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Neoerysiphe cumminsiana (*Erysiphales, Eumycota*), a new powdery mildew fungus in Israel

Abstract

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Information is provided about the distribution of a powdery mildew fungus species new for Israel, *Neoerysiphe cumminsiana* (U. Braun) U. Braun (Erysiphales), recorded on *Crepis* spp. and *Phagnalon rupestre* (L.) DC. A conclusion is reached about the possibility of discovering this fungus in some countries of southern Europe and in northern and southern Africa. The need is noted for the revision of powdery mildew specimens identified as *Erysiphe cichoracearum* DC. and collected in these regions on host plants belonging to Asteraceae.

Introduction

Neoerysiphe cumminsiana (U. Braun) U. Braun is one of five species of the small genus *Neoerysiphe* U. Braun (Erysiphales, Eumycota). This species was described by Braun (1983) as *Erysiphe cumminsiana* U. Braun, based on the specimen of this fungus collected on *Senecio seemanii* Sch.-Bip. (*Asteraceae*) in North America. After the section *Golovinomyces* U. Braun (genus *Erysiphe* R. Hedw. ex DC.) was raised to the genus level (Heluta 1988a), the species was transferred to this genus and named *G. cumminsianus* (U. Braun) Heluta (Heluta 1988b). However, some time later, on the basis of specific morphological characters, especially particulars of conidium surface features, formation of ascospores after wintering, morphology of appressoria, and results of molecular investigations, some species from the genus *Golovinomyces* (U. Braun) Heluta, including *G. cumminsianus,* were transferred to a new genus, *Neoerysiphe* (Braun 1999). Thus, the currently accepted name of the former *Erysiphe cumminsiana* is *Neoerysiphe cumminsiana* (U. Braun) U. Braun.

N. cumminsiana is morphologically very similar to *N. galeopsidis* (DC.) U. Braun and *N. galii* (S. Blumer) U. Braun. All three species have ascocarps equally depressed in the lower part and completely maturing only after wintering, i.e., in a new vegetation period. *Neoerysiphe cumminsiana* differs from *N. galeopsidis* by the color of the appendages (they are hyaline, to yellowish, but not brownish), from *N. galii,* by the mainly lobed, not nipple-shaped appressoria although they can be of the two types in both species. In addition,

N. cumminsiana is a parasite of *Compositae* (*Asteraceae*), *N. galeopsidis* parasitizing *Labiatae* (*Lamiaceae*), and *N. galii* was registered on host plants from *Rubiaceae*.

Thus, since these three species are very similar, *N. cumminsiana* may be reported by mycologists as *Erysiphe cumminsiana, E. galeopsidis*, or *E. galii*. Amano (1986) reported *E. cumminsiana* or *E. galeopsidis* on *Asteraceae* as *Bidens pilosa* L. (Cuba), *Cacalia delphiniifolia* Sieb. et Zucc. and *C. tebakoensis* Makino (Japan), *Crepis biennis* L. (Germany*), Eupatorium guadelupense* Spreng. (South America), *E. microstemon* Cass. (Puerto Rico, USA), *E. rugosum* Houtt. (Canada and USA), *Heliopsis helianthoides* (L.) Sweet and *H. helianthoides* var. *scabra* (Dunal) Fisch. (USA), *Ligularia fischeri* (Ledeb.) Turcz. and *L. stenocephala* (Maxim.) Matsum. et Koidz. (Japan), *Senecio seemanii* Sch.-Bip. (USA), *Tagetes* sp. (Italy), and *Taraxacum* sp. (USA). Gorter (1987) reported *E. galeopsidis* on *Arctotheca calendula* (L.) Levyns from southern Africa; scanning electron micrographs testify that this fungus belongs to the genus *Neoerysiphe*. Havrylenko and Braun (1998) described *Oidium baccharidis* on *Baccharis racemosa* (Ruiz et Pavon) DC. from Argentina. It is probably an anamorph state of *N. cumminsiana.*

According to Braun (1987), *N. cumminsiana* (sub *E. cumminsiana*) is recorded only on species of *Cacalia*, *Eupatorium*, *Heliopsis*, *Ligularia*, and *Senecio* in Asia (Japan) and North America (USA). In other monographs by this author on powdery mildew fungi of Europe (Braun 1995), finds of *E. galeopsidis* on *Crepis biennis* and *Tagetes* sp. are not mentioned and *E. cumminsiana* is not reported. Some time later, Heluta (1999) reported *N. cumminsiana* (sub *G. cumminsianus*) on *Crepis micrantha* Czer., *C. rhoeadifolia* M. Bieb., and *Taraxacum* sp. from the southern part of the Ukraine, mainly Crimea. In addition, Heluta collected this fungus in Crimea in mid-April 2002 on a new host plant *Rhagadiolus edulis* P. Gaertn. (*R. stellatus* auct. non (L.) P. Gaertn.) (unpublished data).

Thus, until the start of this investigation *N. cumminsiana* was known in fact from America, eastern Asia (Japan), southern Africa, and south eastern Europe (Ukraine, 10 localities) on representatives of the genera *Arctotheca*, *Bidens*, *Cacalia, Crepis, Eupatorium, Heliopsis, Ligularia, Rhagadiolus*, *Senecio,* and *Taraxacum*. Note, however, that this species was probably found also in other regions of Eurasia, but was misidentified as another parasite of *Asteraceae*, *Erysiphe cichoracearum* DC., because *Erysiphe (Neoerysiphe) cumminsiana* has been described only recently.

Materials and methods

During our studies on phytopathogenic fungi of Israel, some specimens of powdery mildew fungi parasitizing *Crepis* spp. and *Phagnalon rupestre* (L.) DC. (*Asteraceae*) were collected. We identified all these fungi as *Neoerysiphe cumminsiana*. The specimens are listed below.

On *Crepis* spp.: Mt. Carmel, Haifa, weed plant community, 15.03.2002, leg. V.P. Heluta; Carmel Coast, near Haifa, Atlit, coast of the Mediterranean Sea, 19.03.2002, leg. V.P. Heluta (anamorph only); Sharon Plain, Pardes Hanna, 12.04.2002, leg. E. Nevo.

On *Phagnalon rupestre* (L.) DC.: Upper Galilee, Nahal Keziv, “Evolution Canyon” II, “African”, south-facing slope, 18.03.2002, leg. T.V. Andrianova.

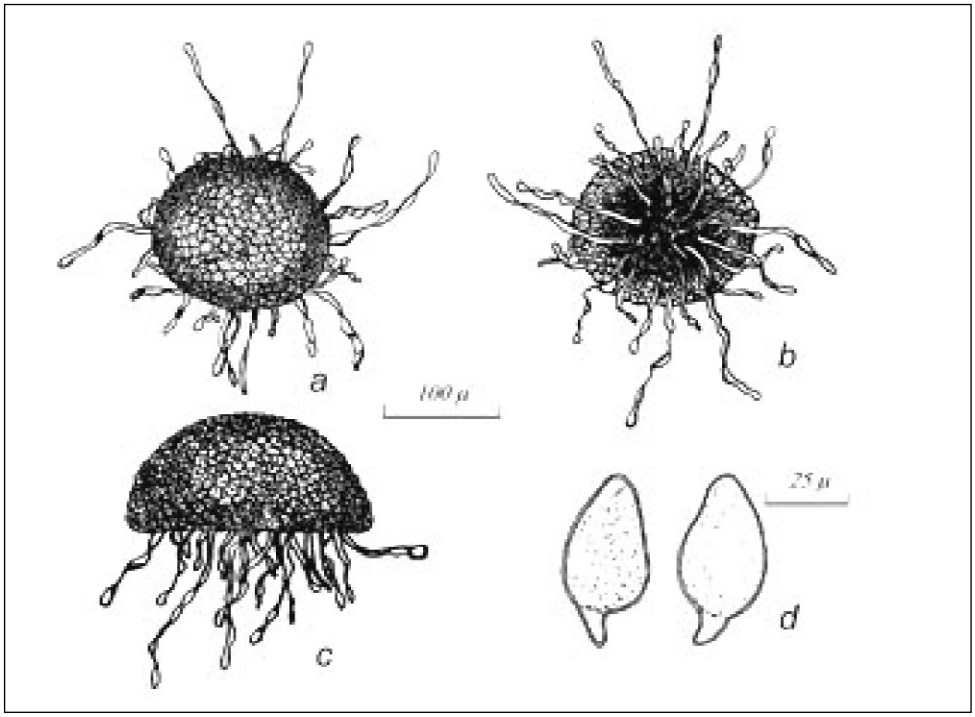

Fig. 1. *Neoerysiphe cumminsiana* (U. Braun) U. Braun: a-b - ascocarps from *Crepis* sp.; c - ascocarp from *Phagnalon rupestre*; d - asci; a - view from above, b - bottom view, c - side view; a-c - from Israel, d - from Ukraine.

Results

Microscope examinations showed that all these specimens had mycelium mainly with lobed appressoria, hemispheric ascocarps depressed in the lower part (Fig. 1, a-c) with hyaline or yellowish appendages. In all cases asci were immature. Specimens collected on *Crepis* spp. were practically identical with the Ukrainian specimens of *N. cumminsiana*, but the fungus from *Phagnalon rupestre* had somewhat larger ascocarps (123-190 µm in diameter) with faintly developed appendages.

Probably, the last difference was caused through specific characters of the host plant. On the lower side of its leaves, a very dense layer of fibers had formed, which is of great importance in the fastening of ascocarps of *N. cumminsiana,* hence, in this case, appendages of the fungus remain underdeveloped.

The integrated description of this fungus, including the morphological data about its Ukrainian specimens, is given below.

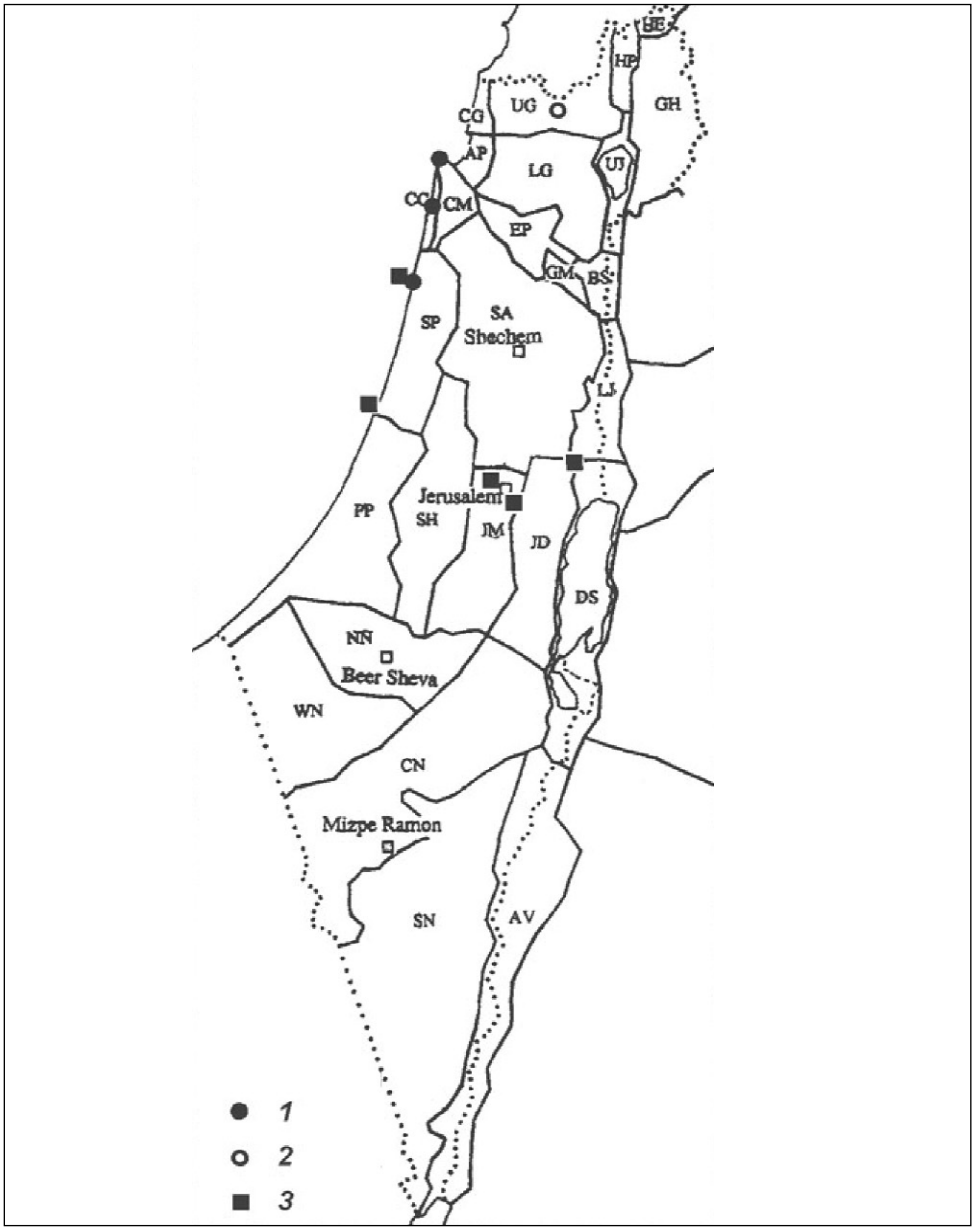

Fig. 2. Distribution of *N. cumminsiana* in Israel: 1 - on *Crepis* sp.; 2 - on *Phagnalon rupestre*; 3 - probably *N. cumminsiana* on *Crepis* spp. (literature data, sub *Erysiphe cichoracearum*). Natural regions of Israel: AP - Akko Plain; AV - Arava Valley; BS - Beit Shean Valley; CC - Carmel Coast; CM - Carmel Mts.; CN - Central Negev; DS - Dead Sea Area; EP - Esdraelon (Yizre'el) Plain; GH - Golan Heights; GM - Gilboa Mts.; HE - Hermon; HP - Hula Plain; JD - Judean Desert; JM - Judean Mts.; LG - Lower Galilee; LJ - Lower Jordan Valley; NN - Northern Negev; PP - Philistean Plain; SA - Samaria; SH - Shefela; SN - Southern Negev; SP - Sharon Plain; UG - Upper Galilee; UJ - Upper Jordan Valley; WN - Western Negev (after Feinbrun-Dothan, Danin, 1998)

***Neoerysiphe cumminsiana* (U. Braun) U. Braun, Schlechtendalia 3: 50 (1999) (Fig. 1)**
Syn.: *Erysiphe galeopsidis* auct., p.p.; *E. cumminsiana* U. Braun, Mycotaxon **18**(1): 124 (1983); *Golovinomyces cumminsianus* (U. Braun) Heluta, Ukr. Bot. Zhurn. **45**(5): 62 (1988)

Mycelium on all green parts of host plants, well developed, grey or yellowish by intense conidial sporulation, appressoria mainly lobed. Anamorph is *Oidium* s. str., conidia cylindrical-ellipsoidal to vase-like, 22.5–38 x (10)13–19.5 µm. Cleistothecia scattered or in large groups, hemispheric, depressed in the lower part, (90)105–190 µm in diam. Cells of peridium obscure, irregularly shaped, 8-20 µm in diam. Appendages in the basal part of ascocarp, mycelioid, hyaline or yellowish, but not brownish, mainly numerous, (0.5)1-1.5(2) times as long as the cleistothecial diam., usually simple, rarely irregularly branched, septate. Asci numerous, 5-18, oblong obovoid, stipitate, somewhat unequal-sided, thin-walled, immature in current vegetation period.

Discussion

A preliminary investigation by one of the present authors (Heluta 1999) showed that *N. cumminsiana* had a more extensive distribution range than it was previously supposed. In addition to America, south eastern Asia, and southern Africa, *N. cumminsiana* was collected in the south of Ukraine (central Europe). This collection was made in 1959, long before its description based on the American specimen. Additional finds of *N. cumminsiana* in Israel (Fig. 2) and in the Ukraine on new host plants promoted the conclusion that this species could be also found in other regions of western Eurasia, mainly in such temperate zones as the Mediterranean region. For example, such powdery mildew fungi as *Erysiphe cichoracearum* or *Oidium erysiphoides* s.l. are recorded on different species of genera *Crepis* and *Rhagadiolus* from Portugal (Mendonça, Sequeira 1962; Sequeira, Mendonça 1965; Sequeira 1969, 1975, 1978, 1981), Spain (Durrieu, Mercé 1972), Romania (Sandu-Ville 1967; Bontea 1986), and central Europe (Blumer 1967). Some of them may have been easily misidentified, and thus they probably belong to *N. cumminsiana*.

This applies especially to such specimens on which immature ascocarps were mentioned. "*Erysiphe cichoracearum*" on *Crepis vesicaria* L. from Portugal (Sequeira, 1981) may well exemplify the case. According to Amano (1986), *Erysiphe cichoracearum* was recorded on *Phagnalon rupestre* and *Ph. saxatilis* (L.) Cass. in France, on the Balearic and Canary Islands, and in the Spanish Sahara. These specimens very likely belong to *N. cumminsiana*.

Judging from our analysis of the literature on powdery mildew fungi of Israel, there is rather high probability that collected specimens identified as *E. cichoracearum* belong to *N. cumminsiana.* Thus, Rayss (1940, 1947) noted *E. cichoracearum,* with mainly immature asci, on *Crepis aspera* L. and *C. palaestina* (Boiss.) Bornm. Dimensions of its conidia and ascocarps corresponded closely with those of *N. cumminsiana*. In addition, one of these specimens (on *Crepis aspera*) was collected in Pardes Hanna (Fig. 2), where we found *N. cumminsiana* on *Crepis* spp. Also, probability is not excluded that this fungus parasitizes other representatives of the family *Asteraceae* in Israel.

Neoerysiphe cumminsiana has a fairly specific distribution, which does not correspond with the set of probable geographic and mycoflorogenetic units of powdery mildew fungi proposed by Heluta (1993, 1995). It is the only representative of Erysiphales, which must be classified as an American-African-Eurasian South Holarctic species. This supposition is not in accordance with Heluta's (1992) hypothesis on migration ways of powdery mildew fungi.

Thus, we have to assume that this hypothesis is not fully correct, or *N. cumminsiana* is a complex of morphologically identical species. In the latter case it descended from an ancestor such as *N. galeopsidis* and probably emerged independently in several regions of America, Africa, or Eurasia. We believe the second supposition is more probable.

From this investigation we conclude that *N. cumminsiana* has a comparatively wide distribution. It seems very likely that it was collected not only in America, eastern Asia, and southern Africa, but also in Israel, plus in countries of southern and central Europe, and northern Africa. However, *N. cumminsiana* was identified incorrectly as *Erysiphe cichoracearum*.

Hence, an additional revision of powdery mildew specimens collected in these regions on *Asteraceae* and identified as *Erysiphe cichoracearum* is necessary, especially those with immature asci. The problem of origin of this fungus has to be clarified, preferably by molecular methods of investigation.

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