

RESISTANCE OF *CULICIDAE* TO SYNTHETIC INSECTICIDES

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Introduction

The resistance of *Culicidae* to synthetic insecticides: DDT, Dieldrin and Malathion has been investigated in the region of Pančevački Rit. This territory comprises a surface of 32,000 hectares 2000 of which are permanent and temporary pools, trenches and canals, especially suitable for the development and investigation of all *Culicidae* in general. From 1947 to 1972 Pancevacki Rit was treated with DDT preparations, applying residual spraying against *Anopheles*, and manual and air-spraying against molestants. During the malaria eradication campaign, especially in the attack phase (1960-1963), all households in the region were treated with 2% DDT emulsion. From 1972 onwards Malathion replaced DDT in the control of mosquitoes. Besides that, the people themselves use various kinds of insecticides in the form of sprays.

Anopheles maculipennis Meig. complex has been studied in detail and analysed from faunistic aspects [1-3], while species of the genus *Culex* and *Aedes* are under investigation now. Simultaneously with faunistic treatment, resistance has been studied.

Material and methods

Resistance has been studied in the species *A. maculipennis* Meig. complex, mainly in the variety *messeae* (94-97%), and the species: *Aedes vexans*, *Aedes sticticus* and *Aedes caspius*. The mosquitoes were collected from the same place, in a control shed near the large, permanent pool, suitable for collecting and permanently densely inhabited by *Culicidae*, which were caught engorged and approximately at the same time (June-July). In this way the total continuity in the study of resistance has been preserved as regards place, time and character of population, which is important for the total value of results. Resistance was studied according

to the methods and material recommended by WHO. The following concentrations of insecticide impregnated papers were used: DDT 0,125, 0,25, 0,5, 1,0, 2,0 and 4,0%; Dieldrin 0,05%, 0,1, 0,2, 0,4, 0,8 and 1,6%; and Malathion 0,2, 0,4, 0,8, 1,6 and 3,2%.

Results and discussion

Resistance to DDT was investigated on the species *A. maculipennis* Meig. variety *messeae* (94-97%). The WHO recommendations were strictly followed, the only exception being the length of exposure, because of the large number of insects which survived and especially on lower concentrations of insecticides. This phenomenon was observed in particular in the attack phase of malaria eradication. The compulsory residual spraying being stopped, the results expressed in terms of LD₅₀ and LD₉₀ values were fairly uniform until 1970. In 1970 the values increased. The reason for this increase could be sought in the more wide spread use of Neosol 6, which was applied because of its longer residual effect, in the control of various species of molestants, as well as mosquitoes which populations were on the increase. The results of investigations are presented in Table 1.

TABLE 1

Susceptibility tests with *A. maculipennis* Meig. complex using DDT-impregnated papers (1960-1970)

Years and months	Exposition 60 minutes				Exposition 90 minutes			Exposition 120 minutes		
	Percent of DDT	No. tested	LD ₅₀ [%]	LD ₉₀ [%]	No. tested	LD ₅₀ [%]	LD ₉₀ [%]	No. tested	LD ₅₀ [%]	LD ₉₀ [%]
1960 17-30.6	0.25-4.0	1405	2.4	> 4	—	—	—	896	1.4	3.2
1962 11.7-27.7	0.25-4.0	—	—	—	—	—	—	4043	1.2	3.1
1963 17.6-6.7	0.25-4.0	3503	1.3	3.5	—	—	—	—	—	—
1965 15.6-30.6	0.125-4.0	2357	1.4	3.6	—	—	—	—	—	—
1966 20.6-29.6	0.125-4.0	—	—	—	3100	0.9	2.7	—	—	—
1967 10.7-22.7	0.125-4.0	1050	1.4	3.5	2268	1.3	2.7	—	—	—
1969 23.6-2.7	0.25-4.0	—	—	—	1846	1.6	3.5	—	—	—
1970 13.7-28.7	0.25-4.0	—	—	—	2978	1.7	> 4	—	—	—

In the regions where the variety *messeae* was dominant, in spite of the treatment with DDT preparations, a higher percentage of mosquitoes could always be found, so that we had to investigate the sensibility of *Anopheles* to another insecticide, which could replace DDT if resistant strains appear. For this purpose we chose Dieldrin. The variety *messeae*, which was tolerant to DDT, proved to be susceptible to Dieldrin, as can be seen from Table 2.

TABLE 2

Susceptibility tests with *A. maculipennis* Meig. complex using Dieldrin-impregnated papers (1961)

Year and months	Dieldrin [%]	No. tested	LD ₅₀ [%]	LD ₉₀ [%]
1961 16.6-20.7	0.05-1.6	5765	0.15	0.25

Since 1972 DDT has been replaced by Malathion in campaigns for the control of insects in general, and also *Culicidae*. Susceptibility to Malathion was investigated on the following species: *Aë. vexans* (61,0%), *Aë. sticticus* (34,0%), *Aë. caspius* (4,8%) and the variety *A. maculipennis messeae* (97%).

The susceptibility test with *A. maculipennis* to Malathion was carried out in 1972 and 1974. The LD₅₀ and LD₉₀ values with one hour exposure are presented in Table 3.

TABLE 3

Susceptibility tests with *A. maculipennis* Meig. complex using Malathion-impregnated Papers (1972-1974)

Years and month	Malathion [%]	No. tested	LD ₅₀ [%]	LD ₉₀ [%]
1972 5.7-20.7	0.4-6.4	2067	1.0	1.7
1974 2.7-25.7	0.2-6.4	1286	0.9	1.6

During the preliminary susceptibility test in the mentioned species of the genus *Aedes* (though females were fed), the exposure of one hour was too long for the species susceptible to Malathion. Mortality was too high even on the lowest concentrations, so that in further work we had to cut exposure to 30 minutes. The results of these investigations are given in Table 4.

TABLE 4

Susceptibility tests with *Aë. vexans*, *sticticus* and *Aë. caspius* using Malathion-impregnated papers (1974)

Year and Month	Malathion [%]	No. tested	LD ₅₀ [%]	LD ₉₀ [%]
1974 2.7-25.7	0.2-6.4	1506	0.4	1.4

Conclusion

1. According to susceptibility or resistance tests, the variety *A. maculipennis* from Pančevački Rit was fairly tolerant to DDT impregnated papers, which was observed more in the years when the region was systematically treated with 2% DDT emulsion or Neosol 6, while it was very susceptible to Dieldrin and Malathion.

2. The species of the genus *Aëdes*: *Aë. vexans*, *Aë. sticticus* and *Aë. caspius* from the locality of Pančevački Rit were very susceptible to Malathion-impregnated papers, so that this insecticide can be used for their control.

3. The LD₅₀ and LD₉₀ values were shown to be directly dependent on the length of exposure.

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BADANIA NAD OPORNOŚCIĄ KOMARÓW NA DZIAŁANIE SYNTETYCZNYCH INSEKTYCYDÓW

A. SITAR

Pančevački Rit jest obszarem bardzo dogodnym dla rozwoju i utrzymywania się różnych gatunków *Culicidae*. Przeważa tu kompleks *Anopheles maculipennis* Meigen, który poddano dokładnemu badaniu w czasie akcji zwalczania malarii. Repre-

zestawiany był głównie (94-97%) *A. maculipennis messeae*, przeto z nim wiążą się testy na działanie insektycydu. Obszar dezynsekowano preparatem DDT i badano wrażliwość komarów w testach z użyciem bibuły nasyconej jednym z insektycydów: DDT, Dieldrin bądź Malathion. Analogicznie badano wrażliwość *Aedes* (*Aë. vexans*, *Aë. sticticus*, *Aë. caspius*) za pomocą malationu, gdyż zwalcza się je tym właśnie insektycydem. Oporność badano metodami WHO. Uwzględniając uzyskane wskaźniki LD_{50} i LD_{90} oraz gęstość populacji komarów na obszarach gdzie przeprowadzono dezynsekcję autorka wnioskuje, że populacja *A. maculipennis messeae* oscylowały na pograniczu wrażliwości i oporności na DDT, wykazując wrażliwość na dieldrynę i malation. Wyniki przeprowadzonego testu u *Culicidae* zależą w znacznym stopniu od czasu ekspozycji na działanie insektycydu.