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Research Article

Host range and seasonal distribution of Powdery Mildews in Tamil Nadu

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Abstract

The study of Powdery mildews carried out in Tamil Nadu during the year 1989 to 1994, revealed infection on 159 angiosperms belonging to 51 host families and of which 23.27% were cultivated plants. These fungi produced both anamorph and teleomorph states. The study resulted in recording 106 fungal taxa belonging to the genera *Erysiphe*, *Leveillula*, *Microsphaera*, *Oidiopsis*, *Oidium*, *Ovulariopsis*, *Phyllactinia*, *Sphaerotheca* and *Uncinula.* The study revealed that there is a host range for certain species, while, some are host specific. The temperature range from 19-31°C in January was found be ideal for the occurrence and rise of temperature during summer months resulted in decline in the disease incidence and total disappearance in May. The minimum rainfall (27 mm) was recorded in January during which maximum number of fungal collections were made. Moderate relative humidity of 63% in January was found to favour conidial production. The shorter duration of sunshine, together with a moderate temperature and relative humidity, may probably have resulted in the germination and development of powdery mildews from July onwards. Ascomata of *Uncinula fici-nervosae*, *U. fici-religiosae*, *U. garugae* and *U. religiosae* were collected at an altitude of about 1000-1500 m in the hilly regions of Kotagiri and Kodaikanal in February. However, the other powdery mildew species recorded from the same regions failed to produce ascomata under these environmental conditions.

Keywords: powdery mildews, Tamil Nadu, distribution, climate

INTRODUCTION

Erysiphaceous fungi are commonly known as powdery mildews because of their enormous production of conidia on their host surfaces. These fungi produce anamorph states (conidial) in tropics and teleomorph (perithecial) states in the temperate regions (Bessey, 1961; Blumer, 1967). These fungi infect leaves, buds, flowers and fruits of a wide range of angiosperm plants and have proved as allergens and toxic to silkworms. Such an important group of pathogens much concerned to mankind, despite of their abundant occurrence in Tamil Nadu, were not studied in detail.

The first account of fifteen species of powdery mildews on thirty three host plants from Coimbatore and surrounding area was provided by Narayanasamy and Ramakrishanan (1967-68). Subsequently, sporadic collections were made from different parts of Tamil Nadu (Bappammal and Hosagoudar, 1992; Bappammal *et al.*, 1995; Hosagoudar, 1984, 1985, 1988, 1990a, b, 1991; Hosagoudar and Mohanan, 1990; Hosagoudar *et al.*, 1991a,b, 1992, 1993, 1997). Literature review of these fungi dealt by Hosagoudar *et al.* (1997). However, a detailed taxonomic account of the powdery mildew fungi of Tamil Nadu was dealt by Bappammal *et al.* (1995) and the present paper deals herewith the details about their host range, seasonal distribution and their occurrence in plain, etc. to facilitate the quarantine and to forecast powdery mildew diseases and to adapt their control measures.

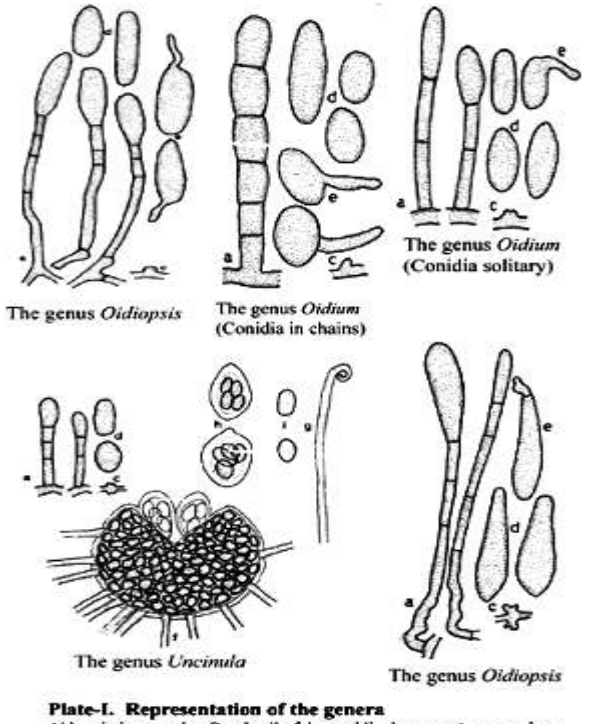

Plate-I. Representation of the genera
Abbreviations used: a-Basal cell of the conidiophores, c. Appressorium, d. Conidia, e. Germinating conidia, f. Fruiting body, g. Perithecial appendage, h. Asci, i. Ascospores

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The study of powdery mildew was conducted during the period from June 1989 to February 1994, resulted in collecting (examining) 304 collections during the period of study, found 159 infected host plants distributed among 51 host families, resulted in recording 106 fungal taxa belonging to the genera *Erysiphe* (13 sp.), *Leveillula* (1 sp.), *Microsphaera* (5 sp.), *Oidiopsis* (2 sp.), *Oidium* (70 sp.), *Ovulariopsis* (2 sp.), *Phyllactinia* (1 sp.), *Sphaerotheca* (6 sp.) and *Uncinula* (6 sp.) (Bappammal *et al.,* 1995) (Fig. 3). Except the genus *Uncinula*, all were in conidial form and have been assigned to their teleomorphs based on their morphological characters based on Braun (1987) (plate-I).

Certain species have a high adaptability to varied environmental conditions, *viz*. *Oidium mangiferae* has been reported from plains (Coimbatore) as well as at an altitude of 2400 m (Myladumparai, Kodaikanal). Similarly, *Oidium acalyphae* noticed on the weed *Acalypha* sp. in Mudumalai Wildlife Sanctuary at an altitude of 500 m was also reported in the evergreen forests of the Seithur hills at an altitude of 1500 m. But they occur either in dry deciduous, scrub or evergreen forests in a shade or in diffused sunlight.

The distribution of host specific powdery mildews, *Oidium mangiferae* on *Mangifera indica* and *Oidium bixae* on *Bixa orellana*, in different geographical regions deserve special mention. *Mangifera indica*, a native of India and *Bixa orellana*, a native of America were introduced into New Zealand and India respectively, for their economic importance. It has been reported that the introduction of *Oidium mangiferae* into New Zealand and *Oidium bixae* into India might have happened through the introduction of powdery mildew infected seedlings of the respective host species despite of the strict quarantine measures (Boesewinkel, 1980; Hosagoudar, 1991). These instances stress the need for designing a highly effective quarantine measures to check the plant materials before their introduction into new geographical regions.

Host range and periodicity of occurrence

The work of Powdery mildews of Tamil Nadu by Bappammal *et al.* (1995) reveals the record of 106 species on 159 host plants, of which 23.27% were cultivated plants, while the remaining were wild plant species. The earlier reports on the occurrence of powdery mildews were predominantly on cultivated plants, causing more severe destruction than on wild plants (Blodgett, 1913; Yarwood, 1957, 1973). This indicated the paucity of information in regard to their occurrence on wild plants and the need to focus interest in this area as the improvement of forest productivity.

Occurrence of a single pathogen on a single host recorded for 85 powdery mildew species indicates that existence of some degree host specialisation (Table 1). Presence of only one species of powdery mildew on only one host species or even genus but occasionally several have been reported (Yarwood, 1936, 1957, 1973). Maximum of two powdery mildews on a single host species has been observed on plants belonging to the same genus (Table 2). *Erysiphe galeopsidis*, *Microsphaera pseudolonicerae*, *Oidium fabacearum*, *O. manihoticola*, *O. ramakrishnanii*, *O. rosacearum*, *O. schmiedeknechtii*, *Sphaerotheca balsaminae* and *S. cassiae* infected each two hosts belong to the same genus (Table 7). *Erysiphe polygoni*, *Oidium acalyphae*, *O. abutili*, *O. pavoniae*, *O. ziziphi* and *Oidiopsis macrospora* occurred on three hosts each belonging to the same genus except *Erysiphae polygoni* and *Oidiopsis macrospora* which infected different genera of the same family (Table 3). *Erysiphe cichoracearum* and *O. ipomoeae* infected four hosts each belonging to the same family (Table 4). *Erysiphe ornotii*, *Leveillula taurica* and *Sphaerotheca fusca* occurred on nine, ten and twelve hosts, respectively, belonging to different genera and even families (Tables 5, 6 & 8). Occurrence of as many as three species of powdery mildews on *Alnus incana*, *Cirsium lanceolata*, *Crataegus monogyna*, *Pyrus communis* and *Prunus domestica* (Blumer, 1933), all the three on same leaf on *Quercus agrifolia* (Yarwood, 1973), four species on grapes (Cooke, 1906) and *Quercus* sp. (Yarwood, 1973) and six species on *Q. serrata* (Hirata, 1966) have already been reported. Salmon (1900) listed *Erysiphe polygoni* on 357 host species on 157 genera.

All the species of *Erysiphe*, *Sphaerotheca* and *Leviellula* with the exception of *E. sikkimensis* on *Quercus macrocarpa* occurred on herbs while the species of *Microspheara* and *Phyllactinia* except *Microsphaera trifolii*, *M. diffusa* and *M. begoniae* on *Tephrosia*, *Desmodium* and *Begonia* respectively occurred on trees only. This observation is in conformity with that of Hirata (1957, 1976). The pathogens, *Oidium manihoticola*, *Erysiphe polygoni* and *E. ornotii* infected both wild and cultivated plants.

Powdery mildews made their appearance in July and the number of collections increased gradually and reached maximum during January, declined gradually from February to April and totally disappeared in May. The same type of periodicity was recorded during the four consecutive years of investigation, indicating the existence of a definite periodicity of their occurrence in Tamil Nadu. This information is valuable in the crop protection point of view in devising suitable measures to control the pathogens at an appropriate time (Fig. 1).

Fig. 2. Average monthwise collection data Erysiphaceae from Tamil Nadu

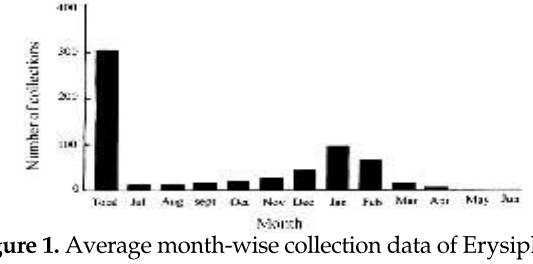

Figure 1. Average month-wise collection data of Erysiphaceae from Tamil Nadu

Table 1. One powdery mildew fungus on one host plant

S. no	Name of the host	Name of the fungus
1.	*Abelmoschus esculentus* (L.) Moench	*Oidium abelmoschi* Thumen
2.	*Abrus precatorius* L.	*Oidium abri* Hosag. *et al.*
3.	*Acacia auriculiformis* A. Cunn. ex Benth.	*Microsphaera acaciae* Braun
4.	*Acanthospermum hispidum* DC.	*Oidium acanthospermi* Chiddarwar
5.	*Aegeratum conyzoides* L.	*Oidium aegerati* Yen
6.	*Ailanthus excelsa* Roxb.	*Oidium ailanthi* Bagyan. *et al.*
7.	*Alnus nepalensis* D. Don	*Oidium betulacearum* Hosag. & Mohanan
8.	*Antigonon leptopus* Hook. & Arn.	*Oidium antigononi* Reddy *et al.*
9.	*Argemon mexicana* L.	*Oidium papaveracearum* Bapp. *et al.*
10.	*Azadirachta indica* A. Juss.	*Oidium azadirachtae* Narayan. & Ramakr.
11.	*Bauhinia purpurea* L.	*Oidium bauhiniae* Gorter & Eicher
12.	*Begonia* sp.	*Microsphaera begoniae* Sivan.
13.	*Bixa orellana* L.	*Oidium bixae* Viegas
14.	*Blainvillea acmella* (L.) Philipson	*Oidium blainvilleae* Bapp. *et al.*
15.	*Boerhavia* sp.	*Oidium boerhaviae* Bapp. *et al.*
16.	*Brassica nigra* Koch.	*Erysiphe cruciferarum* Opiz ex Junell
17.	*Carica papaya* L.	*Oidium caricae- papayae* Yen
18.	*Cassia fistula* L.	*Oidium cassiae-simeae* Yen
19.	*Cassia occidentalis* L.	*Oidium cassiae-simeae* Yen var. *indica* Hosag. *et al.*
20.	*Cassia tora* L.	*Oidium cassiae-hirsutae* Yen
21.	*Chenopodium ambrosioides* L.	*Erysiphe betae* (Vanha) Weltzien
22.	*Citrus aurantium* L.	*Oidium citri* (Yen) Braun
23.	*Clitoria ternatea* L.	*Oidium clitoriae* Narayan. & Ramakr.
24.	*Coriandrum sativum* L.	*Oidium coriandri* Hosag. *et al.*
25.	*Crotalaria laburnifolia* L.	*Oidium crotalariae* (Cliff. & Frag.) Hosag. *et al.*
26.	*Cryptolepis buchanani* R.& S.	*Oidium cryptolepidis* Hosag. *et al.*
27.	*Croton bonplandianum* (L.) Baill.	*Sphaerotheca crotonis* (Ponnappa) Braun
28.	*Dalbergia sisso* Roxb.	*Phyllactinia dalbergiae* Piroz.
29.	*Daucus carota* L.	*Erysiphe heraclei* DC.
30.	*Desmodium* sp.	*Microsphaera diffusa* Cook & Peck
31.	*Euphorbia hirta* L.	*Sphaerotheca euphorbiae-hirtae* Braun & Somani
32.	*Ficus nervosa* Heyne ex Roth	*Uncinula fici-nervosae* Bapp. *et al.*
33.	*Ficus religiosa* L.	*Uncinula fici-religiosae* Bapp. *et al.*
34.	*Ficus religiosa* L.	*Uncinula religiosae* Ramakr.
35.	*Garuga pinnata* Roxb.	*Uncinula garugae* Bapp. *et al.*
36.	*Gmelina arborea* Roth.	*Ovulariopsis gmelinae-arboreae* Hosag. *et al.*
37.	*Grewia* sp.	*Oidium grewiicola* Hosag. *et al.*
38.	*Heliotropium indicum* L.	*Oidium heliotropii-indici* Sawada
39.	*Hevea braziliensis* M. Arg.	*Oidium heveae* Stein.
40.	*Hibiscus rosa-sinensis* L.	*Oidium violae* Pass.
41.	*Hibiscus* sp.	*Oidium balakrishnanii* Hosag. *et al.*
42.	*Hydrangium* sp.	*Oidium hortensiae* Joerst.
43.	*Indigofera* sp.	*Oidium indigofera* Yen
44.	*Jatropha curcas* L.	*Oidium jatrophae* Hosag. *et al.*
45.	*Kydia calycina* Roxb.	*Oidium kydiae* Hosag.
46.	*Lagasca mollis* Cav.	*Oidium lagascae* Chiddar.
47.	*Lawsonia inermis* L.	*Ovulariopsis lawsoniae* Bagyan. *et al.*

Table 1 Contd.,

S. no	Name of the host	Name of the fungus
48.	*Leptadenia reticulata* (Retz.) Wight & Arn.	*Oidium leptadeniae* Prasad & Tyagi
49.	*Malachra capitata* L.	*Oidium malachrae* Hosag. & Stephen
50.	*Mangifera indica* L.	*Oidium mangiferae* Berth.
51.	*Mirabilis jalapa* L.	*Oidium nyctaginacearum* Hosag.
52.	*Moringa pterigosperma* Gaertn.	*Oidium moringae* Hosag.
53.	*Murraya paniculata* (L.) Jack	*Oidium murrayae* Hosag. *et al.*
54.	*Nyctanthes arbortristis* L.	*Oidium braunii* Hosag.
55.	*Ocimum sanctum* L.	*Oidium ocimi* Narayan. & Ramakr.
56.	*Parkinsonia aculeata* L.	*Oidium parkinsoniae* Udaiyan & Hosag.
57.	*Passiflora calcarata* Mast.	*Oidium passifloracearum* Hosag.
58.	*Pavetta* sp.	*Oidium pavettae* Bapp. *et al.*
59.	*Pedilanthus tithymaloides* (L.) Poir	*Sphaerotheca euphorbiae-hirtae* Braun & Somani
60.	*Peltophorum pterocarpum* (DC.) Baker ex Heyne	*Oidium peltophori* (Yen) Boes. var. *indica* Hosag. *et al.*
61.	*Pentatropis capensis* (L.f.) Bullock	*Oidium pentatropidis* Braun & Hosag.
62.	*Pilea melastomoides* (Poir.) Blume	*Oidium pileae* Bapp. *et al.*
63.	*Pisum sativum* L.	*Erysiphe pisi* DC.
64.	*Plectranthus* sp.	*Erysiphe rabdosiae* Zheng & Chen
65.	*Quercus macrocarpa* Michz.	*Erysiphe sikkimensis* Chona *et al.*
66.	*Salvia plebeian* R.Br.	*Erysiphe biocellata* Ehren
67.	*Santalum album* L.	*Oidium santalacearum* Braun & Hosag.
68.	*Scoparia dulcis* L.	*Oidium scopariae* (Sharma & Jain) Bagyan. & Ramach.
69.	*Scutellaria* sp.	*Erysiphe hommae* Braun
70.	*Sesamum indicum* L.	*Oidium sesami* (Paul & Kapoor) Hosag. *et al.*
71.	*Sida cordifolia* L.	*Oidium urenae* Yen
72.	*Solanum seaforthianum* Andr.	*Oidium seaforthiani* Hosag. *et al.*
73.	*Stachytarpheta indica* Vahl.	*Oidium stachytarphetae* Yen
74.	*Tagetes erecta* L.	*Oidium tagetedis* Hosag. *et al.*
75.	*Tamarindus indica* L.	*Oidium tamarindi* (Yen) Braun
76.	*Tecomaria capensis* (Thunb.) spach	*Oidium hiratae* Braun
77.	*Tectona grandis* L.	*Uncinula tectonae* Salmon
78.	*Tephrosia* sp.	*Microsphaera trifolii* (Grev.) Braun
79.	*Trema orientalis* (L.) Blume	*Oidium udaiyanii* Bapp. & Hosag.
80.	*Tribulus terrestris* L.	*Oidium tribuli* Hosag. *et al.*
81.	*Trichilia connaroides* Wight & Arn.	*Oidium trichilii* Hosag. *et al.*
82.	*Triumfetta* sp.	*Oidium doidgei* Bapp. *et al.*
83.	*Verbena rigida* Sprengel	*Erysiphe verbenae* schw.
84.	*Vernonia elaeagnifolia* DC.	*Oidium vernoniicola* Bapp. *et al.*
85.	*Vitis vinifera* L.	*Uncinula necator* (Schw.) Burr.

Table 2. Two Powdery Mildew fungi on one host plant

S. no	Name of the host	Name of the fungus
1.	*Abutilon indicum* (L.) Sweet	*Oidium abutili* Hosag. *Oidium pavoniae* Bagyan. & Braun
2.	*Benincasa hispida* (Thunb.) Cogn.	*Erysiphe ornotii* Cast. *Sphaerotheca fusca* (Fr.) Blumer
3.	*Ficus religiosa* L.	*Uncinula fici* Bapp. *et al.* *Uncinula religiosae* Ramakr.
4.	*Passiflora calcarata* Mast.	*Leveillula taurica* (L.) Arnaud *Oidium goosii* Bapp. *et al.*
5.	*Solanum erianthum* D. Don	*Erysiphe ornotii* Cast. *Leviellula taurica* (L.) Arnaud

Table 3. One powdery mildew fungus on three host plants

S. no	Name of the host	Name of the fungus
1.	*Abutilon indicum* (L.) Sweet *Sida rhombifolia* L. *Pavonia* sp.	*Oidium pavoniae* Bagyan. & Braun
2.	*Abutilon indicum* (L.) Sweet *Abutilon ramosum* (Cav.) Guill & Perr. *Abutilon* sp.	*Oidium abutili* Hosag.
3.	*Acalypha ciliata* Forsk. *Acalypha indica* L. *Acalypha* sp.	*Oidium acalyphae* Chiddar.
4.	*Cajanus cajan* (L.) Millsp. *Lablab purpureus* (L.) Sweet *Phaseolus* sp.	*Oidiopsis macrospora* (Uppal & Kamat) Mundk. & Thirum.
5.	*Muhlenbeckia platyclada* (F.V. Muell. Ex Hook.) Meisner *Polygonum barbatum* L. *Polygonum hydropiper* L.	*Erysiphe polygoni* DC.
6.	*Ziziphus mauritiana* Lam. *Ziziphus trinervia* Roxb. *Ziziphus* sp.	*Oidium ziziphi* (Yen & Wang) Braun

Table 4. One powdery mildew fungus on four host plants

S. no	Name of the host	Name of the fungus
1.	*Parthenium hysterophorus* L. *Sonchus oleraceus* L. *Xanthium indicum* J. Koen. *Zinnia* sp.	*Erysiphe cichoracearum* DC.
2.	*Ipomoea nil* (L.) Roth. *Ipomoea obscura* K. Gawl *Ipomoea* sp. *Merremia* sp.	*Oidium ipomoeae* (Yen & Wang) Braun

Table 5. One powdery mildew fungus on nine host plant

S. no	Name of the host	Name of the fungus
1.	*Benincasa hispida* (Thunb.) Cogn. *Coccinia grandis* (L.) Voigt. *Datura metel* L. *Datura* sp. *Melothria purpusilla* Cogn. *Momordica charantia* L. *Solanum pubescens* Willd. *Solanum erianthum* D.Don *Sonchus* sp.	*Erysiphe ornotii* Cast.

Table 6. One powdery mildew fungus on ten host plants

S. no	Name of the host	Name of the fungus
1.	*Andrographis paniculata* Burm.f. Wall. ex Nees *Andrographis* sp. *Brugmansia suaveolens* (Willd.) Bereht. Humb. & Bonpl. *Capsicum frutescens* L. *Euphorbia heterophylla* L. *Passiflora calcarata* Mast. *Passiflora edulis* Sims. *Solanum erianthum* D. Don *Solanum torvum* SW. *Tagetes* sp.	*Leveillula taurica* (Lev.) Arnaud

Table 7. One powdery mildew fungus on two host plants

S. no	Name of the host	Name of the fungus
1.	*Cassia sophera* L. *Cassia* sp.	*Sphaerotheca cassiae* Pandotra & Ganguly
2.	*Cocculus hirsutus* (L.) Diels *Cocculus* sp.	*Microsphaera pseudolonicerae* (Salm.) Blumer
3.	*Impetiens balsamina* L. *Impetiens chinensis* L.	*Sphaerotheca balsaminae* (Wallr.) Kari
4.	*Leucas hirta* (Heyne ex Roth) Spreng *Leucas* sp.	*Erysiphe galeopsidis* DC.
5.	*Manihot esculenta* Crantz *Manihot glaziovii* M. Arg.	O*idium manihoticola* Hosag. *et al.*
6.	*Phaseolus mungo* L. *Phaseolus radiatus* L.	*Sphaerotheca phaseoli* (Zhao) Braun
7.	*Phyllanthus amarus* Schum & Thonn. *Phyllanthus reticulatus* Poir.	*Oidium ramakrishnanii* Hosag.
8.	*Rosa indica* L. *Rosa* sp.	*Oidium rosacearum* Hosag. & Manian
9.	*Sesbania grandiflora* (L.) Poir. *Sesbania* sp.	*Oidium fabacearum* Hosag.
10.	*Sida acuta* Burm. f. *Sida* sp.	*Oidium schmiedeknechtii* Braun

Table 8. One powdery mildew fungus on twelve host plants

S. no	Name of the host	Name of the fungus
1.	*Bidens pilosa* L. *Benincasa hispida* (Thunb.) Cogn. *Cosmos bipinnatus* Cav. *Cucumis melo* L. *Cucumis* sp. *Dahlia imperialis* Roezel ex E. Ortgies *Jatropha gossypifolia* L. *Lepidagathis* sp. *Luffa acutangula* Roxb. *Physalis minima* L. *Physalis* sp. *Spilanthes calva* DC.	*Sphaerotheca fusca* (Fr.) Blumer

EPIDEMIOLOGY

Powdery mildews are generally favoured by relatively dry atmospheric and soil conditions, moderate temperature, reduced light, fertile soil and succulent plant growth is documented (Anonymous, 1946, 1953; Butt, 1975; Yarwood, 1957, 1973). The existence of the close relationships among the three principal environmental factors, *viz.* temperature, humidity and light is also well established (Yarwood, 1957). In view of these above generalisations, an attempt has been made here to highlight the interactive role of these three principal environmental factors in Tamil Nadu (Fig. 2) on the incidence of powdery mildews in the State.

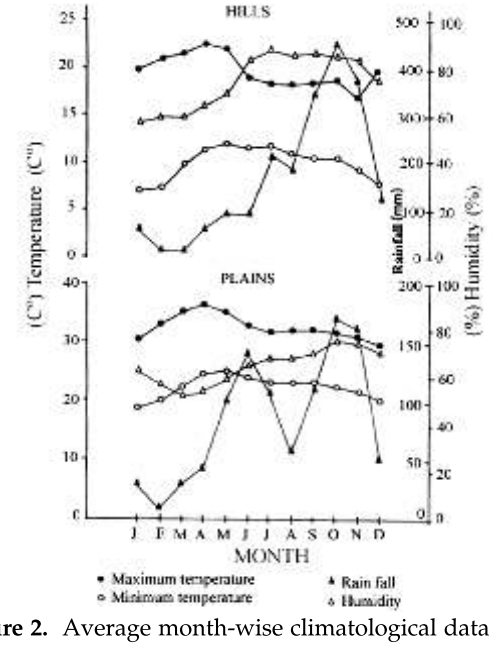

Figure 2. Average month-wise climatological data of Tamil Nadu

i. Temperature

The monthly average maximum temperature was in the months of March (35° C), April (36.5 °C) and in May (35 °C), while, it was minimum during December (20°C), January (19 °C) and February (20 °C). The temperature range from 19-31 °C in January was found be ideal for the occurrence of powdery mildews as evidenced by the maximum collections. This result almost coincides with the optimum range of 11-28 °C (average 22 °C), suggested in different studies for various species of powdery mildews (Yarwood, 1957, 1973; Kapoor, 1984). It is a common observation that alternating moderate and low temperatures favoured the growth of powdery mildew fungi (Cherewick, 1944; Yarwood, 1957; Kumar and Kumar, 1974; Saharan and Kaushik, 1981). Perithecial and ascospores formations were also favoured by the same conditions (Cherewick, 1944; Arya and Ghemawat, 1954). The maximum tolerant temperature for most of the powdery mildews is 30°C. Hence, a rise of temperature in the summer months of March (35.2 °C), April (36.5 °C) and May (35 °C) resulted in a sudden decline in the disease incidence and total disappearance in the month of May (Figs. 3-4).

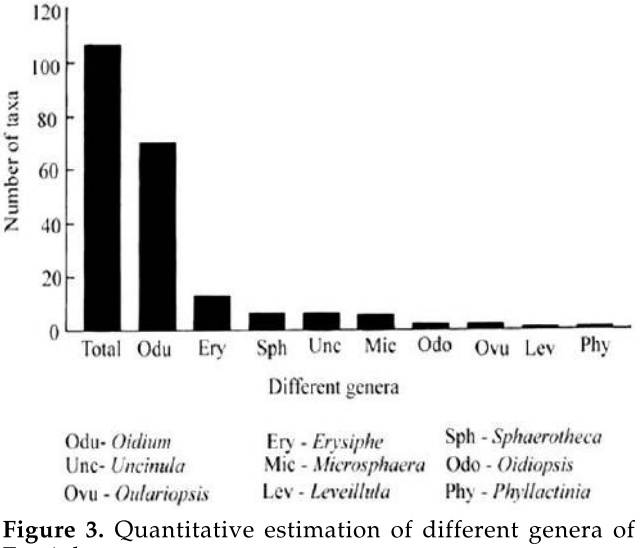

Figure 3. Quantitative estimation of different genera of Erysiphaceae

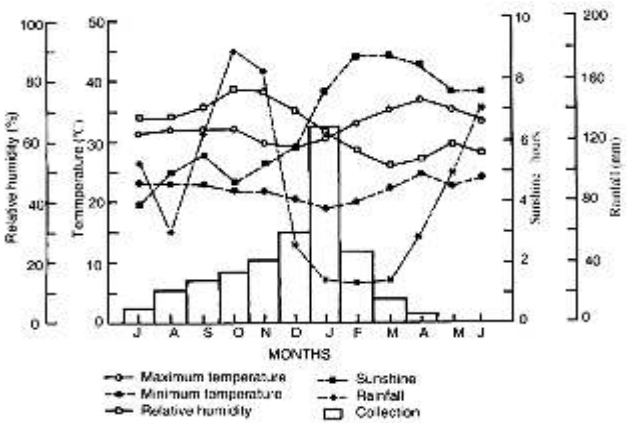

Figure 4. Average month-wise climatological data and collections in plains

The effect of other environmental factors on powdery mildews may be influenced by temperature. For example, low humidity is more injurious to conidia than low temperature (Yarwood, 1936). Combination of temperature, humidity and light are the major factors in the geographical distribution and severity of powdery mildew diseases. The inhibition of sporulation by high temperature has been reported.

ii. rain fall

Minimum rainfall (27 mm) promoted maximum number of collections during the month of January (Fig. 4). Low soil moisture (Delmas, 1953; Yarwood, 1949, 1957, 1973) and absence of rain (Buchheim, 1928; D'Angremond, 1923; Yarwood, 1939, 1973) favouring the severity of powdery mildews. Yarwood (1936) observed that the conidiophores of powdery mildew were damaged by rain. However, maximum rain fall was from September to November, could have contributed to higher foliage output, thus preparing ground for the increased incidence of powdery mildews during the subsequent months (Fig. 4) (Trelease and Trelease, 1929; Yarwood, 1934).

ii. Relative humidity

Maximum relative humidity was in the months of October (77%), November (76%) and September (70%) and the minimum in March (52%), April (54%) and February (57%). However, only the moderate relative humidity of 63% in January was found to favour conidial production. Yarwood (1957) also made similar observation that the production of conidia was more under moderate than under high relative humidity. The low humidity in March (52%) and April (54%) together with high temperatures of 35°C and 37°C (Fig.4) in the respective months appears to be hindrance to the conidial development. Hence, these fungi started disappearing from April onwards. It has been shown already that low humidity is more injurious to conidia at higher temperatures than at lower temperatures (Yarwood, 1936).

iii. Light

Powdery mildews began to appear in the month of July, when the sunshine was four hours. It increased gradually and reached its maximum in February. The shorter duration of sunshine with a moderate temperature and relative humidity would have resulted in the germination and development of powdery mildews from July month onwards and when the sunshine was for eight hours, temperature was low and relative humidity was moderate in January, the conidial formation was at its peak. Domsch (1953) and MacFarlane and Grainger (1947) observed more luxuriant development of barley mildew in seven to eight hour of sunshine per day than in a longer duration (Neger, 1902; Yarwood, 1932). It has also been proved that powdery mildews develop more profusely under shade than in light probably due to low temperature and high humidity (Bewley, 1923; D'Angremond,1923; Miller and Barrett, 1931; Yarwood, 1942, 1973).

TELEOMORPHS

Species of the genus *Uncinula* (*U. fici-nervosae*, *U. fici-religiosae*, *U. garugae* and *U. religiosae*) were collected in their teleomorphs at an altitude of 1000-1500 m at Kotagiri and Kodaikanal during the month of February. During this period, there was no rain and had 6°C temperature and 62% humidity. However, the other powdery mildew species recorded from the same regions failed to produce ascomata under these environmental conditions. Paul (1981) observed cleistothecia of *Leveillula taurica* only in regions with very low temperature (Yarwood, 1957; Khan and Khan, 1970; Butt, 1975; Saharan and Kaushik, 1981; Suhag and Duhan, 1985). From the foregoing account it is evident that the closely interrelated principal environmental factors, namely temperature, humidity, rainfall and light play a significant role in the development and spread of these fungi.

DISCUSSION

The work comprises an account of powdery mildews is mostly based on Coimbatore district and its adjoining areas. It will certainly enrich our knowledge on this group if an intensive work is conducted district wise.

We do not have a concrete idea about the biochemistry of medicinal plants infected with powdery mildews. It is believed that *Phyllanthus amarus* is being prescribed during winter days is more efficient and effective in curing jaundice. However, during winter, this plant is invariably used to be heavily infected with powdery mildew fungus, *Oidium ramakrishnanii*. Hence, this infection may be enhancing the efficiency and efficacy of the chemical component which cures jaundice or the components of both host and pathogen may be synergically combating the disease. Hence, it is interesting to study the host-parasite relation as well as chemical composition of the plant before and after infection.

These powdery mildews are persisting in their anamorphic state producing enormous conidia, which are air born are to be studied in relation to mankind as allergens.

Though there are lot of sporadic literature on this group but a comprehensive account of Powdery Mildews of India is lacking.

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