

Powdery mildews causing fungi in Iran

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Abstract

Powdery mildews are one of the most widespread and easily recognized plant diseases. Their common symptom is a grayish-white, powdery mat visible on the surface of leaves, stems and flower petals. They affect virtually a wide range of angiosperms such as cereals and grasses, vegetables, ornamentals, weeds, shrubs, fruit trees, and broad-leaved shade and forest trees. Seventeen fungal taxa found on 30 host plant species in different localities of Iran are documented. *Salsola crassa* is a new host plant species for *Leveillula saxaouli*. Likewise, *Fagonia indica*, *Prosopis fracta*, *Tribulus longipetalus* and *Zygophyllum eurypterum* are new hosts for *Leveillula taurica*. Some taxa of powdery mildew fungi reported on new hosts in Iran are as follows: *Blumeria graminis* on *Phalaris paradoxa*, *Erysiphe polygoni* on *Polygonum erioptera*, *E. trifolii* on *Trigonella*, *Golovinomyces cichoracearum* on *Gaillardia*, *G. orontii* on *Hibiscus*, *L. saxaouli* on *Haloxylon persicum*, and *L. taurica* on *Alhagi pseudalhagi*.

Key words: Powdery mildew, Erysiphaceae, host, Iran

Introduction

Powdery mildew fungi belong to the family Erysiphaceae (Ascomycota: Erysiphales) which cause serious diseases in a variety of cultivated plants as well as wild plants. This family consists of 18 genera and about 435 species (Braun, 1987). According to Amano (1986), over 169 families and 44 orders of flowering plants are infected by powdery mildew fungi, of which about 90% (162 plant families) are Dicotyledons. It is well known that powdery mildews are distributed all over the world but taxonomy of powdery mildews in each area may be important in the biology and taxonomy of these fungi. Powdery mildews have never been extensively studied in Iran and their host plant is scattered throughout various plant pathological reports or lists (Khodaparast *et al.*, 2000; Khodaparast *et al.*, 2001a; Khodaparast *et al.*, 2001b; Khodaparast *et al.*, 2002; Khodaparast *et al.*, 2003; Khodaparast *et al.*, 2005; Tajik-Ghanbary *et al.*, 2005; Tavanaei *et al.*, 2005; Khodaparast *et al.*, 2007; Khodaparast *et al.*, 2009). Khodaparast and Abbasi (2009) have published the complete list of powdery mildews and their hosts in Iran. However, modern taxonomic position of some species was not presented. The current work attempts to describe and bring new information about old and new taxa and their hosts distributed in Iran.

Material and Methods

Surveys were carried out in different parts of the Sistan and Baluchstan provinces and other

localities of Iran during 2007 and 2008. Hyphae, conidiophores, and conidia of fresh materials were stripped off the leaf surfaces with clear adhesive tape, mounted on a microscope slide with the fungal mycelium uppermost, and examined in water using light microscopy with phase contrast using 20x, 40x, and 100x (oil immersion) objectives (Carmichael, 1955). The following information was noted during the examination of the fresh specimens: size and shape of conidia, presence or absence of fibrosin bodies, nature of conidiogenesis, characteristics of the conidiophores, e.g. size and shape of foot cell, position of the basal septum, shape and position of hyphal appressoria, position of germ tubes, and shape of appressoria on germ tubes of conidia. An average of thirty conidia were measured for each specimen. Observations of conidial germ tubes were carried out using the method of Hirata (1942). Photographs were taken and for the taxonomy and nomenclature of Erysiphales, literature from Braun (1987), Braun (1995), Braun and Takamatsu (2000) and Cook and Braun (2009) was followed.

Results and Discussion

Blumeria Golocin ex Speer, Sydowia 27, p. 2 (1974)

1- *Blumeria graminis* (DC.) Speer, Sydowia 27, p. 2 (1974)

Hordeum vulgare L.; Zabol, Sistan and Baluchstan province

Triticum aestivum L.; Zabol, Sistan and Baluchstan province

Phalaris paradoxa L.; Mashhad, Korasan Razavi province

B. graminis has been recorded as *Erysiphe graminis* DC on *H. vulgare* and *T. aestivum* in Iran (Khodaparast and Abbasi, 2009). This is the first report of *B. graminis* from the Sistan and Baluchstan province. *P. paradoxa* is a new host plant of *B. graminis* in Iran.

Erysiphe DC. Emend. Braun and Takamatsu, Schelechtendalia 4, p. 3 (2000)

2- *Erysiphe convolvuli* DC., Fl. Fr. II, p. 274 (1805)

Convolvulus arvensis L.; Zahak, Sistan and Baluchstan province

E. convolvuli has been recorded on *C. arvensis* in Iran (Khodaparast and Abbasi, 2009). This is first report of this fungus from the Sistan and Baluchstan province.

3- *Erysiphe cruciferarum* Opiz ex Junell, Sv. Bot. Tidskr. 61(1), p. 217 (1967)

Brassica rapa L.; Zahak, Sistan and Baluchstan province

E. cruciferarum has been recorded as *E. polygoni* on *B. rapa* in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new pathogen to the Sistan and Baluchstan province.

4- *Erysiphe lycopsidis* Zheng and Chen, Sydowia 34, p. 234 (1981)

Anchusa ovata Lehm; Zahak, Sistan and Balochstan province

E. lycopsidis has been recorded on *A. ovata* in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new species to the Sistan and Baluchstan province.

5- *Erysiphe necator* var. *necator* Schwein (1834)

Vitis vinifera L.; Zahak, Sistan and Baluchstan province

E. necator has been recorded on *V. vinifera* in Iran (Khodaparast and Abbasi, 2009). This is first report of this fungus from the Sistan and Baluchstan province.

6- *Erysiphe polygoni* DC., Fl.Fr. II, p. 273 (1805)

Polygonum aviculare L.; Zabol, Sistan and Baluchstan province

P. erioptera L.; Birjand, Khorasan Jonobi province

Rumex conglomeratus L.; Zabol, Sistan and Baluchstan province

E. polygoni has been recorded on *P. aviculare* and *R. conglomeratus* in Iran (Khodaparast and Abbasi, 2009) but this fungus is recorded for the first time from Sistan and Baluchstan province. *P. erioptera* is a new host plant for *E. polygoni* in Iran.

7- *Erysiphe trifolii* Grev., Fl. Edin.:459 (1824)

Trigonella foenum-graecum L.; Jiroft, Kerman province

E. trifolii has been recorded as *Microsphaera trifolii* on several host plants in Iran (Khodaparast and Abbasi, 2009). *Trigonella* is a new host plant genus of *E. trifolii* to Iran.

Golovinomyces (Braun) Gel. Biol. Z. Armen. 41(5) 351(1988)

8- *Golovinomyces ambrosiae* (Schwein.) U. Braun & R.T.A. Cook (2008)

Helianthus annuus L.; Zabol, Sistan and Balochstan province

G. ambrosiae has been recorded on *H. annuus* in Iran (Khodaparast *et al.*, 2009) but this fungus is a new species to the Sistan and Baluchstan province.

9- *Golovinomyces cichoracearum* (DC.) V.P. Heluta. Ukr, bot, Zh, 45(5): 62(1988)

Gaillardia rossica L.; Zahak, Sistan and Baluchstan province

G. cichoracearum has been recorded on several host plants in Iran (Khodaparast and Abbasi, 2009). This is first report of this fungus from the Sistan and Baluchstan province. *Gaillardia* are new host plant genus for this mildew to Iran.

10- *Golovinomyces orontii* (Cast.) Gel.

Cucumis sativus L.; Zabol, Sistan and Balochstan province

Hibiscus esculentus L.; Bam, Kerman province

G. orontii has been recorded as *E. cichoracearum* on *C. sativus* in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new species to the Sistan and Baluchstan *Hibiscus* is a new host plant genus for this mildew to Iran.

11- *Golovinomyces sonchicola* U. Braun & R.T.A.Cook (2008)

Sonchus oleraceus L.; Zahak, Sistan and Baluchstan province

G. sonchicola has been recorded on *S. oleraceus* in Iran (Khodaparast *et al.*, 2009). This is first report of *G. sonchicola* from Sistan and Baluchstan province.

Leveillula Arnaud, ANN. Epiphyt. 7, p. 94(1921)

12- *Leveillula saxaouli* (Sorok.) Golovin. Tr. Bot. inst. Im. Komarov. Akad. Nauk. SSSR, ser. II, 10, p. 216 (1956)

Haloxylon persicum Bunge ex Boiss. & Buhse; Zahak, Sistan and Baluchstan province
Salsola crassa M.Bieb.; Bandan, Khorasan Jonobi province

Morphological characteristics of the fungus on *S. crassa* are described as follows:

Diseased leaves displayed typical powdery mildew signs consisting of whitish masses of conidia and conidiophores. Mycelial growth was thick, forming irregular white patches, sometimes effused to cover the whole leaf surface. Conidiophores were erect, simple or branched one or two times at random positions, (41-) 88-148 x 6-10 μm , with cylindrical foot cells, 15-53 x 6-10 μm , bearing a single conidium or occasionally with short chains of 2-3 conidia (Fig. 1A). Conidia (Fig. 1B) were cylindric with cingulum-like rings near the ends, 37-67 x 16-25 μm , with germ tubes often arising near end of conidia and seldom arising at the side of conidia. Appressoria were usually absent. Chasmothecia were found embedded in the mycelial felt, became dark brown to black at maturity, were gregarious to scattered and measured 140-225 μm in diameter (Fig. 1C). Chasmothecium appendages were myceliod, numerous, pale and 18-150 (-171) μm in length (Fig. 1C). The number of asci ranged from (19-) 20-33 in each chasmothecia, were clavate, stalked and measured, 85-112 (-125) x (31-) 35-48 (-59) μm (Fig. 1D). Ascospores ranged from (1-) 2 (-3) in each ascus, and were ellipsoid-ovoid shaped measuring 28-42 x 17-26 μm (Fig. 1D). On the basis of morphological characters of the anamorph and teleomorph, this fungus was identified as *L. saxaouli* (Braun, 1987).

L. saxaouli has been recorded on *H. ammodendron* (C.A.Mey.) Bunge ex E. Fenzl in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new species to the Sistan and Baluchstan province. *H. persicum* is a new host plant species for *L. saxaouli* in Iran and *S. crassa* is a new host plant species (*Matrix nova*) for this mildew.

13- *Leveillula taurica* (Lev.) Arnaud emend. U. Braun

Alhagi pseudalhagi (M. Bieb) Desv.; Zabol, Sistan and Baluchstan province

Fagonia indica Burm F.; Bandan, Khorasan Jonobi

Lycopersicum esculentum Mill.; Zabol, Sistan and Baluchstan province

Medicago sativa L.; Zahak, Sistan and Baluchstan province

Peganum harmala L.; Zahak, Sistan and Baluchstan province

Prosopis fracta (Banks & Soland.) J.F. Macbr.; Zabol, Sistan and Baluchstan province

Tribulus longipetalus Viv. Hebrew.; Zabol, Sistan and Baluchstan province

Zygophyllum eurypterum Boiss. & Buhse; Bandan, Khorasan Jonobi

Morphological characteristics of the fungus on *F. indica* are described as follows:

Diseased plants exhibited dense, compact, white mycelia, typically 1-3 cm in length, forming irregular white patches, sometimes effused to cover the whole leaf surface of *F. indica*. Conidiophores were erect, simple or branched one or two times at random positions, (47-) 97-166 x 4/5-7/8 μm , with cylindrical foot cells, (18-) 24-109 x 4/5-7/8 μm , bearing a single conidium or occasionally with short chains of 2-3 conidia (Fig. 2A). The fungus produced both primary and secondary conidia. Primary conidia (Fig. 2B) were lanceolate and apically pointed, 45-72 x 14-18 (-20) μm with L/W 2.8-3.55. Secondary conidia (Fig. 2C) were ellipsoid to cylindrical, 41-70 x 14-22 μm in size, with germ tubes often arising near end of conidia and seldom arising at the side of conidia. Appressoria were usually absent. Chasmothecia were found embedded in the mycelial felt, became dark brown to black at maturity, were gregarious to scattered and measured 149-217 μm in diameter (Fig. 2D). Chasmothecia appendages were myceliod, arising from the lower half of casmothecia, brown, paler upward (Fig. 2D). The number of asci ranged from 20-31 in each casmothecia, clavate, stalked and 84-114 x 32-45 μm in size (Fig. 2E). Ascospores ranged from (1-) 2 (-4) in each ascus, and were ellipsoid-ovoid shaped measuring 29-41 x 16-23 μm (Fig. 2E). On the basis of morphological characters of the anamorph and teleomorph, this fungus was identified as *L. taurica* (Braun, 1987).

L. taurica has been recorded on several host plants in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new species to Sistan and Baluchstan and Khorasan Jonobi provinces. Among host plants mentioned above, *Fagonia*, *P. fracta*, *T. longipetalus* and *Z. eurypterum* are new hosts (*Matrix nova*) for this mildew and *A. pseudalhagi* is a new host plant species of *L. taurica* in Iran.

14- *Oidium yenii* U. Braun, Zentbl. Mikrobiol. 137, p. 323 (1982)

Lagerstroemia indica L.; Zabol, Sistan and Baluchstan province

O. yenii has been recorded on *L. indica* in Iran (Khodaparast and Abbasi, 2009). This is first report of this fungus from the Sistan and Baluchstan province.

Phyllactinia Lev., Ann. Sci. Nat., Bot., 3 Ser., 15, p. 144 (1851)

15- *Phyllactinia moricola* (P. Henn) Homma

Morus nigra L.; Zahak, Sistan and Balochstan province

P. moricola has been recorded on *M. nigra* in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new species to the Sistan and Baluchstan province.

Podospaera Kunz emend. Braun and Takamatsu Schechtendalia 4, p. 3 (2000)

16- *Podospaera leucotricha* (Ell. & Ev.) Salmon, Mem.

Malus domestica Borkh.; Chahnmeh, Sistan and Baluchstan province

P. leucotricha has been recorded on *M. domestica* in Iran (Khodaparast and Abbasi, 2009) but this fungus is a new species to the Sistan and Baluchstan province.

17- *Podospaera pannosa* (Wallr.) de Bary

Rosa persica Stokes; Chahnmeh, Sistan and Balochstan province

P. pannosa has been recorded as *Sphaerotheca pannosa* on *R. persica* in Iran (Khodaparast and Abbasi, 2009). This is first report of this fungus from the Sistan and Baluchstan province.

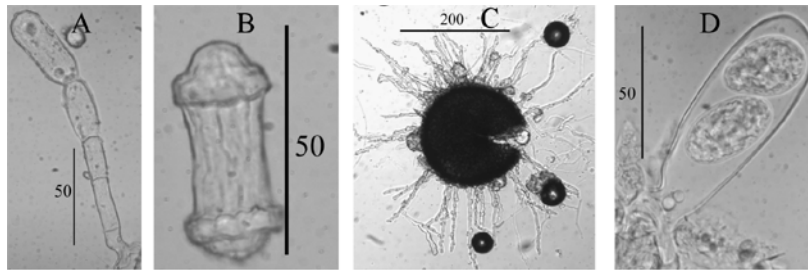


Fig. 1: *Leveillula saxaouli* on *Salsola crassa*: A. conidiophore; B. conidium; C. chasmothecium with appendages; D. ascus with ascospores.

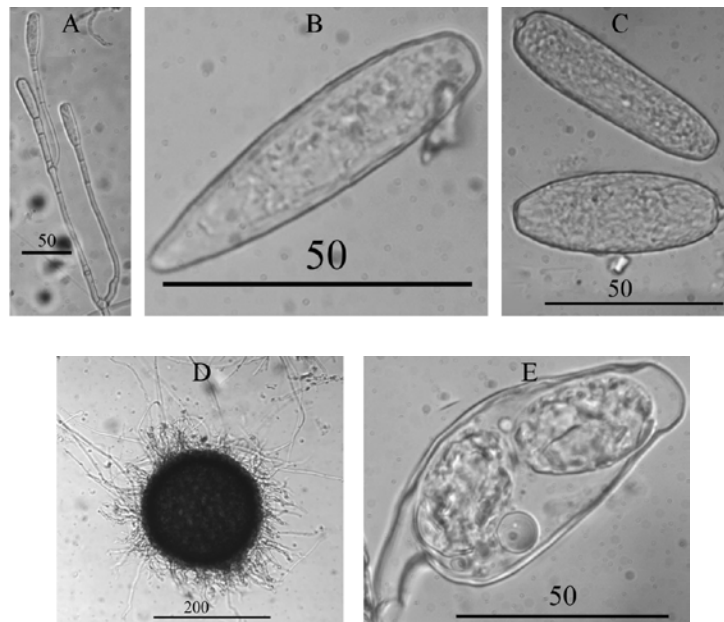


Fig. 2: *Leveillula taurica* on *Fagonia indica*. A. conidiophore; B. primary conidia; C. secondary conidia; D. chasmothecium with appendages; E. ascus with ascospores.

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