Diseases Caused by Fungi and Fungus-Like Organisms

First Report of Molecular Detection of *Leveillula taurica* Associated with Powdery Mildew of Linseed (*Linum usitatissimum*) from India

K. Ajithkumar,¹ A. S. Savitha,² S. Mahadevakumar,³
S. S. N. Maharachchikumbura,⁴ M. Y. Sreenivasa,^{5,†}
A. L. Rathnakumar,⁶ and M. Sujatha⁶

¹ AICRP on Linseed, Main Agricultural Research Station, University of Agricultural Sciences, Raichur - 584 104, Karnataka, India

² Department of Plant Pathology, College of Agriculture, University of Agricultural Sciences, Raichur - 584 104, Karnataka, India

³ Applied Phytopathology Laboratory, Department of Studies in Botany, University of Mysore, Manasagangotri, Mysuru - 570 006, Karnataka, India

⁴ School of Life Sciences and Technology, Center for Informational Biology, University of Electronic Science and Technology of China, Chengdu 611731, P.R. China

⁵ Phytopathology Laboratory, Department of Studies in Microbiology, University of Mysore, Manasagangotri, Mysuru - 570 006, Mysuru, Karnataka, India

⁶ Indian Institute of Oil Seed Research, Rajendranagar, Hyderabad, India

K. Ajithkumar, A. S. Savitha, and S. Mahadevakumar contributed equally to this work.

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Linseed (*Linum usitatissimum* L.) is an important oil-yielding crop cultivated widely in India. During a 2018 to 2019 field survey (rabi season; January to February), characteristic powdery mildew disease symptoms were observed in around 90 ha of linseed in Northern Karnataka (Agricultural Research Station, Raichur). Disease incidence was estimated to range up to 96%. Initial symptoms were tan lesions, which later turned into small, circular chlorotic lesions and yellowing of the abaxial leaf surface with white fungal mycelial growth on the abaxial leaf surface. As the disease progressed, white fungal mycelial growth was also noticed on the adaxial leaf surface. In severe infection, drying and premature defoliation of infected leaves was observed. Twelve samples were collected and subjected to morphological and molecular identification. Microscopic examination revealed the presence of conidia borne on conidiophores (simple, sometimes branched). Conidiophores were 83.17 to 116.45 μm ($n = 90$). Conidia were single-celled, hyaline, dimorphic (pyriform and cylindrical), and 70.2 to 82.7 $\times$ 15.1 to 26.3 μm ($n = 100$). A reference specimen was deposited at Agharkar Research Institute's Ajrekar Mycological Herbarium (AMH 2015-07/AKC 2231-03/SKS/DKM). Since the conidial morphology and characters were very similar to *Leveillula taurica* the

fungus was identified as *L. taurica* (Lév.) G. Arnaud. (Braun and Cook 2012). To further confirm the identity based on ITS-rDNA barcoding, genomic DNA was isolated from a conidial suspension harvested from powdery mildew-affected linseed samples. ITS was amplified using powdery mildew-specific ITS universal primer pair PN23/PN34 and sequenced directly (Chen et al. 2008). The ITS regions were amplified at ~700 bp. BLASTn analysis revealed that the ITS sequence shared 100% similarity with reference sequence AB045148.1. The representative sequences were deposited in GenBank with accession numbers OK036584 (LuLtR1) and OK036585 (LuLtR2). The L1/L2 primer pair from the ITS region was further PCR amplified (Reddy et al. 2013) and an expected amplicon of 374 bp was analyzed. Although the ITS-rDNA and L1/L2 specific regions were analyzed, they are not specific exclusively to *L. taurica*. However, the combination of morphology and molecular sequences was used to confirm the identity. To prove Koch's postulates, pathogenicity tests were conducted on healthy linseed plants grown under greenhouse condition ($28 \pm 2^\circ\text{C}$; >80% relative humidity). Conidia were harvested from infected leaves and the suspension was sprayed on 30 (40-day-old) linseed plants. The development of powdery mildew symptoms was recorded on 22 plants 10 days after inoculation. Control plants inoculated with sterile water remained healthy, and no powdery mildew symptoms were observed. The identity was confirmed upon microscopic observation of spores from artificially inoculated plants, thus confirming the association. *Leveillula taurica* is known to cause powdery mildew on tomato, chilli, and other crops. Amano (1986) and Saharan and Saharan (1994) reported the occurrence of *L. taurica* on linseed, but no further details are available on the association, and there has been molecular confirmation of *L. taurica* associated with linseed from India (Farr and Rossman 2021). To the best of our knowledge, this is the first report of *L. taurica* associated with powdery mildew of linseed in India. Since it is the first confirmed record through molecular sequence analysis, it is important to know its geographical distribution and impact on linseed production to determine management strategies.

References:

- Amano, K. 1986. Host Range and Geographical Distribution of the Powdery Mildew Fungi. Japan Sci. Soc. Press, Tokyo.
- Braun, U., and Cook, R. T. A. 2012. Taxonomic Manual of the Erysiphales (Powdery Mildews). CBS Biodiversity Series No. 11. CBS, Utrecht, the Netherlands.
- Chen, R. S., et al. 2008. Eur. J. Plant Pathol. 121:1.
- Farr, D. F., and Rossman, A. Y. 2021. Fungal Databases, Syst. Mycol. Microbiol. Lab., ARS, USDA. Retrieved 14 August 2021 from <https://nt.ars-grin.gov/fungaldatabases/>
- Reddy, K. P., et al. 2013. Euphytica 190:385.
- Saharan, G. S., and Saharan, M. S. 1994. Indian J. Mycol. Plant Pathol. 24:88.

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[†]Indicates the corresponding author.

M. Y. Sreenivasa; sreenivasamy@gmail.com