FRESHWATER CRUSTACEANS AS BIOLOGICAL CONTROL AGENTS OF MOSQUITO LARVAE IN EGYPT

By

MOHAMMED NASR RAGAB HEIKAL
B. Sc. Agric. Sci. (Pesticides), Fac. Agric., Cairo Univ., Egypt, 2011

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APPROVAL SHEET

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SUPERVISION SHEET

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ABSTRACT

This work is dealing with biological control of mosquito larvae. We first started with testing the efficiency of The Louisiana red swamp crayfish, *Procambarus clarkii* (Gerard, 1852) accidently introduced from USA to Egypt and the cyclopoid copepod, *Mesocyclops* sp. isolated from Beni Swaif and Kaliobia governorates, Egypt both as predators of *Culex quinquefasciatus* mosquito larvae. Data for *Procambarus clarkii* have shown that 4th instar mosquito larvae were the most consumed stage compared to other mosquito instars. Due to the need for animal proteins required in the growth and development of eggs, gravid crayfish females consumed more mosquito larvae than males. Mosquito population densities had positive significant effect on predation rate, with higher mosquito densities, the animal feed on more mosquito larvae. When a mixed diet of fresh vegetables (lettuce) and mosquito larvae were introduced to the crayfish, it depended more on mosquito predation as a source of animal proteins than vegetal food. Data for the cyclopoid copepod have shown that, when 5, 10 and 50 mosquito larvae were used as preys of one female copepod, predation rate was found to be 4.7, 9.1and 11.7 after one day post prey/predator exposure respectively. Predation rate of both egg carrying (ovigerous) and already post hatched females (non-ovigerous) of the copepod was compared for 3 days, with a predation rate of 23.4, 20, and 16.8% in the first, second, and third days respectively post exposure of the preys to the ovigerus copepod females with a total predation rate of 60.2% after the 3rd day of exposure. When copepod females were kept after egg hatching (non-ovigerous) and exposed to mosquito larvae, predation rate has reached 23.4, 18.2, and 17.2% in the first, second and third days respectively with a total of 58.8% at the end of the 3rd day. Four types of water was used to test preference of adult *Culex quinquefasciatus* gravid females to lay their eggs, i) copepod natural water brought from the fields where copepods are commonly existed and having 50 copepods, ii) tap water, iii) distilled water, and iv) mosquito culture water after pupal emergence. Data have shown that copepod natural (field) water with 50 copepods contained the least number of laid egg rafts and mosquito larvae (1.2 egg rafts and 91 larvae), followed by tap water (5.4 egg rafts and 459 larvae), then distilled water (5.6 egg rafts and 537.6 larvae), finally mosquito culture water had the highest numbers of 7.2 egg rafts and 651.4 mosquito larvae throughout a week post female mosquito blood feeding with significant differences between the 3 water types and the copepod natural water. The present study showed that *P. clarkii* and *Mesocyclops* sp can be used in mosquito management programs as safe biological control agents of mosquito larvae.
Key words: Biological control; Crustaceans, Cyclopoid Copepod(s); *Culex quinquefasciatus*; Invasive species; *Mesocyclops* sp., Mosquito larvae; Mosquito predators; Predatory crustaceans; Red swamp crayfish.

DEDICATION

I dedicate this work to my mother and father for all their help, patience, guidance, emotional and financial support, they lovely offered since my birthday. This dedication is also extended to my brothers, my wife and children for all the support they hearty offered and motivations throughout the period of my post graduate studies.

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CONTENTS

INTRODUCTION

Mosquitoes are blood-sucking insects belong to order Diptera, family Culicidae. About 3000 species of mosquitoes have been described throughout the world. These species belong to 28 different genera (Gaffigan *et al*., 2015). Mosquitoes can be annoying and causing serious problems to both humans and animals. They interfere with work and spoil hours of free time. Their attacks on farm animals can cause loss of weight and decreased milk production. Mosquitoes are the most successful transmitters (vectors) of diseases among kingdom Animalia. They are the top killers of humans around the globe.

Female mosquitoes feed on human blood and use the nutrients in blood to produce and nourish their eggs. During blood feeding they transmit diseases to either humans or animals. More than 700 million people are affected by one or more of the mosquito borne diseases resulting in over one million deaths every year. Mosquitoes are vectors of more than 70 infectious disease including Malaria, Filariasis, Rift Valley Fever, Yellow Fever, Dengue, Chikungunya, Zika, and West Nile viruses. The mosquito used in this work is *Culex quinquefasciatus* Say, 1823, it is the vector of the filaria *Wuchereria bancrofti*, avian malaria, and arboviruses including St. Louis encephalitis virus, Western equine encephalitis virus, Zika virus and West Nile virus (Schneider *et al*., 2006).