Malaria
Vector Control

Egypt

Comparative efficacy studies using alternative pesticides (biopesticides, insect growth regulator and ivermectin) on anopheline-malaria mosquitoes in Egypt

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Principal Investigator
Dr Salwa M Abd-Allah
Central Laboratory of Pesticides
Agricultural Research Centre
Alexandria, Egypt

Abstract

The aim of this study was to assess the effectiveness and safety of different pesticides for use in areas at risk of malaria. A larval survey was carried out in Fayoum, Egypt to determine the larval density. Water and sediment analyses were performed on samples from mosquito breeding sites. The potency of different pesticides, including biopesticides, insect growth regulators and ivermectin, and their mixtures, on larvae was assessed in the laboratory as well as in the field. Their efficacy was expressed as the mean percentage reduction of larvae in treated versus control pools.

Results All the pesticides tested exhibited significant larval reduction of the malaria vector. Recently introduced ivermectin, triflumuron and neem (alone or in combinations) proved to be equally efficacious and long-lasting.

Conclusion The study emphasized a combined water management and neem coating strategy as an environmentally safe method that could be implemented as a control measure for rice-field mosquitoes. Neem was recommended as a measure for achieving high control of the malaria vector in endemic regions.

Activities achieved within the framework of the study

The research team consisted of 8 members who worked in close collaboration with the Sinnuris and Fayoum Malaria Health Units. Group discussions were held in schools, mosques, and with officials in the Ministry of Irrigation and Water Resources and the Ministry of Health to increase awareness and to solicit the contribution of individulas and authorities in the control strategy conducted in their community.

Background

Fayoum Governorate is considered the sole focus of malaria in Egypt. *P. falciparum* is the predominant species recorded, since *P. vivax* was eradicated in 1996. The aim of the study was to evaluate the efficacy of new and frequently used alternative pesticides such as *Bacillus thuringiensis israelensis* and *Bacillus sphaericus* formulations under laboratory and field conditions, as a means for developing an efficacious and integrated vector control method.

Materials and methods

Study area

Fayoum is a large agricultural oasis at an altitude of 20 m below sea level. Selection of the study areas in Sinnuris and Fayoum districts was based on the frequency of malaria cases and the proximity of breeding sites to residential areas. The permanent stagnant water sites were randomly selected to represent all parts in each district. Information pertaining to the land characteristics and breeding places was recorded.

Monthly larval survey A monthly larval survey was carried out, and sites with high larval density were chosen as fixed catching stations. Larvae were collected using the dipping method [1] and transported to the laboratory to be counted and identified. Ten dips were

Conclusions and implications of the study

- All pesticides tested exhibited significant larval reduction of the malaria vector with long-lasting effect (up to 30 days post-treatment).
- A combined water management and neem coating strategy could be implemented as a control measure for rice-field mosquitoes (*Anopheles pharoensis*), to minimize the hazards of possible malarial transmission in the future.
- The high frequency of the malaria vector *A. sergenti* could be attributed to the hydraulic situation of subsoil water, hindering the spraying of swamps with weeds and wild plants, and the suitable meteorological conditions. Agricultural and other development projects and land excavation have resulted in development of new breeding sites, which may lead to increased transmission in the future. The utmost need for vector control measures with the studied pesticides, even in low-risk areas, is emphasized.

taken from each location, and the relative density of mosquitoes as a larval index (number of larvae/dip) was calculated monthly.

Rice-land survey (July-October 1999) Sampling along the rice fields was carried out using the standard dipper. Collected anopheline larvae were counted and identified.

Laboratory tests:

Water samples Water samples were randomly collected from different locations in the breeding sites and were categorized according to larval intenstity (high, moderate or negative). The chemical and physical properties of the water, and the presence of pesticide residues were determined [2].

Sediment samples Sediment samples were collected from the upper layer of the pool bottom and analysed.

Laboratory experiments Laboratory experiments included the assessment of the potency of different alternative pesticides and their mixtures on the larvae.

Field trials Field trials were conducted to assess the optimum effective doses of the pesticides in the field, whereby pre-weighed amounts of different formulations and their mixtures were sprayed onto the surface of ponds as treatment measures. They were then evaluated for their efficacy as the mean percentage reduction of larvae in treated versus control pools.

Standard statistical tests were performed. Bioassays were analysed using probit analysis that computes the LC_{50} and LC_{95} and chi-square goodness of fit for comparison.

Main study findings

A. sergenti was the most frequent species (79%), followed by *A. multicolor* (20.8%), of the collected larvae. All tested alternative pesticides exhibited significant larval reduction of the malaria vector (*A. sergenti*) with long-lasting efficacy (up to 30 days post treatment).

There was no significant difference in the percentage larva reduction between ivermectin, *Bacillus thuringiensis* (VectoBac 12AS, VectoBac G), lufenuron (Match) and neem 24 hours post treatment, while *Bacillus sphaericus* (ABG-6490) was the least effective. The corncob formulation (VectoBac G) proved to be more efficacious and long-lasting than the fluid concentrate (VectoBac 12AS). Recently introduced ivermectin, triflumuron and neem (alone or in combinations) proved to be equally efficacious and long-lasting.

The combinations used in this study successfully reduced the larval population density to less than 1.00 larvae/dip (91%-100% larval reduction) up to 30 days post treatment, with LC_{25} TFM-LC_{25} DLM combinations as the most efficacious of all.

A combinated water management and neem-coating strategy is an environmentally safe method and was acceptable to farmers due to the increase in the yield of cultivated crops. Therefore, it could be implemented as a control measure for rice-field mosquitoes (*A. pharoensis*) to minimize the hazards of possible malarial transmission in the future.

Furthermore, owing to its protective effect against adult mosquito biting, it is recommended to impregnate bednets and clothes with neem in order to achieve high control resolution of the malaria vector in highly endemic regions throughout the world.

This study finally suggested that an information system built on the malaria vector control programme could have a strong impact on communities, incorporating health education, water provision, sanitation and the establishment of primary health care.

References

[1] Manual on practical entomology in malaria. Part II: methods and techniques. Geneva, World Health Organization, 1975 (available on request from Division of Malaria and Other Parasitic Diseases, World Health Organization, 1211 Geneva, Switzerland).

[2] Valerio et al. Separation of pesticides, related compounds, polychlorobiphenyls and other pollutants into four groups by silica gel microcolum chromatography (Application to water surface analysis). *Pest* Sci, 1991, 31:209-220.