EFFECTS OF CHEMICAL PESTICIDE ON OXIDATIVE STRESS INDICATORS OF FRESHWATER AFRICAN CATFISH *Clarias gariepinus* JUVENILES

By
Ude Veronica Chiamaka
Prof. Helen Nwamba
Dr Vera Ude
Dr Christie Onyia
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OUTLINE

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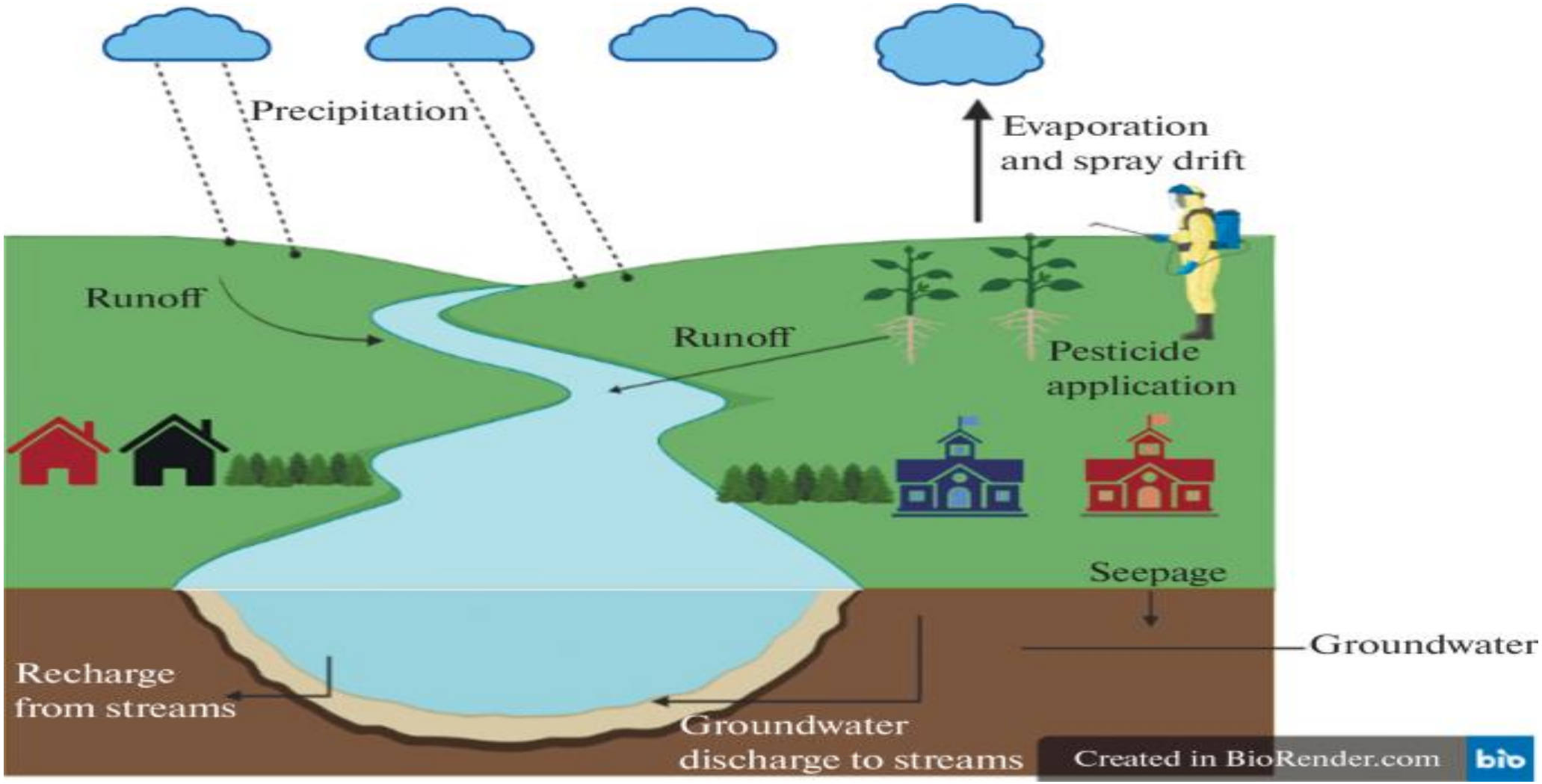
INTRODUCTION

- African catfish (*Clarias gariepinus*) is one of the most desirable aquaculture species particularly in central and western Africa (Adamu *et al.,* 2023).
- Aquatic lives are very vulnerable to pesticide contamination, as run-offs from farms and industries end up in water bodies (Mugudamani *et al.,* 2023)
- In the water, the molecules of these contaminants may bind to the waste materials in suspension, accumulate in the sediment or can be absorbed by the aquatic organisms with attendant physiological responses including effect on behavior, morphological, and biochemical responses (Odo et al., 2017,)
- This study evaluates the impact of Sharpshooter, a chemical pesticide, on oxidative stress indicators of juvenile African Catfish.

Juvenile African Catfish *Clarias gariepinus*

STATEMENT OF PROBLEM

- The increasing use of chemical pesticide in agriculture raises concerns about its potential effects on fish health.
- Oxidative stress, caused by an imbalance between reactive oxygen species (ROS) and antioxidant defenses, can lead to cellular damage, weakened immunity, reduced growth rates in fish and death.
- Pesticides absorbed by fish bodies cause them to move up the food chain and have harmful effects on human health upon consumption (Ray and Shaju, 2023)



Source: Pawan et al., 2023

Figure 1. Pesticide Runoff into Waterbodies

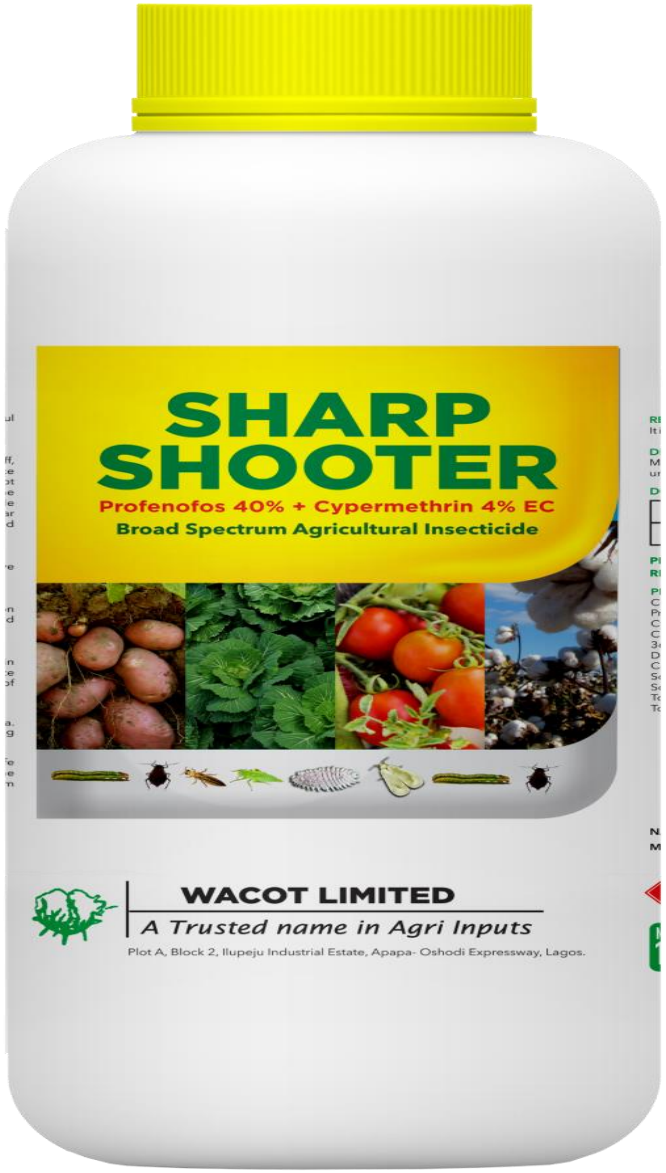
OBJECTIVES

- Determine the 96h LC50 of sharpshooter on C. gariepinus
- Investigate the behavioral changes of Clarias gariepinus to sharpshooter
- Determine the oxidative stress effect CAT, SOD, LPO) of sharpshooter on the African Catfish (C.gariepinus) juveniles.

METHODS

- Collection, Transport and Acclimatization of Experimental Fishes
- Water Quality Test
- Experimental Chemical
- Range Finding Test
- Acute Toxicity Test
- Determination of Sub Lethal Concentration
- In Vitro Exposure for Oxidative Stress Assay
- Determination of Condition Factor (K) and Hepatosomatic Indices (HSI)

EXPERIMENTAL CHEMICAL



The test insecticide used in present study was commercial/technical formulation of sharpshooter insecticide of active ingredient **Profenofos 40% and Cypermethrin 4%**. Manufactured by Shandong Keyuan Chemicals Co. Ltd. China, supplied by West African Cotton Co. Ltd

RESULTS

Table 1: Water Quality test

Concentration (Mgl-1)	pH	Temperature (^{o}C)	Dissolved oxygen (Mgl-1)
Control	8.40 ± 0.01	25.01 ± 0.05	5.0 ± 0.00
0.02	8.75 ± 0.05	25.68 ± 0.05	5.3 ± 0.03
0.04	8.6 ± 0.1	25.54 ± 0.05	5.5 ± 0.00
Standard	6.7 ± 8.5	26-28 ± 0.05	5 - 1.0

RESULTS

Table 2: Estimate of Safe Levels of *C. gariepinus* to Sharpshooter

Chemical	96h LC_{50} (mg-1)	Method	AF	Safe Level (mg-1)
Sharpshooter	0.02	Hart et al., Sprague CWQC CCREM	-0.1	1.875 x 10-03
			0.01	2 x10-03
			0.1 - 0.00001	2 x 10-04
			0.05	2 x 10-03 - 2 x 10-2

RESULTS

Table 3: Cumulative Mortality of *C. gariepinus* exposed at different concentration of sharpshooter.

Concentration (Mgl-1)	Number of fish exposed	Cumulative mortalities (hr)					% survival	% mortality
		24	48	72	96	Total		
Control	12	0	0	0	0	0	100	0
0.02	12	0	0	3	3	6	50	50
0.04	12	0	0	3	5	8	33	67
0.05	12	0	0	5	5	10	17	83

RESULTS

Table 4: Behavioral Responses of *Clarias gariepinus* juveniles exposed to various concentrations of sharpshooter for 24, 48, 72 and 96hrs.

Mgl^{-1} Concentration	Exposure time	Hyperactivity	Equilibrium status	Swimming rate	Fin movement	Jerky movement
	24hrs					
Control		-	-	+ + +	+ + +	-
0.02		+	+ + +	+ + +	+ + +	+ +
0.04		+ +	+ + +	+ + +	+ + +	+ +
0.05		+ + +	+ + +	+ +	+ +	+ + +
	48hrs					
Control		-	-	+ + +	+ + +	-
0.02		+	+ + +	+ + +	+ + +	+ +
0.04		+ +	+ + +	+ + +	+ + +	+
0.05		+ + +	+ + +	+ + +	+ + +	+ + +
	72hrs					
Control		-	-	+ + +	+ + +	-
0.02		-	+ + +	+ + +	+ + +	+ + +
0.04		+ +	+ +	+ + +	+ +	+ + +
0.05		+ + +	+ + +	+ + +	+ + +	+ + +
	96hrs					
Control		-	-	+ + +	+ + +	
0.02		+	+ +	+ + +	+ + +	+ +
0.04		+ +	+ +	+ + +	+ + +	+ +
0.05		+ + +	+ + +	+ +	+ +	+ +

Key = None (-), Mild (+), Moderate (+ +), Strong (+ + +)

RESULTS

Table 5: Sub-Lethal Concentration of Sharpshooter (Mgl-1) (95% Confident Level) depending on exposure time for *Clarias gariepinus*

Lethal Control	**24**	**48**	**72**	**96**
LC_{10}	0.03(0.02 - 0.04)	0.03(0.02 - 0.03)	0.02(0.02 - 0.03)	0.02(0.01 - 0.02)
LC_{20}	0.04(0.03 - 0.04)	0.03(0.02 - 0.04)	0.03(0.02 - 0.03)	0.02(0.02 - 0.03)
LC_{30}	0.04(0.03 - 0.04)	0.03(0.03 - 0.04)	0.03(0.02 - 0.03)	0.02(0.02 - 0.03)
LC_{40}	0.04(0.04 - 0.05)	0.04(0.03 - 0.04)	0.03(0.03 - 0.03)	0.03(0.02 - 0.03)
LC_{50}	0.05(0.04 - 0.05)	0.04(0.04 - 0.05)	0.03(0.03 - 0.04)	0.03(0.03 - 0.04)
LC_{60}	0.05(0.04 - 0.05)	0.04(0.04 - 0.05)	0.04(0.03 - 0.04)	0.03(0.03 - 0.04)
LC_{70}	0.05(0.04 - 0.06)	0.04(0.04 - 0.06)	0.04(0.04 - 0.05)	0.04(0.03 - 0.05)
LC_{80}	0.06(0.05 - 0.09)	0.05(0.05 - 0.07)	0.05(0.04 - 0.05)	0.05(0.04 - 0.06)
LC_{90}	0.07(0.06 - 0.12)	0.06(0.05 - 0.05)	0.05(0.05 - 0.07)	0.06(0.06 - 0.08)

Table 6: Oxidative stress Indicators in Juvenile *Clarias gariepinus* Exposed to Sharpshooter

PARAMETERS	CONC. (Mgl^{-1})	DAY 1	DAY 4	DAY 8	RECOVERY
CAT	CONTROL	1.23 ± 0.01^{a1}	1.23 ± 0.07^{a1}	1.23 ± 0.01^{a1}	1.35 ± 0.015^{a1}
	0.02 $mg/1^{-1}$	1.35 ± 0.04^{a1}	1.47 ± 0.28^{a1}	1.61 ± 0.09^{a1}	1.54 ± 0.06^{a1}
	0.04 $mg/1^{-1}$	1.44± 0.28^{a1}	1.56± 0.35^{a1}	1.81± 0.02^{a1}	1.60± 0.10^{a1}
	0.05 $mg/1^{-1}$	1.55 ± 0.35^{a1}	1.69 ± 0.28^{a1}	1.93 ± 0.09^{a1}	1.82 ± 0.15^{a1}
SOD	CONTROL	38.50 ± 0.71^{a1}	38.50 ± 0.71^{a1}	38.50 ± 0.71^{a1}	39.50 ± 0.71^{a1}
	0.02 $mg/1^{-1}$	41.50 ± 0.71^{a1}	44.50 ± 0.71^{a1}	47.50 ± 0.71^{a1}	43.00 ± 1.41^{a1}
	0.04 $mg/1^{-1}$	44.50 ± 0.71^{a1}	48.50 ± 0.71^{a1}	50.50 ± 0.71^{a1}	46.00 ± 1.41^{a1}
	0.05 mg/I^{-1}	44.50 ± 0.71^{a1}	51.50 ± 0.71^{a1}	52.50 ± 0.71^{a1}	50.50 ± 3.53^{a1}
LPO	CONTROL	2.18 ±0.28^{a1}	2.18 ±0.04^{a2}	2.19 ±0.04^{a1}	2.23 ±0.85^{a}
	0.02 mg/1-1	2.42 ± 0.99^{a1}	0.04 ±0.12^{a1}	4.32 ±0.23^{a1}	3.43 ±0.07^{a}
	0.04 mg/I-	2.57 ± 0.21^{a1}	3.43 ±0.07^{a1}	4.28 ±0.65^{a1}	3.56 ±0.13^{b}
	0.05 mg/11	2.71 ± 0.57^{a1}	3.56 ±0.13^{a2}	4.32 ±0.65^{a1}	4.32 ±0.23^{a}
CF	CONTROL	64.44 ± 0.23^{a1}	64.34 ±0.21	64.58 ±0.25	---
	0.02 mg/I	68.16 ± 5.59^{a1}	65.35 ±0.67	74.10 ±15.07	
	0.04 mg/1-1	75.20 ± 2.94^{a1}	83.43 ±1.79	87.04 ±0.93	
	0.05 mg/I-	87.49 ± 1.32^{a1}	90.10 ±0.53	94.32 ±0.64	
HSI	CONTROL	64.44 ±0.23	64.34 ±0.02	64.58 ±0.23	---
	0.02 mg /1-1	68.16 ±5.59	65.35 ±0.67	74.10 ±15.07	
	0.04 mg/1-1	75.20 ± 2.94	83.43 ±1.79	87.04 ±0.93	
	0.05 mg/1-1	87.49 ±1.32	90.10 ±0.53	94.32 ±0.64	

CONCLUSION

- Sharpshooter pesticide induced toxic stress in forms of abnormal behavior characteristics and percentage mortality in the fish with the effect increasing as the concentration increases.
- Physiological parameters play an important role in determining the toxicity of pesticides.
- Acute toxicity test have been recognized as the very first step in determining the water quality requirement of fish and reveal toxicant concentration (LC_{50}) that cause fish mortality event at short exposure
- Behavioral characteristics were displayed by the exposed fish, such as jerky movement, swimming rate, equilibrium status, hyperactivity and fin movement is evidence that the juvenile *C. gariepinus* were stressed before mortality.

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