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A non-chemical approach for controlling Panama disease occurrence in Taiwan with the essential oil of *Biden pilosa*

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Panama disease caused by *Fusarium oxysporum* f. sp. *cubense* (FOC) is the most destructive disease in banana production. In this study, we explore a potential non-chemical approach to reducing the incidence of Panama disease in fields in Taiwan. Fresh materials collected from 11 naturalized or invasive plants were subjected to steam-distillation, and the isolated essential oils or hydrosols were subsequently evaluated for in vitro antifungal activity against three FOC reference isolates: **YJL-F040** race **1, ATCC-76243** race 2, and **ATCC-38741** subtropical race 4. The essential oil of the Biden pilosa plant demonstrated potent antifungal activity against FOC isolates, showing 22% to 43% inhibition of mycelial growth in races 1, 2, 4, and 70% inhibition of spore germination in race 4. A preliminary field experiment was then conducted in an orchard in Taitung County, Taiwan, and the area was divided into four sections, and one testing area and three control areas were randomly assigned. A re-dissolved 0.01% (v./v.) solution prepared from the essential oils and hydrosol of *B. pilosa* plants were irrigated into the bulk soil areas of 84 banana plantlets during secondary hardening, once a week beginning March 13, 2017. The incidence of Panama disease was investigated from August 28 to November 15, 2017. Disease incidence was just 16% in the testing area, compared to 53%, 51%, and 12% in the three control areas. A second investigation was carried out on four different orchards from March 20, 2018 to December 21, 2018. Incidence rates of Panama disease were 22.2% to 27.3% in the testing areas and 45.2% to 62.2% in the control areas. In-depth analysis of the antifungal compounds in *B. pilosa* essential oils was carried out with gas chromatography–mass spectrometry. Our results suggest a promising non-chemical approach for controlling the occurrence of Panama disease using *B. pilosa* essential oils.

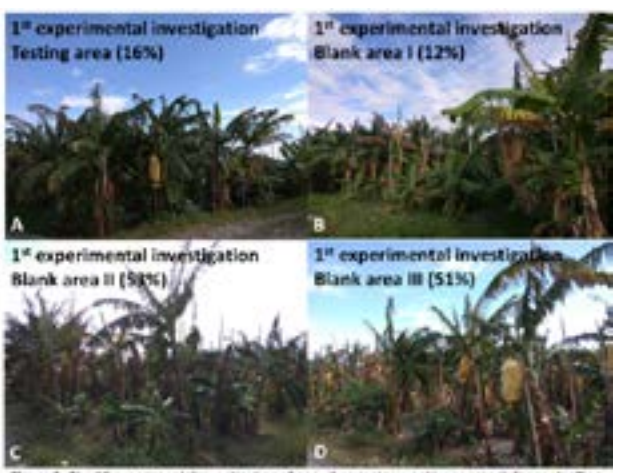

Figure 1: The 1st experimental investigation of non-chemical preventive approach for controlling the occurrence of Panama disease. Incidence of Panama disease was investigated during the period from August 28th to November 15th, 2017. The results showed 16% of disease incidence in the testing area (A) and 53%, 51% or 12% (B-D) in each blank area.

Recent Publications

1. Al-Reza SM, Rahman A, Ahmed Y, Kang SC (2010) Inhibition of plant pathogens in vitro and in vivo with essential oil and organic extracts of *Cestrum nocturnum* L. Pesticide Biochemistry and Physiology 96: 86-92.
2. Deba F, Xuan TD, Yasuda M, Tawata S (2008) Chemical composition and antioxidant, antibacterial and antifungal activities of the essential oils from *Bidens pilosa* Linn. var. Radiata. Food Control 19: 346-352.
3. MS, Ali S, Akhtar M, Singh KS (2012) Efficacy of plant extracts in plant disease management. Agricultural Science 3: 425-433.
4. Sefu G, Satheesh N, Berecha G (2015) Effect of essential oils treatment on anthracnose (*Colletotrichum gloeosporioides*) disease development, quality and shelf life of mango fruits (*Mangifera indica* L). American-Eurasian Journal of Agricultural & Environmental Sciences 15: 2160-2169.
5. Wu ZB, Chi FL, Tsay JS (2015) Development of non-pesticide cultivated technique using plant materials to control *Colletotrichum* spp. associate with anthracnose on coffee plants in Taiwan. Phytopathology 105: S4.151.

Biography

Zhong-Bin Wu is an assistant professor in Department of Horticulture and Landscape Architecture, National Taitung Jr. College, Taiwan. His current research programs focus on the (1) development of non-pesticide cultivation techniques by using plant materials to control plant disease in organic farming, (2) identification of newly crop diseases and (3) development of detection methods for disease diagnosis.

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