

Susceptibility of *Culiseta longiareolata* to insecticides in West Azerbaijan province, northwestern Iran

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Abstract

Mosquitoes are involved in the transmission of a wide range of diseases and among them, *Culiseta longiareolata*, acts as a vector of avian malaria, tularemia and several arboviruses like West Nile fever. The current study was conducted to determine the susceptibility of *C. longiareolata* against deltamethrin 0.05% (pyrethroids), fenitrothion 1.00% (organophosphate) and bendiocarb 0.10% (carbamate). Mosquitoes were collected from different parts of Urmia county, the capital of West Azerbaijan. In the current study, 443 empty 3 – 5 days old adult female *C. longiareolata* were used for susceptibility tests. The susceptibility status of *C. longiareolata* was determined using WHO's recommended procedure. The results indicated higher mortality rates of *Culiseta longiareolata* against studied insecticides. *Culiseta longiareolata*, was resistant to all studied insecticides (deltamethrin, mortality rate: 62.50%, fenitrothion, mortality rate: 35.96% and bendiocarb, mortality rate: 20.16%). The current study represents the first report of susceptibility status of *C. longiareolata* to fenitrothion and bendiocarb in Iran. Considering the climatic diversity and geographical conditions of northwestern Iran, reports of resistance of other mosquitoes' of this region, the susceptibility status of medically and veterinary important mosquitoes should be given serious attention.

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Introduction

Mosquitoes are involved in the transmission of a wide range of diseases. *Culiseta longiareolata*, is one of important mosquito species distributed throughout the broad geographical range of Asia, Europe and Africa.¹ This specie acts as a vector of avian malaria, tularemia and several arboviruses like West Nile fever.²

The use of insecticides is an essential component in the quest for the global control of vectors.³ The frequent use of pesticides for consecutive years to control pest and disease vectors has led to the emergence of resistance in some species.⁴ Despite medical importance of *C. longiareolata* and its role in transmitting arboviral diseases, few studies have been conducted on its susceptibility against current insecticides.⁵⁻⁷ Recently, this species was reported to be susceptible to pyrethroid and carbamate insecticides in East Azerbaijan province.⁷ Also, *C. longiareolata* in northwestern Iran, along with other

species such as *Culex theileri* and *Culex pipiens*, were found resistant to dichlorodiphenyltrichloroethane (DDT) 4.00%, lambda-cyhalothrin 0.05%, and propoxur 0.10% whereas the mentioned species were found tolerant to deltamethrin 0.05% and malathion 5.00%.⁵ In southeastern Iran, *C. longiareolata* was susceptible to deltamethrin, whereas tolerant to DDT 4.00%, malathion 5.00%, propoxur 0.10%, lambda-cyhalothrin 0.05%, and cyfluthrin 0.15%.⁶

Due to the important situation of West Azerbaijan Province, bordering with four countries, the regional history of mosquito-borne diseases, lack of information on the susceptibility status of *C. longiareolata*, its widespread presence in different parts of the world, including in northwestern Iran,⁸⁻¹² the current study was conducted to determine the susceptibility status of *C. longiareolata* against deltamethrin: 0.05% (pyrethroids), fenitrothion 1.00% (organophosphate) and bendiocarb 0.10% (carbamate).

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Materials and Methods

Study area, sample collection and species identification. Mosquitoes were collected from different parts of Urmia county, the capital of West Azerbaijan (Fig. 1). Different habitats were examined during May – October 2019 for larvae collection using the standard dipping method¹³ in three locations (Nazloo: 37.651213, 44.983285, Ghahramanloo: 37.659869, 45.207550, and Moallem: 37.546660, 45.033280). The collected larvae were allowed to develop into adults. All adult samples were identified using standard morphological keys.¹⁴

Adult susceptibility test. In the current study, 433 sugar-fed 3-5 days old adult female samples of *C. longiareolata* were collected from different parts of Urmia county. Among collected samples, 85 specimens were used as control groups (three replicates of susceptibility tests), and 348 were divided into three groups (average of 116 for each group) with each group used for susceptibility tests against one of the studied insecticides (deltamethrin: 0.05%, fenitrothion 1.00% and bendiocarb 0.10%). Each of the insecticides was evaluated at least four times.¹⁵



Fig. 1. Location of West Azerbaijan province and Urmia county and sampling locations, 1: Nazloo, 2: Ghahramanloo, and 3: Moallem; (Original basic map has been prepared from d-maps.com).

Statistical analysis. The mortality rate was measured 24 hr after exposure, as the proportion of the individuals who died after one hour of exposure. The findings of the bioassay were determined in compliance with WHO.¹⁵ Those with $\geq 98.00\%$ overall mortality were considered susceptible, those with $< 98.00\%$ mortality but $\geq 90.00\%$ mortality were considered potentially resistant, and those with $< 90.00\%$ mortality were strongly suspected of being resistant.¹⁵

Results

The results of the experiments shown in Table 1 suggest a higher mortality rate against the examined insecticides. Considering WHO criteria,¹⁵ *C. longiareolata*, was resistant to all studied insecticides (deltamethrin, mortality rate: 62.50%, fenitrothion, mortality rate: 35.96%, and bendiocarb, mortality rate: 20.16%).

Discussion

The current study represents the first report of susceptibility status of *C. longiareolata* to fenitrothion and bendiocarb in Iran. In contrast, the susceptibility status of this species to deltamethrin has been reported previously in three studies.⁵

In the present study, *C. longiareolata* was resistant to three insecticides (deltamethrin, fenitrothion, and bendiocarb), and these results are not consistent with the previous study in East Azerbaijan province, where this species was reported susceptible to pyrethroid and carbamate insecticides.⁷

Also, the stated tolerance of *C. longiareolata*, to deltamethrin 0.05%,⁵ has been changed to resistance to this insecticide in current study.

Despite the geographic proximity of the studied areas in the above studies to the place of the present study, the difference in the results can be due to the history of insecticide use in agriculture and exposure of mosquitoes to these pesticides.¹⁶ In contrast, in a geographically distant region (south-east of Iran), *C. longiareolata* was susceptible to deltamethrin,⁶ whereas, in the current study, the resistance of this species to deltamethrin was determined.

Considering the increasing problems caused by the mosquitoes and mosquito-borne diseases,^{17,18} the results of studies related to the evaluation of the susceptibility

Table 1. The susceptibility status of adult *Culiseta longiareolata* against deltamethrin, fenitrothion and bendiocarb, collected from Urmia county, northwestern Iran, 2019.

Groups	Insecticide (Discriminating concentration)	Replicates	No. of mosquito tested	No. of mosquitoes dead after 24 hr exposure	Mortality (%)
Pyrethroid	Deltamethrin (0.05%)	4	115	75	65.20
Organophosphate	Fenitrothion (1.00%)	4	114	41	35.96
Carbamate	Bendiocarb (0.10%)	4	119	24	20.16
Control	Control	3	85	0	0.00

status of vectors to insecticides should be given serious attention by the health and disease control departments.

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Conflict of interest

The authors declare that they have no conflict interests.

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