J. Mycopathol. Res. **44**(1) : 147-149 (2006)

Mucor thermophilus R. Prakash and Sarbhoy – a synonym of *Gilbertella persicaria* (Eddy) Hesseltine

NITA MATHUR AND SASHI PRABHA LAL
Department of Plant Pathology, IARI, New Delhi 110012

Mucor thermophilus and isolates of *Gilbertella persicaria* were compared for their cultural and microscopic characters followed by their interstrainal matings. The results obtained confirmed *Mucor thermophilus* to be synonym of *Gilbertella persicaria.*

Key Words : *Mucor thermophilus, Gilbertella persicaria*, comparison, mating

Mucor thermophilus R. Prakash and Sarbhoy was described as a new species on the basis of its thermotolerant nature and large sporangiospores, which are broadly ellipsoidal or cylindrical with rounded ends; hyaline; 4.5-12 µm diam (7.5-12 µm). The description was found deficient in providing the correct sporangiospore morphology. The cultotype deposited with Indian Type Culture Collection (ITCC) as ITCC 3364 when studied was observed to produce dark grey to black large sporangia with the sporangial wall splitting into two halves and presence of appendaged sporangiospores, characters not found in the genus *Mucor* but is characteristic of the monotypic genus *Gilbertella* (Benny, 1991). Hence, it was compared with the isolates of *G. persicaria* represented in ITCC (Table 1). The mating behaviour of these isolates was also studied (Table 2).

These isolates, though obtained from different substrates (Table 1) were able to produce typical rotting of fresh healthy peaches, when wound inoculated (Hesseltine, 1964) within 48 h at 30°C, with the growth of the fungus on the inoculated fruits producing both mycelium and sporangiophores. Although these isolates exhibited some variations both in culture and morphology (Table 1), they fall within the species concept of *G. persicaria* as specified by Benny (1991), sporangiospores measuring (5.1-) 7.6–11.4 (17.8) µm × (3.8-) 6.4–8.9 (-12.7) µm, appendages 2-3 (-7) hyaline upto 24 µm long. The appendages became conspicuous when the water mounts were allowed to dry out gradually and examined under the light microscope. The sporangiospores of ITCC 3364 were 7.5-11.5 × 4.5-10.0 µm with 2-5 appendages, 15.5-19.5 µm long.

In 1999 *G. persicaria* – was isolated from rotting French bean pods. The isolate produced both sporangia and zygospores. The single spore isolate from the same were all sporangia producing (ITCC 4885). However, when the zygospores were transferred to fresh media, the zygospores were also obtained (ITCC 4886). On maintenance the strain (ITCC 4886) lost its ability to produce zygospores. Later ITCC 4887 was isolated from unidentified leaf which was a brown strain. ITCC 5105 and 5221 were isolated from ficus leaf.

The examination of *Mucor thermophilus* R. Prakash and Sarbhoy (ITCC 3364) was found to produce sporangia and sporangiospores similar to that of *G. persicaria.* Though the authors reported sporangial wall to be finely echinulate and deliquescent, it was observed to be echinulate, persistent and dehiscing in the manner of *Gilbertella.* The sporangiospores were observed to be appendaged. The appendages became clear in drying water mounts, the character might have been missed by the authors. The strains

Table 1 : Comparison of cultural and morphological characters of *Gilbertella persicaria* isolates from Indian Type Culture Collection (ITCC)

Strains	ITCC 3364	ITCC 4885	ITCC 4886	ITCC 4887	ITCC 5101	ITCC 5221
Isolated from	*Carica papaya* fruit	*Phaseolus vulgaris* pod	*Phaseolus vulgaris* pod	Unidentified leaf	Ficus twig	Ficus twig
Colony characters (on PDA)	Cottony, white becoming dark gray	Cottony white to light gray	Cottony white to dark gray	Cottony white to light brown	Cottony white to light gray	Cottony white to light gray
Chlamydospores	not observed	sparsely produced, intercalary, subglobose to globose, 15.5-23.5 × 11.5-23.5 µm	Not observed	Cylindrical to subglobose, intercalary, 27.5-35.0 × 15.5-19.5 µm	not observed	Subglobose, intercalary, solitary or in chains, 19.5-40.0 × 15.5-35.0 µm
Sporangiophores	Erect or nodding, sometimes branched	Erect or nodding, sometimes branched	Erect or nodding sometimes branched	Erect, nodding or circinate, occasionally branched	Erect or nodding occasionally branched	Erect or nodding branching not observed
Sporangia	White to dark gray, wall finely echinulate; breaking into two halves	White to light gray, wall finely echinulate, breaking into two halves	White to dark gray, wall finely echinulate breaking into two halves	White to dark brown, wall finely echinulate, breaking into two halves	White to light gray, wall finely echinulate, breaking into two halves	White to light gray, wall finely echinulate, breaking into two halves
Columella	Globose to pyriform with slight collerette. 27.5-50.2 µm diam	Globose to pyriform, 15.5-50.5 µm diam	Globose to pyriform 23.5-58.5 µm diam	Globose to pyriform, 19.5-58.5 µm diam	Globose, pyriform or conical 31.0-46.5 µm diam	Globose, cylindrical to pyriform, 39.0-58.5 µm diam
Sporangiospores	Ellipsoidal to ovate 7.5-11.5 × 4.5-10.0 µm	Ellipsoidal to ovate 5.5-11.5 × 3.5-7.5 µm	Ellipsoidal to ovate 9.5-11.5 × 7.5-9.5 µm	Ellipsoidal or flattened on one side 7.5-15.5 × 7.5-9.5 µm	Ellipsoidal to ovate 9.5-11.5 × 7.5-9.5 µm	Ellipsoidal, ovate to subglobose 7.5-9.5 µm
Appendages	No. 2-5 15.5-19.5 µm long	No. 2-4 11.5-19.5 µm long	No. 2-4 11.5-19.5 µm long	No. 2-4 15.5-23.5 µm long	No. 2-4 14.5-19.5 µm long	No. 2-5, 11.5-19.5 µm long
Reaction on healthy peaches on wound inoculation	Rot appeared within 48 hrs the hyphae and sporangia produced on the surface					

exhibited minor variations as indicated in Table 1, though within the species limits (Benny, 1991).

To support the observation that *Mucor thermophilus* (ITCC 3364) is a strain of *G. persicaria* all the six strains were intercrossed (Table 2). ITCC 3364 positively reacted to ITCC 4885, 4886, 4887 and 5221. Similar reaction was noted for ITCC 5101. Hence ITCC 3364 and ITCC 5110 formed one mating type while ITCC no's 4885, 4886 and 4887 and 5221 formed the other mating type. It was interesting to note that in crosses involving ITCC 4887 i.e., ITCC 3364 × ITCC 4887 and ITCC 5221 × ITCC 4887, zygospores developed in the yellow aerial mycelium at the line where the two colonies mated, whereas in all other crosses, the zygospores

Table 2 : Mating of *Gilbertella persicaria* isolates from Indian Type Culture Collection (ITCC)

Strains mated	Zygosporic reaction	Zygospore diam (µm)
ITCC 3364 × ITCC 4885	+	66.5-85.5
ITCC 3364 × ITCC 4886	+	62.5-81.5
ITCC 3364 × ITCC 4887	+	46.5-78.0
ITCC 3364 × ITCC 5221	+	70.0-85.5
ITCC 3364 × ITCC 5101	–	
ITCC 4885 × ITCC 4886	–	
ITCC 4885 × ITCC 4887	–	
ITCC 4885 × ITCC 5101	+	54.5-78.0
ITCC 4885 × ITCC 5221	–	
ITCC 4886 × ITCC 4887	–	
ITCC 4886 × ITCC 5101	+	58.5-70.0
ITCC 4887 × ITCC 5101	+	43.0-58.5
ITCC 4887 × ITCC 5221	–	
ITCC 5101 × ITCC 5221	+	58.5-66.5

developed as a black line just above the surface. In the former case the zygospores are golden brown with comparatively blunt projections while in latter crossing they were dark brown with sharp projections. The suspensors may be equal or one may be smaller. The warts or projections start developing early, first appearing at the eqitorial line at right angles to the suspensors. The zygospores may be globose or compressed between the two suspensors, latter may be smooth or encrusted. The zygospres development was favoured at temperature 30 ± 2°C. At maturity each developed a more or less centrally placed globose globule. According to Schipper (1969, 1973) two described species are synonyms if zygospores are produced when mated. Benny (1991) reported successful mating and production of zygospores between strains of *Gilbertella persicaria* var. *persicaria, Gilbertella persicaria* var. *indica* and *G. hainanesis* (Cheng and Hu, 1965). The latter two thus becoming synonyms to *Gilbertella persicaria* var. *persicaria* and so *Gilbertella* is a monotypic genus (Benny, 1991).

The genus *Gilbertella persicaria* Hesseltine has attracted the attention of Mycologists over the years. Initially described as *Choanephora persicaria* by Eddy, was separated from the genus *Choanephora* and placed in the new genus *Gilbertella* by Hesseltine (1960), on the basis of production of zygospores between opposed suspensors (Mucor type) in the family Mucoraceae. Alexopoulos and Mims (1979) allied the genus with *Choanephora* and *Blakeslea* while others Benjamin (1979) and Kirk (1984) on the basis of Mucor type zygospore development placed it in Mucoraceae. Hesseltine (1960) considered the genus to be a form intermediate between the Mucoraceae and Choanephoraceae and especially between *Mucor* and *Choanephora*. However, Benny (1991) proposed the family Gilbertellaceae to accommodate a single genus *Gilbertella,* characterized by producing sporangia with persistent wall dehiscing via a longitudinal suture, sporangiospores with apical hyaline appendages and Mucor type zygospores. The species is heterothallic.

ACKNOWLEDGEMENT

The authors are greatful to the Head, Division of Plant Pathology, IARI, New Delhi, for providing necessary facilities and Dr. D. K. Agarwal, for his valuable guidance in preparation of manuscript.

REFERENCE

Alexopoulos, G. J. and Mims, C. W. 1979. *Introductory Mycology,* 3rd Ed. John Willey and San New York. 209 pp.

Benjamin, R. K. 1979. Zygomycetes and their spores, Ch. 23 In W. B. Kendrick (ed). *The Whole fungus*. National Museum of Canada, Ottawa. pp. 573-622.

Benny, G. L. 1991. Gilbertellaceae A new family of the Mucorales (Zygomycetes). *Mycol.* **83** : 150-157.

Cheng, J. Y. and Hu, F. M. 1964. The Mucorales of China. 1. Choanephoraceae. *Acta Phytotax. Sin.* **9** : 13-30.

Eddy, E. D. 1925. A storage rot of peaches caused by a new species of *Choanephora. Phytopath.* **15** : 607-610.

Hesseltine, C. W. 1960. *Gilbertella* Gen. Nov. Mucorales. *Bull. Torrey Bot. Club* **87** : 21-30.

Kirk, P. M. 1984. A monograph of the Choanephoraceae. *Mycol. Pap.* **152** : 1.

Mehrotra, M. D. 1964. Fruit rot of tomato caused by *Gilbertella persicaria. Sydowia.* **17** : 1-6.

Prakash, R. and Sarbhoy, A. K. 1993. *Mucor thermophilus* spec. nov. and other Mucorales from India. *Zentralbl. Mikrobiol.* **148** : 531-534.

Schipper, M. A. A. 1969. Zygosporic stages in heterothallic *Mucor. Antonie Van Leeuwenhoek*, **35** : 189-208.

Schipper, M. A. A. 1973. A study on variability in *Mucor hiemalis* and related species *Stud. Mycol.*, **4** : 1-40.

(Accepted for publication January 5, 2005)