THE EFFECTS OF DICHLORVOS {2, 2 - DICHLOROVINYL DIMETHYL PHOSPHATE (DDVP)}-INDUCED STRESS ON THE GROWTH OF FINGERLINGS OF *Clarias gariepinus* (BURCHELL, 1822)

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ABSTRACT

This study was conducted to determine the effects of dichlorvos {2, 2 - dichlorovinyl dimethyl phosphate (DDVP)} on the growth of *Clarias gariepinus* fingerlings. The experiment was conducted in two phases: the first phase involved the exposure of the fish to different concentrations {0.00 (control), 0.4ppm, 0.5ppm, 0.6ppm, 0.7ppm, 0.8ppm, 0.9ppm, 1.0ppm, 1.1ppm and 1.2ppm} of dichlorvos for four days. The second phase was a recovery process in which the fish that survived from the first phase were introduced into clean, dechlorinated, toxicant-free water and were fed at 3% of their body weight for 12 weeks. The change in weight was measured every fortnight and the feed fed was adjusted to accommodate the change in weight. The highest values for weight gain, percentage weight gain, specific growth rate and average daily weight gain occurred in the control and these values were significantly ($p<0.05$) higher than the values of these parameters recorded in the other treatments. The range of values of weight gain, percentage weight gain, specific growth rate and average daily weight gain are 6.76±3.01 - 18.45±8.90g, 69.45±18.52 - 105.52±33.67%, 1.54±0.33 - 2.08±0.46%/day and 0.48±0.21 - 1.21±0.65g respectively. Based on the results of this study, the exposure of fingerlings of *Clarias gariepinus* to dichlorvos {2, 2 - dichlorovinyl dimethyl phosphate (DDVP)} affected the growth of the fish. Therefore, the use of dichlorvos on stored grains should be regulated because uncontrolled usage could cause mortality and impairment of growth in fish if the pesticide gets washed into water bodies inhabited by fish.

Keywords: Toxicity, pesticide, *Clarias gariepinus*, growth performance

INTRODUCTION

Pesticide is any chemical substance or mixture of substances which are applied by farmers in their daily farming practices with the intention of protecting crops from pest infestation. The frequent use of these pesticides at different stages of crop production starting from the processing of seeds to storage of agricultural produce is posing great threat to aquatic environment. These pesticides accidentally get into the surrounding aquatic ecosystem through surface run-off from sites of application. As a result, many non-target organisms like fish of the freshwater bodies are adversely affected. Organophosphate pesticides degrade rapidly by hydrolysis on exposure to sunlight, air, and soil, although small amounts can be detected in food and drinking water. They are assumed to be safe due to their ability to degrade which made them an attractive alternative to the persistent organochloride pesticides which have detrimental effects on the environment (Jenyo-Oni *et al.*, 2011). Although, organophosphates are generally less persistent and bio-accumulative than organochlorides, they have a relatively high toxicity and are acutely toxic to a wide variety of non-target organisms (Hesni *et al.*, 2011). The release of these pesticides into the aquatic environment leads to changes in the external environment of the fish thereby affecting its physiological features (as related to the energetics of the fish i.e. haemoglobin levels and mechanisms level) which determine the health condition of the fish and overtime may manifest in changes in weight (growth) of the fish. According to Elchelberger and Liehleuberg (1971), the characteristics of water quality are basic factors which influence the survival of a fish, its reproduction, growth performance, and over all biological reproduction. Reports related to effects of pesticides on fish reproduction are scarce and do not include a wide or comprehensive range of events involved in reproduction such as the onset of puberty, gametogenesis, oocyte maturation, ovulation, spermiation, spawning, fecundity, fertilization, endocrinology of reproduction and developmental events such as embryogenesis, hatching and post hatching metamorphosis (Farooq *et al.*, 2012). It was reported by Avoaja and Oti (1997) and Aguigwo (2002) that the rate of feeding, food conversion and the efficiency of absorption decreases with increase in the concentrations of pesticides. Investigations have shown changes in carbohydrate and nitrogenous metabolism in fish, which were induced by the stress caused by pesticide-induced hypoxia. These changes include depletion of proteins, glycogen and pyruvate stores from fish tissues such as liver and muscle (Laul et al. 1974).

Hence, this study was undertaken to investigate the influence of sublethal concentrations of dichlorvos (DDVP) on the growth of the fingerlings of *Clarias gariepinus*.

MATERIALS AND METHODS

Healthy fingerlings of *Clarias gariepinus* were bought and transported to the laboratory in the Department of Fisheries, Lagos state University, Ojo, Lagos, Nigeria.The static toxicity experiment was conducted in two phases: in the first phase the fish (20 fingerlings of *Clarias gariepinus* per experimental unit) were exposed to different concentrations {0.00 (control), 0.4ppm, 0.5ppm, 0.6ppm, 0.7ppm, 0.8ppm, 0.9ppm, 1.0ppm, 1.1ppm and 1.2ppm} of dichlorvos for four days, without feeding them. The second phase was the recovery process in which the fish that

survived the first phase were introduced into clean, de-chlorinated, toxicant-free water. The fish were fed 3% of their body weight, three times daily with pelleted diet containing 45% crude protein (CATCOFISH CONCENTRATE COPPENS).The growth was monitored by carefully taking the weight {electronic weighing balance (Mettler PM 400)} of the fish at an interval of two weeks. The change in weight was recorded and the feeding rate was adjusted to accommodate the change in weight.

Statistical Analysis

Analysis of variance (ANOVA) was used to test for differences in fish growth between different levels of treatment and Fisher's least significant difference was used to separate the means. In all cases, the level of significance was set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

The table showed the effects of different concentrations of dichlorvos on the fingerlings of *Clarias gariepinus*. Four growth parameters (weight gain, percentage weight gain, specific growth rate and average daily weight gain) were measured and in all cases the highest value was obtained in the control while lowest value occurred in treatment containing 1.1ppm dichlorvos. Dichlorvos is widely used for public health, agriculture practices and protecting stored farm produces from pests and yet is one of the most toxic organophosphate pesticides. Organophosphate pesticides irreversibly inactivate acetylcholinesterases, which are essential to nerve function in insects, humans, and many other animals. Calta *et al.* (2004) studied the effects of the pesticide, dichlorvos on embryonic development of zebrafish. Developmental abnormalities were observed in embryos and larvae. These include no blood flow, cardiac edema, delayed hatching, and vertebra malformations. In this experiment, there were no mortalities observed in the control tanks, however, mortalities were recorded in the fish exposed to the different concentrations of the toxicant. Weight gain, percentage weight gain, specific growth rate and average daily weight gain were significantly higher ($p<0.05$) in the control fish compared to those exposed to the toxicant.This study showed that exposure of *Clarias gariepinus* to different concentrations of dichlorvos affected the growth rate of the fish, i.e. the increase in the concentrations of dichlorvos led to the decrease in the weight gain, percentage weight gain, specific growth rate and average daily weight gain of the fish. This could be as a result of the suppressive effect of the toxicant on food consumption or increase in the level of activity performed by the fish to escape the polluted water. Avoaja and Oti (1997) observed that *Heteroclarias* (hybrid) exposed to sub-lethal concentrations of thiodon malathion and carbaryl, decreased the rate of feeding, food conversion ratio and feed efficiency with increasing concentrations of the pesticides, resulting drastically in reduction of growth. Similar observations were made by Aguigwo (2002) that specific growth rate, food conversion efficiency and protein efficiency ratio decreased as the concentration of cymbush pesticide increased.

CONCLUSION

Based on the results of this study, the exposure of fingerlings of *Clarias gariepinus* to dichlorvos {2, 2 - dichlorovinyl dimethyl phosphate (DDVP)} affected the growth of the fish. Therefore, the use of dichlorvos on stored grains should be regulated because uncontrolled usage could cause mortality and impairment of growth in fish if the pesticide gets washed into water bodies inhabited by fish.

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Table 1: Effects of different concentrations of dichlorvos on the Growth of *Clarias gariepinus* fingerlings.

Concentration (ppm)	WG (g)	PWG (g)	SGR (%/day)	ADG (g)
0.4	11.08 ± 4.45^{b}	82.91 ± 20.00^{b}	1.79 ± 0.30^{b}	0.79 ± 0.31^{b}
0.5	13.31 ± 5.08^{b}	86.17 ± 13.87^{b}	1.87 ± 0.24^{b}	0.95 ± 0.36^{c}
0.6	11.69 ± 4.74^{b}	83.32 ± 12.16^{b}	1.83 ± 0.19^{b}	0.83 ± 0.33^{a}
0.7	8.31 ± 3.32^{a}	71.57 ± 11.15^{a}	1.65 ± 0.20^{a}	0.59 ± 0.23^{a}
0.8	12.51 ± 4.52^{b}	89.52 ± 26.99^{b}	1.95 ± 0.40^{c}	0.89 ± 0.32^{b}
0.9	9.56 ± 3.01^{ab}	86.42 ± 34.34^{b}	1.71 ± 0.48^{ab}	0.68 ± 0.21^{a}
1.0	11.65 ± 5.87^{b}	91.33 ± 32.36^{b}	1.81 ± 0.48^{b}	0.83 ± 0.41^{b}
1.1	6.76 ± 3.01^{a}	69.45 ± 18.52^{a}	1.54 ± 0.33^{a}	0.48 ± 0.21^{a}
1.2	8.62 ± 3.41^{a}	76.22 ± 20.75^{a}	1.66 ± 0.32^{a}	0.61 ± 0.24^{a}
Control	18.45 ± 8.90^{c}	105.52 ± 33.67^{c}	2.08 ± 0.46^{d}	1.21 ± 0.65^{d}

Means with the same superscript along the row are not significantly different ($p>0.05$)
KEYS
WG = Weight Gain; PWG = Percentage Weight Gain; SGR = Specific Growth Rate; ADG = Average Daily Weight Gain