First report of the powdery mildew *Podosphaera xanthii* on *Gynura bicolor*

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Abstract In April–May 2015, powdery mildew was observed on stems and leaves of hongfengcai (*Gynura bicolor*), a perennial vegetable crop, in central Taiwan. Morphological and molecular characteristics determined this fungus as *Podosphaera xanthii*, which is reported on the plant genus *Gynura* for the first time.

Keywords Erysiphales · Erysiphaceae · powdery mildew · Asteraceae · vegetables · rDNA spacer sequence

Hongfengcai (*Gynura bicolor*), also known as Okinawan spinach, is a perennial plant consumed as a vegetable in Asian countries. The crop is grown in open fields or in net houses in Taiwan under both conventional and organic farming systems.

During April and May 2015, powdery mildew was observed on *G. bicolor* at one side of the edge of a net house in Puyan Township, Changhua County, Taiwan. Symptoms appeared as thin white patches on stems and on upper side of leaf surfaces (Fig. 1). Lower part of the plants was found to be more susceptible. Under microscopic observation, hyphal appressoria of the fungus were indistinct or nipple-shaped. Conidiophores measured 103.8 to 150.0 µm long × 11.3 to 13.8 µm wide, and were followed by 2 to 5 immature conidia with crenate edges. The foot-cells in conidiophores were cylindrical, 50.0 to 75.0 µm long, and constricted at the base (Fig. 2). Conidia were hyaline, ellipsoid, with an

average length and width of 32.9 (26.3 to 40.0) × 19.1 (14.4 to 24.4) µm ($n=58$), with a length-to-width ratio of 1.2 to 2.4. Distinct fibrosin bodies were observed in conidia (Fig. 3). Chasmothecia were absent on the diseased samples. Based on the morphological characteristics, the fungus was considered to be *Podosphaera xanthii* (Braun and Cook 2012). A voucher specimen (TNM No. F0028732) was deposited in the herbarium of the National Museum of Natural Science, Taichung, Taiwan.

To confirm the identification, DNA from symptomatic tissues was extracted with a Plant Genomic DNA Extraction Miniprep Kit (Viogene, Taiwan). PCR amplification of the Internal Transcribed Spacer (ITS) region of ribosomal DNA was performed with the primer pairs ITS1/PM6 and PM5/ITS4 (Takamatsu and Kano 2001; White et al. 1990). The resulting 558 bp sequence was deposited in GenBank as Accession No. KT210086. The sequence similarity was 99.8 % (557/558) compared with that of *P. xanthii* (AB525914)

Fig. 1 Symptoms of powdery mildew on hongfengcai (*Gynura bicolor*)

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Fig. 2 Conidiophore and immature conidia of *Podosphaera xanthii* (TNM No. F0028732). Bar=20 μ m

infecting a plant in Asteraceae family (Takamatsu et al. 2010), revealing that the fungus clustered with the species complex of *P. xanthii* (Braun and Cook 2012).

According to our further surveys, no powdery mildew symptoms were found at nearby commercial hongfengcai-growing fields in Changhua County. The observation indicated the disease was not widespread. However, pumpkin leaves with powdery mildew symptoms were seen adjacent to the place where *G. bicolor* infected by *P. xanthii* was first discovered (Fig. 4). The powdery

Fig. 3 Conidia of *Podosphaera xanthii* (TNM No. F0028732). Bar=20 μ m

Fig. 4 Powdery mildew symptoms on pumpkin leaf near *Gynura bicolor* plants infected by *Podosphaera xanthii*

mildew on the pumpkin plants was identified as *P. xanthii* based on its ITS sequence (GenBank Accession No. KT210087). This result suggests the possibility of the pathogen to spread from a cucurbitaceous host to other hosts which is not commonly seen to be infested with the fungus. *P. xanthii* is reported to infect angiosperm species in Asteraceae, Cucurbitaceae, Fabaceae, Scrophulariaceae, and Solanaceae, etc. (Braun and Cook 2012; Farr and Rossman 2015). The pathogen was recently confirmed to incite diseases on melon, papaya and bitter gourd in Taiwan (Huang and Wang 2007; Tsay et al. 2011; Liu and Kirschner 2015). To our knowledge, this is the first occurrence of the powdery mildew *P. xanthii* on hongfengcai in Taiwan. Remarkably, this is the first record of *P. xanthii* causing powdery mildew on the plant genus *Gynura*.

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