TABLE VII

LENGTH AND WEIGHT RANGES OF KNOWN AGE HYBIRDS IN LAKES HARTWELL AND CLARK HILL

HARTWELL

Age	No. fish	Total Length Range	Weight Range
12 months	1	12.6-	1.0-
23 months	3	13.6-15.9	1.4-2.1
30 months	20	18.0-21.6	3.1-5.7
35 months	30	18.7-21.7	3.1-5.9

CLARK HILL

Age	No. Fish	Total Length Range	Weight Range
23 months	17	15.6-19.1	2.0-3.7
30 months	5	19.7-21.0	3.6-5.0
35 months	11	19.3-21.0	4.1-5.9

TOLERANCE OF STRIPED BASS, *MORONE SAXATILIS* (WALBAUM), LARVAE AND FINGERLINGS TO NINE CHEMICALS USED IN POND CULTURE[1]

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ABSTRACT

Bioassays were conducted on nine chemicals using one week old larvae and one month old fingerling striped bass, *Morone saxatilis* (Walbaum), as the test species. The chemicals tested were potassium permanganate, potassium dichromate, copper sulfate, Dylox, ethyl and methyl parathion, Karmex, butyl ester of 2, 4-D and HTH. Tests were conducted at 70° Fahrenheit in glass containers using reconstituted water as the diluent. The fingerlings were much more tolerant to Karmex, potassium dichromate, potassium permanganate and butyl ester of 2, 4-D than were the larvae. A higher concentration of ethyl parathion, methyl parathion, HTH, copper sulfate or Dylox was required to kill the larvae than the fingerlings.

INTRODUCTION

A successful striped bass, *Morone saxatilis* (Walbaum), program in Louisiana is dependent upon rearing adequate numbers of fingerlings for stocking.

[1]This study was financed, in part, by Louisiana Federal Aid in Fish Restoration Project F-15-3.

Many fish culturists are having difficulties rearing striped bass due to inadequate information on specific cultural techniques. Thousands of striped bass have been killed by parasites and/or bacteria, others have been killed by insects and still others have died from applications of chemicals for weed control. Since the first introduction of striped bass fingerlings into freshwater lakes, many problems have been solved with reference to the use of chemicals in striped bass culture (Hughes, 1969; Regan, et al., 1968). This study was designed to provide additional information for fish culturists in Louisiana and other states.

MATERIALS AND METHODS

Bioassay techniques used followed in general those outlined by Doudoroff, et al. (1951). The striped bass used for these tests were obtained as larvae from the South Carolina Wildlife Resources Department Hatchery at Moncks Corner. Our Commission airplane transported the larvae in plastic bags, containing water and oxygen, which were packed in styrofoam containers. Approximately six hours of flying time were required to transport the fish to the Monroe Fish Hatchery.

Approximately 25,000 striped bass larvae were tempered for 30 minutes and placed in two holding vats in a constant temperature bioassay laboratory which was maintained at 70° Fahrenheit. These holding vats were constructed of fiberglass and each vat held 272.5 liters (72 gallons) of reconstituted water (Table 1).

Table 1. Chemicals Added to Distilled Water To Make Reconstituted Water

Chemical	Grams per liter
Calcium sulfate, $CaSO_4.2H_2O$	0.035
Magnesium sulfate, $MgSO_4.7H_2O$	0.035
Sodium bicarbonate, $NaHCO_3$	0.055
Potassium chloride, KCl	0.002

The reconstituted water sprayed into these vats at one end and flowed out the vats at the other end through a stand pipe. Saran covered funnels connected to the stand pipe prevented the larve from escaping. Four of these vats were connected in a closed recirculating system containing 1703 liters (450 gallons) of water. Every other day 567.8 liters (150 gallons) of water were replaced with fresh reconstituted water. After the larvae were four days old, they were fed brine shrimp every eight hours. They were not fed after being placed in the bioassay containers.

Reconstituted water maintained at 70° Fahrenheit was used as the diluent for bioassays. Glass specimen dishes were used as bioassay containers for striped bass larvae and 3.8 liter (one gallon) wide mouth glass jars lined with a 2 mil polyethylene bag were used for striped bass fingerling bioassays. One liter of water was used for larvae bioassays and two liters of water were used for fingerlings. The reconstituted water was aerated for 15 minutes before being measured and poured into the bioassay containers. No aeration of the water was conducted in the containers.

Ten striped bass larvae were transferred to each bioassay container from a holding vat by the use of a glass syphon tube. Two striped bass fingerlings (averaging 35 mm - 51 mm in length) were used in each container for the bioassays on one month old fish. These fingerlings were obtained from a hatchery pond that had been stocked with 125,000 larvae per 0.405 ha (acre). A short seine haul was made in the pond to prevent overcrowding of the fish in the net. The fish with some water were dipped from the net with a 3.8 liter (one gallon) plastic bucket and poured into a 11.4 liter (three gallon) plastic tub. The fish were tempered in the tub for 30 minutes and then removed from the tub by hand and placed in the bioassay containers. The test chemicals were added after the striped bass had been in the containers for 2-4 hours.

Graduated concentrations of the chemicals tested were added to the containers. One control for each ten bioassay containers was used. Replicate tests were conducted for each concentration. The live and dead fish were checked and the numbers recorded at the end of each 24 hour period for 96 hours.

The chemicals tested, active ingredient or grade of formulation are presented in Table 2.

RESULTS AND DISCUSSION

Toxicity results are reported as LC_0 (no mortality), LC_{50} (50 percent mortality) and LC_{100} (100 percent mortality) in parts per million (ppm) of the active ingredient (Tables 3 and 4).

Potassium permanganate has been recommended for the control of extoparasites on fish (Meyer, 1966a) and for producing oxygen in oxygen deficient ponds (Mathis, et al., 1965). Application rates ranging from 2 to 6 ppm have been presented. *Trichodina* sp. has been successfully controlled on striped bass fingerlings in Louisiana using 3 ppm potassium permanganate in hatchery ponds. Care should be exercised when using this amount on fingerling striped bass since the 96 hour LC_{50} is 4 ppm. However, since most ponds contain organic matter which is oxidized by the potassium permanganate, there is a relatively wide safety margin. Regan, et al. (1968) reported the 96 hour LC_{50} to fingerling striped bass as 2.5 ppm. Potassium permanganate is more toxic to striped bass larvae than fingerlings with a 96 hour LC_{50} of 1.0 ppm.

Potassium dichromate has been recommended for the control of Monogenea at 5 ppm in aquaria (Reichenbach-Klinke, 1966) and for the control of external protozoans (Meyer, 1966b). Potassium dichromate was the least toxic to both striped bass larvae and fingerlings of the chemicals assayed. No mortalities should result when this chemical is used at the above recommended rate.

Surber (1961) has recommended the use of copper sulfate for the control of algae at rates of 0.3 ppm in soft water to 1.0 ppm in hard water. Lawrence (1966) recommended an application range of 0.1 to 1.0 ppm on algae. He further states that in certain waters 1 ppm has been toxic to fish. Copper sulfate has also been recommended for the control of ectoparasites on fish (Davis, 1956). Regan, et al. (1968) reported a 96 hour LC_{50} of 0.62 ppm for fingerling striped bass. Results of this study indicate that copper sulfate has a 96 hour LC_{50} of 0.1 ppm and 0.15 ppm for striped bass larvae and fingerlings respectively. The total hardness of the dilution water was 68.4 ppm. Copper sulfate would not be safe to use at the recommended rates under these test conditions.

Applications of 0.25 ppm Dylox has successfully controlled monogenetic trematodes (Meyer, 1969) and the same rate is recommended for the control of the anchor worm *Lernaea cyprinacea* (Rogers, 1966). Carlson (1966) reported the 24 hour TLm (LC_{50}) for bluegill, *Lepomis macrochirus*, to be 12.0 ppm. Striped bass larvae and fingerlings are more tolerant to Dylox than bluegill. I determined that the 24 hour LC_{50} for larvae was 30.0 ppm and for fingerlings was 16.0 ppm. The 96 hour LC_{50} was 5.0 ppm for larvae and 2.0 ppm for fingerlings. Regan, et al. (1968) reported the 96 hour LC_{50} for fingerling striped bass to be 5.2 ppm. Based on these data Dylox could be used for the control of parasites at recommended rates without any mortality of striped bass.

Ethyl parathion has been used at 0.25 ppm to control predators in a pond six days prior to stocking striped bass fry (McGill, 1967). This rate could be applied to a hatchery pond containing striped bass if care was exercised. Ethyl parathion is more toxic to striped bass fingerlings than larvae. The 96 hour LC_{50} for fingerlings is 1.0 ppm and for larvae it is 2.0 ppm.

Methyl parathion is less toxic to striped bass than ethyl parathion. We have used 1 ppm in Louisiana for insect control in a pond one week prior to stocking striped bass fry with good results. The 96 hour LC_{50} for larvae and fingerlings was 5.0 and 4.5 ppm respectively. Methyl parathion would be safer to use in ponds containing striped bass than ethyl parathion.

Karmex has proven to be effective for the control of several forms of filamentous algae at rates above one-half pound per surface acre (Sills, 1967). He further stated that rates up to 3 pounds per surface acre had no adverse effects on fish. Karmex is also used to reduce heavy phytoplankton blooms in ponds at rates of 1-2 ounces per surface acre. Lawrence (1966) reported that 10 ppm was safe to bluegill in the laboratory and 1 ppm was safe to bluegill in a pond. He reported that the toxicity to fish became evident 14 to 21 days after the chemical was applied. Striped bass larvae are more susceptible to Karmex than are bluegill or striped bass fingerlings. The 96 hour LC_{50} for striped bass fingerlings was 6.0 ppm. Regan, et al. (1968) reported the 96 hour LC_{50} for striped bass fingerlings to be 3.1 ppm. Karmex should be avoided at the higher recommended rates when striped bass larvae are present. It could be used at recommended rates in fingerling ponds, but extreme care should be exercised.

Lawrence (1966) reported 2.5 ppm butyl ester of 2, 4-D to be safe to bluegill. Striped bass larvae are less tolerant with a 24 and 96 hour LC_{50} to be 0.15 ppm. Butyl ester of 2, 4-D was less toxic to the striped bass fingerlings than the larvae with a 24 and 96 hour LC_{50} of 3.0 ppm. Surber (1961) has recommended 2, 4-D ester for the control of emergent aquatics at rates varying from 2 pounds to 8 pounds of active ingredient per acre. The use of butyl ester of 2,4-D should be avoided in ponds containing striped bass larvae, but could be used with care where fingerlings are present.

HTH is a chlorine formulation that we have used as a disinfectant of hatchery equipment and to kill undesirable fish in pot holes in hatchery ponds. Both striped bass larvae and fingerlings can survive 0.2 ppm for 96 hours. Most city water supplies contain 1.0 ppm free chlorine after treatment, but a decreased amount is present in tap water. Unless the chlorine content in water to be used for striped bass is determined, the water should be dechlorinated before it is used.

ACKNOWLEDGEMENTS

I would like to thank James T. Davis, Fisheries Research Supervisor and Harry E. Schafer, Jr., Dingell-Johnson Coordinator for their support throughout the project and their critical review of the manuscript.

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Table 2. Chemicals Used for Striped Bass Bioassays

Chemical	Grade or % AI	Active Ingredient
Potassium permanganate	Technical	Potassium permanganate
Potassium dichromate	Technical	Potassium dichromate
Copper sulfate	Technical	Copper sulfate
Dylox	80% AI	Dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate
Ethyl parathion	46.5% AI	0-0-Diethyl P, p-nitrophenyl thiosphate
Methyl parathion	45% AI	0-0-Dimethyl-O-p-nitrophenyl thiophosphate
Diuron (Karmex)	80% AI	3-(3,4-dichlorophenyl)-1,1-dimethylurea
Butyl ester of 2,4-D	78% AI	Butyl ester of 2,4-dichlorophenoxyacetic acid
HTH	70% AI	Calcium hypochlorite

Table 3. Toxicity of Chemicals to Striped Bass Larvae Reported in Parts Per Million

Chemical	24 hours	48 hours	72 hours	96 hours
Potassium permanganate				
LC_{0}	0.1	0.1	0.1	0.1
LC_{50}	1.5	1.0	1.0	1.0
LC_{100}	2.0	2.0	2.0	2.0
Potassium dichromate				
LC_{0}	100	100	75	75
LC_{50}	150	150	100	100
LC_{100}	200	200	150	150
Copper sulfate				
LC_{0}	0.1	0.1	0.1	0.05
LC_{50}	0.75	0.25	0.25	0.1
LC_{100}	1.0	0.75	0.75	0.5
Dylox				
LC_{0}	15.0	10.0	5.0	3.0
LC_{50}	30.0	15.0	10.0	5.0
LC_{100}	40.0	30.0	20.0	15.0
Ethyl parathion				
LC_{0}	4.0	2.0	1.0	1.0
LC_{50}	6.0	3.0	2.0	2.0
LC_{100}	9.0	4.0	3.0	3.0
Methyl parathion				
LC_{0}	3.0	3.0	3.0	3.0
LC_{50}	5.0	5.0	5.0	5.0
LC_{100}	7.0	7.0	7.0	7.0
Karmex				
LC_{0}	2.0	0.1	0.1	0.1
LC_{50}	3.0	0.5	0.5	0.5
LC_{100}	5.0	3.0	2.0	1.0
Butyl ester of 2,4-D				
LC_{0}	0.1	0.1	0.1	0.1
LC_{50}	0.15	0.15	0.15	0.15
LC_{100}	0.25	0.25	0.25	0.25
HTH				
LC_{0}	0.2	0.2	0.2	0.2
LC_{50}	0.5	0.5	0.5	0.5
LC_{100}	0.7	0.7	0.7	0.7

Table 4. Toxicity of Chemicals to Striped Bass Fingerlings Reported in Parts Per Million

Chemical	24 hours	48 hours	72 hours	96 hours
Potassium permanganate				
LC_0	4.0	3.0	3.0	3.0
LC_{50}	5.0	4.0	4.0	4.0
LC_{100}	6.0	5.0	5.0	5.0
Potassium dichromate				
LC_0	250	100	50	50
LC_{50}	300	125	100	75
LC_{100}	350	150	150	100
Copper sulfate				
LC_0	0.25	0.1	0.1	0.1
LC_{50}	0.4	0.25	0.15	0.15
LC_{100}	0.5	0.5	0.25	0.25
Dylox				
LC_0	12.0	6.0	4.0	1.0
LC_{50}	16.0	8.0	6.0	2.0
LC_{100}	20.0	10.0	8.0	3.0
Ethyl parathion				
LC_0	0.5	0.5	0.5	0.5
LC_{50}	1.0	1.0	1.0	1.0
LC_{100}	2.0	2.0	2.0	2.0
Methyl parathion				
LC_0	4.0	4.0	4.0	4.0
LC_{50}	5.0	4.5	4.5	4.5
LC_{100}	7.0	5.0	5.0	5.0
Karmex				
LC_0	12.0	6.0	1.0	1.0
LC_{50}	14.0	8.0	6.0	6.0
LC_{100}	16.0	12.0	12.0	12.0
Butyl ester of 2,4-D				
LC_0	2.0	2.0	2.0	2.0
LC_{50}	3.0	3.0	3.0	3.0
LC_{100}	4.0	4.0	4.0	4.0
HTH				
LC_0	0.2	0.2	0.2	0.2
LC_{50}	0.3	0.25	0.25	0.25
LC_{100}	0.4	0.3	0.3	0.3