	7	2		
166. Icacinaceae	400	T			9		
167. Cardiopteridaceae	3	T					
<i>Rhamnales</i>							
168. Rhamnaceae	800	T N S	26	3	24		
169. Vitaceae	700	T N S	28	4	28		
170. Leeaceae	70	T					
<i>Malvales</i>							
171. Elaeocarpaceae	400	T N S	2	1	2		
172. Sarcolaenaceae	33	S					
173. Tiliaceae	400	T N S	23	6	22		
174. Malvaceae	1.500	T N S	94	6	48		
175. Bombacaceae	200	T	4	2	3		
176. Sterculiaceae	1.000	T	6	1	27		
177. Scytopetalaceae	32	T			1		

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Number of host species ⁴⁾	Ery- siphaceae Ratio ⁵⁾ (%)	Melio- lineae Number of host species ⁴⁾	Remarks ⁷⁾
<i>Thymelaeales</i>						
178. Geissolomataceae	1	S				
179. Penaeaceae	21	S				
180. Dichapetalaceae	250	T			2	
181. Thymelaeaceae	650	T N S	6	1	10	
182. Elaeagnaceae	65	T N S	10	15	1	
<i>Violales</i>						
183. Flacourtiaceae	1.300	T	1	+	63	
184. Peridiscaceae	2	T				
185. Violaceae	850	T N S	28	3	1	
186. Stachyuraceae	6	N	1	17		
187. Scyphostegiaceae	1	T				
188. Turneraceae	120	T			1	
189. Malesherbiaceae	25	T S				
190. Passifloraceae	600	T	10	2	4	
191. Achariaceae	3	S				
192. Cistaceae	175	N	29	17		
193. Bixaceae	1	T	1	100	1	
194. Sphaerosepalaceae	14	S				
195. Cochlospermaceae	20	T				
196. Tamaricaceae	100	T N	1	1		
197. Frankeniaceae	50	T N				
198. Elatinaceae	45	T N S				
199. Caricaceae	45	T	5	11	1	
200. Loasaceae	250	T N S	1	+		American
201. Datisceae	4	T N S	1	25		
202. Begoniaceae	820	T N S	20	2	1	
<i>Cucurbitales</i>						
203. Cucurbitaceae	850	T N S	119	14	17	
<i>Myrtiflorae</i>						
204. Lythraceae	500	T N S	14	3	1	
205. Trapaceae	3	T N				Aquatic
206. Crypteroniaceae	4	T				
207. Myrtaceae	3.000	T N S	42	1	74	
208. Dialypetalanthaceae	1	T				
209. Sonneratiaceae	7	T				
210. Punicaceae	2	N	1	50		
211. Lecythidaceae	450	T	1	+	10	
212. Melastomataceae	4.000	T			51	
213. Rhizophoraceae	120	T			3	
214. Combretaceae	500	T	3	1	21	
215. Onagraceae	650	T N S	58	9		
216. Oliniaceae	8	T S				

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Ery- siphaceae Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Melio- lineae Number of host species ⁶⁾	Remarks ⁷⁾
217. Haloragaceae	160	T N S	1	1		Aquatic
218. Theligonaceae	3	N				
219. Hippuridaceae	1	N S				Aquatic
220. Cynomoriaceae	1	N				Parasitic
<i>Umbelliflorae</i>						
221. Alangiaceae	18	T N S	3	17	2	
222. Nyssaceae	9	T	2	22		
223. Davidiaceae	1	N				
224. Cornaceae	95	T N	39	41	5	
225. Garryaceae	15	T N			1	
226. Araliaceae	700	T N	7	1	30	Asian
227. Umbelliferae	3.000	N S	225	7		
(SYMPETALAE)						
<i>Diapensiales</i>						
228. Diapensiaceae	18	N				
<i>Ericales</i>						
229. Clethraceae	30	T N	1	3	1	
230. Pyrolaceae	75	T N	1	1		American
231. Ericaceae	2.500	N S	68	3	28	
232. Empetraceae	9	T N S	1	11		
233. Epacridaceae	400	S			3	
<i>Primulales</i>						
234. Theophrastaceae	110	T				
235. Myrsinaceae	1.000	T			33	
236. Primulaceae	800	T N S	8	1		
<i>Plumbaginales</i>						
237. Plumbaginaceae	500	T N S	22	4		
<i>Ebenales</i>						
238. Sapotaceae	800	T N S	1	+	19	
239. Sarcospermataceae	8	T				
240. Ebenaceae	450	T	7	2	18	
241. Styracaceae	150	T N	3	2	10	
242. Lissocarpaceae	2	T				
243. Symplocaceae	400	T	3	1	8	
244. Hoplostigmataceae	2	T				
<i>Oleales</i>						
245. Oleaceae	600	T N S	74	12	45	

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Number of host species ⁴⁾	Ratio ⁵⁾ (%)	Number of host species ⁶⁾	Remarks ⁷⁾
<i>Gentianales</i>						
246. Loganiaceae	500 T		2	+	34	
247. Desfontainiaceae	5 T					
248. Gentianaceae	1,100 T N S		3	+	7	
249. Menyanthaceae	40 N S					Aquatic
250. Apocynaceae	2,000 T N S		11	1	111	
251. Asclepiadaceae	2,000 T N S		44	2	16	
252. Rubiaceae	7,000 T N S		41	1	242	
<i>Tubiflorae</i>						
253. Polemoniaceae	320 T N S		41	13		
254. Fouquieriaceae	7 N					
255. Convolvulaceae	1,600 T N S		39	2	81	American
256. Hydrophyllaceae	270 N		27	10		
257. Boraginaceae	2,000 T N S		161	8	15	
258. Lennaceae	4 N					Parasitic
259. Verbenaceae	2,600 T N S		48	2	103	
260. Callitrichaceae	44 T N S					Often aquatic
261. Labiateae	3,200 T N S		361	11		
262. Nolanaceae	83 T S		1	1		
263. Solanaceae	2,300 T N S		121	5	47	
264. Dukeodendraceae	1 T					
265. Buddlejaceae	160 T N S		1	1		
266. Scrophulariaceae	3,000 T N S		250	8	11	
267. Globulariaceae	27 N					
268. Bignoniaceae	800 T N S		38	5	63	
269. Henriquetziaceae	13 T					
270. Acanthaceae	2,600 T N S		14	1	32	
271. Pedaliaceae	65 T N S		7	13	3	
272. Martyniaceae	16 T		1	6		
273. Gesneriaceae	1,800 T		9	1	13	
274. Columellaceae	4 T					
275. Orobanchaceae	150 T N S					Parasitic
276. Lentibulariaceae	300 T N S					Insect-trepping
277. Myoporaceae	180 T S		1	1		
278. Phrymaceae	1 N					
<i>Plantaginales</i>						
279. Plantaginaceae	265 T N S		50	19	1	
<i>Dipsacales</i>						
280. Caprifoliaceae	400 T N S		109	27	11	
281. Adoxaceae	1 N					
282. Valerianaceae	360 T N S		34	9	2	
283. Dipsacaceae	270 T N S		53	20		
114						

Order and family ¹⁾	Number of species ²⁾	Distribution ³⁾	Number of host species ⁴⁾	Ery- siphaceae Ratio ⁵⁾ (%)	Melio- lineae Number of host species ⁶⁾	Remarks ⁷⁾
<i>Campanulales</i>						
284. Campanulaceae	2.000	T N S	25	1	7	
285. Sphenocleaceae	2	T				
286. Pentaphragmataceae	25	T				
287. Goodeniaceae	320	S	1	+	6	
288. Brunoniaceae	1	S				
289. Stylidaceae	140	S				
290. Calyceraceae	60	T S	1	2		
291. Compositae	19.000	T N S	1470	8	49	
MONOCOTYLEDONEAE						
Liliaceae	3.500		7	+	14	
Stemonaceae	30				1	
Agavaceae	560				13	
Amaryllidaceae	860		1	+		
Velloziaceae	190				1	
Dioscoreaceae	.650		4			
Iridaceae	1.500		1	+		
Commelinaceae	600		3	1		
Gramineae	8.000		608	8	96	
Palmae	3.400				43	
Cyclanthaceae	180				1	
Araceae	1.800		1	+	12	
Pandaceae	880				4	
Cyperaceae	3.700		1	+	44	
Musaceae	220				4	
Zingiberaceae	1.500				11	
Cannaceae	60				1	
Marantaceae	350		15			
Orchidaceae	20.000		1	+	1	
GYMNOSPERMAE						
Pinales					1	
Taxaceae					10	
Gnetaceae					1	
PTERIDOPHYTA						
					16	

Table 2. Families which are distributed, either exclusively or not, in the Northern Hemisphere and have (A) many host species and (B) no or few ones of the Erysiphaceae

(A) Families with many host species

Family	Distribution	Family	Distribution
Juglandaceae (3)	T N S	Anacardiaceae (145)	T N S
Salicaceae (7)	N	Aceraceae (146)	T N S
Betulaceae (8)	N	Buxaceae (165)	N
Fagaceae (9)	N	Tiliaceae (173)	T N S
Ulmaceae (11)	T N S	Malvaceae (174)	T N S
Santalaceae (20)	N	Elacagnaceae (182)	T N S
Polygonaceae (25)	T N S	Cistaceae (192)	T N S
Caryophyllaceae (34)	T N S	Cucurbitaceae (203)	N
Magnoliaceae (40)	N	Onagraceae (215)	T N S
Ranunculaceae (62)	T N S	Cornaceae (224)	T N S
Berberidaceae (63)	T N S	Umbelliferae (227)	T N S
Lardizabalaceae (65)	N	Oleaceae (245)	N S
Guttiferaceae (90)	N S	Polemoniaceae (253)	T N S
Papaveraceae (95)	N	Hydrophyllaceae (256)	N
Cruciferae (97)	N	Borraginaceae (257)	T N S
Resedaceae (99)	N	Labiatae (261)	T N S
Hamamelidaceae (103)	T N S	Scrophulariaceae (266)	T N S
Saxifragaceae (107)	T N S	Plantaginaceae (279)	T N S
Rosaceae (115)	T N S	Caprifoliaceae (280)	T N S
Leguminosae (119)	T N S	Valerianaceae (282)	T N S
Geraniaceae (125)	N	Dipsacaceae (283)	T N S
Simaroubaceae (134)	T N S	Compositae (291)	T N S

(B) Families with no or few host species

Family	Distribution	Family	Distribution
Nyctaginaceae (29)	T N S	Frankeniaceae (197)	T N
Portulacaceae (32) *	T N S	Elatinaceae (198) *	T N S
Amaranthaceae (37)	T N S	Loasaceae (200)	T N S
Illiciaceae (49) *	T N	Myrtaceae (207)	T N S
Aristolochiaceae (73)	T N S	Araliaceae (226)	T N
Theaceae (86) *	T N	Pyrolaceae (230)	T N
Capparaceae (96)	T N	Primulaceae (236)	T N S
Oxalidaceae (124)	T N S	Sapotaceae (238)	T N S
Meliaceae (137)	T N S	Gentianaceae (248)	T N S
Polygalaceae (143)	T N S	Apocynaceae (250)	T N S
Elaeocarpaceae (171)	T N S	Rubiaceae (252)	T N S
Thymelaeaceae (181)	T N S	Acanthaceae (270)	T N S
Tamaricaceae (196)	T N	Campanulaceae (284)	T N S

*) Family without any record of host species.

Table 3. (A) Families with many host species of the Erysiphaceae but no or few ones of the Meliolineae; (B) Families with many host species of the Meliolineae but no or few ones of the Erysiphaceae and (C) Families with many host species of the two fungi

(A)

Family	Distribution	Growth type	Family	Distribution	Growth type
Juglandaceae (3)	N	t	Geraniaceae (125)	N	h s
Salicaceae (7)	N	t s	Aceraceae (146)	N	t s
Betulaceae (8)	N	t	Cucurbitaceae (203)	T N S	h
Fagaceae (9)	T N S	t	Onagraceae (215)	T N S	h
Ulmaceae (11)	N	t s	Umbelliferae (227)	N S	h
Polygonaceae (25)	T N S	h	Polemoniaceae (253)	T N S	h
Caryophyllaceae (34)	N	h	Borraginaceae (257)	T N S	h
Chenopodiaceae (36)	T N S	h s	Labiatae (261)	T N S	h
Ranunculaceae (62)	T N S	h	Scrophulariaceae (266)	T N S	h s
Guttiferae (90)	T N S	h	Plantaginaceae (279)	T N S	h
Papaveraceae (95)	T N	h	Caprifoliaceae (280)	T N S	s h
Cruciferae (97)	N	h	Dipsacaceae (283)	T N S	h
Crassulaceae (105)	T N S	h s	Compositae (291)	T N S	h s
Saxifragaceae (107)	N S	h			
Rosaceae (115)	T N S	t s h			

(B)

Family	Distribution	Growth type	Family	Distribution	Growth type
Proteaceae (15)	S	t s	(162)	T	t s
Loranthaceae (22)	T	s	Sterculiaceae (176)	T	t s
Annonaceae (44)	T	t s	Flacourtiaceae (183)	T	t s
Monimiaceae (53)	T	t s	Myrtaceae (207)	T N S	t s
Lauraceae (56)	T	t s	Lecythidaceae (211)	T	t s
Piperaceae (70)	T	h s	Melastomataceae (212)	T	h s t
Dilleniaceae (76)	T	t s	Combretaceae (214)	T	t s
Connaraceae (118)	T	t s	Araliaceae (226)	T N	t
Rutaceae (132)	N S	s t	Myrsinaceae (235)	T	t s
Burseraceae (136)	T	t s	Sapotaceae (238)	T N S	t s
Meliaceae (137)	T N S	t s	Loganiaceae (246)	T	s t
Malpighiaceae (139)	T	t s	Apocynaceae (250)	T N S	t s
Sapindaceae (148)	T N S	t s	Rubiaceae (252)	T N S	t s
Hippocrateaceae					

*) The letters t, s and h are abbreviations of tree, shrubby and herbaceous, respectively. For example, „ts” means that the family is composed of tree species and shrubby ones and that tree species are generally dominant.

(C)		
Family	Distribution	Growth type
Magnoliaceae (40)	T N S	t s
Simaroubaceae (134)	T N S	t s
Anacardiaceae (145)	T N S	t s
Tiliaceae (173)	T N S	t s h
Oleaceae (245)	T N S	t s
Bignoniaceae (268)	T N S	t s h

Table 4. Countries with records of host species of the Erysiphaceae and the Meliolineae parasitic on Rhamnaceae

Continent	Erysiphaceae	Meliolineae
Asia	Japan, Korea, China, Thailand, Pakistan, USSR (Kazakh, Armenia), Iran, Turkey	Formosa, Philippines, Java, India
Europe	USSR (Ukraine, Latvia, Lithuania), Finland, Sweden, Norway, United Kingdom, Denmark, Holland, Belgium, Poland, Germany, Czechoslovakia, Yugoslavia, Hungary, Romania, France, Switzerland, Italy, Portugal, Spain	
Africa		Sierra Leone, Uganda
North America	USA	USA, San Domingo, Porto Rico, Panama
South America		British Guiana, Brazil, Argentina, Chile
Oceania	Australia	Australia

ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Sydowia](#)

Jahr/Year: 1971/1972

Band/Volume: [25](#)

Autor(en)/Author(s): Hirata K.

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