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A CASE OF DIELDRIN TOLERANCE IN A. LABRANCHIAE FALL IN MOROCCO

by

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In 1959, during our work in Morocco as a short term consultant to WHO, we carried out a certain number of susceptibility tests on A. labranchiae.¹

The physiological susceptibility of A. labranchiae to DDT in Morocco is completely normal: 22 susceptibility tests carried out in five different regions never gave a LC_{50} of more than 1.1%; the LC_{100} was always less than 4% and sometimes even less than 2%. This mosquito appears to be particularly irritable in the presence of DDT and it may therefore be supposed that some behaviouristic avoidance already exists or is developing (Sacca, 1960).

Whereas DDT (wetable powder) has been used for several years in Morocco (Houel and Donadille 1953; Houel 1954) in the anti-anopheles campaign which has been conducted in some of the malarious zones of the country, dieldrin has only been used for this purpose in one case, over a very small area and during one season only. We were therefore surprised, when carrying out susceptibility tests on adult mosquitos, to find that there was a marked tolerance of dieldrin.

Experiments

Eleven susceptibility tests were effected with dieldrin. They can be divided into two groups as follows:

Five tests were first of all performed on a total of 810 mosquitos in four different localities: Sidi-Yahia (Rabat), Sidi Bettache (Rabat), Ain-Atrouss (Meknès)

¹ This work was made possible by the members of the WHO team and the personnel of the Institute of Hygiene and of the Antimalaria Service, and we take this opportunity to thank them very warmly.

and Rommani (Rabat). These tests provided preliminary information and in at least two localities (Sidi-Yahia and Rommani) an unexpected degree of tolerance was noted.

TABLE 1. MORTALITY AMONG A. LABRANCHIAE IN PRELIMINARY TESTS TO DETERMINE SUSCEPTIBILITY TO DIELDRIN IN DIFFERENT LOCALITIES
 (The number of mosquitos tested is indicated in brackets)

Locality	Date	Dieldrin concentration, %						
		0	0.05	0.1	0.2	0.4	0.8	1.6
Sidi Yahia (Rabat)	8 May	0 (55)	0 (28)	8 (49)	14(51)	40(35)	65(20)	
Sidi Bettache (Rabat)	1 June	0 (26)	2 (55)	2 (52)	24(46)	72(56)		
Ain-Atrouss (Meknès)	22 June	5 (20)	8 (47)	8 (47)	34(50)	81(48)		
Rommani (Rabat)	8 Sept.	0 (25)			8 (25)	15(25)	36(25)	76(25)

TABLE 2. MORTALITY AMONG A. LABRANCHIAE IN TESTS TO DETERMINE SUSCEPTIBILITY TO DIELDRIN AT ERAÏIA (ALLAL-TAZI)
 Period of contact: one hour
 (The number of mosquitos tested is indicated in brackets)

Date	Dieldrin concentration, %				
	0	0.2	0.4	0.8	1.6
20 August	0 (35)	76 (45)	85 (34)	71 (46)	74 (50)
26 August	0 (20)		60 (40)	62.5(40)	65 (40)
23 September	0 (20)		66 (38)	75 (40)	73 (41)
30 September	2.5(40)	22.5(40)	62.5(44)	76 (38)	74.5(43)

It should however be observed that this tolerance was not accompanied by any mortality "plateau". We would also draw attention to the fact that the figures at our disposal were insufficient for accurate calculation of the LC_{50} or LC_{100} or for comparison with more complete, subsequent tests: in fact, we rarely had a sufficient number of mosquitos to enable us to make tests with dieldrin concentrations higher than 0.4%.

The other six tests were performed on 729 mosquitos from a single locality (Braila) in an attempt to establish the LC_{50} and the LC_{100} and to obtain more complete information (Tables 2 and 3). Three parallel tests were effected for control purposes, using a susceptible laboratory strain of A. aegypti. These tests gave a LC_{50} of about 0.4%, which means that we can reject the hypothesis that an inadequate concentration on the impregnated papers may have affected the results of the experiments.

In the tests made with the Braila mosquitos (Table II) the rates of mortality do not permit construction of the regression line in probits. In fact, about 30% of the mosquitos survive at any concentration between 0.4% and 1.6%, so that, within these limits, the mortality distribution curve becomes a "plateau".

A higher mortality rate is obtained only by increasing the time of exposure (Table 3)

TABLE 3. MORTALITY IN SUPPLEMENTARY TESTS CARRIED OUT ON
A. LABRANCHIAE FROM BRAILA TO DETERMINE SUSCEPTIBILITY TO
DIELDRIN WHEN THE EXPOSURE TIME IS MORE THAN ONE HOUR

Time of exposure	Concentration	
	0	1.6
2 hours	0 (40)	80 (40)
4 hours	0 (20)	99 (80)

Discussion and conclusions

The results of the four experiments at Braila, in which the exposure time was one hour, call for some comment. The mosquito population seems to be divided into two separate groups: one, representing about 30% of the total population, shows marked dieldrin tolerance, while the other is still susceptible to it. There would seem to be a threshold of susceptibility at the 0.4% concentration, all concentrations above this appearing to have no effect whatever on the tolerant mosquitos (except when the exposure time is extended) which may perhaps constitute a genetically distinct section of the anopheline population, possibly as a result of selection pressure.

However, caution should be exercised in the interpretation of these figures for, in view of the curious fact that some of the mortality rates registered at Braila were not lower but higher than the parallel mortality rates in other localities (Table I), it must be admitted that if it had been possible to repeat the tests at Sidi-Yahia and Rommani in a more complete manner, a mortality "plateau" even higher than that for the Braila strain might have been obtained.

For the present, the reasons for this dieldrin tolerance in Morocco remain a mystery. This insecticide was used in only one antilarval experiment, limited to a rice field measuring 75 hectares and during a single season in 1953 (Houel, 1954). It should be noted that no positive result was obtained from this experiment and that the failure was assumed to be due to the fact that some physical factor had prevented the insecticide from reaching the larvae. According to the first information assembled before our departure, this appears to be the only occasion on which this insecticide has ever been used in agriculture. It is known, of course, that resistance to dieldrin has appeared in some cases (in A. sergenti in Jordan, according to a personal communication from Garrett-Jones) after only two applications of the insecticide to larval breeding-places, and that once the characteristic has been established it can persist for a year or more from the time of the last contact between the strain of the mosquito and the insecticide.

However, it would seem - according to the first information obtained - that the tolerance of A. labranchiae in Morocco also has all the characteristics of resistance consequent upon selection pressure. We cannot, therefore, exclude the possibility that more careful investigations concerning spraying operations for agricultural purposes (for example, on rice fields) may reveal the fact that dieldrin or one of its allied products (for example, Octaclor or BHC) is sprayed in the localities mentioned.¹

¹ Dr G. Houel was kind enough to communicate to me the fact that in the years 1949, 1950, 1951 and 1952, BHC was sprayed on the rice fields in the region of Ailal-Tazi in order to control Culex, and this may have contributed to the establishment of resistance to dieldrin on the part of A. labranchiae at Braila; for the same reason, resistance to dieldrin by A. labranchiae was detected by Andarelli in Algeria.

Summary

Tests to determine the susceptibility of A. labranchiae Fall in Morocco have shown the existence of marked dieldrin tolerance. No satisfactory explanation as to the origin of this phenomenon is offered, except that it may have arisen through the application within the area of insecticides similar to dieldrin, for agricultural purposes.

REFERENCES

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