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DETERMINATION OF LC_{50} OF PIRIMOR AND NUVACRON ON TILAPIA NILOTICA FISH

(With 3 Tables & 3 Figs.)

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تحديد التركيزات المميته المتوسطة لمبيدى
البيريمور والنوفاكرون على أسماك البلطي النيلي

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تعتبر المبيدات الحشرية واحدة من أهم الملوثات العصرية التي يعاني منها الانسان والحيوان على حد سواء. وقد نتج عن الاستخدام المستمر المتزايد للمبيدات الحشرية في مكافحة الآفات تسربها لجزء هام جدا من مكونات البيئة ألا وهو الماء بما يحتويه من أسماك وكائنات حيه أخرى يعتمد عليها الانسان والحيوان في غذائهما. ولتزايد طلب الانسان على البروتين الحيواني الناتج من مصادر مائية مثل الأسماك حدا بنا الى دراسة تأثير البيريميور وهو مبيد حشرى كارباماتى خاص بمقاومة السلالات المقاومة للمبيدات الحشرية الفسفورية من حشرة المن وكذلك النوفاكرون المستخدم لمقاومة دودة القطن وهو من المجموعة العضوية الفسفورية والمقارنة بين التركيز المميت المتوسط لكل منهما منفرداً ومخلوطهما على أسماك البلطي النيلي المأخوذ من النيل في الجزء المقابل لمدينة أسيوط. واستخدم في هذا البحث عدد ٢٢٠ من أسماك البلطي النيلي التي تزن مابين ٣٥ الى ٥٠ جرام لاجراء الاختبارات الأولية للتجربة ثم استخدام ١٤٤ من نفس النوع وبنفس الوزن لاجراء التجارب. ودلت النتائج أن الجرعة الحادة المميته المتوسطة لمبيدات البيريمور والنوفاكرون ومخلوطهما بطريقة ليتشفيلد ورلكوكسون لسنة ١٩٤٩ قد بلغت ١٤٥، ٣٥، ٣٣، ٢٣ جزء في المليون بالنسبة لأسماك اللبلطي النيلي على التوالي. وقد اتبعت طريقة فيني لسنة ١٩٥٢ لمعرفة ما اذا كان هناك تأثير تنشيطي لأحد المركبين على الآخر من عدمه اذا استخدم منفرداً وكان من نتيجة ذلك بيان أن تأثير مخلوط المبيدين يفوق في سميته سمية كل منهما على حده.
يتضح من البحث إن إستخدام خليط المركبات للمبيدات الحشرية الفسفورية والكارباماتية تكون أشد ضراوة على الأسماك من استخدام هذه المركبات منفردة. ولهذا ينصح الباحث بعدم تتابع استخدام هذه المبيدات بل تستخدم منفردة لمقاومة الحشرات الضارة.

SUMMARY

The present study was carried out to investigate the toxic effect of two of the widely used insecticides on Tilapia nilotica fish. Nuvacron; which is a fast-acting organophosphorus insecticide with both systemic and contact action, used widely against pests. Pirimor; a selective carbamate aphicide, effective against organophosphorus-resistant aphide strains. LC_{50} of nuvacron, pirimor and their mixture using water media having pH from 6.4 to 6.8 and total alkalinity of 30 to 38 ppm as $CaCo_3$ were 35, 145 and 33.33 mg/liter water respectively. The potentiation toxicity showed that the interaction between nuvacron and pirimor was synergistic in Tilapia nilotica fish. The clinical signs observed on the toxicated fish were recorded.

INTRODUCTION

The aquatic environment, including streams, rivers, lakes, estuaries and oceans, serves as a reservoir for tremendous quantities of foreign organic chemicals, or xenobiotics. These compounds, many of which are toxic to both aquatic and mammalian species (BEND, et al. 1980).

Pesticides are introduced into the environment for specific purposes and in defined ways, however these substances will move as any other molecule, from their point of entry to their final destination (SHEETS, 1980). Recent environmental studies revealed that most of pesticides applied for pest control enter to the aquatic compartment of the environment through various routes (KANAZAWA, 1975 and MURPHY, 1986). Since man will probably depend more and more upon protein from marine sources in the future, the effect of these xenobiotics on aquatic animals is of importance. Recent environmental studies revealed that most of pesticides applied for pest control was of organophosphorus and carbamate in their chemical nature.

Chemicals in the environment will not necessarily affect man or animals in the same direct ways since they are always found in the presence of other chemicals with which they may interact. According to ALABASTER (1982), there are comparatively few data available on the joint action of toxicants on their uptake in aquatic organisms. Because there is little data on the effects of organophosphates and carbamates on organisms living in water (MENZER and NELSON, 1986) we aim in this paper to study the acute toxic effect of nuvacron, pirimor and the mixture of both on Tilapia nilotica fish.

MATERIAL and METHODS

Insecticides:

Pirimor (pirimicarb); 2-dimethylamino-5, 6-dimethyl-pyrimidine-4-yl dimethylcarbamate, commercial formulation of 50% powder, a product of ICI Plant Protection

Division. Nuvacron (monocrotophos); dimethyl (E)-1-methyl-2-(methylcarbamoyl) vinyl phosphate, as a formulated compound (400 g/L), a product of Ciba-Giegy. Only water was used for tap dissolution of insecticides. Tilapia nilotica is the most popular nile water fish in Assiut water channels which was used as a test fish, 6 to 8 Cm length and 35 to 50 g body weight. Eight fishes were transfered to each tank, and were given commercial dry fish feed once a day for two weeks before the onset of the experiments.

Experimental condition:

Glass aquarium tanks (each of 45 X 24 X 30 Cm) were used. The tank was filled with 20 liters of tap water. The pH and total alkalinity of water were 6.4 to 6.8 and 30 to 38 ppm as $CaCo_3$ respectively. Water temperature was maintained at 23±2°C and aerated with compressed air.

Determination of LD_{50}:

The dose-effect relationship of pirimor, nuvacron and their mixture was determined according to the method of LITCHFIELD and WILLCOXON (1949). 320 fish were used for the preliminary trials and 144 fish were used in the test proper for the three experiments. One group of eight fish was used as control in each trial.

Determination of potentiation toxicity of the mixture:

After the experimental determination of the acute LC_{50} of each insecticides alone and their mixture, the predicted LC_{50} of the mixture was calculated using FINNEY'S (1952) mathematical model for additive joint toxicity, yielding the harmonic mean of the LC_{50} of the components.

RESULTS

The preliminary trials for LC_{50} determination of pirimor in Tilapia nilotica fish showed that mortality started at 100 ppm., while the LC_{100} mortality was at 220 ppm. In case of nuvacron mortality started at 25 ppm., while the maximum concentration which kill all fish in the group was 65 ppm. In fish which received pirimor-nuvacron mixutre, mortality started at 25 ppm., and the LC_{100} was 50 ppm.

The test proper indicated that the LC_{50} with 19/20 confidence limits were 145, 35 and 33.33 ppm for pirimor, nuvacron and the mixture of both respectively.

The recorded results of the LC_{50} values of pirimor, nuvacron and the mixture of both in Tilapia nilotica fish are shown in tables 1, 2 and 3 respectively. Prediction of the lethal values are illustrated using logarithmic probability paper (No. 3128) in Figures 1, 2 and 3 respectively.

The clinical signs of acute nuvacron toxicity in fish were hurried respiration and increased rate of gill cover movements. Before death, fish float at the surface of water gasping for more oxygen. It showed severe nervous manifestations of very rapid movements in various directions. Other fish showed jerky movement with its head down and tail upwards. Comparatively in case of pirimor toxicity the clinical signs were less prominent. In the groups of fish which recieved the mixture, symptoms were more remarked. Before death, fish lie on its back with erect fans and open mouth.

DISCUSSION

The ultimate sinks for most chemicals produced and used by humans are water and soil (MENZER and NELSON, 1986). Organophosphorus and carbamate insecticides have generally replaced the chlorinated hydrocarbon insecticides as the principal weapons against the invasion of the pests (ETO, 1974 and KUHR and DOROUGH, 1976).

The LC_{50} of pirimor (50% soluble powder) was 145 mg/liter water with 19/20 confidence limits of 94.25 to 223.07 mg/l while that of nuvacron (liquid cocentrate containing 40% active ingredient) was 35 mg/l with 19/20 confidence limits of 28 to 43.75 mg/l. The LC_{50} of pirimor-nuvacron mixture was 33.33 mg/l with 19/20 confidence limit of 22.99 to 49.30 mg/l.

MACEK, (1975) studied the acute toxicity of pesticide mixtures on blue gils, DDT did not have greater than additive toxicity with any of the pesticides tested except BHC. Also malathion has greater than additive toxicity with more than half of the chemicals with which it was combined.

MARKING and MAUCK (1975) determined the toxicity to rainbow trout of 20 out of 21 possible paired mixtures of 7 insecticides in the ratio of 1:1 of their respective LC_{50} along unspecific time. For 9 pairs, joint toxicity was between 0.5 and 0.7 times less than additive, for nine others it was not significantly different from additive, and for the remaining two it was 1.4 and 1.7 times more than additive.

STATHAM and LECH (1975 a & b) used the percentage survival of rainbow trout exposed for 4 h to either 2, 4-D butyl ester, dieldrin, rotenone or pentachlorophenol, each in the presence of carbaryl at a concentration of 0.11 of the 96-h LC_{50}. More than additive interaction was found in all cases.

The ratio of our predicted LC_{50} of the mixture (90 mg/l) to that observed (33.33 mg/l) was 2.70. According to Finney's mathematical model for joint toxicity (1952), the interaction between pirimor and nuvacron was shown to be synergistic to Tilapia nilotica fish. According to the toxic evaluation of HAPKE (1988), the lethal concentration of pirimor and nuvacron mixture can be listed under the extremely toxic grade.

Chemicals such as pesticides in the environment will not necessary affect man or animals in direct way only but they are always found in the presence of other chemicals with which they may interact. It is clear from the results of this investigation that the interaction between pirimor and nuvacron exhibited high acute toxic effect to Tilapia nilotica fish in comparison with the individual insecticides.

Our conclusion reveals warning about the dangerous hazardous effects of the insecticide mixtures on aquatic life.

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Table (1): Solution of the dose response curve of pirimor to Tilpia nilotica fish

Dose (ppm)	Response	Observed %	Expected %	Observed minus Expected	Contribution to $(Chi)^2$
100	1/8	12.50	12.50	00.00	0.001
120	2/8	25.00	26.00	01.00	0.001
140	4/8	50.00	44.00	06.00	0.014
160	7/8	87.50	62.00	15.50	0.090
180	6/8	75.00	79.00	04.00	0.010
200	7/8	87.50	91.00	03.50	0.140
220	8/8	100 (99.0)	97.00	02.00	0.014

Table (2): Solution of the dose response curve of nuvacron to Tilpia nilotica fish

Dose (ppm)	Response	Observed %	Expected %	Observed minus Expected	Contribution to $(Chi)^2$
25	2/8	25	24	1	0.001
35	6/8	75	50	25	0.250
45	6/8	75	78	3	0.005
55	7/8	87.5	93	5.5	0.027
65	8/8	100 (99.3)	98.2	1.1	0.006

Table (3): Solution of the dose response curve of mixture of pirimor and nuvacron to Tilpia nilotica fish

Dose (ppm)	Response	Observed %	Expected %	Observed minus Expected	Contribution to $(Chi)^2$
25	1/8	12.50	11.00	1.50	0.0025
30	3/8	37.50	32.00	5.50	0.0140
35	6/8	75.00	61.00	14.00	0.0800
40	5/8	62.50	85.00	22.50	0.2300
45	7/8	87.50	95.50	8.00	0.1400
50	8/8	100 (99.7)	99.30	0.40	0.0022

Fig. (1)
The relationship between concentrations of pirimor and the % of mortality in *Tilapia nilotica* fish (Concentration Mortality Curve)

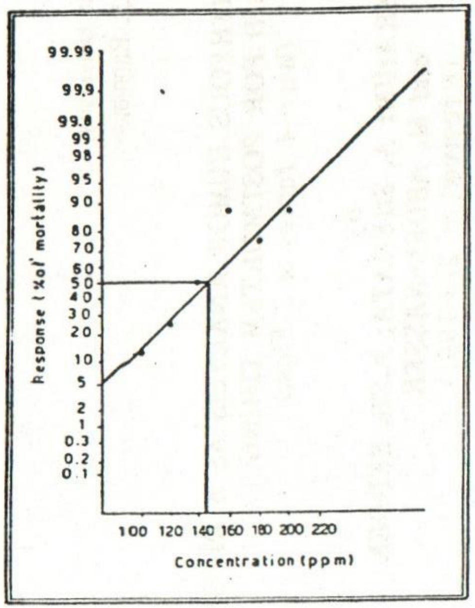

Fig. (2)
The relationship between concentrations of nuvacron and the % of mortality in *Tilapia nilotica* fish (Concentration Mortality Curve)

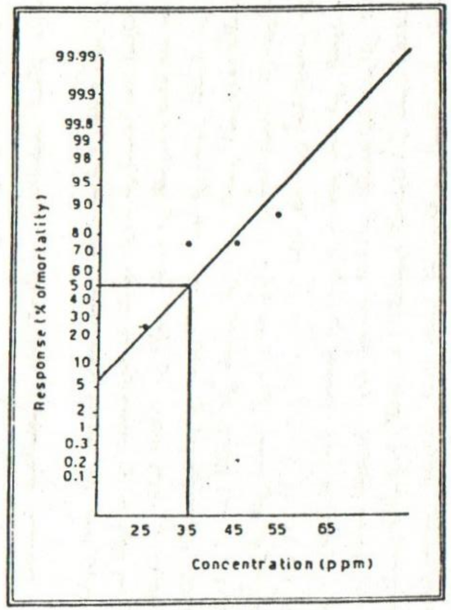

Fig. (3)
The relationship between concentrations of the mixture of pirimor and nuvacron and the % of mortality in *Tilapia nilotica* fish (Concentration Mortality Curve)