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RESEARCH NOTE

Megaselia scalaris (Loew) (DIPTERA: PHORIDAE) INFESTING EDIBLE WILD MUSHROOM, *Boletus griseipurpureus*

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The genus *Megaselia* Rondani of the family Phoridae (Diptera) is the most numerous phorid species and distributed in every geographic region (Disney, 2008). One of the phorid species known as scuttle fly, *Megaselia scalaris* (Loew) is cosmopolitan and synanthropic species (Costa *et al*., 2007). The larvae of *M. scalaris* develop in various types of habitats, consuming a wide range of organic materials from plant and animal remains than any other insect known. Thus, the larvae is often described as detritivore, parasite, facultative parasite, and parasitoid (Tumrasvin *et al.,* 1997; Disney, 2008, Mongiardino Koch *et al*., 2013). As *M. scalaris* can occupied a wide range of habitat and has spectrum of feeding behaviour, this scuttle fly has been reported in many instances including in forencic cases (Varney & Noor, 2010), myasis in humans and animals (Disney, 2008; Ghavami & Djalilvand, 2015), as laboratory pest (Miller, 1979; Costa *et al*., 2007; Garris, 2014) and has been used in genetic, developmental and bioassay studies (Disney, 2008).

Among the species that *Megaselia* have been reported as pest of cultivated and non-cultivated mushroom, *M. halterata*, is the most common and widespread pest of cultivated mushroom (Civelek & Önder, 1997; Lewandowski *et al*., 2012) having infesting cultivated white button mushroom (*Agaricus bisporus*) (Erler and Polat, 2015) while *M. tamilnaduensis* infested oyster mushrooms (*Pleurotus* spp.) (Mohan *et al*., 1996). The fruiting bodies of *Termitomyces albuminosus* (non-cultivated mushroom) was attacked by *M. termitomycana* (Disney & Chou 1996), *Pulveroboletus ravenelii* by *M. pulveroboleti* (Disney & Chou, 1998) and *Rigidoporus microporus* by *M. sororbata* (Disney & Ševčík, 2011). In Japan, fruiting bodies of fungi from the genera *Russula* and *Gymnopilus* were reported to be infested by *M. donaldsonae*, *M. flava, M. gotoi*, *M. kanekoi*, *M. margaretae, M. nakayamai, M. salteri* and *M. stepheni* (Disney *et al.,* 2014). Based on reports by Disney (1994) and Ševčík (2001), only three species of *Megaselia*; *M. lata*, *M. flavicans*, *M. berndseni* (synonym: *M. pygmaeoides*) reported by Bruns (1984) have been recovered from *Boletus* mushrooms.

However, to our knowledge, there is no report on the infestation of *Megaselia* on mushroom in Malaysia. The present study reported the first record of *M. scalaris* infesting wild mushroom, *Boletus griseipurpureus* found in peat swamp forest in Bachok, Kelantan, Peninsular Malaysia.

The wild mushroom, *Boletus griseipurpureus* were collected from swamp forest or marshland, 7 m above mean sea level with latitude 05° 56' 00" and longitude 102° 25' 00" in the district of Bachok, Kelantan, Peninsular Malaysia. A total of 96 fruiting bodies were collected from the sampling sites during fruiting season from late June 2011 to end of September 2012 before the northeast monsoon commenced along the east coast of Peninsular Malaysia.

The *B. griseipurpureus* fruiting bodies harbouring the larvae were transferred into a 500 ml conical flask, covered with double layered of paper towel and secured by a rubber band. The larvae were reared to the adult stage in an incubator at 30°C. The adult flies were collected, mounted on microscopic slides and identified. Identification of the pest was performed based on taxonomic keys and descriptions of Disney (1994), Borror & White (1998) and Triplehorn *et al.* (2005) by using a digital camera (Olympus, Xcam-α) attached to a microscope (Olympus, Model BX41).

From 96 fruiting bodies collected, 54 samples (about 60%) were infested by the larvae that were found in the pore tube and the pileal context (Figures

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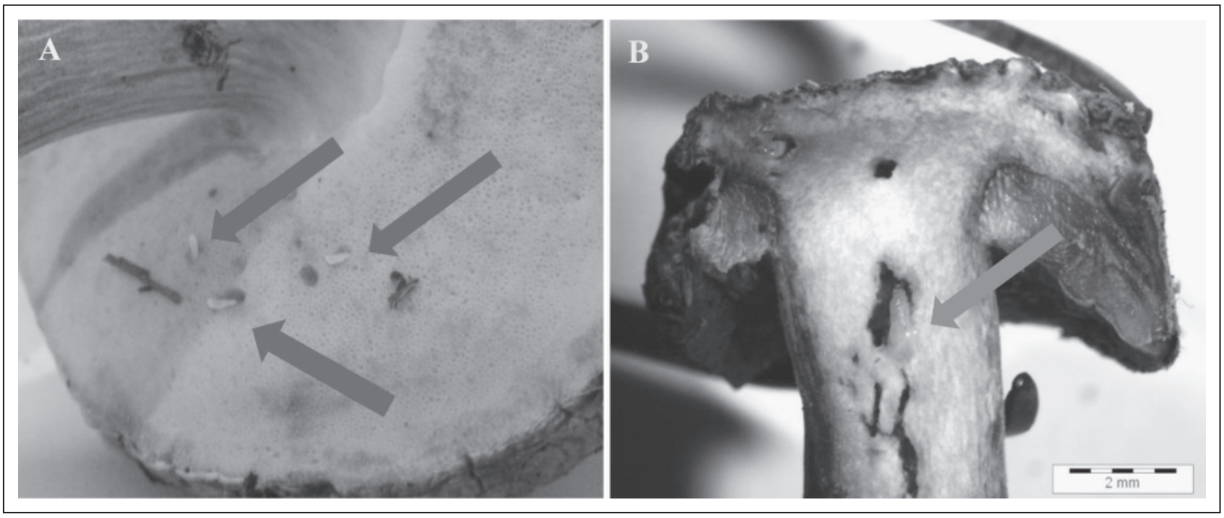

Fig. 1. Infestation by the insect larvae. (A) In the pore tube. (B) In the pileal context.

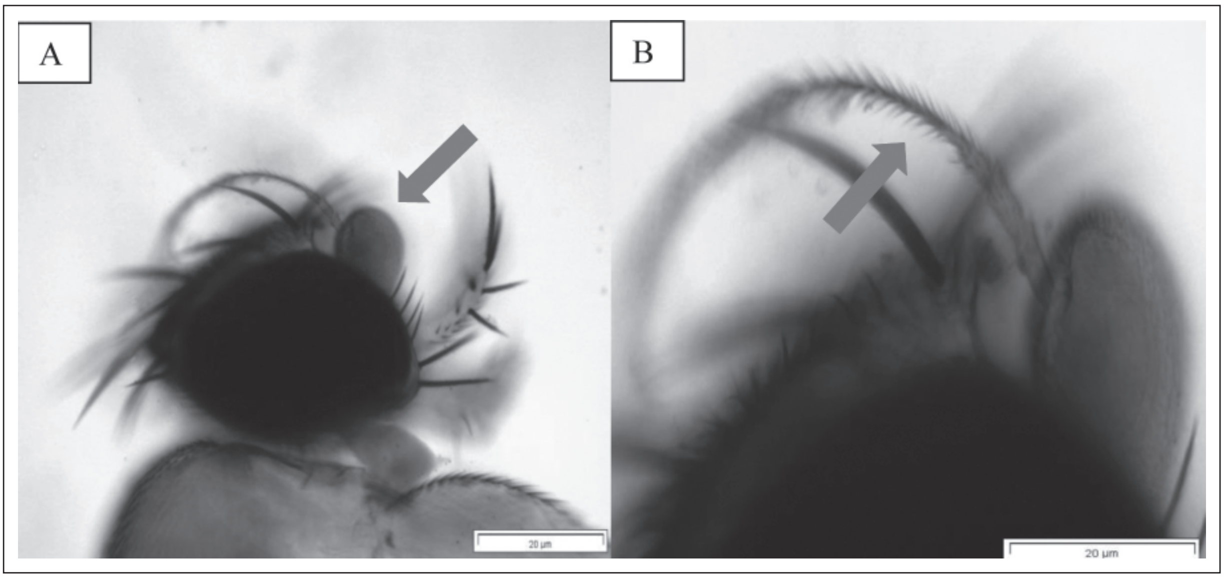

Fig. 2. Antennal structure of male *Megaselia scalaris.* (A) Globular third antennal segment. (B) Apical pseudo-arista.

1A and 1B). Some eggs embedding in the pores were also observed. After two weeks, three adult flies were collected from the rearing. The flies were identified as male *Megaselia scalaris* (Leow) (Diptera: Phoridae) (Figures 2A and 2B) and was confirmed by Dr. Brain V. Brown (Curator, Entomology Section, National History Museum of Los Angeles County, Los Angeles, USA).

Megaselia attacks a wide range of macrofungi such as *Auricularia* sp., *Pleurotus* sp., *Rigidoporus* sp. and *Termitomyces* sp. as they are attracted to putrid odors from the mushrooms (Diyes *et al.,* 2015). Yamashita *et al.* (2005) reported three species of scuttle fly, namely *M. flava, M. kanekoi* and *M. gotoi* feed on deadly and poisonous *Amanita ibotengutake*; and suggested that the edibility of *B. griseipurpureus* could not be drawn from the presence of *M. scalaris* larvae. Besides mushroom structure and size (Yamashita & Hijii, 2003), the infestation by *Megaselia* is also attributed to other factors, including host species (Smith *et al.,* 2006), type of food sources (Idris *et al.,* 2001), abundance of fungal resources (Takahashi *et al*., 2005) and ambient temperature (Barzegar *et al.,* 2011). It was believed that *B. griseipurpureus* has the potential to be the selective host for *M. scalaris* in peat swamp forest. Limiting fluid sugary meals in the swamp forest may in particular make the *M. scalaris* to choose *B. griseipurpureus* as a host species. According to Sukontason *et al.* (2006), *M. scalaris* access fluid meals primarily on sugar because it has sponging mouthparts and Kurunaweera *et al.* (2002) also found *M. scalaris* on flesh ripe banana, which contained high sugar level.

Mushrooms are high in protein, fiber, and carbohydrates (Cheung, 2010) suggesting that *M. scalaris* utilized protein sources from *B. griseipurpureus*. Protein concentration in *B. griseipurpureus* is 34% (Gbolagade *et al.*, 2006) while general crude protein of edible mushrooms range from 15-35% (Cheung, 2010). *Boletus griseipurpureus* with its large fruiting body could provide sufficient amount of protein source for larval development of *M. scalaris*. Corresponding to the current observation, *B. griseipurpureus* is associated with the same host tree and thus produce fruiting bodies at the same site annually in Thailand (Seehanan & Petcharat, 2008; Aung-Aud-Chariya *et al.,* 2012). The mushroom abundance and predictable fruiting bodies location might account for the infestation of *M. scalaris* in the peat swamp forests. Indeed, Diyes *et al.* (2015) mentioned *M. scalaris* preferred to lay their eggs on decaying plant matter (in this case *B. griseipurpureus* live on them). The fine structure of eggs (boat-shaped with gunwale-like palisade of flat platelets form) (Disney, 1994; Harrison & Cooper, 2003; Disney, 2008) fit well in the tubes indicating that the pileus of *B. griseipurpureus* provided an ideal breeding site for *M. scalaris*. Although no visible damage of the fruiting body was observed, the spores might fail to disperse as a consequence of the blockage by the embedded eggs. The decaying plant was greatly found in peat swamp forest do encourage the abundance of mushroom resources. Furthermore, *M. scalaris* larvae is depending on moist from the decaying plant material to survive (Sukontason *et al.,* 2006).

In conclusion, wild *B. griseipurpureus* can be the potential selective host for *M. scalaris* in peat swamp forests and reveals the possibility of *M. scalaris* infesting the edible wild mushroom, *B. griseipurpureus* in Malaysia.

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