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Toxicity of Nogos-100EC to the Indian major carp *Cirrhina mrigala* fry*

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Abstract: Static bioassays were conducted for 168−h LC_{50} tests under laboratory conditions to determine the median lethal concentration (LC_{50}) of nogos to the Indian major carp, *Cirrhina mrigala* fry for different exposure times. Groups of fry (mean weight 1.89g, SD± 0.173) were exposed to seven concentrations of nogos. The 72−, 96−, 120−, 144− and 168−h LC_{50}s for exposure to nogos were 2.679 (95% CL 2.550−2.815), 2.527 (95% CL 2.304−2.770), 2.400 (95% CL 2.205−2.613) 2.364 (95% CL 2.145−2.604), and 2.282 (95% CL 2.071−2.514) mg l^{-1}, respectively. In the present investigation, there were no significant ($p>0.05$) differences between the median lethal concentrations for different exposure times.

1. Introduction

Aquaculture, as a major component of agriculture in Bangladesh, is practiced either as a primary or secondary source of income. Growing demands for rice for an ever increasing population has led to the modernization of agriculture. Irrigation and use of fertilizers and pesticides are essential for the present agriculture. When there is a crop, there must be weeds, pests and diseases, so the pesticides occupy a good position in protecting the crop as well as in increasing yields significantly. Environmental contamination with pesticides is a problem of world wide importance. The indiscriminate use of pesticides for agricultural purposes has created many problems in environmental pollution. The pollution hazards for aquatic life are increasing significantly with the widespread use of pesticides in agriculture. In Bangladesh, organophosphorus pesticides are commonly used by the farmers in crop fields to control insects and pests. These chemicals end up in water bodies after being washed away with rain water, or flood water and are likely to have harmful effects on fish food organisms, fish eggs, larvae, fry and other aquatic life. Pesticides at high concentrations are known to reduce the survival, growth and reproduction of fish (MCKIM *et al.*, 1975). More than 250 pesticides are presently available in the market. Their recommended doses and toxic effects on fish are not clearly known. Therefore, the indiscriminate use of these pesticides in our crop field may pose a serious threat to our potential aquatic resources. Nogos is one of the organophosphorus pesticides commonly used against a wide variety of insect and pests in the crop fields.

The present work was carried out to evaluate the toxicity of nogos to determine the LC_{50} values of the Indian major carp fry, *Cirrhina mrigala* (Hamilton), at different concentrations and exposure periods.

2. Material and methods

Fry (mean weight 1.89 gm SD ± 0.173) of the Indian major carp, *Cirrhina mrigala* (Hamilton) were collected from the Fisheries Research Institute, Riverine Station, Chandpur nursery Bangladesh. The fry were acclimatized for 15–20 days at 27±2°C in a 3000 *l* cement thanks before the test and fed with an artificial diet containing rice bran, wheat bran, mustard oil cake and fish meal. Before starting of the experiment, animals were kept in a 500 *l* fibre glass thanks for 48 hr without feeding.

Preparation of the test solution: Commercial grade (Ciba Geigy, Bangladesh Ltd) nogos-100 EC (Dichlorovos 2, 2-Dichlorovinyl dimethyl

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Table 1. The percentage mortality of major carp (*Cirrhina mrigala*) fry after 168-h exposure to different concentration of nogos.

Solution No.	Concentration (mg l^{-1})	Mortality(%)
Control	0.00	0.00
1	1.50	6.00
2	1.75	18.00
3	2.00	30.00
4	2.25	60.00
5	2.50	66.00
6	2.75	83.00
7	3.00	100.00

posphate) was used as a test chemical for the present study. The above pesticide was obtained from a local market. The dose of nogos was determined on the basis of "active ingredient". The chemical was measured by a micropipette and diluted with distilled water in a glass jar to obtain the desired dose concentration. The test chemical was directly poured into water of the test aquarium.

Experimental system: Static bioassays were conducted following the method recommended by Committee on Method for Toxicity Tests with Aquatic Organisms (1975). Tests were conducted in 24 independent glass aquaria arranged in three rows on a platform. Fish to water ratio was maintained at less than 1.0 gm fish per 1.5 *l* water (APHA, 1980). Each aquarium (30×60×28.5 cm) containted 30 *l* of water. Stone aerators connected to a compressors were used to maintain an adequate DO level in test aquaria.

Experimental procedure: Seven concentrations of nogos and one control were bioassayed (Table 1) with three replicates. Control was maintained in the same way. A batch of 10 fry were released to each of the aquaria. They were assigned among the test aquaria randomly and were not fed during the test period. Each bioassay was conducted for 168-h to obtain the lethal threshold concentration. Records of mortality were made at logarithmic time intervals (HASAN and MACINTOSH, 1986a; 1986b). All tests were done under laboratory conditions at the prevailing room temperature and humidity. Measurement and analyses of the physico-chmical characteristics of the water in the test and control aquaria were carried out according to the methods of APHA (1980).

Table 2. Physico-chemical characteristics of the test solution during the period of bioassay.

Properties	Mean	Range
Temperature (°C)	28°C	27°C−30°C
Dissolved oxygen	5.2 ppm	4.8− 6.9 ppm
pH	7.3	7.2− 8.0
Carbon dioxide	12.0 ppm	11.0−15.0 ppm
Total alkalinity	68.0 ppm	65.0−79.0 ppm
Total hardness	59.0 ppm	57.0−120.0 ppm

Analysis of experimental data: The median lethal concentration (LC_{50}) values and their 95% confidence limits for different exposure times were calculated by using the trimmed Spearman-Karber method (HAMILTON *et al.*, 1977) by using a computer programme developed in GW-basic 3.20. Tests for significant differences were carried out between (LC_{50}) values using APHA (1980).

3. Results

The cumulative percentage mortality of *Cirrhina mrigala* fry at different concentration of nogos after 168-h exposure are presented in Table 1. Very few mortalities were observed at concentrations of 1.50 and 1.75 mg l^{-1} nogos. Out of these two concentrations, 30% mortalities were occurred at 2.00 mg l^{-1}. The control group of fishes showed normal behaviour and remained alive during the experimental period. 60% or more mortalities were recorded at the concentrations above 2.25 mg l^{-1} nogos.

The water quality characteristics of the test solution during the bioassay period are shown in Table 2. It was observed that there was almost no change in the dissolved oxygen concentration and no significant increase in carbon-dioxide content of water.

The median lethal concentrations of nogos and their 95% confidence limits for various exposure times presented in Table 3. The test of significance between median lethal concentrations of different exposure times showed no significant difference ($p>0.05$). Fry which were found alive in different lethal concentrations, were transferred to fresh water after 168-h of exposure and were supplied with food. It

Table 3. Median lethal concentrations (mg l^{-1}) and their 95% confidence limits of Nogos for various exposure times.

Exposure time (h)	LC_{50} (tp-20) mg l^{-1}	95% CL
72	2.679	2.550-2.815
96	2.527	2.304-2.770
120	2.400	2.205-2.613
144	2.364	2.145-2.604
168	2.282	2.071-2.514

* tp- Trim percent

was observed that the fry did not regain their normal appetite and showed signs of insecticidal poisoning.

4. Discussion

Several biological anomalies were found in the test organisms due to pesticidal action. The abnormal behaviour of the experimental fry exposed to nogos included erratic swimming, increased operculum activity, jumping out of the test media, violent spasm, jerking, convulsions and loss of equilibrium. These types of behaviour were pronounced in fry exposed to 2.50, 2.75, and 3.00 mg l^{-1} of nogos. Initially the fry were found to be excited showing erratic movement, but as time increased, their activities were reduced and they lay on the bottom of the aquaria with spasmodic opercular movement. Finally the treated fry exhibited symptoms of increased ventilation, convulsion and a loss of equilibrium. Most of the fry were found to be covered with a thick layer of mucous around their bodies while a few in 3.00 mg l^{-1} concentration showed the symptoms of forming vesicles on the integument. Excess mucus secretion by the treated fishes may be an adaptive effort to prevent entry of pesticides through skin and gill.

The behavioural changes associated with nogos treatment are in conformity with the observations of VERMA *et al*,. (1977). Basudin (diazinon) was reported to give 80% mortality of *Heteropneustes fossilis* at the 10.0 mg l^{-1} concentration (KHAN and AHMED, 1966). ANNESS (1976) reported that diazinon was the most toxic among the organophosphates tested against *Channa punctata*. BEGUM (1975), AHMED (1975) and KHAN (1980) also reported similar results. Nevertheless the present study indicates that nogos at concentrations of 2.50, 2.75 and 3.00 mg l^{-1} was highly toxic to *C. mrigala* fry after 96-h exposure period. LC_{50} values for 12-, 24- and 48- exposure times could not be conducted within the logarithmic range of concentration. In the present investigation, the acute toxicity of nogos ceased, and the lethal threshold concentration was reached within 168-h of exposure. There were no significant differences between the median lethal concentrations for different exposure times. Similar results showing lethal threshold concentration of unionized ammonia within 168-h of exposure have been reported for common carp fry by HASAN and MACINTOSH (1986).

Further research is needed for detailed study on the harmful effect of this pesticides on other aquatic biota and fish species. Research on histopathological changes in fish tissue and blood parameters should also be conducted to assess the nature of toxic effects on fish.

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インド鯉稚魚への殺虫剤 Nogos-100EC の毒性

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要旨：インド鯉（*Cirrhina mrigala*）稚魚への殺虫剤Nogos-100ECの毒性実験を実験室環境で行なった。実験に用いたインド鯉稚魚の大きさは1.89±0.17であり，7段階の殺虫剤濃度の効果を調査した。殺虫剤 Nogos-100EC の示したインド鯉稚魚への致死濃度（LC_{50}）は，実験時間の72，96，120，144および168時間に対し，それぞれ2.679（統計的95%信頼限界：2.550–2.815），2.527（統計的95%信頼限界：2.304–2.770），2.400（統計的95%信頼限界：2.205–2.613），2.364（統計的95%信頼限界：2.145–2.604），2.282（統計的95%信頼限界：2.071–2.514）であった。したがって，本実験におけるインド鯉稚魚への致死濃度（LC_{50}）は，統計的には（$p>0.05$）時間依存性が認められない。