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# Characterisation of *Phytophthora capsici*, causal agent of phytophthora foot rot disease of *Piper nigrum* L. in Sarawak, Malaysia

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## ABSTRACT

*Phytophthora capsici* causes Phytophthora foot rot disease on *Piper nigrum*. The pathogen lacks comprehensive study in Sarawak, Malaysia. In this study, *P. capsici* was isolated and characterised morphologically and molecularly from ten farms across three divisions in Sarawak. The pathogenicity of the isolates was confirmed, and distinct colony growth patterns, sporangia morphologies, and radial growth rates were observed across different media. Torulose hyphae structures were consistently observed, and compatible mating types were present. Fifty-two isolates retrieved from this study were genotyped using five Inter Simple Sequence Repeats and three Random Amplified Microsatellites primers. The UPGMA tree showed a close relationship between populations. A higher diversity within populations (73%) than among populations (27%) was observed. This study provides the first baseline data on the diversity of *P. capsici* in Sarawak, offering insights for managing the disease's impact on pepper cultivation and the potential risk of increasing genetic diversity.

## ARTICLE HISTORY





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Black pepper; genetic diversity; ISSR; morphology; *Phytophthora capsici*; RAMS

## Introduction

Pepper (*Piper nigrum* L.) is a perennial climber vine belonging to the family of Piperaceae, which thrives under hot and humid conditions (Takooree et al. 2019). Its berries, the peppercorns, are widely cultivated

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worldwide (Newerli-Guz and Śmiechowska 2022). The crop has been reported to have originated from the tropical regions of Kerala, India (Krishnamoorthy and Parthasarathy 2009), where over 51 different pepper cultivars have been identified (Mathew et al. 2001). Meanwhile, in Sarawak, Malaysia, 10 *P. nigrum* cultivars have been described by Chen and Tawan (2020).

Malaysia was a leading country in pepper production and exportation, ranked fourth worldwide, utilising an average of 13,255 ha of land for pepper cultivation between 2001 and 2010 (Kandiannan et al. 2014). However, by 2020, Malaysia's ranking in peppercorn production and exports globally dropped to fifth place (Izmir 2020), corresponding to a decrease in the land area dedicated to pepper farming to 8022 ha in 2020 and further to 7754 ha in 2021 (Malaysian Pepper Board 2020). According to Entebang et al. (2020), the majority (98%) of pepper production in Malaysia is from Sarawak, and in 2017, pepper was mainly cultivated in three Divisions of Sarawak, *viz.* Sarikei, Betong, and Serian accounted for 61% of Sarawak's pepper production area. Despite the increasing global demand for pepper in the food and pharmaceutical industries (Yogesh and Mokshapathy 2013), pepper production in Sarawak has declined since the 1980s due to various factors, such as farmers' disinterest in pepper farming due to the decreasing pepper prices (Entebang et al. 2020), along with numerous challenges, such as pests and diseases (Paulus 2007), high production cost and weather conditions (Malaysian Pepper Board 2020).

A major threat to pepper cultivation is the *Phytophthora* foot rot disease, also referred to as "quick wilt" (Kueh 1990). This devastating affliction impacts all parts of the plant throughout its growth phases (Truong et al. 2010). In severe instances, an infected vine can perish within three weeks under favourable conditions, with the potential to spread to adjacent vines in a matter of months (Nguyen 2015). Initially identified in India by Anandaraj and Sarma (1995), *Phytophthora capsici* was recognised as the disease's causative agent. Similarly, in Sarawak, Farhana et al. (2013) identified *P. capsici* as responsible for the disease in local pepper vines. The pathogen has been reported to cause nearly 100% yield loss of pepper in the mid-1950s due to the *Phytophthora* foot rot epidemic in Sarawak (Holliday and Mowat 1963). While no outbreaks have been recorded, isolated disease cases continue to be reported. Between 2010 and 2011, disease incidence varied from 5% in Repok, Sarikei, to 75% in Ulu Sarikei, Sarikei, with various severity (Farhana et al. 2013). In 2019, Kong et al. (2022) observed an acute outbreak in Julau, Sarawak, where one farm lost 90% of its vines within three months. Given that smallholder farmers are the primary cultivators in Sarawak, such disease incidences can lead to significant economic distress.