EFFECTS OF THE JH-ANALOGUES ALTOSID AND ALTOZAR ON THE NORTH AMERICAN HOUSE-DUST MITE, *DERMATOPHAGOIDES FARINAE* HUGHES (ACARINA, PYROGLYPHIDAE) [1]

BY

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ABSTRACT

Effect of the insect growth regulators (IGRs) altosid and altozar which have a juvenile hormone-like activity, were investigated against the mid-aged tritonymphs of the so called North American-house-dust mite, *Dermatophagoides farinae* Hughes. When the tritonymphs were exposed to altosid mixed in the feeding medium at the rates of 0.000161, 0.00028, 0.0028, 0.0161 or 0.0322 ppm the percentages inhibition of adult formation were found to be 26.7, 43.0, 67.0, 70.0 or 75.5 %, respectively. Altozar offered in the feeding medium at the concentrations of 0.000163, 0.000326, 0.00326, 0.0163 or 0.0326 ppm caused 28.3, 53.3, 56.7, 61.7 or 71.7 % inhibition of the development to the adult stage, in respect.

Treating the mid-aged tritonymphs with either altosid or altozar caused the prolongation of the median times needed for the development of the adult stage (DT_{50}) as they were 6.5, 9.9, 10.5, 9.3 and 10.8 days for the forementioned concentrations of altosid, in respect; and 6.1, 7.7, 8.6, 11.1 and 11.5 ays for the forementioned tested concentrations of altozar, in respect; in contrast to 2.2. days only for the checks.

All the previously mentioned results showed regression relationships among log-concentrations and obtained effects in probits.

RÉSUMÉ

Les effets de 2 régulateurs de croissance chez les Insectes l'altosid et l'altozar dont l'activité est proche de celle d'une hormone juvénile, sont étudiés sur des tritonymphes d'âge moyen de *Dermatophagoides farinae* Hughes. L'altosid mélangé à la nourriture dans les concentrations de 0.000161, 0.00028, 0.0028, 0.0161 et 0.0322 ppm, produit une inhibition de la formation de l'adulte de 26,7, 43,0 67,0, 70,0 et 75,5 % respectivement. Pour l'altozar et des concentrations de 0.000163, 0.000326, 0.00326, 0.0163 et 0.0326 ppm. l'inhibition est de 28,3 53,3, 56,7, 61,7 et 71,7 %.

L'activité de ces substances provoque aussi l'allongement de la durée moyenne du développement chez l'adulte (DT_{50}). Pour les concentrations susmentionnées de l'altosid, cet allongement est respectivement de 6,5, 9,9, 10,5, 9,3, et 10,8 jours, pour l'altozar, de 6,1, 7,7, 8,6, 11,1 et 11,5 jours.

Tous ces résultats s'alignent sur une droite de régression en fonction du logarithme des concentrations et suivant une loi de probit.

1. Contribution of the Division of Entomology, Department of Plant Protection, Faculty of Agriculture, University of Alexandria, Egypt.

INTRODUCTION

Investigations carried out by the authors for surveying mite species infesting some stored products in Alexandria and some of its provinces in Egypt during the years 1972, 1973 and 1974 resulted in the identification of 18 different species. Among these species the North American house-dust mite, *Dermatophagoides farinae* Hughes (Wharton, 1970, cf. Bronswijk and Sinha, 1971) was recorded [1]. The subject mite species is one of the Pyroglyphidae incriminated to produce the so called house dust allergy (e.g. Voorhorst *et al.*, 1964 ; Voorhorst *et al.*, 1969 ; Sinha *et al.*, 1970 ; Bronswijk and Sinha, 1971 ; and Pearson and Cunnington, 1973).

According to the ineffectiveness of some insecticides such as DDT and Pyrythrum against acaroid mites, the complexities which arise with fumigation in houses (Solomon, 1961), the hiding behaviour in cracks and crevices of some mites (i.e. *D. pteronyssinus*, the very allied species to the subject mite species, *D. farinae*), and the relative higher tolerance of *D. pteronyssinus* than *A. siro* and *G. destructor* to DDT and Lindane which are the most common conventional insecticides for house pest control (Bronswijk *et al.*, 1971), it deemed necessary to introduce a new group of compounds, other than the known conventional insecticides or acaricides, in the field of mite control. Therefore, two compounds with juvenile hormone like activity altosid and altozar were tested against the subject mite species, *D. farinae* in a trial to find out an effective control measure against the pest and safe enough to mammals in general and man in particular.

This study was achieved inspite of the probable ineffectiveness of insect juvenile hormone mimics or analogues against mites due to the probable difference in their endocrinal mechanisms, (Schneiderman, 1971 ; cf. Menn and Beroza, 1972).

Materials and methods

Pure technical samples of the insect growth regulators altosid (isopropyl (2E — 4E) — 11 methoxy-3, 7, 11-trimethyl-2, 4-dodecadienoate) (86.9 %) and altozar (isopropyl (2E — 4E) —11 methoxy-3, 7, 11-trimethyl-2, 4-dodecadienoate) (63.1 %) supplied by Zoecon Corporation, Palo Alto, California, U.S.A., were used. Concentrations were calculated on the basis of the active ingredient contents.

Bioassay tests :

Tested JHAs (juvenile hormone analogues) concentrations in acetone were sprayed on a thin layer of the feeding medium (finely ground rice-hull) which was previously heated at 90°C for 6 hrs to avoid the presence of other insects or mites (cf. Donia *et al.*, 1961). Sprayed medium was thouroughly mixed. Concentrations were calculated as parts of active ingredients per million parts of food. Controls were sprayed with pure acetone only. Treated medium was distributed in equal parts in the form of thin layers into small Petri-dishes 2 cm. in diameter and 2 cm deep. Twenty mid-aged tritonymphs (4 days old at 25 ± 0.1°C, 75.3 ± 0.2 % relative humidity and complete darkness) [2] were kept in each Petri-dish among the treated food-stuff particles till the end of the experiment. Every tested concentration was triplicated and so were the controls. Both percentages of inhibition of adult formation and the tritonymph durations were recorded

1. After Saleh, El-Gayar and El-Helaly (1975).
2. After Saleh, El-Helaly and El-Gayar (1975).

and compared with those of the checks under laboratory conditions of 27 ± 0.17°C and 66 ± 1 % relative humidity.

Statistical analysis :

For studying the effects of the tested compounds on the subject mite, two criteria were used ; first, the median inhibitory concentration of adult formation (IC_{50}) at a fixed time which is the time needed by check animals to develop to the adult stage and secondly, the median developing time (DT_{50}) for the treated mid-aged tritonymphs at every tested concentration. Drawing and fitting both the ic-p-lines and the dt-p-lines were achieved by following the probit analysis statistical method of Litchfield and Wilcoxon (1949).

Results and discussion

Either altosid or altozar proved to inhibit adult formation (from 26.7 to 75.0 % in altosid and from 28.3 to 71.7 % in altozar) when tested at the same range of concentrations from 0.00016 to 0.032 ppm against the mid-aged *D. farinae* tritonymphs (Figure, 1). Probit analysis of the data proved the linearity of the log.conc.-effect relationship which resulted in two ic-p-lines (Figure, 1). IC_{50}s derived from the forementioned figure were 0.00078 ppm (ranging from 0.00035 to 0.00173 ppm) for altosid and 0.001 ppm (ranging from 0.000419 to 0.002389 ppm) for altozar at 95 % confidence level. The two ic-p-lines showed marked parallelism which reflects the similarity of the mode of action of the two tested compounds (Finney, 1952).

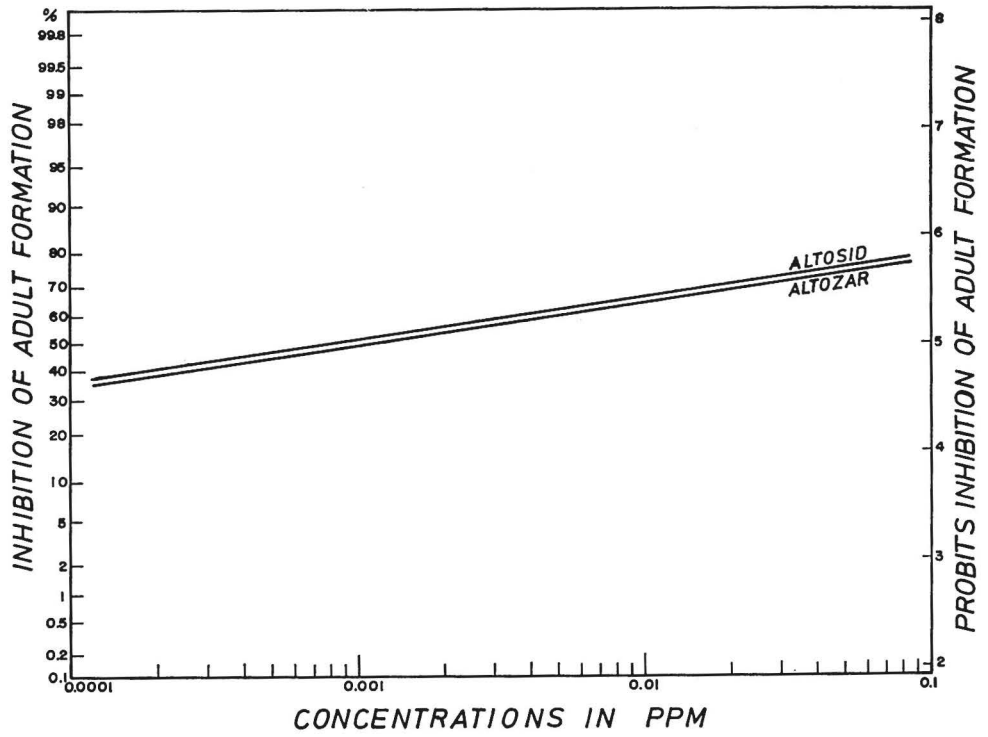

Fig. 1. — The ic-p-lines obtained when the mid-aged tritonymphs of *D. farinae* were exposed to different concentrations of the IGRs altosid or altozar mixed with the feeding medium.

Comparing the two tested juvenoids on the basis of their equieffective concentrations (IC_{50}) (BUSVINE, 1957), altosid was found to be slightly more effective against *D. farinae* tritonymphs than altozar. If the inhibition of adult formation in treated tritonymphs could be considered as a control measure, both compounds could be ranked, according to their effective concentrations, as potent acaricides. Field experiments are needed to support this conclusion.

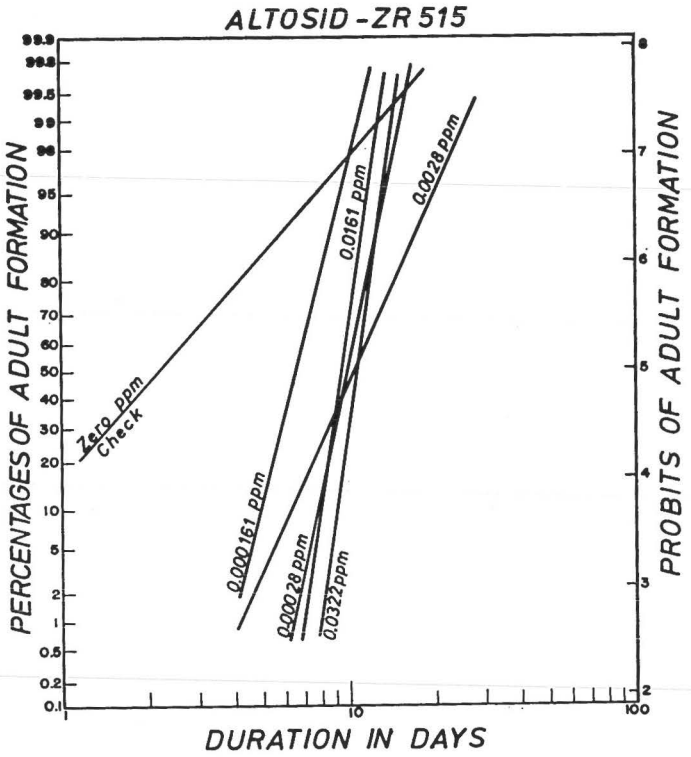

FIG. 2. — The dt-p-lines obtained when the mid-aged tritonymphs of *D. farinae* were exposed to different concentrations of altosid compared with the check.

Figure (2) pooled all the results obtained by studying the effect of the different tested concentrations of altosid on the durations of the treated tritonymphs. The data showed that the DT_{50} values obtained were 6.5, 9.9, 10.5 ; 9.3 and 10.8 days at 0.000161, 0.00028, 0.0028,0.0161 and 0.0322 ppm altosid, in respect.

Prolongation of the tritonymphal duration increased from 6.5 days to 10.5 days due to the increase of concentrations from 0.00016 to 0.0028 ppm. At 0.016 ppm this duration was only 9.3 days then increased again to reach 10.8 days at 0.032 ppm. It is difficult to explain whether this irrigularity attributed to the individual heterogeneity of the tested tritonymphs or to the mechanism of action of the tested compound at different concentrations.

SLAMA (1971, cf. BHATNAGAR-THOMAS, 1973) reported that the sensitivity of an insect to a hormone or its analogue is restricted to a critical period during embryogenesis and metamorphosis, after which both the exogeneous and endogeneous hormone cease to act. The high slope values of the drawn lines (10.7066, 12.0773, 6.0939, 17.9533 and 17.6991 at 0.000161, 0.00028, 0.0028, 0.0161 and 0.03220 ppm concentrations, respectively) in contrast to that relatively low slope value of the drawn line obtained for the checks (2.9753) could be considered as an indication

that a new mode of action differs from that of the pure acetone alone in the checks was working, and that was surely the altosid juvenilizing mode of action.

On comparing the two DT_{50} values obtained at the concentrations of 0.0028 and 0.0322 ppm of altosid they were found to lie very close to each other (10.5 and 10.8 days, respectively) inspite of the wide range between the two compared concentrations (about 10 folds).

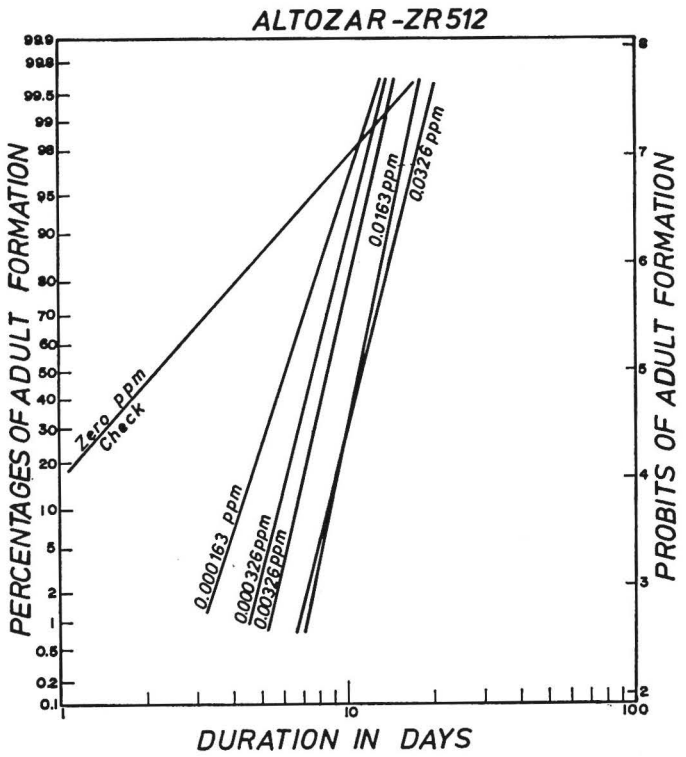

FIG. 3. — The dt-p-lines obtained when the mid-aged tritonymphs of *D. farinae* were exposed to different concentrations of altozar compared with the check.

The median developmental periods needed for the transformation of the treated tritonymphs increased proportionaly with the increase of altozar concentrations (Figure, 3). The prolongation of the forementioned periods might be attributed either to the homogeneity of the tested individuals being equal at all tested concentrations or to the homogeneity of the tested tritonymphs in their response to the effect of altozar than altosid. This may also declare the importance of the determination of the critical age of the tritonymphs at which the tested compounds should be applied and this needs further investigations. On the basis of the DT_{50} values obtained at nearly the same tested concentrations of either altosid (6.5, 9.9, 10.5, 9.3 and 10.8 days) or altozar (6.1, 7.7, 8.6, 11.1 and 11.51 days), no clear difference between the effect of the tested compounds was observed, only the second compound, altozar was slightly more effective.

In the course of the present study none of the tested concentrations of altosid or altozar produced any malformations or morphological abnormalities in both the treated mid-aged tritonymphs of the subject mite-species, *Dermatophagoides farinae* (Hughes) or the adults produced from them.

The present fidings prove that the insect growth regulators altosid and altozar affect and retard the development of the mid-aged tritonymphs of the North American house-dust mite, *Dermatophagoides farinae* (Hughes) towards the adult stage inspite of the probable difference in the hormonal mechanisms controlling development and metamorphosis in mites and insects (SCHNEIDERMAN, 1972, cf. MENN and BEROZA, 1972).

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