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TOXICITY OF SOME PESTICIDES TO THE NILE BOLTI FISH *Oreochromis niloticus* (LINN.)

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ABSTRACT

The acute toxicity of six pesticides belonging to different groups of chemicals, namely: chlorpyrifos (Chlorozan), lambda -cyhalothrin (Karate), methomyl (Lannate), buprofezin (Applaud), pyrazosulfuron (Agreen) and thiodicarb (Larvin) to the Nile Bolti fish 1 and 5 gm weight were investigated. The LC_{50} and LC_{90} values were calculated after 24, 48, and 96 h post-treatment. The obtained results show that there was a wide range of toxicity of the tested pesticides, however the pyerthriod insecticide lambda –cyhalothrin proved itself to be the highest toxic compound to the tested fish as LC_{50} and LC_{90} values after 96 h post-treatment recording 0.016 & 1.70 and 1.199 & 164.62 mg/l) for the Nile Bolti fish 1 and 5 gm, respectively. On the other hand, the compound pyrazosulfuron exhibited the lowest toxicity to the Nile Bolti fish 1 and 5 gm at the both levels of toxicity (LC_{50} and LC_{90} values after 96 h were 327.76 & 768.22 and 1318.8 & 1755.53 mg/l), respectively. The other tested insecticides occupied an intermediate position.

Keywords: Toxicity, pesticides, Nile Bolti fish, *O. niloticus*.

INTRODUCTION

In the last four decades, the industrial pollutants and human activities increased many environmental problems arising from the release of toxic contaminants in the aquatic environments (APHA, 1985).

Toxicity tests represent an important methodological approach to the identification, characterization and assessment of chemicals .Aquatic organisms have been used extensively as biomarker for water pollutants (Kenage, 1979).

Pesticides are one of the major classes of toxic substances used for management of pests in agricultural lands and control of insect victors of human diseases (Begum, 2004). The runoff from treated areas enters the rivers and aquaculture ponds are likely to be contaminated by pesticides.

Therefore, the present investigation aimed to study the acute toxicity of six pesticides belonging to different groups of chemicals to the Nile Bolti fish as a biomarker.

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MATERIALS AND METHODS

Test Organism

The Nile tilapia, *O. niloticus* Linn. was used to determine the acute toxicity of the tested pesticides. Tow sizes of fish body weight were used. young fingerlings 1 ± 0.1 gm in body weight and 5 ± 0.3 gm in weight .Young fish were purchased from a commercial fish hatchery in Abassa Research Station, Sharkia Governorate, Egypt,and kept at room temperature in glass aquarium 60x50x40 cm size, aerated by air pump .Acclimatization to laboratory conditions for 4 days was done using dechlorinated tap water. Fish were fed with standard diet adlibitum five days a week twice a day.

Chemicals Tested

The commercial formulation of the tested pesticides namely: pyrazosulfuron (Agreen 6.5% W.P), buprofezin (Applaud 25% S.C), chlorpyrifos (Chlorozan 48% E.C), lambda-cyhalothrin (Karate 2.5% E.C), methomyl

(Lannate 90% S.P) and thiodicarb (Larvin 37% F.L) were used. These compounds were supplied by cotton pests assessment project.

Bioassay

Toxicity tests

The toxicity tests were performed according to the USEPA procedure for the static non-renewal technique (EPA, 1975). Fish individuals were starved for 48 h before treatment and 96 h during the experiment. Mortality was less than 1% during the acclimatization period.

Preliminary screening test was carried out to determine the appropriate concentration for the test compound. Each test consisted of a control and at least five concentrations. Three replicates per each concentration with ten fish in each replicate were used. Twenty – liter glass aquaria were used for young fish (1 and 5 gm). At the beginning of the tests and every 24 h, the symptoms and the number of dead fish were recorded during the holding period (4 days). The results of the median lethal concentration (LC_{50}) were computed using the EPA probit analysis.

RESULTS AND DISCUSSION

The toxicity of chlorpyrifos, lambda-cyhalothrin,methomyl, buprofezin, pyrazosulfuron and thiodicarb to the Nile Bolti fish *O. niloticus* 1 and 5 gm weight after 24 , 48 and 96 h post-treatment are recorded in Tables 1to 6.

Toxicity of the Tested Pesticides to the Nile Bolti Fish

One gram fish

The toxicity of the tested pesticides to the Nile Bolti fish *O. niloticus* of 1 gm body weight is illustrated in Tables 1, 2 and 3. It is obvious that the pyrethroid insecticide lambda-cyhalothrin exhibited the highest toxicity to the Nile Bolti (1gm.body weight) at both levels of toxicity. The corresponding values of LC_{50} and LC_{90} after 96 h were 0.016 and 1.70 mg/l, respectively (Table 3). On the other hand, pyrazosulfuron revealed the lowest toxicity, however the LC_{50} and LC_{90} values after 96 h were 327.76 and 768.22 mg/l, respectively. The insecticide lambda-cyhalothrin is more toxic than the insecticide pyrazosulfuron by 20485 times, 4555 times than chlorpyrifos and 2810.6 times than buprofezin. The other insecticides occupied an intermediate position between the tested insecticides. At both levels of toxicity the effectiveness of the tested insecticides could be descendingly arranged as follows: lambda-cyhalothrin > methomyl > thiodicarb > buprofezin > chlorpyrifos > pyrazosulfuron.

The same phenomenon took place with the 24 and 48 h post-treatment against 1 gm Nile Bolti fish. The LC_{50} values after 24 h for the tested insecticides i.e. lambda-cyhalothrin, methomyl , thiodicarb, chlorpyrifos, buprofezin and pyrazosulfuron were 0.41 , 4.46 , 17.34 , 200.83 , 220.98 and 495.91 mg/l, respectively. The data show that lambda-cyhalothrin was the highest toxic insecticide, while pyrazosulfuron was the lowest one (Table 1).

Regarding the toxicity of the tested insecticides after 48 h in Table 2, Data obtained showed similar trend with 24 h of exposure. The LC_{50} values after 48 h were 0.072, 3.00, 7.57, 55.38, 126.62 and 365.74 mg/l for the insecticides lambda-cyhalothrin, methomyl, thiodicarb, chlorpyrifos, buprofezin and pyrazosulfuron after 48 h, respectively.

So, at the LC_{90} values the toxicity of the preceding six insecticides could be descendingly arranged as follows: lambda-cyhalothrin > methomyl > thiodicarb > buprofezin > chlorpyrifos > pyrazosulfuron 96 h of exposure (Table 3).

The picture with 48 h of exposure was low different, the toxicity of the six tested insecticides could be descendingly arranged as follows: lambda-cyhalothrin > methomyl > thiodicarb > chlorpyrifos > buprofezin > pyrazosulfuron and methomyl > lambda-cyhalothrin > thiodicarb > buprofezin > chlorpyrifos > pyrazosulfuron at the both levels of toxicity LC_{50} and LC_{90} after 48 h, respectively (Table 2).

Five grams fish

The toxicity of the tested pesticides to the Nile Bolti fish *O. niloticus* of 5 gm body weight is illustrated in Tables 4, 5 and 6 . The picture with the Nile Bolti 5 gm weight, however, show the same trend to that with the Nile Bolti 1 gm as obiviously shown in Tables 4, 5 and 6. Data show that the pyrethriod insecticide

Table 1. Toxicity of some pesticides to the Nile Bolti fish *Oreochromis niloticus* (1 gm) after 24 hours

Pesticides	LC_{50} (Conf.Lim.)		LC_{90} (Conf. Lim.)		Slope (Conf. Lim.)	
Chlorpyrifos (Chlorozan)	200.83	105.95 – 283.5	510.39	345.1 - 1922.3	3.16	1.16 - 5.15
Methomyl (Lannate)	4.46	3.83 – 5.17	16.39	13.33 – 21.34	2.27	1.91 – 2.62
Buprofezin (Applaud)	220.98	101.84 – 8300.6	473.89	292.75 - 5872	3.86	0.08 – 7.65
Pyrazosulfuron (Agreen)	495.91	346.57 – 620.13	997.37	770.27– 1871.56	4.22	2.04 – 6.40
Lambda-cyhalothrin (Karate)	0.41	0.039 – 10.55	111.07	5.84 -413.00	0.53	0.18 – 0.88
Thiodicarb (Larvin)	17.34	15.48 – 19.09	40.22	35.90 – 46.45	3.50	2.92 – 4.08

Table 2. Toxicity of some pesticides to the Nile Bolti fish *Oreochromis niloticus* (1 gm) after 48hours

Pesticides	LC_{50} (Conf.Lim.)		LC_{90} (Conf. Lim.)		Slope (Conf. Lim.)	
Chlorpyrifos (Chlorozan)	55.38	38.9 – 73.2	705.57	487- 1178	1.15	0.92- 1.3
Methomyl (Lannate)	3.00	2.56– 3.48	11.82	9.63-15.35	2.15	1.8 -2.48
Buprofezin (Applaud)	126.62	55.9– 202.5	374.38	223 -7456	2.72	0.6 - 4.7
Pyrazosulfuron (Agreen)	365.74	167.2–520.5	844.28	583-2795.8	3.52	1.21-5.83
Lambda-cyhalothrin (Karate)	0.072	0.04–0.12	16.93	6.77- 59.1	0.54	0.44-0.63
Thiodicarb (Larvin)	7.57	0.52 – 18.26	74.29	27.8 -112	1.29	0.32 -2.2

Table 3. Toxicity of some pesticides to the Nile Bolti fish *Oreochromis niloticus* (1 gm) after 96 hours

Pesticides	LC_{50} (Conf.Lim.)		LC_{90} (Conf. Lim.)		Slope (Conf. Lim.)	
Chlorpyrifos (Chlorozan)	72.88	6.62 - 173.5	724.05	266.8-1775	1.28	0.31- 2.25
Methomyl (Lannate)	1.93	1.62 - 2.26	7.60	6.22 -9.82	2.16	1.79 -2.51
Buprofezin (Applaud)	44.97	35.6- 54.67	303.03	227- 447.5	1.54	1.25 -1.83
Pyrazosulfuron (Agreen)	327.76	206.03 -426.1	768.22	580.7-356	3.46	1.82- 5.10
Lambda-cyhalothrin (Karate)	0.02	0.01 - 0.035	1.70	0.851- 4.19	0.63	0.53- 0.74
Thiodicarb (Larvin)	9.36	0.05 - 24.53	78.69	28.5 - 638	1.38	0.16 -2.60

Table 4. Toxicity of some pesticides to the Nile Bolti fish *Oreochromis niloticus* (5 gm) after 24 hours

Pesticides	LC_{50} (Conf.Lim.)		LC_{90} (Conf. Lim.)		Slope (Conf. Lim.)	
Chlorpyrifos (Chlorozan)	446.06	222.87 - 899.5	2961.83	770.8 - 3866.0	1.55	0.04- 3.16
Methomyl (Lannate)	22.24	19.59 - 25.1	61.54	51.2- 79.5	2.89	2.32- 3.47
Buprofezin (Applaud)	277.46	111.43 - 534.88	866.92	233.8 - 1671.9	2.59	0.31- 5.49
Pyrazosulfuron (Agreen)	1681.09	1612-1759.3	2491.48	2292 -2812	7.50	5.97 -9.03
Lambda-cyhalothrin (Karate)	15.73	8.98 - 55.77	710.54	501 - 980.21	0.77	0.02- 1.57
Thiodicarb (Larvin)	61.54	56.87 - 65.81	105.54	95.9 -120.7	5.47	4.30- 6.63

Table 5. Toxicity of some pesticides to the Nile Bolti fish *Oreochromis niloticus* (5 gm) after 48 hours

Pesticides	LC_{50} (Conf.Lim.)		LC_{90} (Conf. Lim.)		Slope (Conf. Lim.)	
Chlorpyrifos (Chlorozan)	324.66	89.79 - 634.92	2001.40	887.6-8184.7	1.62	0.42 - 2.81
Methomyl (Lannate)	15.66	8.34 - 23.67	40.65	26.29-41.40	3.09	1.26 - 4.92
Buprofezin (Applaud)	277.15	11.44 – 876.77	753.71	333.9 –1231.4	2.94	0.95 - 6.85
Pyrazosulfuron (Agreen)	1509.15	1451.3 -1563.1	2040.18	1939- 2184.3	9.78	7.96 -11.60
Lambda-cyhalothrin (Karate)	4.10	0.0959 -34.67	195.49	25.9- 1131.0	0.76	0.183- 1.34
Thiodicarb (Larvin)	48.09	28.67 - 63.25	97.94	72.62- 241.5	4.14	1.61 - 6.68

Table 6. Toxicity of some pesticides to the Nile Bolti fish *Oreochromis niloticus* (5 gm) after 96 hours

Pesticides	LC_{50} (Conf.Lim.)		LC_{90} (Conf. Lim.)		Slope (Conf. Lim.)	
Chlorpyrifos (Chlorozan)	412.19	92.89 - 1148.3	1977.36	851.1-9725.0	1.88	0.28 - 3.48
Methomyl (Lannate)	12.26	4.48 -20.49	34.66	20.69-211.21	2.83	0.91 -4.76
Buprofezin (Applaud)	202.54	92.96 - 274.02	495.09	349.6-1890.1	3.30	1.08 - 5.51
Pyrazosulfuron (Agreen)	1318.8	1122.1-1453.9	1755.53	1583-2159.1	10.31	5.22-5.40
Lambda-cyhalothrin (Karate)	1.199	0.013 - 7.58	164.62	20.01-2757.2	0.60	0.17 - 1.03
Thiodicarb (Larvin)	35.1463	19.84 - 47.20	76.92	56.51-159.06	3.76	1.67 - 5.85

lambda-cyhalothrin exhibited the highest toxicity to the Nile Bolti fish 5 gm (Tables 6), LC_{50} and LC_{90} values in mg/l after 96 h were 1.199 and 164.62, respectively, with pyrazosulfuron show the lowest toxicity, the LC_{50} and LC_{90} values after 96 h were 1318.8 and 1755.53 mg/l. The pyerthriod insecticide lambda-cyhalothrin is more toxic than pyrazosulfuron by 1268 times, 170 times than buprofezin and 273 times than chlorpyrifos.

The other used insecticides used occupied an intermediate position between the highest and lowest insecticide. At both levels of toxicity, the toxicity of the preceding six insecticides could be descendingly arranged as follows: lambda-cyhalothrin > methomyl > thiodicarb > buprofezin > chlorpyrifos > pyrazosulfuron.

Respecting the 24 h of exposure for 5gm Nile Bolti fish, data show that the pyrethriod insecticide lambda-cyhalothrin is the highest toxic insecticide at the LC_{50} value of toxicity, but pyrazosulfuron (Agreen) exhibited the lowest toxicity showing the LC_{50} value of 1681,09 mg/l after 24 h . The other four insecticides occupied the intermediate position with LC_{50} values 22.24 , 61.54 , 277.46 and 446.06 mg/l for methomyl (Lannate), thiodicarb (Larvin), buprofezin (Applaud) and chlorpyrifos (Chlorozan), respectively (Table 4).

The insecticide lambda-cyhalothrin (Karate) was the highest toxic insecticide after 48 h of exposure, LC_{50} value was 4.1 mg/l to the 5 gm Nile Bolti fish, while the LC_{50} value of the insecticide pyrazosulfuron (Agreen) was 1509.15 mg/l after 48 h of exposure. Slope values of the tested pesticides ranged between 0.76 to 9.78 (Table 5) .

In general, Data obtained show that LC_{50} values ranged between 0.016 to 327.76 and between 1.199 to 1318.8 mg/l to the 1 and 5 gm Nile Bolti fish after 96 h respectively. The pyrethriod insecticide lambda-cyhalothrin (karate) exhibited the highest toxicity and pyrazosulfuron (Agreen) revealed the lowest toxicity to the tested fish.

As mentioned before, the relative toxicities of different insecticides belonging to different groups of chemicals to fish were studied by Quentin and Croswel (1966) , EPA (1975), Evenson (1996), Lind (2002) and Zaheer and Law (2005).

The acute toxicity of some organophosphates, carbamates and pyrethriod insecticides to fishes were studied by several investigators e.g., Tilak *et al.* (1981), Mount and Norberg (1984), Arora *et al.* (1986), Saliva *et al.* (2003), Campagna *et al.* (2004), Chindah *et al* (2004), Stalin *et al.* (2008) and Rabia (2009). The authors showed that there was a wide range in toxicity of the used insecticides to the aquatic organisms specially the fish species.

In conclusion, further screening trials are needed to established categories of aquatic organisms had high sensitivity against specific groups of chemical pollutants using earlier toxic symptoms with the aim to detect levels below that mentioned in this work.

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سـمية بعض مبيـدات الآفـات للسـمك البلطـى النيلـى

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قسم وقاية النبات – كلية الزراعة – جامعة الزقازيق – مصر

تم دراسة السمية لست من المبيدات الحشرية التابعة لمجاميع كيماوية مختلفة وهى كلوربيرفوس، لمبادا- سيهالوثرين ،ميثوميل، ببروفيزين، بيرازوسيلفيرون و ثيودكارب للسمك البلطى النيلى وزن ١ و ٥ جرام وذلك لتقدير التركيز القاتل لـ ٥٠ و٩٠٪ من الأفراد بعد ٢٤، ٤٨ و ٩٦ساعة من المعاملة. أظهرت النتائج أن هناك مدى واسع من السمية للمبيدات المختبرة حيث أظهر المبيد الحشرى لمبادا- سيهالوثرين أعلى سمية لسمك البلطى النيلى وزن١ و ٥ جرام حيث كانت قيم التركيز القاتل لـ ٥٠ و٩٠٪ من الأفراد بعد ٩٦ساعة من المعاملة هى ٠,٠١٦ ، ١,٧ و ١,١٩٩ , ١٦٤,٦٢ ملليجرام / لتر. على الجانب الآخر كان المبيد بيرازوسيلفيرون أقل المبيدات سمية للسمك عند مستويي السمية للتركيز القاتل لـ ٥٠ و٩٠٪ بعد ٩٦ساعة من المعاملة حيث كانت تلك القيم ٣٢٧,٧٦ ، ٧٦٨,٢٢ و ١٣١٨,٨ ، ١٧٥٥,٥٣ ملليجرام / لتر للسمك البلطى النيلى ١ و ٥ جرام على التوالى.