A report on two new hosts (*Oxalis corniculata* L and *O. corymbosa* DC) of powdery mildew fungus (*Erysiphe cichoracearum* DC)

Subha Alam* and Tabreiz A. Khan

Section of Plant Pathology and Nematology,
Department of Botany,
Aligarh Muslim University, Aligarh, India
Email: subhaalam@gmail.com

Abstract: The powdery mildew disease caused by *Erysiphe cichoracearum* on *Oxalis corniculata* and *O. corymbosa* was recorded for the first time from Uttar Pradesh, India. The symptoms of disease appeared in the first week of March on the upper surface of leaves and then on other green parts of the plant. The development of few cleistothecia on the upper surface of leaves was also observed in the last week of April, when conidial production was slowed down and ceased. The infected plants remained stunted due to reduction in size and number of the leaves. The effect of severe infection of *E. cichoracearum* on *O. corniculata* also led to a premature defoliation and early death of the plants. The disease severity was more on *Oxalis corniculata* as compared to *O .corymbosa*. The frequency of occurrence of disease on *O. corniculata* was 75.8 % as compared to 46.0 % on *O. corymbosa*.

Keywords: Powdery mildew, *Erysiphe cichoracearum*, *Oxalis corniculata*, *O. corymbosa*

Introduction

Powdery mildew pathogens are obligate parasites, ascomycetous fungi which grow principally on foliage of angiosperms and cause damage to a wide variety of crops. The fungus attacks stems, flowers and fruits of plants. Initially the fungus shows very mild infection, producing small patches on the host, later it becomes chlorotic and may kill the whole plant as a result of severe infection. The pathogen is characterized by their superficial hyaline mycelium and haustoria in the epidermal cells of the hosts. Large number of cultivated and wild species of different families has been recorded as the hosts of the members of Erysiphaceae. A considerable amount of damage by this fungus has also been recorded on different crops (Paul and Mujal, 1982).

Oxalis corniculata is grown as weed in several areas of Aligarh district, whereas, *Oxalis corymbosa* is grown as an ornamental plant. Moreover, both the species are the source of unani drug, which may be considered as refrigerant, antiscorbutic, astringent, appetizer and also used in the treatments of fever, dysentery, jaundice, scurvy, insomnia, anemia, diarrhea, indigestion, vomiting, mild constipation, eye problems, mouth problems, sore throat, liver problem, hepatitis and excessive thirst (David Bruce and Leonard, 1998-2006). During the survey of fungal diseases of ornamental plants in and around Aligarh district it was observed that some of the plants viz., *O. corymbosa* and *O. corniculata* were heavily infected with the powdery mildew disease. Therefore, it was found desirable to conduct an investigation on the identification of causal agent of powdery mildew disease of *Oxalis spp.*

Materials and Methods

A survey was conducted in and around the A.M.U. campus to determine the incidence of powdery mildew disease on several weeds. For identification of pathogen, twigs of *Oxalis corniculata* L. and *O. corymbosa* DC, infected with powdery mildew disease were collected from different localities. Samples were packed in polythene bags and labelled to indicate the location and date of collection. These samples were brought to the laboratory for further studies.

The conidia were dusted over a clean glass slide and examined under the microscope for various conidial characters such as shape and size. In order to ascertain the presence or absence of fibrosin bodies in conidia, these were treated with 3% KOH solution and observed under microscope (Kable *et al*., 1963).

Both, anamorphic stages viz., conidiophores and conidia and teleomorphic stages viz., cleistothecia, cleistothecial appendages, asci and ascospores including mycelium were examined under the compound microscope to determine the characteristic morphological features of the powdery mildew fungus. These morphological features included the colour of mycelium in older pustules (Yarwood, 1978), shape of conidia, asci and ascospores (Alcorn, 1968), presence or absence of fibrosin bodies in conidia (Kable *et al*.,1963) and types of germ tube (Kable *et al*., 1963; Zara Covitis, 1965). Atleast fifty replicates of each anamorphic and teleomorphic characters were studied to determine their diameter, length and width.

To determine the type of germ tube and appressoria, conidia were dusted over a dry, clean glass slides placed on glass triangles in a sterilized Petridishes containing water at the bottom which were then transferred to B.O.D. incubator running at 22 - 25ºC. After 24 hours, conidia were stained in cotton blue and mounted in lactophenol to observe the types of germ tube viz., simple and straight and flexous, branched, forked and moderately long, place of emergence of germ tube (terminal, subterminal and lateral) on the conidia. Types of appressoria were also determined to find out whether they were lobed or unlobed. The frequency of occurrence of powdery mildew disease on *Oxalis* spp. was also calculated. The severity of powdery mildew disease on *Oxalis* spp. was graded as:

No infection = No visible disease symptoms.

Mild infection = Pustules small in size and few in number.

Moderate infection = Many pustules, larger in size and tending to coalesce.

Severe infection = Big pustules and covering almost the entire leaf area.

Results and discussion

The powdery mildew symptoms first appeared in the week of March on the upper surface of leaves and then on other green parts *of Oxalis corniculata* and *O. corymbosa*. It's attack was characterized by the formation of whitish grey, dusty or floury patches (lesions) on both sides of the leaves as well as on fruits and younger part of stem. The dusty patches of powdery mildew on leaves were also reported by Odile Carrise in 2009. With the advancement of disease, the white spots increased in numbers and size, coalesce and eventually covered the entire, both, upper and lower surfaces of the leaves (Fig. 1 and 2). This superficial floury mass consisted of large number of conidia and mycelia of the fungus causing the disease. Infected plants remained stunted due to reduction in size and number of the leaves. The severe infection of *E. cichoracearum* on *O. corniculata* also led to a premature defoliation and early death of the plants. Black, pin point bodies, representing the ascigerous stage of the fungus developed only in few infected dried leaves of *O. corniculata*. It was interesting to note that the *E. cichoracearum* showed severe infection on *O. corniculata*, while mild to moderate infection was observed in *O. corymbosa*.

Conidiophores were simple, erect, straight, measuring 39-47 × 8-12 µm in size and bearing conidia in chains. Conidia were ovate to barrel shaped, measuring 18-27 × 8-20

µm in size. In some cases the conidium fell off before the development of next succeeding conidium on the conidiophores, hence, the chain of conidia was not visible. Fibrosin bodies were absent in conidia. On germination, a single simple germ tube was always produced from the distal end a little behind (sub-terminal) of each conidium. In some cases the position of the germ tube was found as lateral also (Fig. 3). The development of few cleistothecia on the upper surface of leaves was observed in the last week of April, when conidial production slowed down and eventually ceased. Cleistothecia are the main fruiting bodies of the fungus which is golden-brown to black in colour (Odile Carrise, 2009). Young cleistothecia began to make their appearance on white powdery mildew mycelium on leaves of *O. corniculata* and *O. corymbosa*. Cleistothecia were white initially and then turned light brown to dark brown and finally became black when fully matured (Fig.4). Cleistothecia were epiphyllous, scattered to sub - gregarious, large, globose having a diameter of about 90-118 µm, polygonal in shape. Appendages were numerous, 43-97 per cleistothecium and entangled with mycelium. Myceloid appendages turned brown in colour when mature. The size of appendages ranged between 98-137 × 5-8 µm (about 0.5-2.0 times the size of cleistothecia). It was interesting to note that some of cleistothesia were completely lacking appendages but had the asci and ascospores. Appressoria are rarely formed by conidia floating on water (Nour, 1958) but are produced when the germ tubes come into contact with another conidium or germ tube (Hossain and Manners,1964). Appressoria type club shaped in *E. cichoracearum* (Braun, 1987). In each cleistothecium 4-8 asci were present except cleistothecia which were abortive, indicating that mature cleistothecia did not have asci. Asci were stalked, broadly ovate or elliptic, oblong and arranged in the form of rosette (Fig. 5). The size of the asci ranged from 61.0-73.4 × 3.0-38.9 µm. Ascospores 2-3 per ascus, hyaline, ellipsoid - ovoid to subglobose and 18.0-24.6 × 11.0- 17.8 µm in size. However, some abortive asci were also observed.

The frequency of occurrence of powdery mildew disease on *O. corniculata* was recorded as 75.8% in and around A.M.U. campus. However, on *O. corymbosa* it was 46%. The morphological features of both anamorphic and teleomorphic stages were more or less similar to powdery mildew fungus *E. cichoracearum* as reported earlier by Salmon (1900) and Paul and Thakur (2006). Literature scanned reveal that this is the first report of the occurrence of *E. cichoracearum* on both the species of *Oxalis* (*O. corniculata* and

O. corymbosa) from India and elsewhere. Moreover, there are also reports available to indicate that *Oidium oxalidis* and *Oidiopsis taurica* were also involved to cause powdery mildew disease on *O. corniculata* (Kamat and Patel, 1948; Sharma and Khare, 1992). With the discovery of new hosts of *Erysiphe cichoracearum* an important medicinal plant *O. corniculata* and ornamental plant *O. corymbosa*, it becomes necessary to manage the disease in order to protect these important plants so as the plant may used commercially for its medicinal and ornamental purposes.

References

Alcorn, J. L. (1969). Infection experiment with cucurbit powdery mildew. Aust. J. Sci. **31 (1)**: 296-297

Alcorn, J. L. (1968). Cucurbit powdery mildew on pawpaw. Qld. J. Agric. and An. Sci. 25 (3): 161-164. (Rev Appl. Mycol. **48** : 52, 1968).

Braun,U. (1987). A monograph of Erysiphales (Powdery Mildews). Nova Hedvigia **89**:1-700.

David Bruce and Leonard (1998-2006). Healing plants of the Hawaiian Kingdom.

Hossain, S.M.M. and J. G. Manners. (1964). Relationships between internal structure of the conidium and germination in *E. graminis.* Trans. Brit. Mycol. Soc. **47**:39-44.

Kable, P. F. and Ballantyne, B. (1963). Observations on the cucurbit powdery mildew in the Ithaca District. Pl. Dis. Reptr, **47**: 482.

Kamat, M. N. and M. K. Patel (1948). Some new hosts of *Oidiopsis taurica* (Lev.) Salmon in Bombay.**1(2)**: 153-158.

Nour, M. A. (1958). Studies of *Leveillula taurica* (Lev.) Arn. and other powdery mildews. Trans. Brit. Mycol. Soc, **41**: 17-38.

Odile Carisse (2009). Grape disease management in Quebec. Agriculture and Agri Food Canada.

Paul Y. S. and R. L. Mujal (1982). New host record of powdery mildew from India. Indian Phytopath. **35 (1):** 170-171.

Paul Y. S. and Thakur, V. K. (2006). Indian Erysiphaceae. Scintific Publishers, Jodhpur India **PP. 134.**

Salmon, E. S. (1900). A monograph of the Erysiphaceae. Mem. Torry. Bot. Club. **9:** 1-292.

Sharma, N. D. and Khare, C. P. (1992). Morphology of anamorphs of some powdery mildew fungi of Jabalpur Division. Acta Botanica Indica **20:** 269-277.

Yarwood, C. E. (1978). History and taxonomy of powdery mildews. Page 1-32 in D. M. Spencer ed. The Powdery Mildews'' Academic Press, London, New York, San Francisko.

Zara Covitis, C. (1965). Attempts to identify Powdery Mildew Fungi by conidial characters. Trans. Brit. Mycol, Soc **48(4):** 553-558.

Fig 1: Leaves of *O. corniculata* showing powdery mildew symptoms (b) produced by *Erysiphe cichoracearum*

Fig. 2: The leaves of Oxalis corymbosa showing powdery midlew symptoms produced by Erysiphe cichoracearum

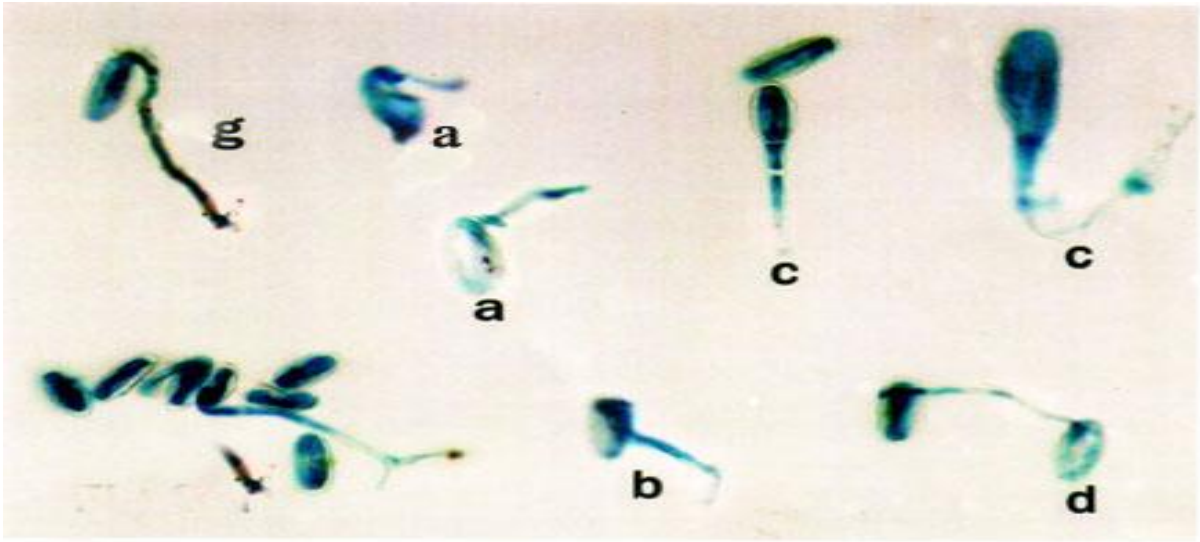

Fig. 3: Conidiophore with conidia (C) showing the mode of germination (a, b, g)

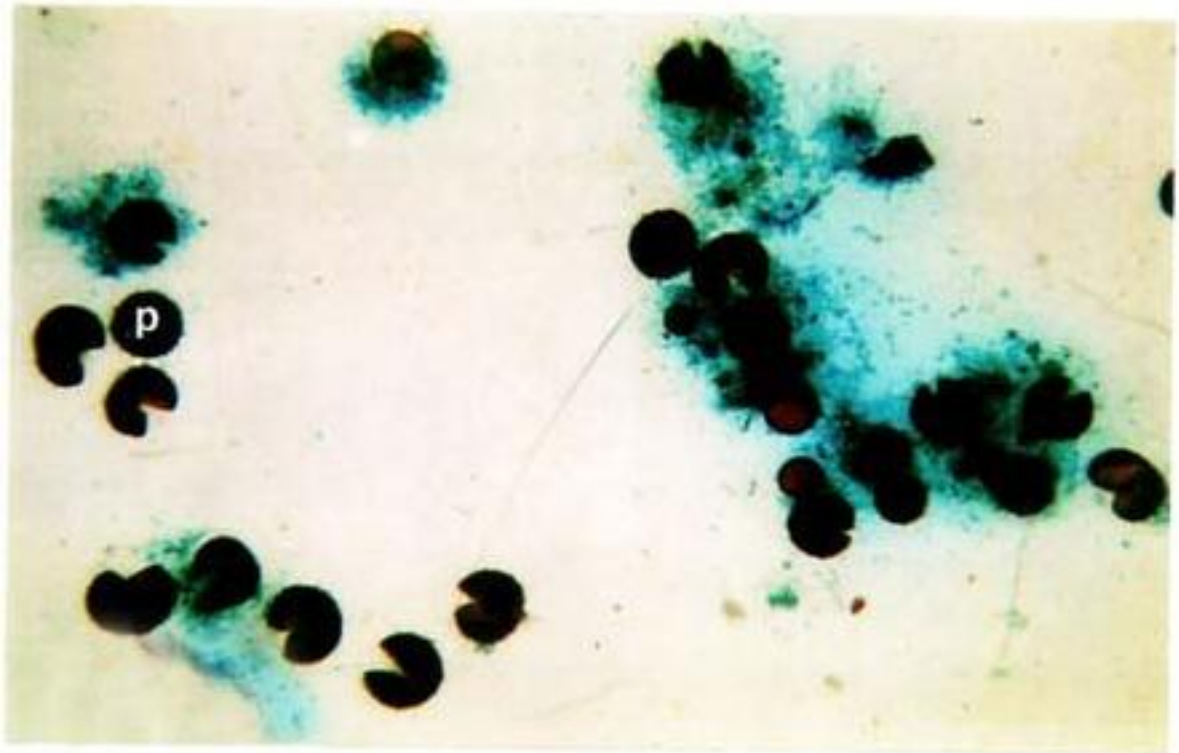

Fig. 4: Cleistothecia (p) of *Erysiphe cichoracearum* collected from the leaves of *O. corniculata* and *O. corymbosa.*

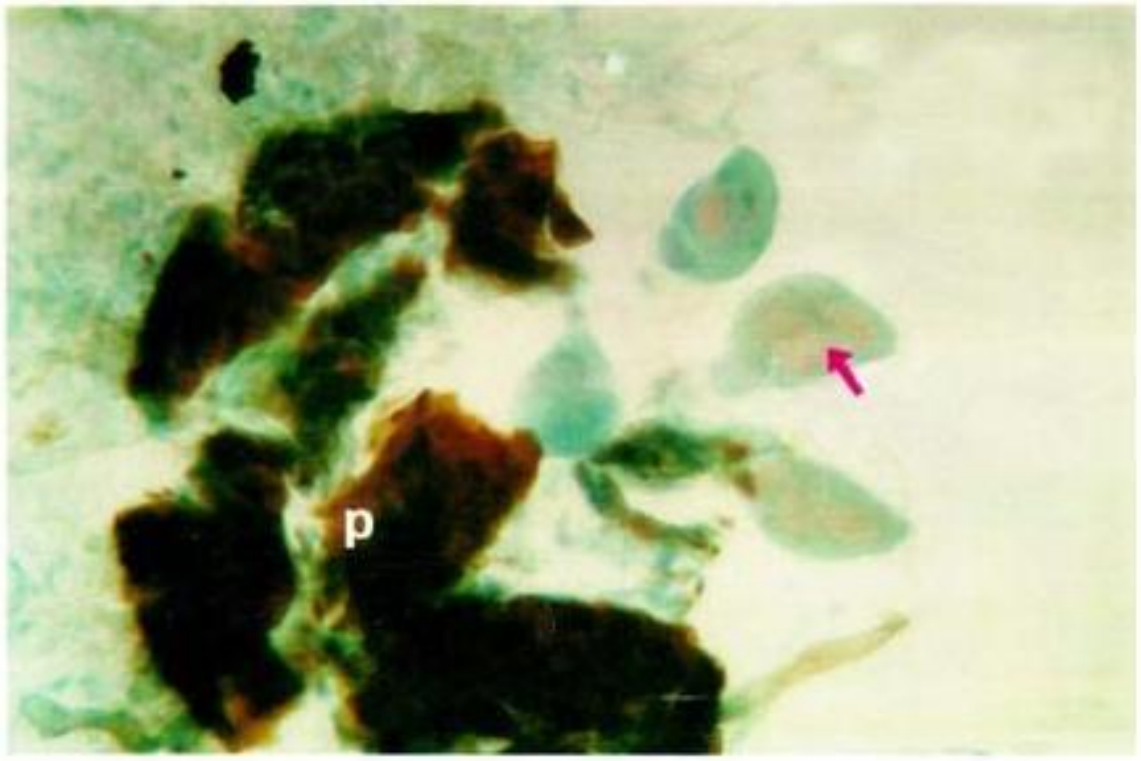

Fig 5: **Ruptured cleistothecia (P) with asci & ascospores (→)**