

## ABSTRACT

Malaria continues to be a world-wide human health problem. Insecticide resistance challenge efficacy and sustainability of malaria control programs and therefore call for sustainable malaria control strategies. Environmental factors affect mosquito development and survival and should be considered when designing these strategies. However, there is limited knowledge on mosquito ecology, especially on interactions with predator such as dragonfly *Pantala flavescens* nymph and parasite such as *Beauveria bassiana* fungus across stages. This study focused on investigating additive effects of *P. flavescens* and *B. bassiana* on *Anopheles gambiae*. Specific objectives were to determine: predation efficacy of *P. flavescens* nymph against *A. gambiae* larvae; development rate of *A. gambiae* larvae reared in presence of varying densities of *P. flavescens* nymphs; efficacy of *B. bassiana* against *A. gambiae* larvae; and survival of adult mosquitoes exposed to fungus after predator and/or parasite pre-exposure at larval stage. All experiments consisted of survival bioassays quantified either as pupation day or dead larvae and adults. Mosquito eggs were obtained from The Center for Global Health Research, KEMRI; dragonfly nymphs from Ahero Irrigation Scheme, Kenya; and *B. bassiana* spores (IMI- 391510) provided by IN2CARE®, The Netherlands. Predation efficacy investigation involved four replicates of 30 larvae exposed to 1 dragonfly nymph. Development rate investigation involved exposing four replicates of 30 larvae to varying numbers (0-4) of constrained dragonfly nymphs. Four replicates of 30 larvae were exposed to varying spore concentration (0-12 mg) to determine fungal efficacy. Three replicates of 30 adults pre-exposed to predator and/or fungus were exposed to same fungus for adult survival. Predation efficacy test showed significant difference in mean number of dead larvae ( $Z=-12.667$ ,  $P<0.001$ ). Development rate test showed significant difference ( $P<0.001$ ) for groups exposed to 1 or 2 nymphs but group exposed to 4 nymphs ( $P=0.227$ ) was not significantly different. Fungal efficacy test showed that larvae exposed to 3, 6 and 12 mg of fungus had HR, 2.0, 2.5 and 3.5, respectively. In adult survival test, adults not pre-exposed to any factor, those pre-exposed to predator, parasite or both predator and parasite had HR of 45.8, 67.4, 50.9 and 112.0, respectively. It is clear that single and additive effects of the predator and/or parasite affect mosquito development and survival, because it affects mosquito physiology and immunity. However, field studies should be done to prove consistency in the field. The knowledge can then be employed by Ministry of Health for malaria control in areas with *P. flavescens*.