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ROTENONE AND ITS USE IN ERADICATION OF UNDESIRABLE FISH FROM PONDS

KAZI AZIZUL HAQUE

Freshwater Fisheries Research Station, Chandpur

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Rotenone, its origin and use are described. Results of application of the chemical to three ponds of the Fish Seed Multiplication Farm at Jamalpur, Mymensingh, for eradication of undesirable species are given. Rotenone takes time to reach the deep bottom of ponds in absence of any effective agitation of water. It was observed that snakes, frogs and crustaceans are not readily affected by this plant derivative as they can escape the action through terrestrial respiration. A list of fishes and other aquatic organisms in order of their susceptibility to rotenone is presented. A concentration of 1.0 p.p.m. at summer temperature, around 30°C in this region, was found adequate to kill fishes.

In pond management, piscicide is used for removal of undesirable species and thining out excessive fish population due to rapid reproduction. Piscicidal action is preferred to dewtering and drying of pond bottom because the latter process is uneconomic and may result in loss of fertility of the pond. Rotenone is a widely known piscicide. It is a white compound ($C_{25}H_{22}O_6$) extracted mostly from plants of family Leguminosae. According to Gunther and Jeppson[3] the important genera are *Derris*, *Lonchocarpus*, *Milletia*, *Mundulea* and *Tephrosia*. *Derris* grows in the Far East. Two species, *Derris ellipitica* and *Derris malaccensis* are cultivated. *Lonchocarpus* are found in south and central America. Ong[4] states that *Tephrosia* is widely distributed in Africa, Australia, Asia and North America. Rotenone was first isolated from a *Derris* species in 1902 and named after a local Japanese plant 'Rohten'. Subsequently the compound was extracted from the same and some other sources. Gunther and Jeppson[3] further state that different species of plants in their different parts contain different concentrations of active material. Greatest single attribute of rotenone is its specificity to fish when used in recommended dosage. According to Rounsefell and Everhart[5] rotenone is apparently harmless to plants and higher vertebrates in usual dosage and the affected fish is not rendered inedible. Bennet[2] states that a concentration of 0.5 p.p.m. of derris powder with 5% rotenone should be lethal to fish. However, experience with market products has shown that it is risky to depend upon a dosage of less than 1 p.p.m. to give a complete kill of fish. Rounsefell and Everhart[5] further state that rotenone is more lethal at higher temperature and have been found ineffective below 48°F. The chemical is somewhat more toxic in acid than in alkaline water. Toxicity is more quickly lost in hard, alkaline water than in acidic soft water. The chemical has not yet found wide use in fishery management in this country. Not much work on the application of the chemical for pond management and other fisheries investigation has been reported. The present study was undertaken to determine the dosage of rotenone necessary for eradication of undesirable species and also to find out susceptibility of different indigenous species to this plant derivative.

Materials and Methods

Rapid multiplication and excessive growth of miscellaneous fishes, particularly *Tilapia mossambica*, have been impeding the production of the Fish Seed Multiplication Farm ponds at Jamalpur in the district of Mymensingh. Three ponds of the farm were selected for rotenone treatment with a view to complete eradication of the fish population. Emulsifiable cube root containing 5% rotenone, 11% other cube extracts and 84% inert ingredients, manufactured by Chemical Insecticide Corporation, New Jersey, U.S.A., under the trade name Chem. Fish Special O.F. was used at concentrations 1.0 p.p.m., 1.5 p.p.m. and 2.0 p.p.m. respectively on the 22nd and 23rd of May, 1970. The ponds had the original numbering 2, 4 and 5. Methods described by Rounsefell and Everhart[5] and Swingle[6] have been followed. All the ponds were of rectangular shape. Hence, the area was determined by taking average measurements of length and width through the waterline by a 100-foot measuring tape. Average depth was estimated by taking at least 3 depth readings from different parts of the ponds with the help of a bamboo pole. Volume of water in each of the pond was estimated from the area and average depth. Requirement of rotenone for the desired concentration was calculated. The desired quantity of rotenone was weighed in a small container by a spring balance. The measured rotenone was then poured into a steel drum wherein pond water was added to liquefy the mixture. The mixture was then spread over the surface water in the ponds. Wind direction at the time of application of the chemical was taken into consideration and care was taken that no amount of the piscicide is lost due to wind.

Before actual application of the chemical in the pond, data in respect of water and air temperature and pH of pond water was recorded. Temperature record in the afternoon was also noted. Water and air temperature was recorded at 26°C and 28°C respectively in the morning between 6-00 hr. to 8-00 hours at 33°C and 34.5°C respectively in the afternoon at 16-00 hours. In all the ponds the water was alkaline, pH ranging from 8.5 to 9.4. Table 1 below shows the average depth of water, estimated volume of water, quantity of rotenone applied and the estimated concentration of rotenone used in each pond.

TABLE 1.—TOTAL QUANTITY AND ESTIMATED CONCENTRATION OF ROTENONE APPLIED AGAINST DEPTH AND VOLUME OF WATER IN EACH POND.

Pond No.	Average depth (ft)	Vol. of water (ft^3)	Quantity of rotenone applied (lb)	Estimated conc. of rotenone (p.p.m.)
4	3ft 11 in	44246.6	2.74	1.0
5	3ft 11 in	43866.6	5.44	2.0
2	7ft 4 in	105295.6	9.75	1.5

Immediately after the chemical was spread, water was agitated by beating with bamboo poles. Collection of affected fish started as soon as they appeared at the surface. First collection was completed within an hour of rotenone application and the second collection was done between 15-00 hours to 16-00 hours the same day. A third collection was necessary in pond No. 2 and was conducted the next morning. The fish collected was grouped species-wise and weight recorded before disposal. Some fishes of the first collection being fresh and edible were used for organoleptic test and the remaining fishes sent to the market for sale. Fishes of the second and third collections being decomposed were thrown away. The ponds were kept under observation for at least two days subsequent to rotenone treatment.

Results and Discussion

The treatment was conducted in summer days in May. Water temperature in all the ponds was high enough to ensure good result. In all the ponds fishes showed signs of distress within 5–10 min of application of the chemical. It was found that the *Cyprinid* fishes were the first to be in distress and appeared at the surface. Then other fishes like *Tilapia*, *Mystus*, *Glossogobius*, *Wallago* etc. were found to come to the surface gradually. One uncommon *Cyprinid* fish of genus *Labeo* was caught. The fish was later identified as *Labeo diplostomus*. The species was not expected in the Fish Seed Farm ponds. The entry might have occurred alongwith other fry brought from the river Jamuna/Brahmaputra for nursing and rearing in the ponds.

In the course of removal, some small prawns also were caught in live condition during first collection. Seining of ponds No. 4 and 5 approximately 48 hr after treatment brought quite a good number of these small prawns unaffected by the action of the chemical. One aquatic snake was found dead after about 48 hr in pond No. 4 whereas another snake was seen entering the water of the same pond from its bank at about the same time. Therefore, the effect of rotenone on aquatic snake is not clear. It might be that the rotenone was effective on the snake that lived in the pond and the snake that entered the pond was an outsider and not an inhibitant of the pond. There were number of small frogs in the ponds. As a result of rotenone treatment many frogs died but equally good number were found to escape action of the chemical. The frogs were found to rest on the shore along the waterline. Attempts to drive them to water were not successful. Ineffectiveness or partial effectiveness of rotenone to snakes and frogs can be attributed to the fact that these reptiles and amphibians are adapted to land respiration. As they smell any uneasiness in their aquatic life, they come to the shore and their respiration is not affected. The effect on prawns (*Palaemon* sp.) may also perhaps be explained similarly although these animals can live out of water only as long as their gills remain moistened.

Total quantity of fish removed during successive removal is given in Table 2.

The recovery does not give any indication of the production because the ponds were not stocked for the purpose of raising a good crop. Besides, the ponds were netted several times to transfer the young carps to another pond for culture. However, there are some additional points indicative of the result of rotenone application.

Only in pond No. 2, the deepest of the three, third removal was necessary. Apparently, agitation by beating with bamboo poles did not make the chemical to reach the bottom of the pond readily as it took sometime to affect the bottom fish fauna. Further evidence of this is exhibited in the larger harvest of *Cirrhina mrigala*, a bottom dweller from the same pond. In the other two shallow ponds, quantity in second removal of this species was lesser than the first.

The only *Catla catla* caught from the same pond was seen in distress a few minutes after the pond was treated with the poison but then it disappeared only to come to the surface in completely decomposed condition next morning. Evidently, the fish was affected right after poisoning but rested at the bottom dead. The only *Wallago attu* was taken out from the pond during second removal

TABLE 2.—QUANTITY OF EACH SPECIES OF FISH TAKEN OUT FROM THE THREE PONDS WITH ROTENONE DURING SUCCESSIVE REMOVALS.

Pond	Species	Quantity of fish removed (kg)		
		1st	2nd	3rd
2	*Cirrhina mrigala*	9.450	26.650	0.380
	Labeo rohita	2.550	—	—
	Barbus sp.	5.150	0.050	—
	Cirrhina reba	0.900	—	—
	Glossogobius giuris	0.850	0.200	0.200
	Amblypharyngodon mola	0.375	0.250	—
	Wallago attu	—	2.600	—
	Catla catla	—	—	1.100
	Tilapia mossambica	5.150	0.100	2.010
	Mastacembalus pancalus	0.250	—	—
	Palaemon sp.	0.150	—	—
4	*C. mrigala*	8.750	3.750	—
	L. rohita	1.900	—	—
	C. reba	8.50	—	—
	Labeo diplostomus	0.080	—	—
	Barbus sp.	0.050	—	—
	T. mossambica	3.250	3.500	—
5	*C. mrigala*	7.900	3.200	—
	L. rohita	2.500	—	—
	C. reba	0.050—		—
	Barbus sp.	3.450	7.800	—
	Mystus tengara	0.075	—	—

in live condition although by that time the fish was in distress. From these and other empirical observations, it was found that the following fishes and other aquatic animals that inhibited the ponds under treatment were affected. The names are given in order of their susceptibility to rotenone. Local names are given in parenthesis. *Labeo rohita* (Rui); *Cirrhina mrigala* (Mrigal); *Barbus* sp. (Punti); *Amblypharyngodon mola* (Moya); *Catla catla* (Catla); *Labeo diplostomus* (Doria); *Glossogobius giuris* (Baila); *Tilapia mossambica* (Tilapia); *Mystus tengara* (Tengra); *Mastacembalus pancalus* (Baim); *Ophicephalus punctatus* (Lata); *Wallago attu* (Boal); *Palaemon* sp. (Chingri).

The ponds treated with different doses of rotenone were under observation for 2 days. Ponds Nos. 4 and 5 were seined thoroughly with fine meshed net in the morning of the 24th May, 1970. During the observation there was no sign of life in any of the ponds except a few *Palaemon* sp. and small frogs. No significant difference between the effect of different concentrations viz., 1.0 1.5 and 2.0 p.p.m. was observed. It may, therefore, be concluded that in summer, when the temperature of this region is around 30°C, a concentration of 1 p.p. m. is good enough to remove undesirable species of fishes. The present work, though gives some information on the use of rotenone in this country, is by no means enough to recommend its large scale application. Many things are yet to be known about the methods and desirability of its wide application.

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