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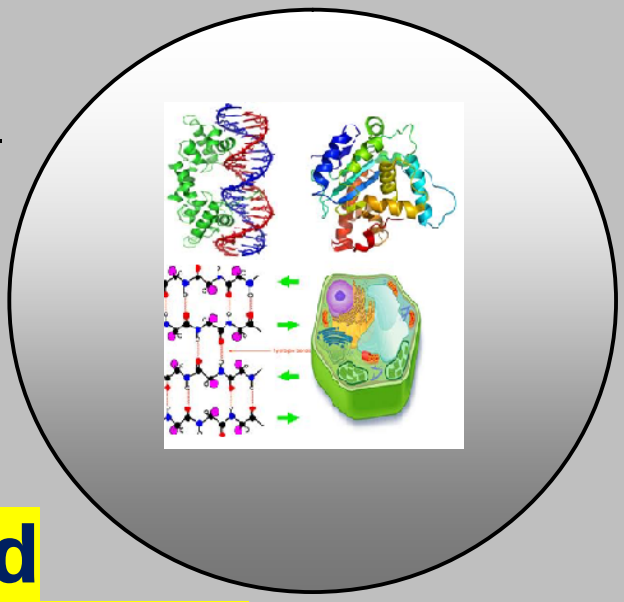

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Effects of Some Selected Pesticides on the Mortality of Tilapia Fish *(Oreochromis niloticus)*

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ABSTRACT

An experiment was conducted to study the effects of some selected pesticides on the mortality of tilapia fish (Oreochromis niloticus). We also observed water quality parameters of the experimental buckets. Six pesticides were used in this experiment. Among them three were insecticides (Malathion, Diaginon and Curatar) and three were herbicides (Amclore, Silah and Top). The pesticide Curatar had significant effect on the mortality of tilapia fish. Curatar proved to the most destructive effect on tilapia fish. It killed 1.859 out of six fingerlings. This was follwed by Diazinon, which killed 1.641 fishes. Again, Malathion followed Diazinon which also killed 1.391. After that, Silah was follwed by Malathion. Lastly Amclore (0.844) and Top (0.813) had identical toxicity in respect of killing fishes, and they killed the lowest number of fishes. The concentrations 7.5 µl or mg proved to the most poisonous effect on the mortality of tilapia fish. The mortality on the basis of concentrations was significantly highest (2.094) due to application of 7.5 µl or mg. This was followed by 5.0 µl or mg, which killed 1.688 fishes. Again, 2.5 µl or mg followed 5.0 µl or mg which also killed 1.156. Lastly in 0 µl or mg killed lowest number (0.145) of fishes. The mortality was significantly highest (1.865) after 72 hrs. this was followed by after 24 hrs., which killed 1.479 fishes. Again, after 8 hrs. followed 24 hrs. which also killed 1.083. Lastly after 1 hr. killed the lowest number (0.656) of fishes. The effects of interaction of pesticide and their concentrations, pesticides and their time of observations and lastly concentrations and their time of observations were ranged from 0.000 to 2.983, 0.1875 to 2.625 and 0.000 to 3.083 respectively. The ranges of physico-chemical parameters such as air temperature, relative humidity, water temperature, pH, dissolved oxygen, electrical conductivity and total dissolved solid of the experimental buckets were more or less similar range in all the buckets during the whole period of the experiment.
Key words: Pesticides, Mortality, Tilapia fish, Concentrations, Time interval.

INTRODUCTION

Fish and fisheries are inseparable matters in the life of the people of Bangladesh. At one time in the past the people of Bengal were popularly known as "Macche Bhate Bangali". Fisheries are an important sector of economy in Bangladesh. It plays an important role in nutrition, income generation employment and foreign exchange earnings. Another side pesticide is substances used to control pests including insects, water weeds, and plant diseases. Naturally-occurring pesticides have been used for centuries, but widespread production and use of modern synthetic pesticide did not begin until the 1940s. Today, those are big business. Pesticides are beneficial chemicals. They can protect against forest and farm crop losses and can aid in more efficient food production. But it has also some bad effects. Pesticides can reduce the availability of plants and insects that serve as habitat and food for fish and other aquatic animals. Spraying herbicides can also reduce reproductive success of fish and aquatic animals. Spraying herbicides to kill all aquatic plants can result in severely low oxygen levels and the suffocation of fish. Using herbicides to completely "clean up" a pond will significantly reduce fish habitat, food supply, dissolved oxygen, and fish productivity. Bangladesh is an agricultural country, so use of pesticide is increasing day-by-day. When pesticides enter aquatic systems, the environmental costs can be high. Fish have been main victims of pesticide poisoning. Use of pesticide is one of main factors contributing to the decline of fish and other aquatic species. The influence of the organophosphorus (OP) compound diazinon on glutathione (GSH) content and acetylcholinesterase (AChE) in tilapia (*Oreochromis niloticus*) to sublethal concentrations of diazinon for 30 days caused a reduction in total GSH and AChE activity (Elnswishy *et al*., 2007). The effect of trichlorfon on acetylcholinesterase activity and histopathology of cultivated fish *Oreochromis niloticus*, the results indicated a significant decrease in the muscular AChE activity in the treated individuals (Guimaraes *et al*., 2007). The toxicological effects of the herbicide oxyfluorfen on acetylcholinesterase in two fish species: *Oreochromis niloticus* and *Gambusia affinis*. These findings demonstrate that *G. affinis* is most tolerant to oxyfluorfen toxicity compared with *O. niloticus* (Hassanein, 2002). The biochemical and histopathological effects of glyphosate herbicide on Nile tilapia (*Oreochromis niloticus*) the organs exhibited show varying degrees of histopathological change (Jiraungkoorskul *et al*., 2003).Impacts of pesticide on aquatic animals become an important issue in many countries, but, advancement in this regard is not sufficient. Moreover, Tilapia are widely recognized as one of the most important fish species of farming in a wide range of aquaculture systems from single small scale waste feed fish ponds to intensive culture systems (Pullin, 1985). The specific objectives of this study to determine the effect of pesticides on mortality of tilapia fish *(Oreochromis niloticus)*, and observe the water quality parameters of the experimental buckets.

MATERIAL AND METHODS

The experiment was carried out in the laboratory of Environmental Science, Bangladesh Agricultural University, Bangladesh. The fish fingerlings were collected from the field laboratory of Bangladesh Fisheries Research Institute (BFRI). All the fingerlings were same variety named by GIFT tilapia and the average age of those fingerlings was 25 days. When it was collected from BFRI field laboratory to the experimental laboratory, it was carried by open plastic bucket. It always ensured for free oxygen by shaking. Fish fingerlings take play most vital role in this experiment. The mean values of length and weight of fish fingerlings were 2 ± 0.0044 and 2.32 ± 0.046 respectively. The ranges of fish fingerlings length and weight were 1.985 to 2.500 in. and 2.25 to 2.4 g. respectively.

The buckets under the study

Sixteen polyvinyl chloride (PVC) buckets were selected for conducting the research work. All the buckets having similar in size, shape, and depth. The buckets were not interconnected and had no inlet and outlets. Each of the buckets having same water holding capacity. The surface area of each of the bucket was measured by the following process; the radius of the lower and upper portions of the bucket was measured by a scale and determined value using following equation,

Surface area $_{(\text{Upper portion})} = \pi r^2_{(\text{upper portion})}$

Surface area $_{(\text{Lower portion})} = \pi r^2_{(\text{lower portion})}$

Surface area of the bucket is the most important factor for this experiment. The mean values of surface area of those experimental buckets in upper and lower portion were 78.33 ± 0.7255 and 50.27 ± 0.0094 respectively. The ranges of surface area of those experimental buckets in upper and lower portion were 78.28 to 78.54 in^2 and 50.26 to 50.29 in^2 respectively.

Materials required

Pesticide selection was done by primary survey in shops and also consults with the farmer's level. In this research work six types of pesticides were used. The specific materials of this study were:

Three different type of insecticides
Malathion 57EC,
Diaginon 60 EC, and
Curatar 5 G.
Three different types of herbicides
Amclore 5G,
Silah 500 EC, and
Top 500 EC.

Experimental design

The experiment was conducted in completely randomized design (CRD) in which were used. Among the six pesticides there insecticides (Malathion, Diaginon and Curatar) and three herbicide (Amclore, Silah and Top). Four concentration (e.g 0 µl, 2.5 µl, 5.0 µl and 7.5 µl or 0 mg, 2.5mg, 5.0mg and 7.5mg) were used per 10 liter water. There were four replication in each concentration. The data observed in every 1, 8, 24 and 72 hour's interval (Table 1).

Experimental procedure

Bucket preparation and management

All the buckets were placed in position in an open place. Each bucket was filled by 10liters of tap water. The volume of water was measured by a measuring cylinder.

Application of pesticide on the bucket water

The pesticide was added in different buckets according to experimental design. Concentration was measured by a micropipette (Micropipette, VWR Scientific products 2-2 red, made by SWISS) and digital electric balance (Mettler Toledo, serial no. PL 601-S, made in Switzerland).There was sixteen numbers of buckets. Insecticides or herbicides were applied in each bucket in one concentration but every four buckets were having similar concentrations.

Stocking of fish

Six fingerlings of GIFT tilapia were released in each bucket. Stocking of fish was done very carefully and also taken to gradually acclimate the fish to bucket conditions.

Data observation

Observation of dead fish

The number of dead fishes was observed by eye inspection according to experimental design (after 1hr, 8hrs, 24 hrs and 72hrs).

Study of water quality parameters

Water quality parameters of the experimental buckets were recoded throughout the experimental period. Physico-chemical parameters such as air temperature (ºC), relative humidity (%), water temperature (ºC), dissolved oxygen (mg/l), pH,electrical conductivity (µS/cm), total dissolved solid (ppt).

Study of physical factors

Water temperature

Water temperature was recorded by digital dissolved oxygen meter (portable dissolved oxygen meter, session TM 6, serial no. 51850-18, made in USA).

Study of chemical factors

pH

pH values were determine by a pH meter (Portable pH meter, Milwaukee smart pH meter, serial no. 277191, made in USA) for measuring pH value of the bucket water, the sensor of the pH meter was poured in the bucket water.

N.B:

Range - 0.0 to 14.0 pH
Resotution - 0.1 pH
Accuracy - ± 0.2 pH
Calibration - Manual two points
Battery - 1 x 9V.

Dissolved Oxygen (DO)

The values of dissolved oxygen were measured by a digital dissolved oxygen meter (Portable dissolved oxygen meter, sension TM6, serial no. 51850-18, made in USA). When values of dissolved oxygen were measured then the sensitive sensor of this instrument was poured in the buckets water.

Electrical conductivity and total dissolved solid

Electrical conductivity values were recorded by a electrical conductivity meter (Portable EC meter, HANNA DiST 3, serial no. HI 98303, made in USA). The values of total dissolved solid (TDS) were measured by a TDS meter (Portable TDS meter, HANNA DiST 2, serial no. HI 98302, made in USA). For measuring EC and TDS values, the sensor portion of those instruments were poured in the bucket water.

Bio- security maintain

Bio-security maintains is one of the most essential parts of my experiment, the buckets were thoroughly washed by detergent and hot water. After it all the buckets were kept in open place for sun-drying, because by sun-drying the micro-organisms and hazardous materials were destroyed.

Statistical analysis

The collected data for various characters were statistically analyzed using MSTAT Computer Package Program. All the collected data for mortality were analyzed statistically following analysis of variance (ANOVA) technique and the mean difference were adjudged by DMRT (Duncan's Multiple Range Test) and ranking was indicated by letters.

RESULTS

Mortality number

Among the six types of pesticides the effects of pesticide on the mortality was in insecticide for malathion (1.391), diazinon (1.641), curator (1.859), and in herbicide for amclore (0.844), silah (1.078) and top (0.813). The effects of concentrations on the mortality was in concentration 0, 2.5, 5.0 and 7.5 µl or mg were 0.145, 1.156, 1.688 and 2.094 respectively and the effects of time of observations on the mortality was after 1 hour, 8 hours, 24 hours and lastly after 72 hours were 0.656, 1.083, 1.479 and 1.856 respectively.

The effects of interaction of pesticide and their concentrations, pesticides and their time of observations and lastly concentrations and their time of observations were ranged from 0.000 (P_3C_1) to 2.983 (P_3C_4), 0.1875 (P_4T_1) to 2.625 (P_3T_4) and 0.000 (C_1T_1) to 3.083 (C_4T_4) respectively. So, from this present study, it can be concluded that, the curatar (insecticide) and silah (herbicide) was more effective to create poisonous environment for the fish life. On the basis of concentrations the 7.5 µl or mg had more toxic effects than the other concentration and on the basis of time of observations the effects of mortality were significantly higher in after 72 hours observation than other observation time.

Water quality Parameters

The water quality parameters are very important for survival, growth and production of fish. The ranges of water quality parameters so far recorded were within expectable ranges and they were described below.

Water temperature

Water temperature is the most important factor, which influences the physical, chemical and biological condition of water body. During the period of study temperature showed 72 hrs variations in all the chemicals some time it was increasing and sometime it was decreasing trends towards end of the experiment. These trends in temperature might be associated with the change in weather from daytime and nighttime. The findings of the present study agree with the findings of Dewan (1973) and Ali *et al*. (1982). The mean values of water temperature were recorded in all chemicals were around 21.6 to 31.1^{0}C and this findings was strongly by Mumtazuddin *et al*. (1982), Ali *et al*. (1982) stated that water temperature within the range of 20.5^{0}C to 36.^{0}C is favorable for fish culture. Rahman *et al*. (1982) and Wahab *et al*. (1995) also said that water temperature ranging from 26.06 to 31.97^{0}C is the best. The ranges of water temperature recorded in the present study were almost similar to the ranges of temperature recorded by them.

Dissolved Oxygen

Dissolved oxygen is other vital chemical parameters of water for fish. The highest value of dissolved oxygen was observed in 8 the November, during the present of study. The results of the Present study agree with the findings of Dewan (1973) and Islam *et al*. (1978) recorded the highest concentration of dissolved oxygen during winter month. But the ranges of dissolved oxygen recorded in the present study 5 to 8.3 mg/l was found to lie within productive range (5.4 to 8.25 ppm) reported by Alikhunhi (1957), George (1961) and Ali *et al*. (1982). But the ranges of dissolved 2.2 to 7.1 mg/l and 3.40 to 8.79 mg/l respectively. The dissolved points (3 ppm or low) as stated by Ellis (1937), Haque (1995), Azam (1996), found more or less similar results of this present of study. According to Rahman (1992) dissolved oxygen content of fish production should be 5 ppm or more. From the above findings, it can be concluded that the dissolved oxygen content of the experimental buckets were within the productive range of fish culture.

Table 1. The layout of the experiment.

Brand of pesticides	Concentration (µl or mg)	Replication	Different Experimental Parameter : Dead fish,D.O,Water temp.,pH,EC,etc. Hours of observations (hr.)			
			1 hr	8 hrs	24 hrs	72 hrs
Malathion	0	4	**Data was recorded**	**Data was recorded**	**Data was recorded**	**Data was recorded**
	2.5	4	✓	✓	✓	✓
	5	4	✓	✓	✓	✓
	7.5	4	✓	✓	✓	✓
Diaginon	0	4	✓	✓	✓	✓
	2.5	4	✓	✓	✓	✓
	5	4	✓	✓	✓	✓
	7.5	4	✓	✓	✓	✓
Curatar	0	4	✓	✓	✓	✓
	2.5	4	✓	✓	✓	✓
	5	4	✓	✓	✓	✓
	7.5	4	✓	✓	✓	✓
Amclore	0	4	✓	✓	✓	✓
	2.5	4	✓	✓	✓	✓
	5	4	✓	✓	✓	✓
	7.5	4	✓	✓	✓	✓
Silah	0	4	✓	✓	✓	✓
	2.5	4	✓	✓	✓	✓
	5	4	✓	✓	✓	✓
	7.5	4	✓	✓	✓	✓
Top	0	4	✓	✓	✓	✓
	2.5	4	✓	✓	✓	✓
	5	4	✓	✓	✓	✓
	7.5	4	✓	✓	✓	✓

pH

During the period of study the pH values of water showed less variation among the treatments. The pH values of the experimental buckets varied from 6.2 to 7.9.

Azam (1996), Nahar (1997), Kawsar (1998), Tanseem (1998), Rashid (1999), Israfil (2000) found almost similar results. Swingle (1967) stated that pH 6.5 to 9.0 is suitable for fish culture and pH more than 9.5 is unsuitable because free co_2 is not available in this situation.

At pH 11 fishes die, pH less than 6.5 reduces fish growth, physiological activities and tolerance to toxic substances. According to Boyd (1982) the acidic and alkaline death points for fish are about pH 4 and 11 respectively from the above discussion, it can be concluded that all the experimental buckets under the study were suitable for fish culture on the basis of pH.

Electrical conductivity

Electrical conductivity is another chemical parameter of water for fish culture. The results of the present study agree with the findings of Wilcox. In this experiment the ranges of electrical conductivity were 401 to 450 µS/cm, which was found to lie within good range (250 to 750 µS/cm) reported by Wilcox.

Total dissolved solids

In this present study, Total dissolved solids (TDS) has not any specific effects. The ranges of TDS in this experiment were 0.18 to 0.21 ppt, which was found to be within the permissible range (<400mg/l) observed by Meade (1989).

DISCUSSION

Mortality number

The mortality of tilapia fishes among different insecticides and herbicides, different concentrations, different time of observation and their interactions were given Table 2 to 7. From the Analysis of Variance it reveals that there was significant variation due to application of pesticide at 1% level of probability (Table 2).

Table 2. Analysis of Variance of mortality of tilapia fish.

Source	Degrees of freedom	Sum of squares	Mean square
Pesticide (A)	5	59.333	11.867**
Concentration (B)	3	204.438	68.146**
Pesticide × Concentration (AB)	15	27.438	1.829**
Time of observation (C)	3	77.646	25.882**
Pesticide × Time of observation (AC)	15	9.229	0.615**
Concentration × Time of observation (BC)	9	19.583	2.176**
Pesticide × Concentration × Time of observation (ABC)	45	8.167	0.181^{NS}
Error	288	72.000	0.250

Table 3. Effects of pesticide on the mortality of tilapia fish.

Pesticides	Mortality (no.)
Malathion	1.39c
Diazinon	1.64b
Curatar	1.859a
Amclore	0.843e
Silah	1.078d
Top	0.812e
CV (%)	9.34 %

In column figures having common letter(s) or without letter do not differ significantly whereas the figures bearing dissimilar letter(s) differ significantly at 1% level of probability.

The mortality of tilapia fish was significantly highest (1.859) due to application of Curatar. This was follwed by Diazinon, which killed 1.641 fishes. Again, Malathion followed Diazinon which also killed 1.391. After that, Silah was follwed by Malathion. Lastly Amclore (0.844) and Top (0.813) had identical toxicity in respect of killing fishes, and they killed the lowest number of fishes (Table 3).

The mortality of tilapia fish was significantly highest (2.094) due to application of 7.5 µl or mg. This was followed by 5.0 µl or mg, which killed 1.688 fishes. Again, 2.5 µl or mg followed 5.0 µl or mg which also killed 1.156. Lastly in 0 µl or mg killed lowest number (0.145) of fishes.

The interaction of pesticides and their concentration on the mortality of tilapia fish exhibited significant variation (Table 2). Their interaction ranged from 0.000 to 2.938. From table 4, it was observed that the highest number of mortality was obtained from P_3C_4. This was followed by P_2C_4 (2.750), P_3C_3 (2.563), P_2C_3 (2.125), P_1C_4 (2.063), P_3C_2 (1.938), P_1C_3 (1.750), P_5C_4 (1.750), P_1C_2 (1.563), P_2C_6 (1.438), P_5C_3 (1.375), P_6C_4 (1.313), P_6C_3 (1.188), P_4C_3 (1.125), P_5C_2 (1.000), P_6C_2 (0.625), P_4C_2 (0.375), P_2C_1 (0.250), P_1C_1 (0.1871), P_5C_1 (0.1871), P_6C_1 (0.125), P_4C_1 (0.125) and P_3C_1 (0.000). But some interactions were statistically identical; those were shown in Table 4. The lowest number of mortality was noticed in P_3C_1.

The interaction of pesticides and their time of observations on the mortality of tilapia fish exhibited significant variation (Table 2). Their interaction ranged from 0.1875 to 2.625. From table 5, it was observed that the highest number of mortality was obtained from P_3T_4 which was statistically identical with P_2C_4. This was followed by P_2T_3 (2.063), P_1T_4 (1.938), P_2T_3 (1.813), P_3T_2 (1.688), P_44_2 (1.563), P_2T_2 (1.500), P_1T_3 (1.438), P_5T_4 (1.375), P_5T_3 (1.375), P_1T_2 (1.188), P_4T_3 (1.188), P_3T_1 (1.063), P_6T_3 (1.000), P_1T_1 (1.000), P_5T_2 (1.000), P_2T_1 (0.750), P_6T_2 (0.687), P_5T_1 (0.562), P_4T_7 (0.437), P_6T_1 (0.375) and P_4T_1 (0.187). But some interactions were statistically identical; those were shown in Table 5. The lowest number of mortality was noticed in P_4T_1.

Table 4. Effects of interaction of pesticides and their concentrations on the mortality of tilapia fish.

Interaction P × C	Mortality (no.)
$P_1 \times C_1$	0.187j
$P_1 \times C_2$	1.563def
$P_1 \times C_3$	1.750cde
$P_1 \times C_4$	2.063c
$P_2 \times C_1$	0.250j
$P_2 \times C_2$	1.438efg
$P_2 \times C_3$	2.125c
$P_2 \times C_4$	2.750ab
$P_3 \times C_1$	0.000j
$P_3 \times C_2$	1.938cd
$P_3 \times C_3$	2.563b
$P_3 \times C_4$	2.938a
$P_4 \times C_1$	0.125j
$P_4 \times C_2$	0.375ij
$P_4 \times C_3$	1.125gh
$P_4 \times C_4$	1.750cde
$P_5 \times C_1$	0.187j
$P_5 \times C_2$	1.000h
$P_5 \times C_3$	1.375efgh
$P_5 \times C_4$	1.750cde
$P_6 \times C_1$	0.125j
$P_6 \times C_2$	0.625i
$P_6 \times C_3$	1.188fgh
$P_6 \times C_4$	1.313fgh
CV (%)	9.34 %

In column figures having common letter(s) or without letter do not differ significantly whereas the figures bearing dissimilar letter(s) differ significantly at 1% level of probability.

P_1 = Malathion C_1 = 0 µl or mg
P_2 = Diazinon C_2 = 2.5 µl or mg
P_3 = Curatar C_3 = 5.0 µl or mg
P_4 = Amclore C_4 = 7.5 µl or mg
P_5 = Silah
P_6 = Top

Table 5: Effects of interaction of pesticides and their time of observations on the mortality of tilapia fish.

Interaction P × T	Mortality (no.)
$P_1 \times T_1$	1.000hi
$P_1 \times T_2$	1.188fgh
$P_1 \times T_3$	1.438defg
$P_1 \times T_4$	1.983bc
$P_2 \times T_1$	0.750ij
$P_2 \times T_2$	1.500def
$P_2 \times T_3$	1.813bcd
$P_2 \times T_4$	2.500a
$P_3 \times T_1$	1.063ghi
$P_3 \times T_2$	1.688bcde
$P_3 \times T_3$	2.063b
$P_3 \times T_4$	2.625a
$P_4 \times T_1$	0.187k
$P_4 \times T_2$	0.437jk
$P_4 \times T_3$	1.188fgh
$P_4 \times T_4$	1.563cdef
$P_5 \times T_1$	0.562jk
$P_5 \times T_2$	1.000hi
$P_5 \times T_3$	1.375efgh
$P_5 \times T_4$	1.375efgh
$P_6 \times T_1$	0.375jk
$P_6 \times T_2$	0.687ij
$P_6 \times T_3$	1.000hi
$P_6 \times T_4$	1.188fgh
CV (%)	9.34 %

In column figures having common letter(s) or without letter do not differ significantly whereas the figures bearing dissimilar letter(s) differ significantly at 1% level of probability.

P_1 = Malathion, P_2 = Diazinon ,P_3 = Curatar, P_4 = Amclore ,P_5 = Silah ,P_6 = Top
T_1= 0 µl or mg, T_2 = 2.5 µl or mg, T_3 = 5.0 µl or mg, T_4 = 7.5 µl or mg

Table 6. Effects of interaction of concentrations and their time of observations on the mortality of tilapia fish.

Interaction C × T	Mortality (no.)
$C_1 \times T_1$	0.000h
$C_1 \times T_2$	0.083h
$C_1 \times T_3$	0.208h
$C_1 \times T_4$	0.291h
$C_2 \times T_1$	0.583g
$C_2 \times T_2$	1.000ef
$C_2 \times T_3$	1.292de
$C_2 \times T_4$	1.750c
$C_3 \times T_1$	0.916f
$C_3 \times T_2$	1.458d
$C_3 \times T_3$	2.042c
$C_3 \times T_4$	2.333b
$C_4 \times T_1$	1.125ef
$C_4 \times T_2$	1.792c
$C_4 \times T_3$	2.375b
$C_4 \times T_4$	3.083a
CV (%)	9.34 %

In column figures having common letter(s) or without letter do not differ significantly whereas the figures bearing dissimilar letter(s) differ significantly at 1% level of probability.

$C_{1=}$ 0 µl or mg $T_{1=}$ 0 µl or mg
$C_{2=}$ 2.5 µl or mg $T_{2=}$ 2.5 µl or mg
$C_{3=}$ 5.0 µl or mg $T_{3=}$ 5.0 µl or mg
$C_{4=}$ 7.5 µl or mg $T_{4=}$ 7.5 µl or mg

The interaction of concentrations and their time of observations on the mortality of tilapia fish exhibited significant variation (Table 2). Their interaction ranged from 0.000 to 3.083. From table 6, it was observed that the highest number of mortality was obtained from C_4T_4.

This was followed by C_4T_3 (2.375), C_3T_4 (2.333), C_3T_3 (2.042), C_4T_2 (1.792), C_24_2 (1.750), C_3T_2 (1.458), C_2T_3 (1.292), C_4T_1 (1.125), C_2T_2 (1.000), C_3T_1 (0.916), C_2T_1 (0.583), C_1T_4 (0.291), C_1T_3 (0.208), C_1T_2 (0.083) and C_1T_1 (0.000). But some interactions were statistically identical; those were shown in Table 6. The lowest number of mortality was noticed here in C_1T_1.

Water Quality Parameters

The quality of water viz. dissolved oxygen, water temperature, pH, electrical conductivity total dissolved solid during the study period have been recorded and shown in Table 7 to 10.

Dissolved Oxygen (DO)

Dissolved oxygen concentration during the study period of the water under different chemicals varies from 5 to 8.3 mg/l. The mean values of dissolved oxygen concentration in Malathion, Diazinon, Curatar, Amclore, Silah and Top were 6.41± 0.82, 6.74± 0.75, 5.96±0.69, 6.33±0.81, 6.10±0.58 and 6.90±0.63 respectively (Table 7). The highest and lowest dissolved oxygen content in water were observed in the Diazinon and Curatar respectively. The ranges of dissolved oxygen concentration among different chemicals were 5.45 to 7.98 mg/l in Malathion, 5.6 to 8.3 mg/l in Diazinon, 5 to 7.4 mg/l in Curatar, 5.3 to 7.95 mg/l in Amclore, 5.2 to 7.2 in Silah and 5.7 to 8.2 mg/l in Top.

Table 7. The mean values of dissolved oxygen concentration as observed due to application of pesticides.

Statistical values	Dissoloved oxygen (mg/l)					
	Insecticide			Herbicide		
	Malathion	Diazinon	Curatar	Amclore	Silah	Top
Maximum range	7.98	8.3	7.4	7.95	7.2	8.2
Minimum range	5.45	5.6	5	5.3	5.2	5.7
Mean ± standard deviation	6.41± 0.82	6.74± 0.75	5.96±0.69	6.33±0.81	6.10±0.58	6.90±0.63

When water temperature was increase then dissolved oxygen content in the water was decrease and also increase when water temperature decrease. The dissolved oxygen concentrations were fluctuate in different time because the experimental bucket was positioned in different place so sunlight heat in different place in different and then dissolved oxygen was increase or decrease with place.

Water temperature

The water temperatures of the water under different buckets were nearly same. The mean values of water temperature in the Malathion. Diazion, Curatar, Amclore, Silah and Top were 26.64±1.306, 27.38±1.149, 27.87±0.867, 27.19±2.428, 26.15±2.523, and 26.16±1.107 respectively (Table 8). The maximum and minimum water temperatures were recorded in Malathion (31.1^{0}C) on 7th November, 2008 and in Silah (21.6^{0}C) on 17th November, 2008 respectively. The fluctuations of water temperature in different chemicals were 25.45 to 31.1^{0}C in Malathion, 25.8 to 30.2^{0}C in Diazionon, 26.2 to 29.5^{0}C in Curatar and 22.8 to 29.5 in Amclore 21.6 to 28.6^{0}C in Silah and 24.5 to 28.6^{0}C in Top.

Table 8. The mean values of water temperature as observed due to application of pesticides.

Statistical values	Water temperature (^{0}C)					
	Insecticide			Herbicide		
	Malathion	Diazinon	Curatar	Amclore	Silah	Top
Maximum range	31.1	30.2	29.5	29.5	28.6	28.6
Minimum range	25.4	25.8	26.2	22.8	21.6	24.5
Mean ± standard deviation	26.64±1. 306	27.38±1.14 9	27.87±0.867	27.19±2.428	26.15±2.523	26.16±1.107

Water temperature was varies with intensity of sunlight length, when the experiment was started then 10 or 11 o'clock in time, so intensity of sunlight is very high but after 8 hr, when the sun was set down then intensity of sunlight is zero and for this the water temperature was low than the time 1 hr. So, after 24 hrs and lastly 72 hrs. water temperature was high because intensity of sunlight. The water temperature was fluctuated in same time in same concentration because the bucket which was used in this experiment those are positioned in different place, so water temperatures increased or decreased with intensity of sunlight length.

Electrical conductivity (EC)

The values of electrical conductivity of different chemicals during the study period varied from 401 to 450 µS/cm. The mean values of electrical conductivity in the Malathion, Diazion, Curator, Amclore, Silah and Top were 432.78±7.504, 428.09±9.729, 428.81±3.538, 437.03±4.546, 412.29±5.747 and 440.85±3.760 respectively (Table 9). The highest and the lowest values of EC were observed in the Top a Silah respectively.

The electrical conductivity values varied in different chemicals were 422 to 447 µS/cm in Malathion, 411 to 445 µS/cm in Diazinon, 422 to 435 µS/cm in Curatar and 426 to 445 µS/cm in Amclore, 401 to 424 in Silah and 433 to 450 in Top. The values electrical conductivity was fluctuate because when water temperature was decrease then electrical conductivity was increase.

Table 9. The mean values of electrical conductivity as observed due to application of pesticides.

Statistical values	Electrical conductivity (µS/cm)					
	Insecticide			Herbicide		
	Malathion	Diazinon	Curatar	Amclore	Silah	Top
Maximum range	447	445	435	445	424	450
Minimum range	422	411	422	426	401	433
Mean ± standard deviation	432.78±7.504	428.09±9.729	428.81±3.538	437.03±4.546	412.29±5.747	440.85±3.760

pH

During the study period, the pH values of water under different chemicals were found to be more or less netural. The mean values of pH in the Malathion. Diazinon, Curatar, Amclore, Silah and Top were 6.949±0.148, 6.490±0.126, 7.221±0.110, 7.376±0.301, 6.639±0.123 and 7.257±0.187 respectively (Table 10). The maximum and minimum pH values were recorded in Amclore (7.9) and Diazinon (6.2) respectively. The fluctuations of pH values among different chemicals were 6.6 to 7.2 in Malathion, 6.2 to 6.8 in Diazinon, 7 to 7.4 in Curatar, 7 to 7.9 in Amclore, 6.4 to 6.8 in Silah and 7 to 7.5 in Top.

Table 10. The mean values of pH as observed due to application of pesticides.

Statistical values	pH					
	Insecticide			Herbicide		
	Malathion	Diazinon	Curatar	Amclore	Silah	Top
Maximum range	7.2	6.8	7.4	7.9	6.8	7.5
Minimum range	6.6	6.2	7	7	6.4	7
Mean ± standard deviation	6.949±0.148	6.490±0.126	7.221±0.110	7.376±0.301	6.639±0.123	7.257±0.187

Total dissolved solid (TDS)

The value of total dissolved solid during the study period of the water under different chemicals varies from 0.18 to 0.21 ppt in all chemicals. In this experiment, there were no any specific effects of total dissolved solid.

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