

**EPIDEMIOLOGY OF CUCURBIT POWDERY MILDEW IN ROHILKHAND REGION OF UTTAR PRADESH, INDIA****ABHIRUCHI AGNIHOTRI<sup>a</sup>, G.K.SHARMA<sup>b1</sup>, AND NEELOFAR KHANAM<sup>c</sup>**<sup>ac</sup>Department of Botany, Hindu College, Moradabad, Uttar Pradesh, India<sup>b</sup>School of Biotechnology, IFTM University, Moradabad, Uttar Pradesh, India**ABSTRACT**

**Epidemiology of powdery mildew on cucurbits were studied in Rohilkhand region of Uttar Pradesh, India. Most of the cucurbits were found infected in one or the other localities of the study area which comprised eight districts of Rohilkhand region of Uttar Pradesh. The study area showed the occurrence of *Sphaerotheca fuliginea* and *Erysiphe cichoracearum*. The knowledge regarding perpetuation of the pathogens and annual recurrence of the disease on cucurbits seems to remain evading in the near future.**

**KEYWORDS :** Epidemiology, Powdery Mildew, *Sphaerotheca fuliginea*, and *Erysiphe cichoracearum*

Cucurbits form an important and large group of vegetables grown extensively in Western Uttar Pradesh (India). Powdery mildew is a destructive disease and causes considerable losses to the number of cucurbitaceous crops grown in India. Three powdery mildew species, *Sphaerotheca fuliginea* (Schlecht.) Poll., *Erysiphe cichoracearum* DC. And *Leveillula taurica* (Lev.) Arnaud, are recognized as causal organisms of the disease on cucurbits on worldwide basis (Sitterly, 1978, Sharma and Khan, 1991). Powdery mildew fungi grow as a white powdery mass on leaves, petioles and stems. The resulting decrease in photosynthesis may cause significant reductions in the quality and yield of fruit. Cucurbit fruits are not directly attacked by powdery mildew fungi; however they may be malformed or sunburned due to loss of foliage cover. In severe infections both the size and number of fruit may be reduced. Kristkova et al. (2002) reported both *Sphaerotheca fuliginea* and *Erysiphe cichoracearum*. They claimed *Erysiphe cichoracearum* is a predominating species of Czechoslovakia. Recently Kristkova et al. 2009 again identified the caused organism of powdery mildew disease on cucurbits. Davis et al. (2006) reported the causal organism of powdery mildew disease on cucurbits in United States.

Since than many reports show that *Sphaerotheca fuliginea* is dominant species on cucurbits followed by the *Erysiphe cichoracearum*. Reports of *Leveillula taurica* infecting cucurbits are only from a limited number of countries (Gupta and Sharma, 2012a, b; Lebeda et al., 2010). Available reports from some states in India like

Bihar (Khan, 1976); Haryana (Gupta and Sharma, 2012b), Madhya Pradesh (Dave et al., 1971) and Rajasthan (Siradhana and Chaudhary, 1971) show similar dominance of *Sphaerotheca fuliginea*. Thus *Sphaerotheca fuliginea* was recognized as the only species causing the disease on cucurbits in different parts of world including India. Most of these are new reports and lack objectively in efforts to establish the identity of species on cucurbits. Few reports of availability of powdery mildew species are available from some districts of Uttar Pradesh. Cucurbit isolates *Sphaerotheca fuliginea* and *Erysiphe cichoracearum* cross-infect all cucurbit species and genera (Lebeda et al., 2007). Population of *Sphaerotheca fuliginea* and *Erysiphe cichoracearum* vary spatially and temporally (Kristkova et al., 2009). From several districts of Uttar Pradesh particularly western districts; studies on powdery mildew in order to establish their identity, have not been undertaken. There is no much information available from Rohilkhand region of Uttar Pradesh. This situation prompted us to study the occurrence and severity of powdery mildew on cucurbits and establish the identity of species causing the disease in Rohilkhand division of Uttar Pradesh.

**MATERIALS AND METHODS**

A survey was conducted in the February and March 2004 in different locations of Rohilkhand region of Western Uttar Pradesh to assess the incidence and intensity of powdery mildew on cucurbits and to establish the identity of causal species. Five to ten field plots or other cultivation units like kitchen garden etc. were surveyed in each locality.

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<sup>1</sup>Corresponding author

Samples of leaves and stems collected from the infected cucurbits, packed in polythene bags and properly marked were brought to the laboratory for further studies. Incidence of disease (percent occurrence) on each cucurbit crops in a district was calculated.

Severity (intensity) of the disease on different cucurbits in different localities of the districts was rated on 0-3 scale. Average of the ratings from different fields of a locality was assigned as severity grade on each cucurbit in the locality. Symptoms on each cucurbit sample were characterized. Characteristics of cleistothecia and conidial characters of the fungi were used to establish the identity.

For the presence or absence of fibrosin bodies in conidia, conidia from each samples dusted on three replicate clean glass slides were treated with few drops of 3% KOH (Potassium hydroxide) aqueous solution and 100 conidia selected at random from each slide were examined under microscope. Conidia from each sample were subjected to germination test in order to study morphology of germ tubes and development of appressoria. Conidia were gently dusted on three clean glass slides from each sample and slides were placed on glass rod triangles, kept in petriplates containing sterilized distilled water in the bottom lid and upper lid lined with moistened cotton wool. The petriplates were incubated at 20°C ( $\pm$  2) for 24h and slides were examined for the morphology of germ tubes. Percent germination and percent forking by germ tube were determined by examining 100 conidia from each replicate slide. A set of slides from each sample, incubated in the same way as described above, were examined after 48h for detecting the development of appressoria and percent appressorial development by germ tubes was determined at the end of incubation period by accounting 100 conidia from each slide.

## RESULTS AND DISCUSSION

Rohilkhand region included 8 districts viz. Shahjahanpur, Pilibhit, Bareilly, Rampur, Moradabad, Bijnor, Badaun and Mahatma Jyotibaphule Nagar in Uttar Pradesh (India). Ten cucurbits viz. *Cucurbita moschata*, *Lagenaria siceraria*, *Cucurbita maxima*, *Luffa cylindrica*, *Cucumis melo*, *Cucumis melo* var. *utilissimus*, *Cucumis*

*melo* var. *momordica*, *Cucumis sativus*, *Citrullus vulgaris* var. *fistulosus*, and *Coccinia cordifolia*. The Powdery mildew disease was wide spread appearing on all the cultivated cucurbits. *C. cordifolia* (a wild cucurbit) was also infected. No variation in symptoms was noticed. Powdery mildews in all the samples were ectophytic. The disease intensity on the cucurbits showed a variation among the localities. The highest intensity was found on *L. siceraria*, being mild to severe.

Anamorph characters like shape and size of conidia, dimensions of conidia (length and breadth), L/B index, presence and absence of fibrosin bodies in conidia, morphology of germ tube and development of appressoria and point of origin of germ tube on conidia were studied to identify and to test the reliability of these characters in the identification of powdery mildew species involved in the development of disease on cucurbits. Among the cultivated cucurbits the conidia from *L. siceraria* measuring 36.2 x 19.2  $\mu$ m were biggest and from *C. melo* var. *utilissimus* were smallest (31.2 x 14.7  $\mu$ m) in size. The conidia from *C. cordifolia* were 37.2 x 17.2  $\mu$ m in size. Length/Breadth (L/B) index of each cucurbit showed a degree of consistency. It was less than 2 for cultivated cucurbits and more than 2 for *C. cordifolia*. Fibrosin bodies were present in a high percentage of conidia obtained from all the cultivated cucurbits but were absent from conidia obtained from *C. cordifolia*. Some conidia in samples of cultivated cucurbits did not show fibrosin bodies in conidia in each samples ranged between 74-91. The number of fibrosin bodies per conidium showed a range of 7-9.

On germination, conidia from cultivated cucurbits developed laterally simple and forked germ tubes. The percentage of forking of germinating conidia also varied from each cucurbit. It ranged 52-66. The conidia obtained from cultivated cucurbits did not develop appressoria. Conidia obtained from *C. cordifolia* invariably formed simple germ tubes (non-forked) emerging from the apical part of the conidium which subsequently produced appressoria. On the basis of the perithecal and conidial characters, the powdery mildew species infecting all the cultivated cucurbits was identified as *S. fuliginea* (Schlecht.) Poll. and *C. cordifolia* as *E. cichoracearum* DC.

Teleomorphs were observed on leaves and stems of *L. siceraria* and *C. moschata* collected from localities of Moradabad, Pilibhit, Badaun and Bareilly districts. Microscopic examination of the teleomorph found in *L. siceraria* showed that these were scattered to densely gregarious brown, globose, measuring 78.2- 104 µm in diameter. Appendages were mycelioid, brown, variable in number and length. Each teleomorph contained broadly elliptical ascus measuring 58.6-88 x 29-60 µm (63 x 42 µm). Ascospores were 8 in number, ellipsoidal to spherical in shape, 17.23 x 10-20 µm (19.8 x 16.7 µm). Teleomorph of *C. moschata* were more leaves than stems, scattered, 68.2-108 µm in diameter. Appendages variable in number and mycelioid, single ascus, elliptical, 58.2-88 x 27-56 µm in size, 8 ascospores ellipsoidal, 17-24 x 13-21 µm. Based on these cleistothecial characters the powdery mildew species present on both cucurbits was identified as *Sphaerotheca fuliginea* (Schlecht.) Poll.

We have limited genetic knowledge of the powdery mildew pathosystem (Jahn et al., 2002). Breeding of cucurbits for resistance to cucurbit powdery mildew is hindrance by lack of clear and uniform descriptions of the of the genetic variation in the pathogenicity of the cucurbit powdery mildew pathogens (Lebeda & Sedlakova, 2006; McCreight, 2006) and genetics of resistance in the cucurbits (Pitrat et al., 1998).

*Sphaerotheca fuliginea* and *Erysiphe cichoracearum* were found infecting the cucurbits in all the districts of Rohilkhand region. *L. taurica* was, however, not encountered. The overall incidence of the disease on cucurbits in Rohilkhand region showed that the pathogens are firmly widely distributed in the area and are infecting a high percentage of fields grown with cucurbits in Rohilkhand region. Bottle guard and melons are highly infected cucurbits of the area but other cucurbits are relatively less affected. Of the two species recorded *S. fuliginea* was found to be most frequent species in the area being dominant in all the districts. *E. cichoracearum* in general was restricted to *C. cordifolia*, *S. fuliginea* is unquestionably most important powdery mildew species of cucurbits on world-wide basis (Lentham & Priest, 1989, Sharma and Khan, 1994, Lebeda et al., 2010). *E.*

*cichoracearum* has been relegated to second position though its occurrence is fairly wide the world including India (Molot & Lecoq, 1986; Kristkova et al., 2009; Gupta & Sharma, 2012a, b). The significance of *E. cichoracearum*, mostly found on *C. cordifolia*, is not well determined. Thus, this study, for the first time records the occurrence of two species on cucurbits growing on area of Rohilkhand region in Western Uttar Pradesh and establishes their identity as *Sphaerotheca fuliginea* on cultivated cucurbits and *Erysiphe cichoracearum* on *C. cordifolia*.

## REFERENCE

- Dave G.S., Khosla H.L. and Nema. K.G., 1971. Identity of powdery mildews of cucurbits. I JNKVV Res. J., 5: 133.
- Davis AR., Tetteh A., Wehner T., Levi A. and Pitrat M., 2006. Watermelon resistance to powdery mildew race 1 and race 2. Cucurbitaceae. 412-420.
- Gupta M.K. and Sharma G.K. 2012a. Species composition of powdery mildew on cucurbits in Punjab, India. Asian Journal of Microbial. Biotech. & Env. Sc., 14: 257-262.
- Gupta M.K. and Sharma G.K. 2012b. Studies on the dynamics of powdery mildews on cucurbit in Haryana. India. Indian J. Sci. Res., 3: 101-106.
- Jahn M, Munger HM, McCreight JD, 2002. Breeding cucurbit crops for powdery mildew resistance. In The powdery mildews: a comprehensive treatise, (Belanger RR, Bushnell WR, Dik AJ, Carver TLW, eds), Ed. APS Press, St. Paul (MN, USAA): 239-248.
- Khan M. W., 1976. Studies on the cucurbit powdery mildew IV. Intensity and identity of cucurbit powdery mildew in Bihar. Indian Phytopat., 29: 314-315.
- Kristkova E., Lebeda A., Sedlakova B. and Duchoslav M., 2002. Distribution of cucurbit powdery mildew species in the Czech Republic. Plant Protection-Science. 415-416.
- Kristkova E., Lebeda A. and Sedlakova B., 2009. Species spectrum, distribution and host range of cucurbit powdery mildew in the Czech Republic, and in some other European and Middle Eastern countries. Phytoparasitica, 37:337-350.

- Lebeda A. and Sedlakova B., 2006. Identification and survey of cucurbit powdery mildew races in Czech. Population. In proceeding of cucurbitaceae (Homes, G. J. ed). Universal Press, Raleigh (NC USA): 444-452.
- Lebeda A., Widrlechner MP., Staub J., Ezura H., Zalapa J., and Kristkova E., 2007. Cucurbits (Cucurbitaceae; Cucumis Spp., Cucurbita spp., Citrullus spp.), Chapter 8. In: Singh R. (ed.): Genetis Resources, Chromosome Engineering, and Crop Improvement Series, Volume 3- Vegetable Crops. CRC Press, Boca Raton: 271-376.
- Lebeda A., Sedlakova B., Pejchar M. and Jerakova H., 2010. Variation for fungicide resistance among cucurbit powdery mildew population in the Czech Republic. *Ada Hort.*, 871: 465-475.
- Letham D.B. and Priest M.J., 1989. Occurrence of cleistothecia of *Sphaerotheca fuliginea* on cucurbits in South Australia and New South Wales. *Australasian Plant Pathology*, 18:2, 35-37.
- Pitrat M., Dogimont C., Bardin M., 1998. Resistance to fungal disease of foliage in melon. In: McCreight MC. (ed.): Cucurbitaceae 98. Evaluation and Enhancement of cucurbit Crops. ASHS Press, Alexandria: 167-173.
- Molot. P.M. and Lecoq.H., 1986. Powdery mildew of cucurbit. I.Bibliographic Data. Preliminary studies. *Agronomie*. 6: 335-362.
- McCreight JD., 2006. Melon-powdery mildew interactions reveal variation in melon cultigens and *Podosphaera xanthii* races 1 and 2. *J Amer Soc Hort Sci.*, 131: 59-65.
- Sitterly W.R., 1978. Powdery mildew of cucurbits. In: Spencer,D.M.: The powdery mildew, 359-379. London: Academic press Inc. Ltd .In English
- Sharma G.K. and Khan M.W., 1994. Species spectrum of cucurbit powdery mildew in Andhra Pradesh. *IIBS*, 73: 77-79.
- Sharma G.K. and Khan M.W., 1991. Observations on occurrence and identity of powdery mildew of cucurbits in Tamil Nadu. *Indian Phytopath.* 44: 45-51.
- Siradhana B.S. and Chaudhari S.L., 1971. Occurrence of *Erysiphe cichoracearum* and *Sphaerotheca fuliginea* at Udiapur, Rajasthan. *Indian J. Mycol.Pl. Path.*, 2: 7-79.