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'IMPACT OF PESTICIDES ON PHYSIOLOGICAL ACTIVITIES OF FISH CATLA CATLA IN RIVER GANGA AT GHAZIPUR DISTRICT'

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ABSTRACT

Introduction: *Long-term benefits are provided by fisheries and aquatic resources (ponds, rivers, streams, seas, and oceans). These advantages may be directly monetary ones, such as jobs, profits, and cost savings.*

Aim of the study: *The main aim of the study is Impact of Pesticides on Physiological Activities of Fish Catla in River Ganga at Ghazipur District"*

Material and method: *Two-way classification was used to analyze the data on the levels of pesticide residue in Catla (factorial experiment). To examine variations across the parameters under investigation, analysis of variance and Duncan's Multiple Range tests were used.*

Conclusion: *The study's findings indicate that the elevated pesticide toxicity levels seen in the Ganga River are attributed to the pesticide toxicity levels present in its tributaries.*

1. INTRODUCTION

1.1 OVERVIEW

Long-term benefits are provided by fisheries and aquatic resources (ponds, rivers, streams, seas, and oceans). These advantages may be directly monetary ones, such as jobs, profits, and cost savings. For instance, the seafood business offers jobs to wholesalers, retailers, and commercial fisheries. Recreational boating, sport fishing, swimming, relaxation, and appreciation of nature are some other indirect but still significant advantages of fish and aquatic environments. The aquaculture sector is plagued by safety issues and work dangers. Environmental deterioration has been brought on by certain practises. The general public believes that farmed fish are "cleaner" than equivalent wild fish. However, compared to wild fish, certain farmed fish have a significantly greater body load of hazardous compounds, both natural and man-made, such as antibiotics, pesticides, and persistent organic pollutants. Unaware consumers, especially those who are pregnant or breastfeeding, may have health issues as a result of these pollutants in fish. Numerous organizations' regulate various aspects of aquaculture practises, such as site selection, pollution control, water quality, feed delivery, and food safety. Aquaculture rules and international supervision for the business are exceedingly complicated. Fish reproductive is impacted by several PCB compounds that were employed as pesticides and are classified as anti-estrogenic and estrogenic pollutants in the environment. Insecticides are used to manage a broad range of insectivorous and herbivorous pests that, in their absence, would reduce the amount and quality of food supply. Sadly, despite their benefits, synthetic chemical compounds have considerable downsides, and pesticides pose a danger to the long-term survival of important ecosystems, disrupt the interactions between different creatures' environments, and reduce biodiversity. Organophosphate, carbamate, chlorinated hydrocarbons, pyrethroids, and nicotinoids are the main chemical categories of insecticides that are often used. Insecticide contamination of water is mostly caused by intensive farming mixed with surface runoff and drainage, generally a few weeks after application. Fish are highly vulnerable to water pollution from the environment. Therefore, contaminants like pesticides may have a major impact on several physiological and biochemical processes, and various insecticide types may seriously compromise the health of fish.

1.1.1 Pesticides Toxicity in Fish

include chemicals that are used to control a variety of species, such as insects, water weeds, and plant diseases. Fish health is negatively impacted by the use of pesticides in agricultural areas to manage pests since they are particularly hazardous to non-target creatures like fish and may occasionally cause fatality. In those days, the issue of waste water disposal was brought on by an expansion in human population and a high pace of industrialization. Large-scale fish mortality in aquatic environments has been considerably influenced by home wastes, untreated or just partly treated industrial effluents, and contaminants including heavy metals, pesticides, and various organic compounds. Several authors have examined the toxicity of pesticides in fish, and their findings indicate that these toxins have a variety of consequences when used chronically, including oxidative damage, suppression of ACHE action, histological abnormalities, developmental changes, mutagenesis, and carcinogenicity. In India, the production of pesticides increased from 5,000 tons in 1958 to 102240 tons in 1998. While this was going on, the value of the demand for pesticides in 1996–1997 was projected to be approximately Rs 22 billion (USD 0.2 billion), or roughly 2% of the global market. Since pesticides and other comparable organophosphate chemicals are abundant in the environment, they may have fatal or non-lethal effects on fish.

While naturally occurring, pesticides have been used for generations, modern synthetic pesticides were not widely produced and employed until the 1940s. Pesticides are a significant industry nowadays. The United States uses about a billion pounds of pesticides year, costing $ b billion. Pesticides are divided into a variety of classes depending on their intended application, including insecticides, fungicides, herbicides, rodenticides, nematicides, acaricides, molluscicides, homocide, and ovicide. Herbicides (for weed control), insecticides (for insect control), and fungicides (for mycotic control) are the three main pesticides. Nematicides are insecticides used to manage nematodes, or round worms that live in the soil, leaves, and stems. An acaricide is a kind of insecticide used to manage ticks and mites.

2. LITERATURE REVIEW

Hershell, George & Manager, Quality (2023) This study of the literature examines how pesticides affect different species of fish in India. In this literature, the manufacture of pesticides in India is discussed, along with the benefits and drawbacks of using pesticides. the methods through which pesticides are introduced into aquatic environments. Pesticides have the potential to cause significant economic damage by killing fish and making them unsuitable for human consumption. For people who ingest these tainted fish, there is a potential health risk.

Abdullahi, Shafiu Nafiu & Sani, Ibrahim (2021) While considered to be aquatic pollutants, pesticides play a key role in enhancing food production by effectively preventing hazardous pests with little labour and effort. These toxicants are persistent in the aquatic environment and affect fish and other non-target creatures. The emergence of pesticide-tolerant organisms necessitated the use of several pesticides, some of which carried a danger of exposure to water. Regulatory organizations like the WHO have banned the use of certain pesticides for agricultural purposes (2020). Unfortunately, a lot of items are sold in Nigeria or given away by donor organizations. Due to inadequate logistics and delays in obtaining the pesticides at the place of need, the donated pesticides often become "obsolete" while in stock. It was reviewed how pesticides affect freshwater fish in terms of categorization, bioavailability, biotransformation, and both direct and indirect impacts. The biomarkers of pesticide poisoning that result in behavioral abnormalities such irregular swimming and hyperactivity as well as other disturbances in fish physiology were addressed. Additionally, there are changes in DNA damage, histology, hematology, eating behavior, antioxidant enzyme activity fluctuations, and growth performance.

Umer, Zeshan & Parveen, Saltanat (2020) The increased use of chemicals and other harmful substances has placed the continuous existence of living things at risk due to fast industrialization and exponential population expansion. These factors have caused pollution of the air, water, soil, and food. Due to the residues of pesticides and fertilizers they carry, agricultural runoff has a negative impact on the quality of both surface and ground water. To gather data on pesticide contamination in aquatic ecosystems and its consequences on fish health, the current review article was created. Due to acute toxicity in fish, when rapid and increased death occurs, pesticide contamination is a big problem. Finney's Probit analysis statistical approach was used to get the LC50 values for mortality data for the fish species under examination. Pesticides at sub-lethal levels alter every aspect of a fish's biology, including histology, hematology, defence mechanisms, and behavior. These alterations render the fish fatal. Since some pesticides that have been outlawed but are still being used in household and agricultural practises have serious negative effects on organisms that are not intended targets, coordinated efforts, wise pesticide use, and integrated pest management are seen as the primary ways to reduce pesticide pollution in aquatic systems. To determine the fatal and sub-lethal effects of the specific pesticide employed on the survival and performance of non-target invertebrate and vertebrate species, including fish health, further study should be conducted.

V, Tamizhazhagan (2018) Indian big fish Catla is a primary food supply and a very rich source of proteins found in the Indian big carp, and it is employed in different toxicological investigations in the life science and medical fields. A broad range of knowledge on the animal has been gathered from numerous sources including books, journals, and genuine classical manuscripts, among others. Many toxicology techniques produced in lower animals applied to toxicants including herbicide, pesticide, insecticide, heavy metals, etc. Researcher, pharmacologist, and toxicological therapy may be beneficial for the security of the whole fish. The accumulated data from behavioral, hematological, enzyme, recovery, histological, immunological, and other investigations may aid researchers in focusing on the important areas of inquiry that have not yet been identified.

Ullah, Sana & Zorriehzahra, Mohammad (2014) Pesticides are often used in agriculture across the globe to increase crop output with little labour and effort. Fish are one of the most notable non-target creatures that are hazardous as a result of pesticide exposure. Most often, these pesticides' acute concentrations cause fatality, while their sublethal concentrations cause other lethal alterations. These alterations may take the form of behavioral changes in the exposed fish, such as altered feeding, attacking, or avoiding behaviors, as well as other types of alterations, such as changes in histology (liver, kidneys, gills, muscles, brain, intestine), hematology (RBCs, WBCs, or Plasma), anti-oxidant defence system (Glutathione reductase, Peroxidase, Catalase, Superoxide dismuta The fact that so many chemicals are prohibited is due to the fact that several environmental authorities are working on this issue.

3. METHODOLOGY

3.1 Study Area and Sample Collection

Fish samples were collected from ten sampling sites along the right and left banks of the Ganga river between its stretches from Ghazipur for one year on a fortnightly basis to determine the organochlorine (dichlorodiphenyltrichloroethane, dichlorodiphenyldi chloroethylene, endosulfan, and endosulfan sulphate) and nitrogen containing pesticide residues (carbofuran and cartap) There is a map ofthe research region with sample locations. Fish samples were sent to the Department of Zoology's Fisheries Research lab. To check for specific pesticide residues, three fish samples were taken and analyzed. Fish samples were dissected, descaled, and washed in dechlorinated water. Fish samples' muscle tissues were removed, chopped into tiny pieces, and frozen at 20°C for further study.

3.2 Detection and Quantification of Pesticides

By using a gas chromatograph with an electron capture detector and nitrogen (N2) flowing at a rate of 30-32 mL/minute, as well as variable temperature setups (injector temperature of 220°C; oven temperature of 150°C maintained for 4 minutes, then raised to 290°C at a rate of 8°C/minute, and then held for 10 minutes; detector temperature of 300°C), it was possible to determine the presence of six pesticides in fish flesh. The detection and measurement of pesticides used a gas chromatograph. The retention durations of the pesticides used in this investigation were first measured after injection of a 1 L reference solution. Turbochrome (Perkin Elmer, Inc., USA) software was used to construct the calibration curves for all standard pesticides, and Super cal-5 (Perkin Elmer, Inc., USA) software was used to determine the limit of detection. Following the application of normal pesticide solutions, a 1 L aliquot of concentrated fish flesh elute was injected. Based on retention time, the residue peak(s) of the injected elute(s) were identified. All test solutions' retention times were within 2% of those of typical pesticide solutions. By comparing the height/area of the residue peak(s) in the chromatograms to the height/area obtained from a known quantity of the relevant reference/standard solution, the residue amount of the test solution was calculated.

3.3 Statistical Analysis of Data

Two-way classification was used to analyse the data on the levels of pesticide residue in Catlacatla (factorial experiment). To examine variations across the parameters under investigation, analysis of variance and Duncan's Multiple Range tests were used.

4. RESULTS

4.1 Dichlorodiphenyltrichloroethane (DDT)

The mean annual concentrations of DDT in Catlacatla exhibited variations, ranging from a low of 3.240 ± 0.0274 µg g−1 at the Before Hudiaranulla fall (RB) sampling site to a high of 3.389 ± 0.0166 µg g−1 at the After Degh fall (RB) monitoring site in the river. The observed disparity in the concentration of DDT in fish muscle between the two mentioned sites was found to be statistically significant (p0.05). However, the differences in DDT concentration among the other river sampling sites, namely Bakar Mandinulla fall (LB), Before Hudiara Nulla fall (LB), After Hudiaranulla fall (LB), Balloki Headworks (LB), Ghazipur bridge (RB), After Farrukhabadnulla (RB), before Degh fall (RB), and Balloki Headworks (RB), were determinedto be statistically nons Statistically significant variations were observed in the levels of DDT in fish muscle across the sample sites Bakar Mandinulla fall (LB), Balloki Headworks (LB) and Ghazipur bridge (RB) (p0.05). The month of September 2020 exhibited the lowest mean concentration of DDT in Catlacatla at
3.041 ± 0.010µg g−1, while the month of December 2020 showed the highest mean concentration at 3.351 ± 0.004µg g−1 (Table 4.1(d) and Figure 4.3). There was a statistically significant difference ($p<0.01$) seen in the toxicity of DDT throughout these months.

Table 4.1 Variance analysis of pesticide levels in Catlacatla from the Ganga River(a)

S.O.V	D.F1	*F*-Values			
		DDT	DDE	Endosulfan	Carbofuran
Months	11	650.88**	395.44**	185.54**	30.81**
Sampling Site	9	14.22**	61.12**	115.33**	8.24**
Months × Sites	9	2028**	4.90**	22.71**	0.28^{NS}

(b)

S.E	DD	DDE	Endosulfan	Carbofuran
Months	0.0049	0.0071	0.0009	0.0129
Sampling Sites	0.005	0.0062	0.0008	0.012
Months × Sites	0.016	0.0211	0.0031	0.0390

(c) Sampling sites wise comparison of means (μg/g ± SE)

Sampling station	DDT	DDE	Endosulfan	Carbofuran
LB-1 = Shahdara bridge	3.331 ± 0.0246^{C}	2.292 ± 0.0249^{E}	0.112 ± 0.0031^{F}	0.260 ± 0.0158^{C}
LB-2 = Bakar Mandi nulla fall	3.359 ± 0.0239^{BC}	2.317 ± 0.0234^{DE}	0.116 ± 0.0027^{EF}	0.265 ± 0.0134^{BC}
LB-3 = Before Hudiara nulla fall	3.270 ± 0.0235^{BC}	2.340 ± 0.0270^{CD}	0.119 ± 0.0021^{CD}	0.297 ± 0.0160^{BC}
LB-4 = After Hudiara nulla fall	3.250 ± 0.0235^{B}	2.411 ± 0.0296^{B}	0.131 ± 0.0057^{B}	0.314 ± 0.0161^{B}
LB-5 = Balloki Headworks	3.270 ± 0.0234^{BC}	2.351 ± 0.0305^{BC}	0.135 ± 0.0051^{B}	0.304 ± 0.0171^{BC}
RB-1 = Shahdara bridge	3.240 ± 0.0274^{BC}	2.322 ± 0.0274^{DE}	0.112 ± 0.0031^{F}	0.270 ± 0.0150^{BC}
RB-2 = After Farrukhabad nulla	3.250 ± 0.0229^{BC}	2.346 ± 0.0268^{BC}	0.116 ± 0.0032^{DE}	0.299 ± 0.0150^{BC}
RB-3 = Before Degh fall	3.247 ± 0.0220^{BC}	2.341 ± 0.0263^{BC}	0.118 ± 0.0020^{D}	0.312 ± 0.0170^{AB}
RB-4 = After Degh fall	3.389 ± 0.0166^{A}	2.460 ± 0.0340^{A}	0.136 ± 0.0031^{A}	0.370 ± 0.0191^{A}
RB-5 = Balloki Headworks	3.255 ± 0.0214^{B}	2.290 ± 0.0196^{E}	0.121 ± 0.0028^{C}	0.292 ± 0.0160^{BC}

(d) Month wise comparison of means (μg/g ± SE)

Months	DDT	DDE	Endosulfan	Carbofuran
September	3.041 ± 0.010^{G}	2.180 ± 0.015^{H}	0.127 ± 0.004^{C}	0.230 ± 0.009^{D}
October	3.170 ± 0.008^{D}	2.255 ± 0.011^{F}	0.095 ± 0.002^{F}	0.150 ± 0.030^{E}
November	3.144 ± 0.005^{E}	2.234 ± 0.004^{F}	0.116 ± 0.004^{E}	0.290 ± 0.006^{C}
December	3.351 ± 0.004^{A}	2.509 ± 0.014^{A}	0.120 ± 0.003^{D}	0.360 ± 0.010^{A}
January	3.355 ± 0.002^{A}	2.392 ± 0.027^{E}	0.137 ± 0.003^{A}	0.321 ± 0.015^{AB}
February	3.347 ± 0.003^{A}	2.405 ± 0.012^{DE}	0.136 ± 0.011^{AB}	0.333 ± 0.013^{AB}
March	3.299 ± 0.012^{B}	2.419 ± 0.017^{D}	0.129 ± 0.004^{C}	0.336 ± 0.009^{AB}
April	3.344 ± 0.004^{A}	2.440 ± 0.016^{C}	0.134 ± 0.004^{B}	0.352 ± 0.006^{A}
May	3.340 ± 0.003^{A}	2.480 ± 0.013^{B}	0.134 ± 0.006^{B}	0.350 ± 0.005^{A}
June	3.341 ± 0.005^{A}	2.432 ± 0.018^{C}	0.130 ± 0.002^{B}	0.308 ± 0.011^{BC}
July	3.238 ± 0.003^{C}	2.220 ± 0.003^{F}	0.116 ± 0.002^{D}	0.339 ± 0.009^{AB}
August	3.097 ± 0.013^{F}	$2.\ 2.186 \pm 0.007^{G}$	0.099 ± 0.002^{G}	0.234 ± 0.008^{D}

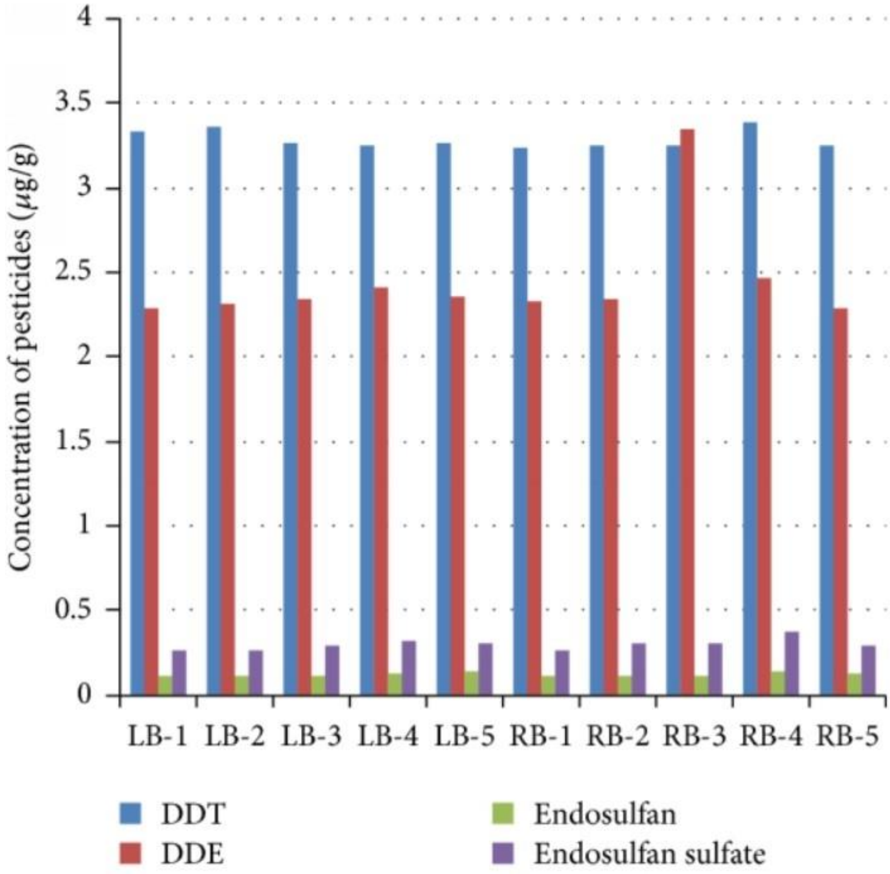

Figure 4.1 A comparison of the many pesticides found in the muscles of Catlacatla fish from 10 different Ganga river regions.

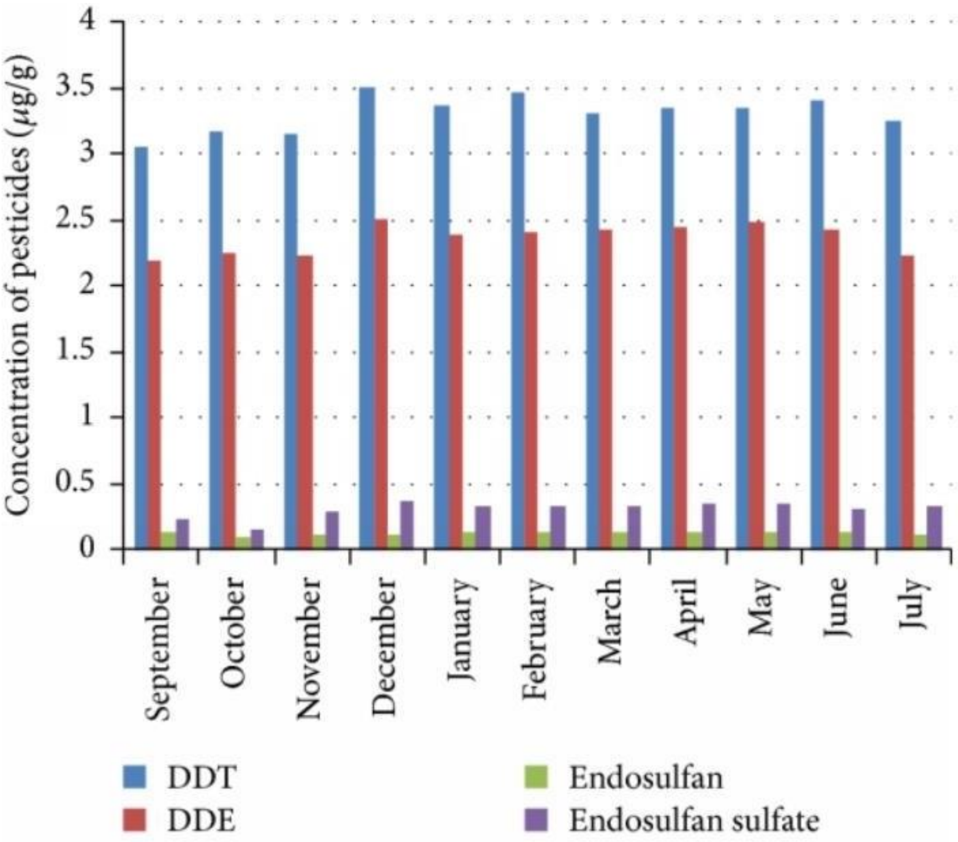

Figure 4.2 Pesticide concentrations in Catlacatla taken from the Ganga River are compared on a monthly basis.

4.2 Dichlorodi phenyl dichloroethylene (DDE)

According to the data shown in Table 4.1(c), Catlacatla specimens obtained from the Balloki Headworks (RB) river sampling site exhibited a minimal mean annual concentration of DDE of 2.290 ± 0.0196 μg g−1. Conversely, the greatest mean annual concentration of DDE, amounting to 2.460 ± 0.340 μg g−1, was observed at the After Degh fall (RB) river site. There was a statistically significant variation ($p<0.01$) seen in the toxicity of DDE across the various river sample locations. During the month of September 2020, the lowest mean concentration of DDE in Catlacatla was seen at 2.180± 0.015μg g−1. Conversely, the greatest mean concentration of DDE in Catlacatla was found during the month of December 2020, measuring 2.509± 0.014μg g−1. These findings are shown in Table 4.1(d) and Figure 4.12. There was a statistically significant change ($p<0.01$) in the toxicity of DDE throughout these months.

5. CONCLUSION

The study's findings indicate that the elevated pesticide toxicity levels seen in the Ganga River are attributed to the pesticide toxicity levels present in its tributaries. These tributaries transport a significant load of concentrated industrial, household, and agricultural waste materials, which are subsequently discharged into the main river water. Regrettably, prior to the convergence of these tributaries with the Ganga River, no measures were undertaken for the treatment of pollutants, either for their removal or degradation. The segment of the Ganga River extending from Ghazipur has been determined to be contaminated, resulting in the water being unsuitable for sustaining aquatic organisms. It is important to cultivate awareness among the general populace via various forms of media, including as print and electronic platforms, in order to foster a comprehensive understanding of the detrimental consequences associated with pesticide use. This heightened awareness is crucial in encouraging individuals to curtail or minimise their reliance on these substances. At now, it is essential to implement a continuous monitoring programme in order to address and improve the current state of affairs.

REFERENCES

1. Hershell, George & Manager, Quality. (2023). A Review Literature on Pesticides in the Fish.
2. Abdullahi, Shafiu Nafiu & Sani, Ibrahim. (2021). IMPLICATION OF PESTICIDES USAGE ON FRESHWATER FISH: A REVIEW. FUDMA Journal of Sciences. 5. 319-332. 10.33003/fjs-2021-0501-571.
3. Umer, Zeshan & Parveen, Saltanat & Shah, Zeshan. (2020). A REVIEW ON PESTICIDES POLLUTION IN AQUATIC ECOSYSTEM AND PROBABLE ADVERSE EFFECTS ON FISH. Pollution Research. 39. 309-321.
4. V, Tamizhazhagan. (2018). TOXICOLOGICAL CRITICAL REVIEW REPORT OF CATLA CATLA (HAMILTON, 1822). 7397-7402. 10.5281/zenodo.1342756.
5. Ullah, Sana &Zorriehzahra, Mohammad. (2014). Ecotoxicology: A Review of Pesticides Induced Toxicity in Fish. Advances in Animal and Veterinary Sciences. 3. 40-57. 10.14737/journal.aavs/2015/3.1.40.57.
6. Masiá, A., J. Campo, A. Navarro-Ortega, D. Barceló, Y. Picó, "Pesticide monitoring in the basin of Llobregat River (Catalonia, Spain) and comparison with historical data", Science of the Total Environment 503–504, 58–68, 2015.
7. Michelle D, "Research Associated, fisheries and wildlife", Virginia cooperative extension Virginia Experiment Station, 2009.
8. Topal, A., Atamanalp, M., Uçar, A., Oruç, E., Kocaman, EM, Sulukan, E., Akdemir, F., Beydemir, S, Kılınç, N., Erdoğan, O., Ceyhun, SB, "Effects of glyphosate on juvenile rainbow trout (Oncorhynchus mykiss): Transcriptional and enzymatic analyses of antioxidant defence system, histopathological liver damage and swimming performance", Ecotoxicology and Environmental Safety111, 206–214, 2015.
9. Mela M, Randi M, Ventura DF, Ribeiro CA, "Effects of dietary methylmercury on liver and kidney histology in the Neotropical fish hopliasmalabaricus ", Ecotoxicology Environmental Safety, 68,426-435, 2007.
10. Mata GC, Jabalpur MP, "Histopathological changes in liver of Teleost fish Catlacatla treated with 1.2% Lindane", J. Fish. And Agricola. 2(1): 17-19, 2011.