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Diversity of powdery mildew fungi from North Western Himalayan Region of Himachal Pradesh – a checklist

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Abstract

Powdery mildews are obligate biotropic fungal parasites responsible for disease on a wide range of host plants. They are easily recognizable as white powdery growth on leaves, shoots and sometimes on flowers and even on fruits. This checklist of powdery mildew fungi of Himachal Pradesh, India is based on an exhaustive bibliographic survey of the literature. Fifteen genera (*Blumeria*, *Erysiphe*, *Euoidium*, *Golovinomyces*, *Leveillula*, *Microsphaera*, *Neoerysiphe*, *Oidium*, *Oidopsis*, *Phyllactinia*, *Pleochaeta*, *Podosphaera*, *Pseudoidium*, *Sphaerotheca* and *Uncinula*) and 92 species of powdery mildew have been recorded from the state. About 168 plant species belonging to 122 genera and 49 families are infected by these fungi. Molecular studies of powdery mildew fungi from Himachal Pradesh are needed to revise and to classify these fungi in their correct taxonomic position.

Key words – bibliographic survey – Erysiphales – fungal parasites – Himalaya – taxonomy

Introduction

Powdery mildews are a group of fungal parasites belonging to a single order, Erysiphales. They are obligate biotrophs responsible for many common plant diseases. They are widespread on various hosts including agricultural crops, vegetables, trees, herbs, shrubs, grasses, ornamental plants and weeds. Based on literature, it is estimated that more than 7000 plant host species, throughout the world, are attacked by powdery mildew fungi. However, powdery mildew fungi are more common on cultivated crops than on other plant hosts (Pawar & Patil 2011). The fungi infect almost every group of plants i.e. from grasses to higher angiosperms (Braun & Cook 2012).

Powdery mildews are easily recognizable on infected plant parts. The first symptom appears as white powdery spots that may occur on both surfaces of leaves, on shoots and sometimes on flowers and fruits. These spots gradually spread over a large area of the leaves and stems. Disease symptoms usually appear with the onset of summer and begin to disappear during scorching heat and rainy season (Pap et al. 2013).

Powdery mildew fungi grow superficially or epiphytically on plant surfaces. These fungi grow abundantly in dry and cool seasons. Leaves infected with powdery mildew may turn completely yellow, die, and fall off, which may expose fruit to sunburn. On some plants, powdery

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mildew may cause the leaves to twist, buckle, or otherwise distort. The present compilation brings together as much information as possible related to powdery mildews reported from Himachal Pradesh. Hopefully, this checklist will help stimulate further taxonomic research on these fungi, not only in Himachal Pradesh but in other parts of India.

Himachal Pradesh is a hilly state covering an area of 55,673 sq. km and situated in the heart of Himalaya in the northern part of India (Fig. 1). The state extends between 30’22’40” – 33’12’40” North and 75’44’55” – 79’04’20” East. It is a mountainous state with elevation ranging from about 350 meters to 7,000 meters above sea level. Climatically the state varies from hot and sub-humid tropical in the southern tracts to cold, alpine and glacial in the northern and eastern mountain ranges with more elevation. This is perhaps one of the reasons for the variable and rich biodiversity in the state. Dense evergreen to deciduous forest covers 66% of the state. Alpine shrub and meadows are distributed in west and northeast Himalaya with alders, birches, rhododendrons and moist alpine shrubs. Orchards are widely scattered and Himachal is said to be the fruit bowl of India. There are 12 major national parks and sanctuaries to conserve the flora and fauna of the main Himalayan range.

Powdery mildew fungi produce specialized absorption cells (haustoria) which extend into the plant epidermal cells to gain their nutrition. Asexual spores (conidia) are produced either singly or in chains on specialized hyphae (conidiophores). Sexual spores (ascospores) are enclosed in spherical fruiting bodies (chasmothecia). The chasmothecia generally do not have any natural opening, hence, asci and ascospores are released when a crack develops in its outer thick wall. A variety of appendages may occur on the surface of the chasmothecia which are sometimes useful to identify the fungus, at least to genus level. The appendages are thought to help attach the fruiting bodies to the host, particularly to the bark of woody plants, where they overwinter. Besides morphology-based taxonomy, powdery mildew fungi are now going through DNA sequence data, which is not only helping to revise the existence of many fungal species, but to determine their taxonomic position as well.

Materials & Methods

Data collection

The checklist was prepared by using following sources of information:

1. Field surveys carried out from 2012 to 2016 in various localities of lower regions of Himachal Pradesh. Infected leaves were examined primarily with a hand-lens and then with a dissecting microscope for the presence of mildew symptoms. A piece of clear adhesive tape was placed on infected leaves and then stripped off to remove fungal structures. The tape was then placed on a microscope slide with a drop of distilled water. The microscopic observations were carried out for morphological characteristics of mycelia on the host, appressoria, size and shape of conidia, conidiophores and chasmothecia.
2. Exhaustive bibliographic survey of the literature published in various national and international journals, books, and magazines. The literature consulted for present study included several books on Indian fungi including: Erysiphaceae of India (Ahmad et al. 2007), Fungi of India (Butler & Bisby 1931, Vasudeva 1960, Mukherji & Juneja 1974, Sarbhoy et al. 1975, 1980, Bilgrami et al. 1991, Jamaluddin et al. 2004), Indian Erysiphaceae (Paul & Thakur 2006b), Powdery Mildews of India: check list (Hosagoudar & Agarwal 2009), Taxonomic Manual of the Erysiphales (Powdery Mildews) (Braun & Cook 2012) and New plant fungal diseases during 21st century in India (Gautam et al. 2012).

In addition, the following papers were consulted (Ahmad et al. 1995, 1998, 2006, Bhardwaj et al. 1985, Bharat 2003, 2006, 2009, 2010, 2013, Bharat & Bhardwaj 2000, Bharat & Gupta 2010, Braun & Paul 2009, Chona et al. 1960, Gautam 2014a, 2014b, Gautam & Avasthi 2016a, 2016b, 2017, Gill 1968, Gill et al. 1961, Gupta & Bhardwaj 1998, Gupta et al. 2016, Kala & Gaur 1983, Kumar et al. 1975, Lall & Gupta 1965, Paul 1984, 1997, Paul & Bhardwaj 1982, 1987, 2001, Paul & Kapoor 1983, 1986, Paul & Kaul 1988, Paul & Munjal 1982, Paul & Pal 1984,

Paul & Thakur 2004a, 2004b, 2006a, Sharma et al. 1992, 2017, Singh & Nagaich 1971, Singh & Raj 1973, Sohi & Nayar 1969a, 1969b, Sohi et al. 1966, Soni et al. 1993, Sydow 1938).

The names of some powdery mildew species as reported in the cited publications have been replaced by currently accepted names, according to MycoBank (www.mycobank.org) and Species Fungorum (www.speciesfungorum.org) websites and Braun & Paul (2009).

Results

Fifteen genera and 92 species of powdery mildew are known from Himachal Pradesh. These are recorded on about 168 plant host species belonging to 122 genera and 49 families. The species richness of fungi was highest in *Erysiphe* (33 species) followed by *Phyllactinia* (17), *Podosphaera* (9), *Microsphaera* (8), *Golovinomyces* (6), *Pseudoidium* (3), *Uncinula* (3), *Euoidium*, *Neoerysiphe*, *Oidopsis* and *Sphaerotheca* (2 each), and *Blumeria*, *Leveillula*, *Oidium* and *Pleochaeta* (1 each).

Thirty hosts of family Asteraceae were infected with powdery mildew followed by Fabaceae (28), Rosaceae (18), Solanaceae (7), Salicaceae (9), Polygonaceae (8), Moraceae (8), Amaranthaceae (6), Apiaceae (5), Brassicaceae (5), Lamicaeae (5 each), Ranunculaceae, Betulaceae, Poaceae, Juglandaceae, and Plantaginaceae (4 each), Berberidaceae, Boraginaceae, Cannabaceae, Euphorbiaceae, Fagaceae, Linaceae, Rubiaceae and Ulmaceae (3 each), Acanthaceae, Combretaceae, Cucurbitaceae, Malvaceae, Meliaceae and Menispermaceae (2 each), Anacardiaceae, Apocynaceae, Balsaminaceae, Capparidaceae, Caprifoliaceae, Chenopodicaeae, Cleomaceae, Convolvulaceae, Elaeagnaceae, Ericaceae, Geraniaceae, Lauraceae, Lythraceae, Nitrariaceae, Onagraceae, Papaveraceae, Phyllanthaceae, Rutaceae, Sapindaceae and Vitaceae (1 each).

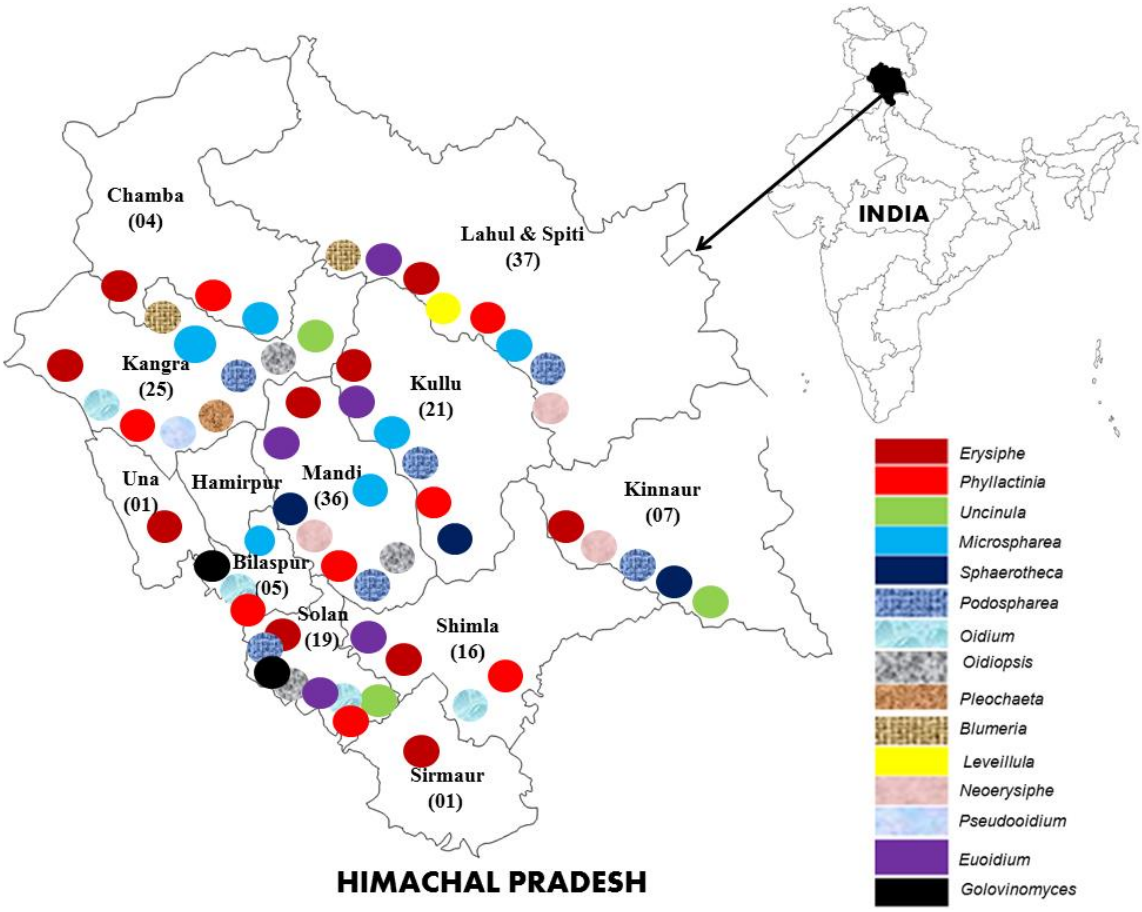

Fig. 1 – Map of study area showing diversity and distribution of powdery mildew fungi in Himachal Pradesh. (Coloured circles illustrate fungal genera and numbers below district name number of records reported from each district).

A complete list of powdery mildews recorded in Himachal Pradesh, their hosts and distribution is presented in alphabetical order:

Blumeria graminis (DC.) Speer
on Poaceae – *Avena fatua*, *Hordeum vulgare*, *Triticum aestivum*
Distribution – Kukumseri (Lahul & Spiti), Palampur (Kangra)

Erysiphe adunca (Wallr.) Fr. (syn. *Uncinula adunca* (Wallr.) Lév.; *Uncinula adunca* var. *regularis* (R.Y. Zheng & G.Q. Chen) U. Braun; *Uncinula salicis* (DC.) G. Winter) (Fig. 2C)
on Salicaceae – *Populus alba*, *Populus ciliata*, *Salix* sp.
Distribution – Manali (Kullu), Kullu (Kullu), Naggar (Kullu), Shimla (Shimla)

Erysiphe aquilegiae DC. (syn. *Erysiphe aquilegiae* var. *ranunculi* (Grev.) R.Y. Zheng & G.Q. Chen)
on Ranunculaceae – *Aconitum heterophyllum*
Distribution – Keylong (Lahul & Spiti)

Erysiphe aquilegiae* var. *clematidis Y.S. Paul & V.K. Thakur
on Ranunculaceae – *Clematis gauriana*
Distribution – Kamrunag (Mandi)

Erysiphe astragali DC. (syn. *Microsphaera astragali* (DC.) Trevis.)
on Fabaceae – *Oxytropis lapponica*
Distribution – Moolang (Lahul & Spiti)

Erysiphe australiana (McAlpine) U. Braun & S. Takam. (syn. *Uncinuliella australiana* (McAlpine) R.Y. Zheng & G.Q. Chen)
on Lythraceae – *Lagerstroemia indica*
Distribution – Palampur (Kangra)

Erysiphe azalea (U. Braun) U. Braun & S. Takam. (syn. *Erysiphe rhododendri* var. *barottii* Y.S. Paul & V.K. Thakur)
on Ericaceae – *Rhododendron* sp.
Distribution – Tikkan (Mandi)

Erysiphe berberidis Y.S. Paul & J.N. Kapoor
on Berberidaceae – *Berberis* sp.
Distribution – Chauntra (Mandi)

Erysiphe betae (Vanha) Weltzien (syn. *Erysiphe betae* var. *betae* (Vanha) Weltzien; *Erysiphe betae* var. *spinaciarum* Y.S. Paul & J.N. Kapoor) (Fig. 4E)
on Amaranthaceae – *Chenopodium ambrosioides*, *Chenopodium* sp., *Spinacia oleracea*
Distribution – Chauntra (Mandi), Palampur (Kangra), Bajaura (Kullu)

Erysiphe betae* var. *paulii Y.S. Paul & J.N. Kapoor
on Amaranthaceae –*Beta vulgaris* var. *benghalensis*
Distribution – Palampur (Kangra)

Erysiphe clandestine Biv. (syn. *Uncinula clandestina* f. *clandestine* (Biv.) J. Schröt.)
on Betulaceae – *Alnus laevigata*
Distribution – Dadour (Mandi), Kullu (Kullu)

Erysiphe clintonii (Peck) U. Braun & S. Takam. (syn. *Uncinula clintonii* Peck)
on Moraceae – *Morus* sp.
Distribution – Kullu (Kullu)

Erysiphe cruciferarum Opiz ex Junell (syn. *Erysiphe cruciferarum* var. *indica* Y.S. Paul & V.K. Thakur)
on Brassicaceae – *Coronopus didymus*, *Lepidium latifolium*
Distribution – Baura (Shimla), Tabo (Lahul & Spiti)

Erysiphe cruciferarum* var. *chandra Y.S. Paul & V.K. Thakur
on Brassicaceae – *Capsella bursa-pastoris*
Distribution – Palampur (Kangra)

Erysiphe cruciferarum* var. *cleomae Y.S. Paul & V.K. Thakur
on Cleomaceae – *Cleome spinosa*
Distribution – Maranda (Kangra)

Erysiphe cummunis (Wallr.) Schltdl.
on Brassicaceae – *Lepidium sativum*
on Fabaceae – *Astragalus* sp., *Desmodium* sp.
Distribution – Dalhausie (Chamba), Kullu (Kullu), Solan (Solan)

Erysiphe ehretiae (Keissl.) U. Braun & S. Takam. (syn. *Uncinula ehretiae* Keissl.)
on Boraginaceae – *Ehritia acumintata*
Distribution – Palampur (Kangra)

Erysiphe farmanii U. Braun & Y.S. Paul (syn. *Farmanomyces sphaerosporus* Y.S. Paul & V.K. Thakur)
on Fagaceae – *Quercus glauca*
Distribution – Salogra (Solan)

Erysiphe ficicola U. Braun & Y.S. Paul (syn. *Uncinuliella ficicola* Y.S. Paul & V.K. Thakur)
on Moraceae – *Ficus roxburghii*
Distribution – Subathu (Solan)

Erysiphe galii S. Blumer
on Rubiaceae – *Rubia* sp.
Distribution – Solan (Solan)

Erysiphe heraclei DC. (syn. *Erysiphe heraclei* var. *himalayensis* Y.S. Paul & V.K. Thakur)
on Apiaceae **–** *Bunium persicum*, *Coriandrum sativum*, *Daucus carota*, *Selinum veginatum*
Distribution – Katrain (Kullu), Palampur (Kangra), Sharbo (Kinnaur)

Erysiphe heraclei* var. *paulii Y.S. Paul & V.K. Thakur
on Apiaceae – *Heracleum candicans*
Distribution – Kukumseri (Lahul & Spiti)

Erysiphe kusanoi (Syd. & P. Syd.) U. Braun & S. Takam. (Fig. 2D)
on Cannabaceae – *Celtis australis*
Distribution – Balt (Mandi)

Erisiphe lindelophiae Y.S. Paul & V.K. Thakur
on Boraginaceae – *Lindelofia stylosa*
Distribution – Molang (Lahul & Spiti)

Erysiphe machiliana U. Braun & Y.S. Paul (syn. *Uncinuliella machiliana* Y.S. Paul & V.K. Thakur)
on Lauraceae – *Machilus odoratissima*
Distribution – Saproon (Solan)

Erysiphe malloticola U. Braun & Y.S. Paul (syn. *Uncinula maloti* Y.S. Paul & V.K. Thakur)
on Euphorbiaceae – *Mallotus philippensis*
Distribution – Kangar (Una), Nahan (Sirmour)

Erysiphe miyabei (E.S. Salmon) U. Braun & S. Takam. (syn. *Uncinula miyabei* (E.S. Salmon) Sacc. & P. Syd.; *Uncinula miyabei* var. *alnicola* Y.S. Paul & V.K. Thakur)
on Betulaceae – *Alnus nepalensis*, *Alnus notidia*
Distribution – Kotgarh (Shimla)

Erysiphe mori (Miyake) U. Braun & S. Takam. (syn. *Uncinula mori* var. *moricola* Y.S. Paul & V.K. Thakur)
on Moraceae – *Morus serrata*
Distribution – Shimla (Shimla)

Erysiphe munjalii Y.S. Paul & L.N. Bhardwaj
on Amaranthaceae – *Amaranthus mangostans*
Distribution: Solan (Solan)

Erysiphe necator Schwein. (syn. *Uncinula necator* (Schwein.) Burrill)
on Vitaceae – *Vitis vinifera*
Distribution – Solan (Solan)

Erysiphe paulii U. Braun & S. Takam. (syn. *Uncinula himalayensis* Y.S. Paul)
on Solanaceae – *Solanum verbascifolium*
Distribution – Solan (Solan)

Erysiphe peristrophes (N. Ahmad, A.K. Sarbhoy & Kamal) U. Braun & S. Takam. (syn. *Uncinula peristrophes* N. Ahmad, A.K. Sarbhoy & Kamal)
on Acanthaceae – *Peristrophe bicalyculata*
Distribution – Shimla (Shimla)

Erysiphe pirottiana (Bacc.) U. Braun & S. Takam. (syn. *Uncinula pirottiana* Bacc.)
on Moraceae – *Ficus carica*
Distribution – Kotgarh (Shimla)

Erysiphe pisi DC. (syn. *Erysiphe pisi* var. *kukumi* Y.S. Paul & V.K. Thakur)
on Fabaceae – *Medicago falcata*, *Pisum sativum* var. *arvense*, *Vicia faba*
Distribution – Kukumseri (Lahul & Spiti), Chauntra (Mandi), Solan (Solan)

Erysiphe pisi* var. *medicaginis Y.S. Paul & V.K. Thakur
on Fabaceae – *Medicago sativa*
Distribution – Kukumseri (Lahul & Spiti)

Erysiphe pisi* var. *pisi DC.
on Fabaceae – *Pisum sativum*; *Vicia faba*
Distribution – Kukumseri (Lahul & Spiti); Tabo (Lahul & Spiti)

Erysiphe polygoni DC. (syn. *Erysiphe polygoni* var. *rumicis* Y.S. Paul & V.K. Thakur) (Fig. 3B)
on Amaranthaceae – *Chenopodium ambrosioides*
on Polygonaceae – *Fagopyrum esculentum*, *Polygonum aviculare*, *Rumex patientia*
on Ranunculaceae – *Clematis gratis*
Distribution – Katrain (Kullu), Naggar (Kullu), Chaumtra (Mandi), Tabo (Lahul & Spiti)

Erysiphe polygoni* var. *fagopyri Y.S. Paul & V.K. Thakur
on Polygonaceae – *Fagopyrum esculentum*
Distribution – Kukumseri (Lahul & Spiti)

Erysiphe polygoni* var. *kailashi Y.S. Paul & V.K. Thakur
on Polygonaceae – *Rheum australe*
Distribution – Sharbo (Kinnaur)

Erysiphe polygoni* var. *paulii Y.S. Paul & V.K. Thakur
on Polygonaceae – *Polygonum plebeium*
Distribution – Kukumseri (Lahul & Spiti)

Erysiphe polygoni* var. *polygoni DC.
on Polygonaceae – *Polygonum plebeium*
Distribution – Kukumseri (Lahul & Spiti)

Erysiphe quercicola U. Braun & Y.S. Paul (Fig. 3D)
on Fagaceae – *Quercus incana*
Distribution – Balt (Mandi), Chail Chowk (Mandi), Subathu (Solan)

Erysiphe quercifolia U. Braun & Y.S. Paul (syn. *Uncinula quercifolia* Y.S. Paul & V.K. Thakur)
on Fagaceae – *Quercus incona*
Distribution – Subathu (Solan)

Erysiphe religiosa (T.S. Ramakr.) U. Braun & Y.S. Paul (syn. *Uncinula aspera* var. *solani* Y.S. Paul & V.K. Thakur)
on Moraceae – *Ficus religiosa*
Distribution – Kotgarh (Shimla), Subathu (Solan)

Erysiphe sordida* var. *spitiana Y.S. Paul & V.K. Thakur
on Plantaginaceae – *Plantago tabetica*
Distribution – Tabo (Lahul & Spiti)

Erysiphe trifolii Grev. (syn. *Erysiphe martii* Lév.) (Fig. 2B)
on Fabaceae – *Trifolium repens*
Distribution – Balt (Mandi), Chail Chowk (Mandi), Palampur (Kangra)

Erysiphe verniciferae (Henn.) U. Braun & S. Takam. (syn. *Uncinula verniciferae* Henn.)
on Anacardiaceae – *Pistacia integerrima*
Distribution – Kotgarh (Shimla)

Euoidium agerati (J.M. Yen) U. Braun & R.T.A. Cook (syn. *Oidium agerati* J.M. Yen)
on Asteraceae – *Ageratum conyzoides*
Distribution – Berthin (Bilaspur)

Euoidium strobilanthis Y.S. Paul & J.L. Kaul
on Acanthaceae – *Strobilanthes* sp.
Distribution – Solan (Solan)

Golovinomyces artemisiae (Grev.) V.P. Heluta (syn. *Erysiphe artemisiae* Grev.)
on Asteraceae – *Artemisia scoparia*.
Distribution – Shimla (Shimla).

Golovinomyces biocellatus (Ehrenb.) V.P. Heluta (syn. *Erysiphe biocellata* Ehrenb.)
on Lamiaceae – *Mentha* sp., *Nepeta laevigata*
Distribution – Keylong (Lahul & Spiti), Kukumseri (Lahul & Spiti)

Golovinomyces cichoracearum (DC.) V.P. Heluta (syn. *Erysiphe cichoracearum* DC.; *Erysiphe cichoracearum* var. *saussureae* Y.S. Paul & V.K. Thakur) (Figs 3G, 4G)
on Asteraceae – *Artemisia maritime*, *Chrysanthemum* sp., *Cousinia thomsonii*, *Dahlia variabilis*, *Heliantus annuum*, *Lactuca decipiens*, *Matricaria chamomilla*, *Saussurea costus*, *Sonchus* sp.
on Boraginaceae – *Eritrichium rupestre*
on Brassicaceae – *Capsella bursa-pastoris*
on Cucurbitaceae – *Cucurbita pepo*
on Malvaceae – *Abelmoschus esculentus*
on Plantaginaceae – *Veronica biloba*
on Rosaceae – *Malus sylvestris*
Distribution – Baura (Shimla), Chauntra (Mandi), Karpat (Lahul & Spiti), Kullu (Kullu), Madgran (Lahul & Spiti), Manali (Kullu), Moorang (Lahul & Spiti), Nauni (Solan), Solan (Solan), Spiti (Lahul & Spiti)

Golovinomyces depressus (Wallr.) V.P. Heluta (syn. *Erysiphe depressa* (Wallr.) Link)
on Asteraceae – *Arctium lappa*
Distribution – Kukumseri (Lahul & Spiti)

Golovinomyces orontii (Castagne) V.P. Heluta (syn. *Erysiphe orontii* var. *papaveris* Y.S. Paul & V.K. Thakur; *Oidium lini* Škorič)
on Linaceae – *Linum usitatissimum*
on Papaveraceae – *Papaver somniferum*
Distribution – Kukumseri (Lahul & Spiti), Shimla (Shimla)

Golovinomyces sordidus (L. Junell*)* Heluta (syn. *Erysiphe sordida* var. *similensis* Y.S. Paul & V.K. Thakur)
on Plantaginaceae – *Plantago major*
Distribution – Kukumseri (Lahul & Spiti)

Leveillula taurica (Lév.) G. Arnaud (syn. *Erysiphe lindelofiae* Y.S. Paul & V.K. Thakur)
on Asteraceae – *Sonchus asper*
on Boraginaceae – *Lindelofia stylosa*
on Capparidaceae –*Capparis spinosa*
on Convolvulaceae – *Convolvulus arvensis*
on Plantaginaceae – *Plantago major*
Distribution – Spiti Valley (Lahul & Spiti), Moolang (Lahaul & Spiti)

Microsphaera acaciae (S. Blumer) U. Braun
on Fabaceae – *Acacia catechu*
Distribution – Panjgrain, Barmana (Bilaspur)

Microsphaera barberidis (DC.) Lév.
on Berbidaceae – *Barberis vulgaris*
Distribution – Kukumseri (Lahul & Spiti)

Microsphaera caprifoliacearum* var. *caprifoliacearum U. Braun
on Caprifoliaceae – *Lonicera* sp.
Distribution – Rohanda (Mandi)

Microsphaera hydsari Braun
on Fabaceae – *Hedysarum cachumarianum*
Distribution – Kayardo (Lahul & Spiti)

Microsphaera juglendis* var. *paulii Y.S. Paul & V.K. Thakur
on Juglandaceae – *Juglens regia*
Distribution – Bharmour (Chamba)

Microsphaera martii (Lév.) Y.S. Paul & V.K. Thakur
on Fabaceae – *Trigonella foenum-graecum*
Distribution – Palampur (Kangra)

Microsphaera prasadii M.K. Bhatn. & K.L. Kothari
on Rubiaceae – *Hamiltonia suaveolens*
Distribution – Ner Chowk (Mandi)

Microsphaera trifolii (Grev.) U. Braun
on Fabaceae – *Trifolium repens*
Distribution – Diphu, Katrain (Kullu)

Neoerysiphe galeopsidis (DC.) U. Braun (syn. *Arthrocladiella althaeae* Y.S. Paul & V.K. Thakur; *Erysiphe galeopsidis* DC.)
on Lamiaceae – *Phlomis bracteosa*
on Malvaceae – *Althaea rosea*
Distribution – Sharbo (Kinnaur), Chhatru (Lahul & Spiti).

Neoerysiphe geranii (Y. Nomura) U. Braun (syn. *Erysiphe kapoorii* Y.S. Paul & V.K. Thakur)
on Geraniaceae – *Geranium wallichianum*
Distribution – Karsog (Mandi)

Oidiopsis solani N. Ahmad, A.K. Sarbhoy, Kamal & D.K. Agarwal
on Nitrariaceae – *Peganum harmala*
on Solanaceae – *Solanum melongena*
Distribution – Jai Singhpur (Kangra)

Oidiopsis taurica (Lév.) E.S. Salmon
on Linaceae – *Reinwardtia indica*
Distribution – Palampur (Kangra)

Oidiopsis taurica* f.sp. *balsaminacearum Y.S. Paul & J.N. Kapoor (Fig. 3A)
On Balsaminaceae – *Impatiens balsamina*
Distribution – Palampur (Kangra)

Oidiopsis taurica* f.sp. *euphorbiacearum Y.S. Paul & J.N. Kapoor
on Euphorbiaceae – *Euphorbia geniculata*
Distribution – Palampur (Kangra)

Oidiopsis taurica* f.sp. *ranunculacearum Y.S. Paul & J.N. Kapoor
on Ranunculaceae – *Delphinium ajacis*
Distribution – Kasauli (Solan)

Oidiopsis taurica* f.sp. *rosacearum Y.S. Paul & J.N. Kapoor
on Rosaceae – *Amygdalus communis*
on Solanaceae – *Solanum melongena*
Distribution – Chauntra (Mandi)

Oidiopsis taurica* f.sp. *solonacearum Y.S. Paul & J.N. Kapoor
on Solanaceae – *Capsicum annum, Capsicum frutescens, Solanum melongena, Solanum tuberosum*
Distribution – Chauntra (Mandi)

***Oidium* sp.** (Fig. 3F)
on Amarantaceae – *Amaranthus* sp.
on Asteraceae – *Coreopsis* sp., *Eupatorium cannabinum, Galinsoga parviflora, Vernonia cinerea*
on Fabaceae – *Lathyrus* sp.
on Lamiaceae – *Coleus barbatus, Nepeta leucophylla*
on Menispermaceae – *Stephania rotunda*
on Rutaceae – *Aegle marmelos*
on Solanaceae – *Datura stramonium, Nicandra physalodes, Petunia* sp.
on Urticaceae – *Urtica dioica*
Distribution – Shimla (Shimla), Palampur (Kangra), Solan (Solan), Berthin (Bilaspur)

Phyllactinia alnicola U. Braun (syn. *Microsphaera alni* (DC.) G. Winter)
on Juglandaceae – *Juglans regia*
on Salicaceae – *Flacourtia sapida*
Distribution – Kullu (Kullu)

Phyllactinia andrachnes H.S. Gill, Munjal & Chona
on Phyllanthaceae – *Andrachne cordifolia*
Distribution – Kullu (Kullu)

Phyllactinia bauhiniae Y.S. Paul (syn. *Phyllactinia bauhiniae* Y.S. Paul)
on Fabaceae – *Bauhinia* sp.
Distribution – Samela (Kangra)

Phyllactinia belliricae* var. *cedrelae Y.S. Paul & V.K. Thakur
on Combretaceae – *Terminalia bellirica*
Distribution – Palampur (Kangra)

Phyllactinia cassiae-fistulae U. Braun & Y.S. Paul (syn. *Phyllactinia bauhiniae* var. *cassia* Y.S. Paul & V.K. Thakur)
on Fabaceae – *Cassia fistula*

Distribution – Panjgrain, Barmana (Bilaspur)

Phyllactinia delbergiae Piroz.
on Fabaceae – *Dalbergia sissoo*
Distribution – Panjgrain, Barmana (Bilaspur)

Phyllactinia guttata (Wallr.) Lév. (syn. *Phyllactinia corylea* (Pers.) P. Karst; *Phyllactinia suffulta* (Rebent.) Sacc.; *Phyllactinia guttata* var. *guttata* (Wallr.) Lév.) (Fig. 2E)
on Berberidaceae – *Barberis lycium*
on Betulaceae – *Alnus nitida*
on Fabaceae – *Caesalpinia* sp., *Desmodium* sp., *Robinia pseudoacacia*
on Meliaceae – *Cedrela toona*, *Toona ciliata*
on Moraceae – *Morus alba*, *Morus serrata*, *Morus* sp.
on Rosaceae – *Cotoneaster bacillaris*, *Cydonia oblonga*, *Prunus* sp., *Pyrus serotina*, *Spiraea* sp.
on Salicaceae – *Salix babylonica*, *Salix* sp.
on Ulmaceae – *Ulmus laevigata*
Distribution – Balt (Mandi), Bharmour (Chamba), Chail Chowk (Mandi), Dalhausie (Chamba), Jhantigri (Mandi), Jogindernagar (Mandi), Kullu (Kullu), Manali (Kullu), Palampur (Kangra), Solan (Solan)

Phyllactinia hippophaes Thüm. ex S. Blumer
on Elaeagnaceae – *Hippophae* sp.
Distribution – Kukumseri (Lahul and Spiti)

Phyllactinia juglandis* var. *junglandae Y.S. Paul & V.K. Thakur
on Junglandaceae – *Juglans regia*
Distribution – Karsog (Mandi)

Phyllactinia juglandis* var. *paulii Y.S. Paul & V.K. Thakur (Fig. 4F)
on Junglandaceae – *Junglans regia*
Distribution – Karsog (Mandi)

Phyllactinia mali (Duby) U. Braun (Fig. 4D)
on Rosaceae – *Pyrus communis*; *Pyrus pashia*
Distribution – Naggar (Kullu), Shimla (Shimla)

Phyllactinia miracula Y.S. Paul
on Elaeagnaceae – *Hippophae* sp.
Distribution – Lahul Valley (Lahul & Spiti)

Phyllactinia populi (Jacz.) Y.N. Yu. (syn. *Phyllactinia guttata* var. *populina* Y.S. Paul & V.K. Thakur) (Fig. 2E)
on Saliciaceae – *Populus* sp.
Distribution – Karsog (Mandi)

Phyllactinia pyri-serotinae Sawada (syn. *Phyllactinia guttata* var. *rosacearum* Y.S. Paul & V.K. Thakur)
on Rosaceae – *Cotonearter bacillaris*
on Salicaceae – *Populus* sp.
Distribution – Shimla (Shimla), Solan (Solan)

Phyllactinia roboris (Gachet) S. Blumer
on Solanaceae – *Solanum verbascifolium*
Distribution – Solan (Kullu)

Phyllactinia terminaliae T.S. Ramakr (syn. *Phyllactinia belliricae* Y.S. Paul & V.K. Thakur)
on Combretaceae – *Terminalia bellirica*
Distribution – Palampur (Kangra)

Phyllactinia toonae Y.X. Yu & Y.Q. Lai. (syn. *Phyllactinia guttata* var. *cedrelae* Y.S. Paul & V.K. Thakur)
on Meliaceae – *Cedrela toona*
Distribution – Palampur (Kangra)

Pleochaeta shiraiana (Henn.) Kimbr. & Korf.
on Cannabaceae – *Celtis australis*
Distribution – Palampur (Kangra)

Podosphaera ainsliaeae (Y.S. Paul & V.K. Thakur) U. Braun & Y.S. Paul (syn. *Sphaerotheca ainsliaeae* Y.S. Paul & V.K. Thakur)
on Asteraceae – *Ainsliaea aptera*
Distribution – Karsog (Mandi)

Podosphaera aphanis (Wallr.) U. Braun & S. Takam. (syn. *Sphaerotheca aphanis* var. *potentillae* Y.S. Paul & V.K. Thakur)
on Rosaceae – *Potentilla* sp.
Distribution – Hansa (Lahul & Spiti)

Podosphaera clandestina (Wallr.) Lév. (syn. *Podosphaera clandestina* var. *cydoniae* N. Ahmad, A.K. Sarbhoy & Kamal)
on Rosaceae – *Cydonia oblonga*
Distribution – Kullu (Kullu)

Podosphaera euphorbiae-hirtae (U. Braun & Somani) U. Braun & S. Takam (Fig. 4B)
on Euphorbiaceae – *Euphorbia hirta*
Distribution – Balt (Mandi), Chail Chowk (Mandi)

Podosphaera fuliginea (Schltdl.) U. Braun & S. Takam. (syn. *Oidium erysiphoides* Fr.; *Sphaerotheca fuliginea* (Schltdl.) Pollacci) (Fig. 3C)
on Apiaceae – *Heracleum candicans*
on Asteraceae – *Calendula* sp., *Conyza stricta*, *Cosmos* sp., *Erigeron bonariensis*, *Zinnia elegans*
on Cucurbitaceae – *Cucurbita moschata*
on Fabaceae – *Dolichos biflorus*, *Vigna mungo*, *Vigna radiata*, *Vigna umbellata*
on Linaceae – *Macrolium* sp.
on Rubiaceae – *Galium aparine*
Distribution – Balt (Mandi), Chail Chowk (Mandi), Kullu (Kullu), Palampur (Kangra), Solan (Solan)

Podosphaera fusca (Fr.) U. Braun & Shishkoff (syn. *Podosphaera xanthii* (Castagne) U. Braun & Shishkoff; *Sphaerotheca ainsliaeae* Y.S. Paul & V.K. Thakur; *Sphaerotheca fusca* (Fr.) S. Blumer; *Sphaerotheca fusca* var. *compositarum* Y.S. Paul & V.K. Thakur; *Sphaerotheca phaseoli* (Z.Y. Zhao) U. Braun) (Figs 2A, 3E, 4C)

on Asteraceae – *Ageratum conyzoides*, *Ainsliaea aptera*, *Blumea* sp., *Calendula* sp., *Coreopsis lanceolata*; *Senecio chrysanthemoides*, *Sonchus* sp., *Taraxcum officinale*, *Xanthium strumarium*
on Fabaceae – *Phaseolus mungo*
Distribution – Balt, Chail Chowk (Mandi), Chhatru, Keylong, Udaipur, Kukumseri (Lahul & Spiti), Jachh, Karsog (Mandi)

Podosphaera leucotricha (Ellis & Everh.) E.S. Salmon
on Rosaceae – *Malus domestica*
Distribution – Kalpa (Kinnaur), Sharbo (Kinnaur)

Podosphaera tridactyla (Wallr.) de Bary (syn. *Podosphaera tridactyla* var. *prunicola* Y.S. Paul & V.K. Thakur; *Podosphaera tridactyla* var. *tridactyla* (Wallr.) de Bary)
on Rosaceae – *Prunus cornuta*
Distribution – Madgran (Lahul & Spiti)

Podosphaera xanthii (Castagne) U. Braun & Shishkoff (syn. *Sphaerotheca fusca* var. *cucumis* Y.S. Paul & V.K. Thakur; *Sphaerotheca heteropogonis* Y.S. Paul & V.K. Thakur)
on Poaceae – *Heteropogon contortus*
Distribution – Padar (Mandi)

Pseudoidium cryptolepidis (Hosag., Vijay., Udaiyan & Siddappa) U. Braun & R.T.A. Cook
on Apocynaceae – *Cryptolepis buchanani*
Distribution – Balt (Mandi), Chail Chowk (Mandi)

Pseudoidium indica Y.S. Paul & L.N. Bhardwaj
on Onagraceae – *Oenothera rosea*
Distribution – Palampur (Kangra)

Pseudoidium prinsepiae (Y.S. Paul & L.N. Bhardwaj) U. Braun & R.T.A. Cook (syn. *Oidium prinsepiae* Y.S. Paul & L.N. Bhardwaj)
on Rosaceae – *Prinsepia utilis*
Distribution – Mandi (Mandi)

Sphaerotheca fagopyri Syd. & Butler
on Polygonaceae – *Fagopyrum esculentum*
Distribution – Kullu (Kullu)

Sphaerotheca fuliginea* var. *galinsogae Y.S. Paul & J. Paul
on Asteraceae – *Galinsoga parviflora*
Distribution – Sharbo (Kinnaur)

Uncinula aceris (DC.) Sacc.
on Sapindaceae – *Acer oblongum*
Distribution – Solan (Solan)

Uncinula aspera* var. *aspera U. Braun
on Moraceae – *Ficus carica*
Distribution – Sharbo (Kinnaur)

Uncinula celtidis* var. *celtidis Y.S. Paul & V.K. Thakur
on Cannabaceae – *Celtis australis*
Distribution – Palampur (Kangra)

Host index

In this section scientific name of host plants along with the powdery mildew fungi occurring on them are provided.

Abelmoschus esculentus – Golovinomyces cichoracearum
Acacia catechu – Microsphaera acacia
Acer oblongum – Uncinula aceris
Aconitum heterophyllum – Erysiphe aquilegiae
Aegle marmelos – Oidium sp.
Ageratum conyzoides – Euoidium agerati, Podosphaera fuliginea
Ainsliaea aptera – Podosphaera ainsliaeae, Podosphaera fuliginea
Alnus laevigata – Erysiphe clandestina
Alnus nepalensis – Erysiphe miyabei
Alnus nitida – Phyllactinia guttata
Alnus notidia – Erysiphe miyabei
Althaea rosea – Neoerysiphe galeopsidis
Amaranthus mangostans – Erysiphe munjalii
Amaranthus sp. *– Oidium* sp.
Amygdalus communis – Oidiopsis taurica f.sp. *rosacearum*
Andrachne cordifolia – Phyllactinia andrachnes
Arctium lappa – Golovinomyces depressus
Artemisia maritime – Golovinomyces cichoracearum
Artemisia scoparia. – Golovinomyces artemisiae
Astragalus sp. *– Erysiphe cummunis*
Avena fatua – Blumeria graminis
Barberis lycium – Phyllactinia guttata
Barberis vulgaris – Microsphaera barberidis
Bauhinia sp. *– Phyllactinia bauhiniae*
Berberis sp. *– Erysiphe berberidis*
Beta vulgaris – Erysiphe betae var. *paulii*
Blumea sp. *– Podosphaera fuliginea*
Bunium persicum – Erysiphe heraclei
Caesalpinia sp. *– Phyllactinia guttata*
Calendula sp. *– Podosphaera fuliginea*
Capparis spinosa – Leveillula taurica
Capsella bursa-pastoris – Erysiphe cruciferarum var. *chandra, Golovinomyces cichoracearum*
Capsicum annum – Oidiopsis taurica f.sp. *solonacearum*
Capsicum frutescens – Oidiopsis taurica f.sp. *solonacearum*
Cassia fistula – Phyllactinia cassiae-fistulae
Cedrela toona – Phyllactinia guttata, Phyllactinia toonae
*Celtis australis – Erysiphe kusanoi***,** *Pleochaeta shiraiana, Uncinula celtidis* var. *celtidis*
Chenopodium ambrosioides – Erysiphe betae, Erysiphe polygoni
Chenopodium sp. *– Erysiphe betae*
Chrysanthemum sp. *– Golovinomyces cichoracearum*
Clematis gauriana – Erysiphe aquilegiae var. *clematidis*
Clematis gratis – Erysiphe polygoni
Cleome spinosa – Erysiphe cruciferarum var. *cleomae*
Coleus barbatus – Oidium sp.
Convolvulus arvensis – Leveillula taurica
Conyza stricta – Podosphaera fuliginea
Coreopsis lanceolata – Podosphaera fuliginea
Coreopsis sp. *– Oidium* sp.

Coriandrum sativum – Erysiphe heraclei
Coronopus didymus – Erysiphe cruciferarum
Cosmos sp. – *Podosphaera fuliginea*
Cotonearter bacillaris – Phyllactinia guttata, Phyllactinia pyri-serotinae
Cousinia thomsonii – Golovinomyces cichoracearum
Cryptolepis buchanani – Pseudoidium cryptolepidis
Cucurbita moschata – Podosphaera fuliginea
Cucurbita pepo – Golovinomyces cichoracearum
Cydonia oblonga – Phyllactinia guttata, Podosphaera clandestina
Dahlia variabilis – Golovinomyces cichoracearum
Dalbergia sissoo – Phyllactinia delbergiae
Datura stramonium – Oidium sp.
Daucus carota – Erysiphe heraclei
Delphinium ajacis – Oidiopsis taurica f.sp. *ranunculacearum*
Desmodium sp. – *Erysiphe cummunis, Phyllactinia guttata*
Dolichos biflorus – Podosphaera fuliginea
Ehritia acumintata – Erysiphe ehretiae
Erigeron bonariensis – Podosphaera fuliginea
Eritrichium rupestre – Golovinomyces cichoracearum
Eupatorium cannabinum – Oidium sp.
Euphorbia geniculate – Oidiopsis taurica f.sp. *euphorbiacearum*
Euphorbia hirta – Podosphaera euphorbiae-hirtae
Fagopyrum esculentum – Erysiphe polygoni, Erysiphe polygoni var. *fagopyri, Sphaerotheca fagopyri*
Ficus carica – Erysiphe pirottiana, Uncinula aspera var. *aspera*
Ficus religiosa – Erysiphe religiosa
Ficus roxburghii – Erysiphe ficicola
Flacourtia sapida – Phyllactinia alnicola
Galinsoga parviflora – Oidium sp., *Sphaerotheca fuliginea* var. *galinsogae*
Galium aparine – Podosphaera fuliginea
Geranium wallichianum – Neoerysiphe geranii
Hamiltonia suaveolens – Microsphaera prasadii
Hedysarum cachumarianum – Microsphaera hydsari
Heliantus annuum – Golovinomyces cichoracearum
Heracleum candicans – Erysiphe heraclei var. *paulii, Podosphaera fuliginea*
Heteropogon contortus – Podosphaera xanthii
Hippophae sp. – *Phyllactinia hippophaes, Phyllactinia miracula*
Hordeum vulgare – Blumeria graminis
Impatiens balsamina – Oidiopsis taurica f.sp. *balsaminacearum*
Juglans regia – Microsphaera juglandis var. *paulii, Phyllactinia alnicola, Phyllactinia juglandis* var. *junglandae, Phyllactinia juglandis* var. *paulii*
Lactuca decipiens – Golovinomyces cichoracearum
Lagerstroemia indica – Erysiphe australiana
Lathyrus sp. – *Oidium* sp.
Lepidium latifolium – Erysiphe cruciferarum
Lepidium sativum – Erysiphe cummunis
Lindelofia stylosa – Erysiphe lindelophiae, Leveillula taurica
Linum usitatissimum – Golovinomyces orontii
Lonicera sp. – *Microsphaera caprifoliacearum* var. *caprifoliacearum*
Machilus odoratissima – Erysiphe machiliana
Macrolium sp. – *Podosphaera fuliginea*
Mallotus philippensis – Erysiphe malloticola

Malus domestica – Podosphaera leucotricha
Malus sylvestris – Golovinomyces cichoracearum
Matricaria chamomilla – Golovinomyces cichoracearum
Medicago falcata – Erysiphe pisi
Medicago sativa – Erysiphe pisi var. *medicaginis*
Mentha sp. *– Golovinomyces biocellatus*
Morus alba – Phyllactinia guttata
Morus serrata – Erysiphe mori, Phyllactinia guttata
Morus sp. *– Erysiphe clintonii, Phyllactinia guttata*
Nepeta laevigata – Golovinomyces biocellatus
Nepeta leucophylla – Oidium sp.
Nicandra physalodes – Oidium sp.
Oenothera rosea – Pseudoidium indica
Oxytropis lapponica – Erysiphe astragali
Papaver somniferum – Golovinomyces orontii
Peganum harmala – Oidiopsis solani
Peristrophe bicalyculata – Erysiphe peristrophes
Petunia sp. *– Oidium* sp.
Phaseolus mungo – Podosphaera fuliginea
Phlomis bracteosa – Neoerysiphe galeopsidis
Pistacia integerrima – Erysiphe verniciferae
Pisum sativum – Erysiphe pisi, Erysiphe pisi var. *pisi*
Plantago major – Golovinomyces sordidus, Leveillula taurica
Plantago tabetica – Erysiphe sordida var. *spitiana*
Polygonum aviculare – Erysiphe polygoni
Polygonum plebeium – Erysiphe polygoni var. *paulii, Erysiphe polygoni* var. *polygoni*
Populus alba – Erysiphe adunca
Populus ciliata – Erysiphe adunca
Populus sp. *– Phyllactinia populi, Phyllactinia pyri-serotinae*
Potentilla sp. *– Podosphaera aphanis*
Prinsepia utilis – Pseudoidium prinsepiae
Prunus cornuta – Podosphaera tridactyla
Prunus sp. *– Phyllactinia guttata*
Pyrus communis – Phyllactinia mali
Pyrus pashia – Phyllactinia mali
Pyrus serotina – Phyllactinia guttata
Quercus glauca – Erysiphe farmanii
Quercus incana – Erysiphe quercicola
Reinwardtia indica – Oidiopsis taurica
Rheum australe – Erysiphe polygoni var. *kailashi*
Rhododendron sp. *– Erysiphe azalea*
Robinia pseudoacacia – Phyllactinia guttata
Rubia sp. *– Erysiphe galii*
Rumex patientia – Erysiphe polygoni
Salix babylonica – Phyllactinia guttata
Salix sp. *– Erysiphe adunca, Phyllactinia guttata*
Saussurea costus – Golovinomyces cichoracearum
Selinum veginatum – Erysiphe heraclei
Senecio chrysanthemoides – Podosphaera fuliginea
Solanum melongena – Oidiopsis solani, Oidiopsis taurica f.sp. *rosacearum, Oidiopsis taurica* f.sp. *solonacearum*
Solanum tuberosum – Oidiopsis taurica f.sp. *solonacearum*

Solanum verbascifolium – Erysiphe paulii, Phyllactinia roboris
Sonchus asper – Leveillula taurica
Sonchus sp. *– Golovinomyces cichoracearum, Podosphaera fuliginea*
Spinacia oleracea – Erysiphe betae
Spiraea sp. *– Phyllactinia guttata*
Stephania rotunda – Oidium sp.
Strobilanthes sp. *– Euoidium strobilanthis*
Taraxcum officinale – Podosphaera fuliginea
Terminalia bellirica – Phyllactinia belliricae, Phyllactinia terminaliae
Toona ciliata – Phyllactinia guttata
Trifolium repens – Erysiphe trifolii, Microsphaera trifolii
Trigonella foenum-graecum – Microsphaera martii
Triticum aestivum – Blumeria graminis
Ulmus laevigata – Phyllactinia guttata
Urtica dioica – Oidium sp.
Vernonia cinerea – Oidium sp.
Veronica biloba – Golovinomyces cichoracearum
Vicia faba – Erysiphe pisi, Erysiphe pisi var. *pisi*
Vigna mungo – Podosphaera fuliginea
Vigna radiata – Podosphaera fuliginea
Vigna umbellata umbellata – Podosphaera fuliginea
Vitis vinifera – Erysiphe necator
Xanthium strumarium – Podosphaera fuliginea
Zinnia elegans – Podosphaera fuliginea

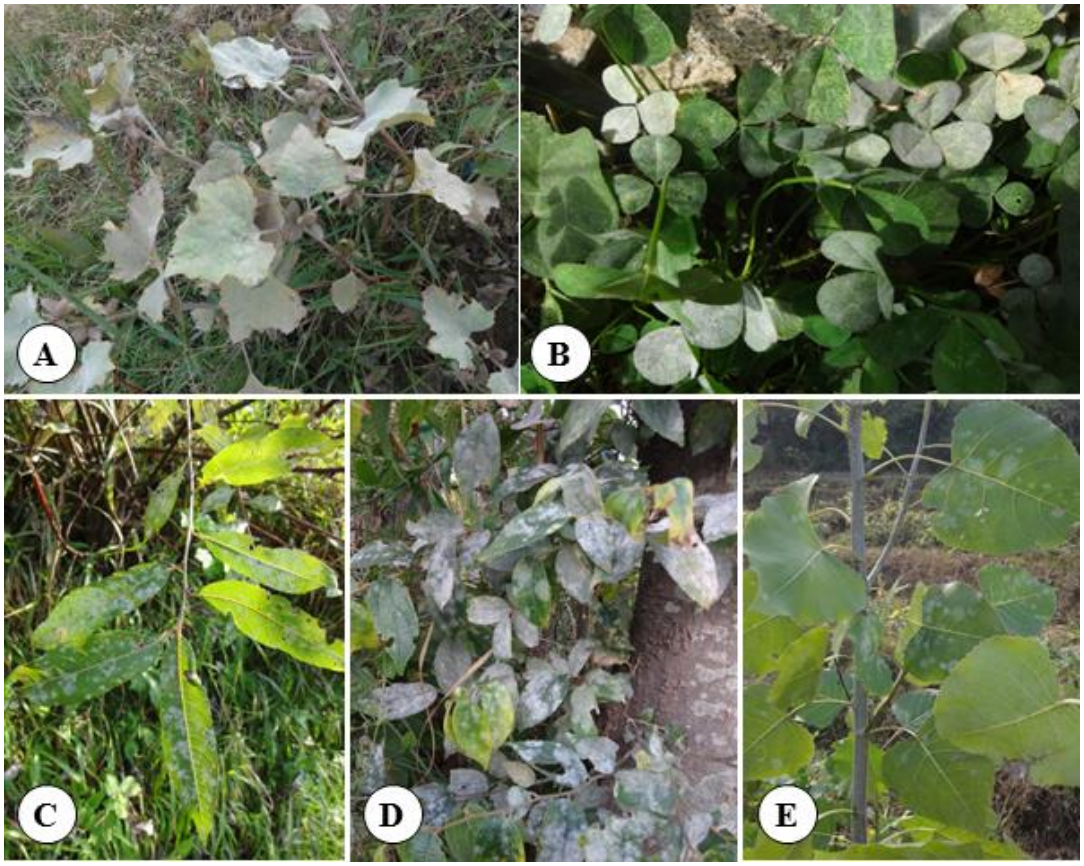

Fig. 2 – Powdery mildews A *Podosphaera fusca on Xanthium strumarium*. B *Erysiphe trifolii* on *Trifolium repentis*. C *Erysiphe adunca* on *Salix* sp. D *Erysiphe kusanoi* on *Celtis australis*. E *Phyllactinia populi* on *Populus* sp.

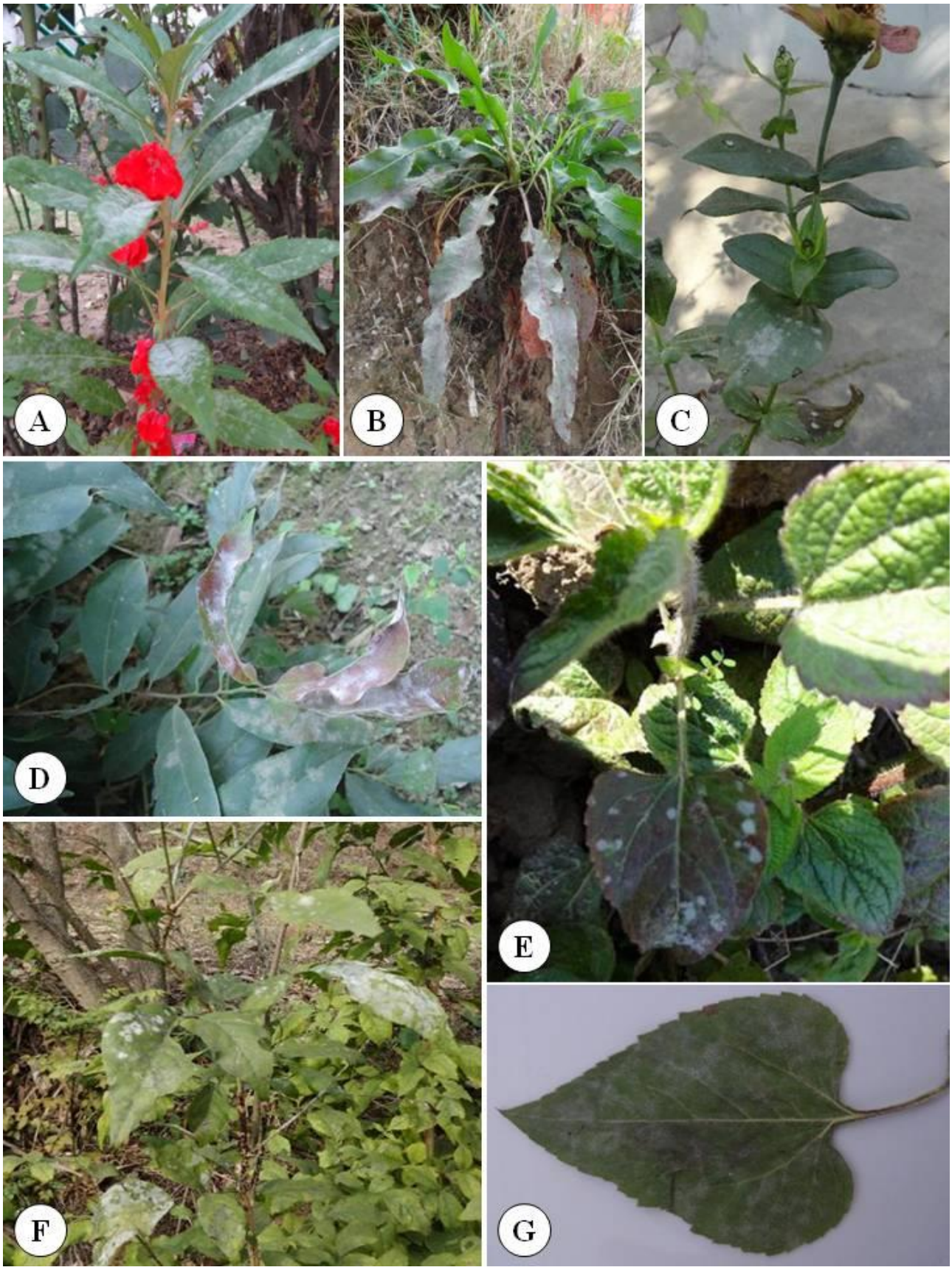

Fig. 3 – Powdery mildews A *Odiopsis taurica* on *Balsam* sp. B *Erysiphe polygoni* on *Rumex* sp. C *Podosphaera fuliginea* on *Zinnia elegans*. D *Erysiphe quercicola* on *Quercus* sp. E *Podosphaera fusca* on *Ageratum conyzoides*. F *Oidium* sp. on *Aegle marmelos*. G *Golovinomyces cichoracearum* on *Helianthus annuus*.

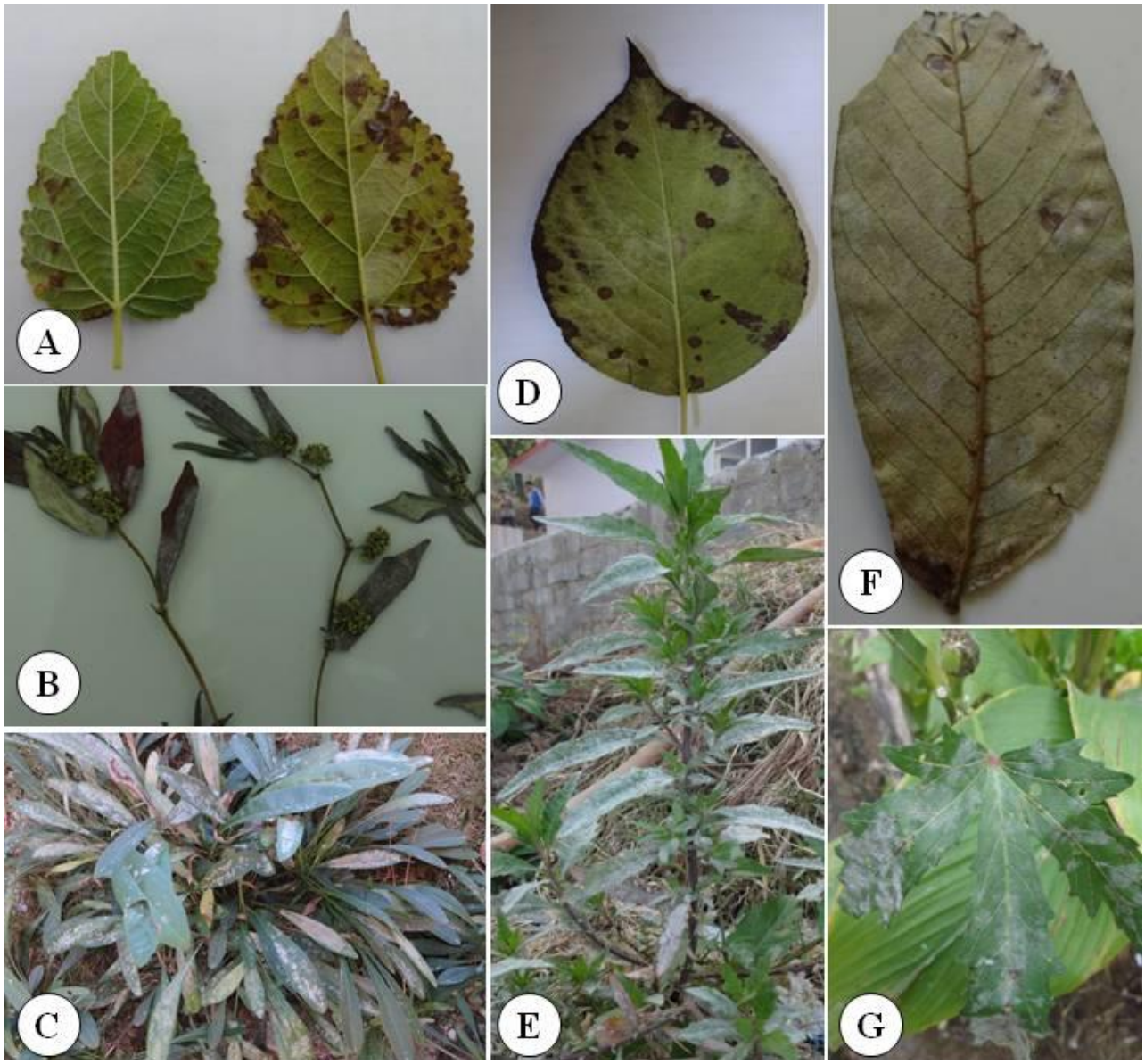

Fig. 4 – Powdery mildews A *Phyllactinia guttata* on *Morus alba*. B *Podosphaera euphorbiae-hirtae* on *Euphorbia hirta*. C *Podosphaera fusca* on *Coreopsis lanceolata*. D *Phyllactinia mali* on *Pyrus pashia*. E. *Erysiphe betae* on *Chenopodium* sp. F *Phyllactinia juglandis* on *Juglans regia*. G *Golovinomyces cichoracearum* on *Abelmoschus esculentus*.

Discussion

Being a north Indian hilly state and part of North Western Himalaya, Himachal Pradesh has faourable environmental conditions for growth and development of powdery mildew fungi. Several studies on these fungi have already been carried out in the state (Chona et al. 1960, Gill et al. 1961, Lall & Gupta 1965, Sohi & Nayar 1969 a, b, Singh & Nagaich 1971, Singh & Raj 1973, Bhardwaj et al. 1985, Ahmad et al. 2007, Gupta et al. 2016, Gautam 2014 a, b, 2016 a, b, 2017). Paul & Thakur (2006b) carried out a detailed survey and reported occurrence of the fungi from almost every district of the state.

Although, the number of records from Lahul & Spiti, Mandi, Kangra, Kullu, Solan and Shumla are higher than from other districts, more genera are found in Solan, Kangra and Mandi. There are districts of the state that have not yet been investigated in any detail. We did not find any published record from district Hamirpur. During the literature survey we came across a study conducted by Braun & Paul (2009) in which taxonomy and nomenclature of new Indian powdery mildew taxa described by Paul & Thakur (2006b) were revised and reassessed on the base of the

current phylogenetic generic concept of the Erysiphaceae. However, molecular studies of powdery mildew fungi are still required besides morphological taxonomy, which will not only help in revision and reassessment of the existing fungal species, but also help to find their correct taxonomic position as well. As such, we hope that the data presented in this paper will provide both a reference work and be an incentive for further work and encourage others to continue adding to the body of information available on the powdery mildews of North Western Himalaya as well as from India.

Acknowledgements

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