Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.3, No.9, 2013

The Toxicity Effect of N. P. K. Agro -Fertilizer on *Oreochromis Niloticus* Fingerlings, the Pysiological Impact.

Uhuo,Cosmas.A[1]*; Nwele,David.E[1]; Odikamnoro, Oliver.O[1]; Ibiam, Gideon.A[2] & Azi, Simon.O[2].
1. Department Of Applied Biology Ebonyi State Universityabakaliki
Ebonyi State Nigeria. Pmb 053
2. Department Of Medical Laboratory Sciences, Ebonyi State University Abakaliki
Ebonyi State, Nigeria. Pmb 053
Email Of The Corresponding Author:* Coscusanas@Gmail.Com, Coscusans@Yahoo.Com Uhuo Cosmas.A.

Abstract
The study on the acute toxicity level of inorganic fertilizer (N. P. K., 20: 10: 10) to the fingerlings of *Oreochromis niloticus* (mean weight 0.9 ± 0.6g) was investigated using static bioassays over a period of 96hrs intervals. The 96 hours LC50 of the exposed fishes was also determined to be 0.82sg/L with lower and upper confidence limits of 0.6 and 1.15g/L respectively. However certain stressful behavioural changes like erratic swimming with inconsistent jumping, incessant gulping of air, loss of balance, were commonly observed before death, which occurs with increase in the time of exposure. Water quality determined during the investigation showed fluctuation in oxygen content and increase in Ph, Conductivity and total dissolved solute as the concentration of the fertilizer was increased. The increased stress behavioral pattern among this fish is as a result of the increased effect of the fertilizer.
Keywards: Effects, fertilizer, Oreochromis Niloticus, fingerlings, water.

Introduction Fertilizer is a substance added to soil to improve plant yield and growth, towards achieving quality and quantity of foods available to mankind. Fertilization of a fish pond actually increases the production of beneficial phytoplankton, free- floating algae that act as the basis of the food chain. The primary inorganic nutrients N:P:K are essential for algal growth, Goldman, *et al* (1983). Water quality is one of the most important factors affecting successful pond fish culture Diana, (1997). But if water quality is excellent, survival growth and reproduction can achieve high value. The addition of nitrates, phosphates and potassium actually increases alkalinity in water body thus, affecting the biology of aquatic organisms. Aquatic organisms such as fish accumulate pollutants directly from contaminated water and indirectly via the food chain Chan, *et al* (1999). Heavy metal toxicity has been extensively studied with the application of chemical fertilizers containing traces of heavy metals causing contamination of fish with those metals Bold & Wynme,(1978). The toxic impact of inorganic application of fertilizer to aquatic bodies is that fish productivity suffers after all and this may cause several physiological and biochemical defects in fishes. Other researchers demonstrated that interaction between the concentration of the toxicant and time had significant effect on the tail beat and opercular ventilation, skin lesion, and hemorrhage of the gill filaments and fins were also observed on dead fish as reported by (Diana, 1997) and Sprague, (1971). Also reported a sub lethal effect of N. P. K fertilizer on *Oreochromis niloticus, Clarias gariepinus* and catfish hybrids which resulted to poor growth and death as a result of accumulation of the toxicant chemical used in the treatment. However, there have been reported cases of fish kills following fertilizer application and discharge of these effluents by industries into the recurring water body as N. P. K fertilizer on its own has been found to be toxic without the combination of other toxicants,

1. Ekweozor, *et al* (2001). **Materials and Methods**

Experimental fish and acclimatization

Fingerlings of *Oreochromis niloticus* with mean weight 0.9 ± 0.6g were obtained from a branch of Phenoma fish farm at Ugwu Omu Nike, Emene, Enugu State, in oxygenated plastic containers and transported to Applied Biology laboratory Ebonyi State University. They were stocked differently in 12, glass aquaria (50cm x 30cm x 20cm) with dechlorinated and well, oxygenated municipal tap water. The fish were acclimatized separately in aquaria, to laboratory conditions for 2 weeks during which period they were fed twice daily (0800h and 16000h) at 3% biomass on a 30% crude protein diet. Holding tanks were cleaned daily and water was changed every 24hours to discard faecal material and left over food. Mortality was less than 2% during acclimation. The fish were not fed for 48 hours before and during the exposure period.
Various concentrations of N. P. K (20: 10: 10) fertilizer were prepared on a volume to volume (%) basis (weight of fertilizer in grams per 10 litres of water) with dechlorinated tap water. This was used for preliminary runs until suitable concentrations that would result in 100% mortality within 72 hrs were derived and this was used as the stock solution. From this, the following concentrations were prepared along the principles of serial dilution method employed by Chan, *et al* (1999) : 25.00, 6.25.3.13 and 1.60g/L.

Dechlorinated tap water without fertilizer (0.00g/L) served as the control. Ten fish were exposed to each of the six concentrations with every concentration having replicates.
The exposure period lasted 96 hrs. Water physicochemical parameters such as temperature, PH, dissolved oxygen and conductivity of the test media were determined every 24 hours during the experimental period APHA, (1985).

2. The test aquaria were examined for fish mortality on a daily basis. Fish were considered dead when there is lack of response to gently prodding with a glass rod. Dead fish were recorded and removed immediately from test solutions to avoid fouling the test media. The 96 hours LC50 was determined as a probit analysis using the arithmetic method of the percentage mortality data. The lower and upper confidence limits of the LC50 were determined and results were subjected to statistical analysis with Duncan multiple range test between the various concentrations of fertilizer and the control. **Results**

Mortality Rate Of *Orechromis Niloticus* Exposed To Various Acute Concentration Of N: P: K (20: 10:10) Fertilizer

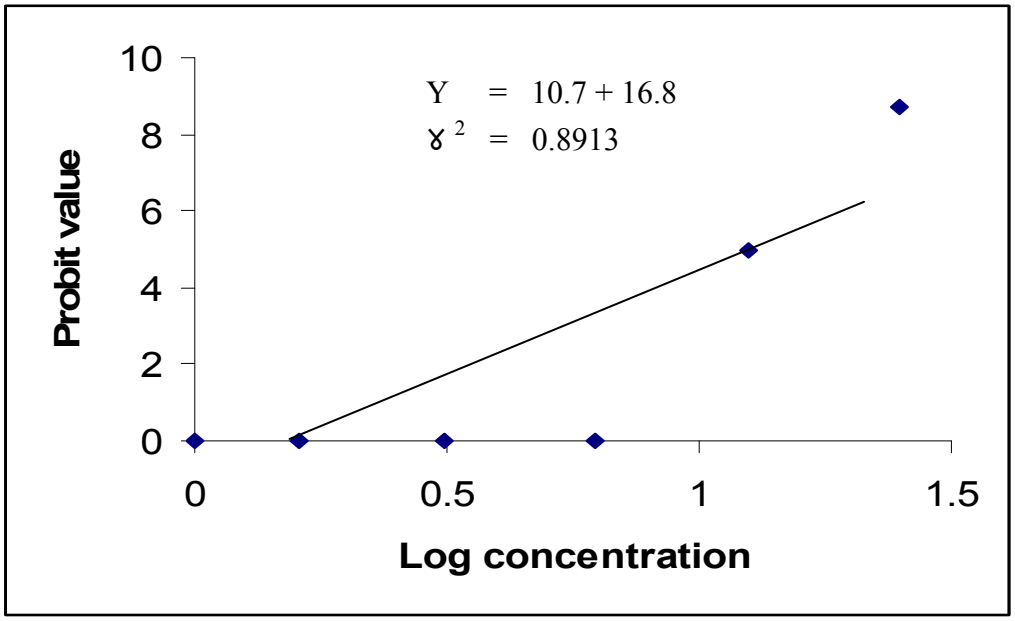
The 96 hours LC50 obtained for the N: P: K (20:10:10) fertilizer was 0.82g/L (Probity = -10.7 + 16.8x). A positive correlation was indicated by the linear relationship, the graph of logarithmic concentration versus probity mortality (Fig. 1). Table 1 shows that the survival time for *Oreochromis niloticus* species declined with the increase in the concentration of the toxicant and time of exposure. Different behavioural responses were exhibited by the test fish during the exposure period like, loss of equilibrium, rapid swimming, and attempt to jump out of the toxicant, air gasping followed by the lethal (death) phase when opercular movement and responses to tactile stimuli cease completely. It should be noted however, that no behavioural change occurred in the control tank. On visual examination, most of the dead fish has severed tail fin and had hemorrhaged gill, erosion of the caudal fin and opercular flaps. The skins of some dead fish were dry and brittle to touch and had lost their protective linings. Signs of respiratory stress before death were shown by the widely opened mouth and opercular plates for the dead fish. Mortality which occur between 72h and 96h in only two of the treatment tanks, was highest (100%) in 25.00mg/L and lowest (50%) in 12.5mg/L none was recorded in 6.25mg/L, 3.13mg/L, 1.60mg/L and 0.00mg/L which is the control. At high concentration (25mg/L), the colour of the exposed fish became darkened in their skin colour than normal.

Physicochemical Parameters of *Oreochromis Niloticus* Exposed To Acute N.P.K (20:10:10) Fertilizer

The results of the physicochemical water parameter are presented in table 2. Water parameter monitored during the experiment, varied slightly with the N.P.K (20: 10: 10) fertilizer concentration when compared with the control. The temperature was observed to have remained constant, while dissolved oxygen value has a little fluctuation, increasing from 3.50 to 3.80, then decreasing to 3.4 and increasing again to 3.60 and finally back to 30.50 in both the lowest concentration and the control. The pH values indicated that the medium changed from being strongly alkaline to normal alkaline that is from 9.25 to 7.60 and indicated that the medium is optimum for fish growth. Total dissolved solute (T. D. S) and conductivity decreased in value from solution with higher concentration of the toxicant chemical to solution with lower concentration of the toxicants.

Table 1: Mortality Of *Oreochromis Niloticus* Exposed To Different Concentrations Of N- P – K (20: 10: 10) Fertilizer For 96 Hours

Concentration	**Log Conc.**	**Mortality rate 2 replicates**				**Mortality (%)**	**Probity mortality**
		24hr	**48hr**	**72hr**	**96hr**		
25.0	1.3979	0-0	0-1	10-0	0-9	100	8.72
12.50	1.0969	0-0	0-0	0-0	0-10	50	5.00
6.25	0.7959	0-0	0-0	0-0	0-0	0	0.00
3.13	0.4955	0-0	0-0	0-0	0-0	0	0.00
1.60	0.2041	0-0	0-0	0-0	0-0	0	0.00
0.00	0.00	0-0	0-0	0-0	0-0	0	0.00



Graphical representation of the mean probit mortality rate of *Oreochromis niloticus* exposed to N. P .K (20:10:10)

Table 2: Mean Water Parameters Of *Oreochrmis Niloticus* Exposed To Acute N: P: K (20:10:10) Agro-Fertilize

TEST PARAMETER	**CONCENTRATION G/L**					
	25.0	12.50	6.25	3.13	1.60	0.00
Temperature	27.20	27.24	27.40	27.50	27.53	25.60
Ph	3.50	9.25	8.50	8.30	7.80	7.60
T.D.S	1366	3.80	3.40	3.60	3.50	3.50
Conductivity	1448	590	437	289	159	55

3. Discussion

Behavioral responses observed include attempt to jump out of the toxicant (tank), loss of equilibrium, air gulping, restlessness and finally death was recorded at the initial stage of this work. The behavioural change observed in this current investigation is in accordance with the earlier reports of Lawani, & Alawode,(1987),Goldman, & Horme, (1983), Avoaja & Oti (1997). The abnormal behaviour tends to suggest some nervous disorder and insufficient oxygen supply. Oladimeji, & Onwumere, (1987) noted hemorrhage of the fins, erosion of the caudal fins, reduced growth and gill damage in *Oreochromis niloticus* subjected to fertilizer effluents at sub lethal concentration. This gill damage reduced proper gaseous exchange in the respiratory organs and between the organs and the surrounding water, thus leadings to air gulping by the stressed fish. Reduced adenosine (A. T. P) level in the muscles of fish may cause poor swimming performance but the direct poor swimming performance was attributed to respiratory impairment, Chang, & Ouyang, (1988) reported that swimming performance may be due to stress caused by the toxin on the fish. Both respiratory impairment and stress caused by toxin were identified in the experimental fish and must have contributed in poor swimming activity. Other researchers demonstrated the effect of N. P. K fertilizer on *Clarias gariepinus,* and reported that the fish was sensitive to fertilizer treatment. This present investigation indicated that *O. niloticus* is tolerant to fertilizer treatment even at higher dose level that would not sustain Clarias species within 6 hours. Their survival rate however declined with increase in concentration and length of exposure

The water quality parameters may have probably contributed to the variation in behavioural pattern, opercular ventilation rate and the mortality of the test fish during the study period. There was a significant positive correlation between pH and dissolved oxygen values. However the other parameters tested showed no significant difference. In the case of dissolved oxygen, the treatment showed fluctuation in oxygen concentration, this could be a result of oxygen depletion with time. Chaisemartin, (1993) had earlier reported that the introduction of a toxicant into an aquatic system might decrease the dissolved oxygen concentration, which will impair respiration leading to asphyxiation and finally death. Sub lethal concentration of toxicants in aquatic ecosystem may not necessarily result to the mortality of the aquatic organisms. However, they may have significant effect on some organisms and the organs, which results in physiological dysfunction according to Ekweozor *et al*,(2001).

The observed increase in swimming activity shown by the test fish on exposure to the toxicant chemical were directly proportionate to the concentration of the N: P: K (20: 10:10). In the bioassay there was a gradual decrease in the swimming rate as the time progresses which were subsequently followed by death. Similar pattern of behaviour before death was reported by McGlashan, & Hughies, (2001).

Conclusion

Results obtained from this research showed that fingerlings of *O. niloticus* exhibit high level of tolerance to N: P: K (20:10:10). Their mortality may be as a result of accumulation of the toxicant sediments, which settles on the treatment tank, at the time of gulping in air. Although (N: P: K) fertilizers have been found to be good stimulant to the green algae and phytoplankton on which the fish feeds on, application has to be limited and restricted to pond conditions. Loss of appetite and poor food intake due to poison from the toxic water may have contributed to poor swimming activities which directly may be attributed to lack of strength.

References

APHA, American Public Health Association (1985). Standard method for examination of water and waste waters. 15th (ed). New York, N. Y. U. S. A. 1193p.

Avoaja, D. A. & Oti, F. F. (1997). Effect of sub lethal concentration of some pesticides on the growth and survival of the African Fresh water catfish-Hetero Claris. *Journal of Biotechnology, 8(1): 40 40-45*.

Bold, H. C., & M. J. Wynme, (1978). Introduction to the Algae. Prentice Hall, Inc. Englewood Cliffs, Jersey, 706p.

Chaisemartin, C., (1993). Natural adaptation of fertilizers containing heavy metals of healthy and contaminated populations of Austropolamobius paplips (LE). *Hydrobiology* **17:** 229-240.

Chan, Y. K., Housdson, P. B., & Chaisemartin, C. (1999). Application of Chemical fertilizers containing trace of heavy metals. *J. Aqua.Biol.* **21:** 112-120.

Chang, E. Y. B., & Ouyang, H., (1988). Dynamics of Dissolved Oxygen and vertical circulation in fish ponds. *Aquaculture*, **74:** 263-276.

Das, M. K., (2003). Fish health management in inland fisheries a comprehensive study.*Environ. Ecol*. **21:** 72- 78.

Diana, J. (1997).Water quality in ponds: Dynamics of pond Aquaculture. Egna, H. &Boyd, C. E. (Eds). CRC Press LLC, Boca Raton, New York 53-71.

Ekweozor, I. K. E., Bobmanuel, N. O. K & Gabriel, U. U, (2001). Sub lethal effects of ammonial fertilizer waste wasters on three commercial fish species from the Niger DeltaNigeria. *J. Appl. Sci. Environ Manag,* 5**(1):** 63-68.

Goldman, C. R., & Horme, A. J., (1983). Limnology. McGraw – Hill, New York, 464pp.

Heing, C. & Tate, S. K (1997). Heavy metal toxicity to aquatic fishes. *J. Fish Biol.* **15:**325-339.

Lawani, S. A., & Alawode, J. A., (1987).The use of fish for monitoring water pollution.,*Nig J. Biotechnol*. **4:** 5-7

McGlashan, D. K., & Hughies, J. M., (2001). Genetic evidence for historical continuitybetween population of the Australian freshwater fish *J. Fish Biol.* **59:** 55-67.

Oladimeji, A. A., & Onwumere, B. G (1987). Toxicity of treated waste waters fromthe NNPC refinery, Kaduna to *Oreochromis niloticus Nig. J. Biotechnol*, **4:** 18-24.

Sprague, J. B. (1971). Measurement of pollutant toxicity to fish, Utilizing and applyingbioassay results *Water Resources*. **4:** 3-32.

Acknowledgements

The authors are indebted to the management of Phenoma farms and Applied Biology Research Lab. Ebonyi State University is not left out for their financial support, ideas and courage throughout the period of this work.

This academic article was published by The International Institute for Science, Technology and Education (IISTE). The IISTE is a pioneer in the Open Access Publishing service based in the U.S. and Europe. The aim of the institute is Accelerating Global Knowledge Sharing.

More information about the publisher can be found in the IISTE's homepage: http://www.iiste.org

CALL FOR PAPERS

The IISTE is currently hosting more than 30 peer-reviewed academic journals and collaborating with academic institutions around the world. There's no deadline for submission. **Prospective authors of IISTE journals can find the submission instruction on the following page:** http://www.iiste.org/Journals/

The IISTE editorial team promises to the review and publish all the qualified submissions in a **fast** manner. All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Printed version of the journals is also available upon request of readers and authors.

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar