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THE EFFECTS OF MOISTURE ON OVIPOSITIONAL RESPONSES AND LARVAL ECLOSION OF *AEDES ALBOPICTUS*

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ABSTRACT. Moisture plays a major role in the dynamics of mosquito populations, especially those breeding in container habitats. Despite this importance, the role of moisture conditions as they affect oviposition and egg development in *Aedes* vectors remains largely unexplored. We investigated the effect of exposing gravid female *Aedes albopictus* mosquitoes and their eggs to different moisture levels (MLs) for various periods on oviposition and hatching. Overall, high-moisture substrates (HMSs; 66% and 72%) provided better environments for egg laying. The timing of initial egg laying was far longer at the lowest substrate moisture level (LSML, 25% and 41.2%) than at HMSs. The numbers of eggs laid were much lower in the drier environments. At LSMLs, gravid females retained increasing numbers of mature eggs until death, and egg retention decreased gradually with increasing ML. The HMSs also provided better environments for larval eclosion. The numbers of eggs hatched were lower at the LSML than the HSML environment. No egg hatching occurred after 1 h exposure to moisture. However, egg hatching occurred by installment, with spontaneous hatching (SH) increasing gradually with increasing ML. High-moisture conditions combined with long exposure (30 h and 48 h) favored SH. These results suggest that *Ae. albopictus* females can respond to better moisture conditions for increased success of embryonation and larval eclosion. This information may be useful in the colonization of floodwater *Aedes* species.

KEY WORDS *Aedes albopictus*, moisture, oviposition, embryonation, egg hatching

INTRODUCTION

The ability of ovipositing females to distinguish among oviposition sites is important for many species, because microhabitat quality is often the major determinant of larval survival (O'Malley 1990). The ovipositional behavior of mosquitoes is mediated by many cues associated with the aquatic habitat where the larvae develop (Isoe and Millar 1996). In almost all Aedine species, females deposit eggs preferentially on moist substrates at sites where there has been standing water previously and where flooding will likely occur again (Hill et al. 2006). At such waterline sites, eggs are exposed to an array of moisture conditions during the period from deposition to larval eclosion. Freshly oviposited eggs must retain sufficient moisture for successful embryonation (Strickman 1980).

Originating in Asia, *Aedes albopictus* (Skuse) has been incriminated as a vector of dengue (Malavige et al. 2004) and chikungunya (Delatte et al. 2009) viruses and proven to be a particularly invasive species (Hawley 1988). *Aedes albopictus* has become well established in most countries around the world because of its ovipositional behavior (Reiter 1998). Therefore, simultaneous introduction of both dengue viruses and their vectors is still possible in many parts of the world, as the eggs of this mosquito can transmit viruses (Rosen 1987). Once established, *Ae. albopictus* uses various aquatic habitats, including phytotelmata and artificial containers. Larvae have been collected from a wide range of containers, including discarded tins, plastic containers, car parts, brick holes, dead leaves on the ground, tree holes, and rock pools (Hawley 1988, Sota et al. 1992, Simard et al. 2005). All of these breeding sites share the same general characteristic in that they are areas of standing water replenished by rainfall.

Invasion by *Ae. albopictus* is spreading at increasing rates both worldwide and within countries. In Malaysia, the larvae of this species can be found in most containers within homes (unpublished data). Malaysia has a year-round equatorial climate and high levels of both sunshine and rainfall (Ahmad et al. 2006), and thus the breeding sites may be subject to constant overflow and drying events that trigger large variations in moisture conditions within the habitats. In the present study we report the effects of moisture levels (MLs) on oviposition and egg hatching success in the Malaysian strain of *Ae. albopictus* with the hypothesis that females can assess the quality of habitats with respect to suitability for completion of embryonation and success of their offspring.

MATERIALS AND METHODS

Rearing of mosquitoes

The *Ae. albopictus* colony used in this study was derived from pupae collected from different

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