ENCOUNTER THE POULTRY RED MITE RESISTANCE
TO ACARICIDES IN CZECHOSLOVAK
POULTRY-FARMING

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Abstract. Poultry red mite susceptibility to permethrin, deltamethrin, tetramethrin, trichlorfon, fenitrothion, carboxylic and DDT, respectively, was screened within the territory of Bohemia by a
method of diagnostic doses. The survey indicated widely spread resistance to DDT; in a few cases
inefficacy of permethrin, tetramethrin and trichlorfon, respectively, was also documented.

Resistance to pesticides is considered a principal encumbrance in controlling satisfactorily many arthropods of medical or veterinary importance. The number of species in which resistance has appeared is over 400 (Georgi, 1981). No evidence
of its existence in the field has yet been reported in Dermatophaeus gallinae (De Geer, 1778), an important poultry parasite, although the reduced efficacy of OP-compounds or carbamates, for example, mentioned by Genchi et al. (1984) from Italy, suggests such a case.

Recently, we have found remarkable DDT-resistance persisted in a laboratory colony of mites two years after collecting them in a poultry breeding farm in Czechoslovakia (Zeman and Železný 1988). The present survey was conducted to screen D. gallinae resistance to some chemicals in the field.

MATERIALS AND METHODS

D. gallinae. Engaged mites were collected in plastic bags in poultry houses in several localities of
Bohemia (Table 3). They were immediately transported to the laboratory and stored for one week
prior to examination at 25 °C/60 % RH under weak ventilation through the bags by an aquarium
air pump.

Test design. A method of diagnostic doses (Georgi, 1981) was employed in this survey. The following compounds suspected of inefficacy were involved in investigation: permethrin, deltamethrin, tetramethrin, trichlorfon, fenitrothion, carboxylic and DDT. Proper method of testing susceptibility was the same we used to assess toxicity of acaricides in D. gallinae (Zeman and Železný 1983). A series of analytical or technical grades were dissolved in acetone, pipetted into small glass tubes and air dried to prepare testing concentrations on their inner walls (10 cm²).

About 20 females were allowed to self-dose in a treated tube; each concentration involved three tubes. The mites were exposed at 25 °C and 60 % RH for 24 h; they were then transferred to clean recovery
vials using a vacuum pump and stored under the same conditions. Mortality counts were made after the next 24 h. Mites were considered dead if they neither responded to being touched nor moved normally. Abbott’s correction was made when mortality in the controls differed by ± 5 % (see Table).

Diagnostic concentrations. Susceptibility of a laboratory strain we examined earlier (Zeman and Železný 1985) served as a basis for the estimation. The laboratory culture originally initiated in 1989 from mites collected in a poultry breeding farm in Hřivokněží, East Bohemia.

Three concentrations were established in each compound, so that both deviations towards higher
and lower susceptibility in the field strains could be found. The concentrations were computed as
LC 50, LC 90 and LC 95, respectively. In DDT, where some resistance occurred in the lab strain,
only the regression line for a non-resistant part of the population was taken into consideration.
Eventually, the calculation was proved in preliminary experiments with the laboratory strain. Resultant sets of diagnostic concentrations are shown in Table 1; the concentrations are given in µg of a substance per ml. Mites surviving the LC 99.5 were considered resistant to an acaricide; likeness of recording them depends on a number of individuals tested reaching generally 98.5 % for n = 60.

**Table 1. Diagnostic concentrations used to screen the acaricide resistance in *D. gallinae***

<table>
<thead>
<tr>
<th>Compound</th>
<th>LC 0.5 (µg/ml)</th>
<th>LC 50 (µg/ml)</th>
<th>LC 99.5 (µg/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>permethrin</td>
<td>0.52</td>
<td>12.5</td>
<td>312.5</td>
</tr>
<tr>
<td>deltamethrin</td>
<td>0.12</td>
<td>7.9</td>
<td>487.5</td>
</tr>
<tr>
<td>tetramethrin</td>
<td>16.8</td>
<td>407.5</td>
<td>9587.5</td>
</tr>
<tr>
<td>fenitrothion</td>
<td>54.5</td>
<td>670.3</td>
<td>8125.0</td>
</tr>
<tr>
<td>trichlorfon</td>
<td>23.4</td>
<td>353.8</td>
<td>5550.0</td>
</tr>
<tr>
<td>carbaryl</td>
<td>0.25</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>DDT</td>
<td>13.0</td>
<td>86.7</td>
<td>63250.0</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

In Table 2 intervals of mortality are recorded for the lab strain at the diagnostic concentrations in three successive experiments. Table 3 summarizes susceptibility of red mites from poultry houses. As can be seen from the tables, the lab strain has roughly an intermediate position in terms of the susceptibility when compared with the field samples. Distinguishably higher susceptibility, namely to OP-compounds, fenitrothion and trichlorfon, was recorded in Slaný I. and Včelná strains. Mites from the localities Chotěboř, Slaný II. and Opava, respectively, showed a resemblance under the tests, and those from Habry I. and Habry II. were substantially more tolerant to acaricides.

**Table 2. Mortality in the laboratory strain of *D. gallinae* at diagnostic concentrations**

<table>
<thead>
<tr>
<th>Compound</th>
<th>LC 0.5</th>
<th>LC 50</th>
<th>LC 99.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>permethrin</td>
<td>1.6−1.7</td>
<td>54.8−58.6</td>
<td>100</td>
</tr>
<tr>
<td>deltamethrin</td>
<td>0−5.9</td>
<td>67.8−74.6</td>
<td>100</td>
</tr>
<tr>
<td>tetramethrin</td>
<td>4.5−14.5</td>
<td>30.5−61.9</td>
<td>100</td>
</tr>
<tr>
<td>fenitrothion</td>
<td>1.5−18.6</td>
<td>75.9−96.7</td>
<td>100</td>
</tr>
<tr>
<td>trichlorfon</td>
<td>3.3</td>
<td>9.1−45.2</td>
<td>100</td>
</tr>
<tr>
<td>carbaryl</td>
<td>0−1.4</td>
<td>21.6−37.1</td>
<td>100</td>
</tr>
<tr>
<td>DDT</td>
<td>0−4.4</td>
<td>67.7−80.0</td>
<td>91.8−95.8</td>
</tr>
</tbody>
</table>

The investigation provided evidence of widely spread DDT-resistance in the Czechoslovakia. No survivors of the LC 99.5 at 98.5 % were observed in the Č. Budějovice and Slaný I. strains; the latter exception being verified after three-month rearing in the laboratory. Low abundance of resistant individuals comparable with the lab strain occurred in the material from Chotěboř, Slaný II., Opava a Včelná, respectively. The resistance developed to a great extent at the locality Habry, where the Habry II. strain showed 10 % mortality at the LC 99.5. The findings documented an extra-
ordinary stability of resistance to DDT in *D. gallinae*, considering that the compound has not been applied in Czechoslovakia since 1976.

Some resistance to two pyrethroids, permethrin and tetramethrin, was also evident in Hruby II. and Hruby II. strains, likely accompanying the highest level of DDT resistance. Permethrin had an excellent initial potency at the very beginning in the field. However, during a few seasons the dramatic fall of its efficacy has been observed. Currently, it suppresses scarcely 20% of parasites at some localities if applied at a formerly recommended field rate.

Another type, OP-resistance, seems to be present in the specimens from Hruby II. and Chotebo II., in which some mites survived the LC 99.5 of trichlorfon. It could be expected that long-term utilization of trichlorfon-based treatments would have such a negative impact. On the other hand, surprisingly no traces of insusceptibility to fenitrothion were found in the material examined. This result is contrary to failure occasionally reported from the field. Some of the author's observations suggest that a behavioural aberration plays a role in this case. Although the red mites inhabiting wooden laying nests hide normally in deep crevices or interstices between the boards, on the twigs where the nests were protected by fenitrothion-dip, they clustered exceptionally at outer rubbed spots disregarding regular shelters. Thus the mites seemed to be able elude risky fenitrothion-covered places. However, this behaviour feature could not be confirmed by the method used.

No resistance to deltamethrin and carbaryl was apparent in the material examined, although the strains differed somewhat in their insusceptibility.

Rupel and Tondl (1970), who tested toxicity of acaricides in red mites in several localities of Czechoslovakia, did not report insusceptibility in any strain. Most probably, the resistance revealed in the course of the past decades. Many mites are known to develop resistance within the particularly short period of 1 to 4 years due to their arhenotokous (Saito et al. 1983). Haplodiploidy facilitates the selection of pre-adaptive alleles when they are recessive. Likewise *D. gallinae* males were designated to be haploid (Oliver 1983).

Acknowledgements. The author wishes to thank Mr. F. Greiner for technical assistance. The financial support by Czech Veterinary Sanitation Centre, Prague, is gratefully acknowledged.

**VÝZVĚTENÍ PŘEŽIVTNOSTI KURINÍHO KLECHA K KÁRAŘÍNCEM V PŘÍČVODSTVÍ ČECHOSLOVAKI

P. Zeman

**Разме. На территории Чехии была методом диагностических доз исследована чувствительность клещей к перметрину, тетраметрину, хлорофосу, фенитрофосу, мерыл и ДДТ. Была обнаружена широко распространенная рецидивность и ДДТ, в некоторых случаях выявлена неэффективность перметрину, тетраметрину и хлорофоса.

**REFERENCES


**RUPF V., TONDL F., 1970:** An experimental study on the susceptibility of females of *Dermatobia hominis* (De Geer) to carbaryl, imidac, fenitrothion, p, DDT and gamma BHC. Folia parasitologica 17: 257—260.


**ZEMAN P., ZELEZNÝ J., 1985:** The susceptibility of the poultry red mite, *Demodex gallinae* (De Geer), to some acaricides under laboratory conditions. Exp. Appl. Acarology 1: 17—22.

**FOLIA PARASITOLOGICA 34: 372, 1987.**


The author of the book, emeritus consultant dermatologist, Glasgow Royal Infirmary and lately honorary clinical lecturer in dermatology, University of Glasgow draws on his four years' training in dermatology and makes the best use of the contacts established with numerous recognized scholars who work in other relevant fields. His book is directed chiefly towards the dermatologist in practice and is intended to supply the clinical, histo-pathological, immunological and zoological details necessary for a sound understanding of the quite numerous eruptions caused by arthropods on the human skin. Encouraging all this information in one volume the book has a unique range and improves the likelihood of the correct diagnosis, treatment and prevention of cutaneous conditions induced by arthropods.

The book is arranged for convenience systematically in accordance with the zoological classification of the arthropod species concerned. Following sections with general considerations and a survey of some basic zoological details about insect and arachnid structure, the chapters cover Thyasemoptera (thrips) and Blattaria (cockroaches), insects and Arachnida (ticks and mites), skin infestations by Hemiptera and Homoptera (bugs), skin eruptions caused by Coleoptera (beetles), cutaneous myiasis, reactions to dipy- terric biting flies, Hymenoptera stings, flea bites and other diseases caused by fleas, reactions to Lepidoptera (butterflies and moths), scorpion stings, spider bites, scabies, hair follicle mites in man, infestation with gnawing mites, Pyemotes infestation, infestation with cheyletoid mites, house dust mites and skin disease in humans, skin eruptions caused by mites from stored food, infestation with trombicult mite larvae, the effects of tick bites, cutibites and millipede burns, delusion of cutaneous parasites, and insecticides and other methods of controlling arthropods. Appended is the taxonomic index containing clinical, immunological, histological, and other details.

The book is based on a large number of original papers and provides a scholarly and comprehensive survey of contemporary knowledge of the problems. It is well arranged and thoroughly documented. The chapters contain lists of the pathogenic species of arthropods, together with geographic location and appropriate references. Important data, e.g., relevant details of the biology of the pathogens, diagnostic signs of infestation, dermatological details, therapeutic measures etc. are conveniently summarized in tables. Many arthropods which are vectors of disease are also listed tabular form but not otherwise discussed. The ample illustrations give appropriate examples of pathogenic arthropods and in an outstanding level document parasitological and pathohistological changes of the skin. The large number of references cited in the bibliography at the end of each chapter provide an invaluable guide to the enormous literature surveyed by the author.

The book has successfully filled the hiatus in dermatological literature. It will be useful to dermatologists, general physicians, hospital pathologists, immunologists, and the public health authorities but may also be of good use to entomologists and acarologists.

**Dr. V. BUKOV, C.Sc.**