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First Report of Phytophthora blight of White Arum Lily caused by *Phytophthora meadii*

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White arum lily (*Zantedeschia aethiopica*), a member of the Araceae family, has long been the major ornamental crop of Jwu Tzy Hu in the Yan-Ming Mountain area located in Taipei, Taiwan. Recently, a devastating blight disease occurred (Fig. 1), and almost ruined cultivation of white arum lily in this area. The disease was especially serious during Typhoon season in the summer and became epidemic within a short period time. Infected leaves first showed water soaking, then turned dark brown and rotten subsequently (Fig. 2B). When petioles were infected, tissues become sunken, twisting, dislocating, and the whole leaf drooped (Fig. 2C). Flower rot (Fig. 2A) as well as root rot was also observed on the diseased plants. Because the infected tissues were completely decomposed and rotted away, the bacterium *Xanthomonas campestris* (5), which has been reported to cause soft rot of white arum lily, or other soft rot bacteria were first suspected to be involved in white arum lily blight in the Yang-Ming Mountain. The evidence that *X. campestris* is the causing agent of this disease, however, is still lacking. Meanwhile, a species of *Phytophthora* was consistently isolated from the advanced portion of the diseased tissues of the infected plants. This report describes identification of *Phytophthora meadii* McRae isolated from white arum lily collected from the Yan Ming Mountain area in 1996 and 1997.

Diseased samples were collected and washed against tap water. Diseased tissues with advanced water soaked lesions were cut into small pieces (1 cm long for root segments, and 5 x 5 mm for leaves, petioles, stems, and flowers), and surface sterilized with 0.5% NaClO for 1 min. The surface sterile tissues were then placed on a selective medium (6) and potato dextrose agar (PDA) at room temperature for 3-5 days. Mycelial blocks or bacteria growing out of the diseased tissues were transferred to the 5% clarified V-8 juice agar plate (CV-8; 5% V-8 juice plus 0.2% $CaCO_3$ were centrifuged at 1,500 rpm for 5 min, and then amended with 2% agar). Cultures of *Phytophthora* species were purified by single-zoospore isolation.

A total of 15 isolates of *Phytophthora* with identical characteristics were obtained from diseased tissues of white arum lily. While growing on CV-8 agar plates under light at 24C, sporangia were produced and formed sympodially on sporangiophores. Sporangia were ovoid, obpyriform or ellipsoid with semi-spherical papilla. They are deciduous in water and with short pedicels. Besides, a few sporangia (about 10%) had 2 papilla or exhibited unusual shape. Size of sporangia ranged 20-60 x 15.2-34 μm (av. 45.1 x 25.6 μm) and the L/B ratios ranged 1.16-2.17 (av. 1.76). The mean length of pedicels was 7.96 μm and ranged from 3.6 to 15.2 μm. Chlamydospores and hyphal swellings were not formed. All isolates belonged to the A^2 mating type. They were able to stimulate the A^1 mating type of *P. parasitica* (isolate P991) to produce oospores and vice versa. The numbers of oospores produced by white arum lily isolates through the polycarbonate membrane method designed by Ko (7) were less than 100 per cm^2 and most of them were aborted. Sizes of viable oospores, oogonia, and antheridia ranged 17.5-(20.3)-25 μm, 20-(25.1)-27.5 μm, and 6-(10.8)-15 X 10-(13.7)-15 μm, respectively. The fungus was able to grow on 5% V-8 agar from 12 to 32C and the optimal growth temperature was 24-28C (Fig. 3). Based on the classification keys of Waterhouse (11, 12) and Stamps *et al*. (10), *P. meadii* and *P. palmivora* Butler (Butler) sensu stricto are closely related species. However the pedicels of sporangia of former are much longer

Fig. 1. A diseased field (A) and a damping off plant (B) of white arum lily infected by *Phytophthora meadii*.

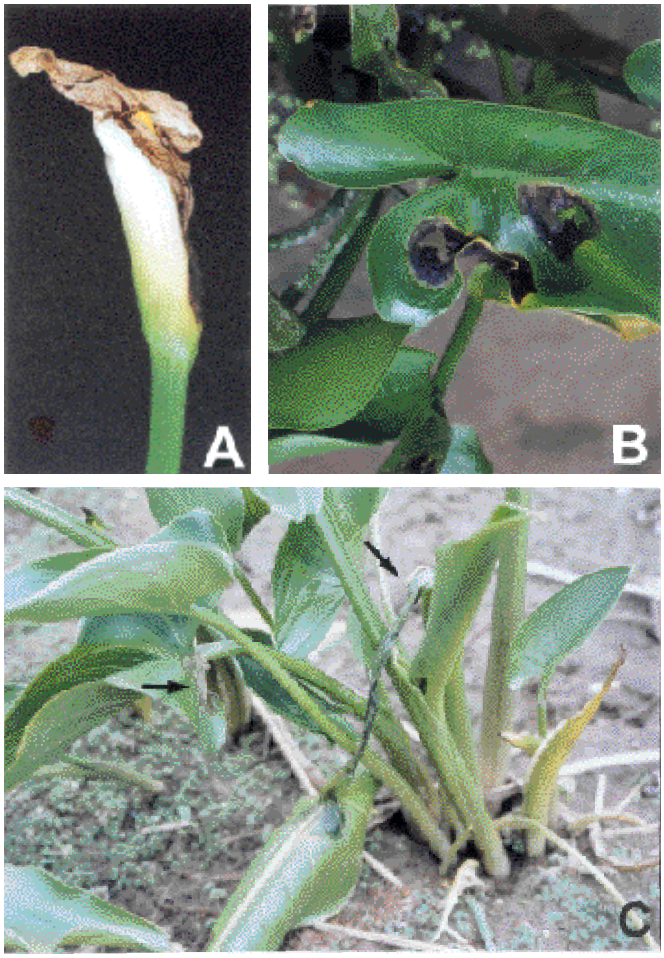

Fig. 2. Disease symptoms on a flower (A), leaf (B) and petiole (C) of white arum lily attacked by *Phytophthora meadii.*

than that of latter, which is about 1-2 μm. Therefore the fungus isolated from white arum lily was identified as *Phytophthora meadii* McRae, which was completely identical to the *Phytophthora* isolated from *Aglaonema nitidum* (1).

Zoospore suspension with concentration of about 10^5 zoospores per milliliter was used for inoculation study. Large amount of sporangia was prepared according to the procedures developed by Hwang *et al*. (4). Healthy white arum lily plants with 5-10 leaves grown in pots were used for pathogenicity test. Prior to inoculation leaves and petioles of some plants were pricked with insect needles. The wounded and unwound plants were then inoculated with zoospore suspension by the aid of a sprayer until zoospore suspension dropped off. Inoculated plants were moved into a moist chamber (100% relative humidity) at room temperature for 2 weeks. Controls were pricked with insect needles and inoculated with distilled water. Five plants were used for each treatment and tests were performed twice. Water-soaked spots appeared on leaves and petioles 2-5 days after inoculation and lesions enlarged rapidly and turned brown. Almost every marked wounded area was infected, but some unwounded places also showed gradually disease symptoms after inoculation. This indicated that wounded-inoculation was unnecessary for pathogen infection whereas wounded-treatment made disease development more rapid. The symptoms induced by inoculation were similar to those found in the fields. All controls remained healthy during test periods. To ascertain that *P. meadii* was the causal organism, inoculated-diseased tissues were taken and surface-sterilization for reisolation. *Phytophthora meadii* were reisolated from all the disease spots.

Phtophthora meadii was first found to cause root rot of rubber in India by McRae in 1918 (8). Later the same disease was reported in Sri Lanka (9) and Malaysia (3). On ornamental plants, it has been shown that *P. meadii* caused *Phytophthora* leaf blight on *Aglaonema nitidum* in Taiwan (1)

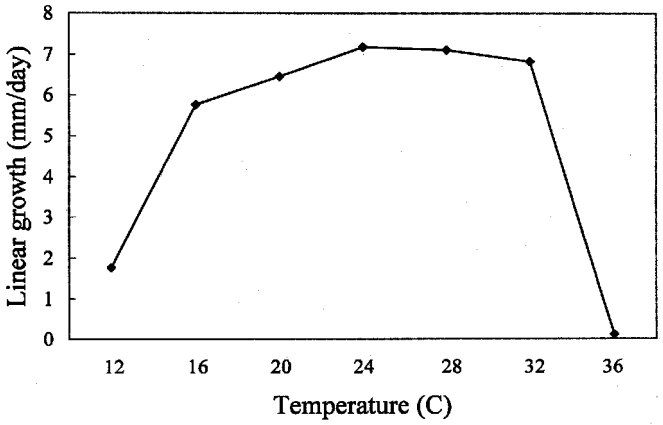

Fig. 3. Linear growth rates of a isolate of *Phytophthora meadii* from white orum lily on 5% CV-8 agar in darkness.

and West Indian holly (*Leea coccinea*) in Hawaii (2), respectively. However, *P. meadii* has not been reported to infect white arum lily at any other place. Both *A. nitidum* and white arum lily are members of the Araceae family. Previously, it has been demonstrated that isolates of *P. meadii* obtained from *A. nitidum* were able to attack a couple of ornamental plants in Araceae in pathogenicity tests (1). In the present study, it was demonstrated that *P. meadii* indeed causes infection to white arum lily in the fields.

Key words: *Phytophthora meadii*, white arum lily

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摘　要

劉瑞芬[1]、李政曒[1]、安寶貞[2,3]. 1999. *Phytophthora meadii* 引起白色海芋疫病之初報. 植病會刊 8:37-40.
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台北陽明山竹仔湖地區之白色海芋 (*Zantedeschia aethiopica*) 自 1995 年起紛紛罹患軟腐病害，植株逐年死亡。在罹病初期，葉片與葉柄先出現水浸狀病斑，爾後病斑逐漸擴大、轉變為黑褐色、進而腐敗分解。葉柄罹病時，患部腐敗，嚴重扭曲隘縮，其上之葉片下垂。此外，花器和根部也會分別出現枯萎、謝花與腐敗現象。採集罹病白色海芋，自葉片、花器、及根部病組織上均可以分離出一種疫病菌，經形態與生理特徵測定，鑑定為 *Phytophthora meadii* McRae, 與從粗肋草上分離者相同。本試驗共分離出 15 菌株，均為 A^2 配對型 (mating type)。胞囊脫落性 (deciduous)，形態橢圓形或近似橢圓形，具顯著之半球型乳突 (papilla)。胞囊大小平均為 45.1×25.6 μm，長寬比 (L/B) 平均 1.76。脫落之胞囊具有短梗，長度平均 7.96 μm。藏卵器、卵胞子、及藏精器的大小分別平均為 20.3 μm, 25.1 μm 及 10.8×13.7 μm。 以該菌進行病原性測定的結果顯示，被接種的白色海芋均會出現與田間一致的病徵，而且相同之病菌均可自接種產生之病斑上再分離出，顯示 *P. meadii* 確實為白色海芋之病原菌。*Phytophthora meadii* 感染白色海芋不需要傷口，但傷痍感染時病勢進展較快。在台灣，*Phytophthora meadii* 為第二次被發現引起作物病害，它危害白色海芋在世界其他地方亦尚未被報導過。

關鍵詞：白色海芋，疫病，疫病菌 *Phytophthora meadii*