DYLOX® AS A CONTROL FOR ECTOPARASITES OF FISH

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ABSTRACT

Dylox® was effective against some fish parasites, ineffective against others. Although experimental results were inconsistent, a few workers report success in treating trichodinid protozoans. No success resulted from treating catfish with *Ichthyophthirius*. Applications of 0.25 ppm (active ingredient) successfully controlled monogenetic trematodes of *Gyrodactylus, Dactylogyrus,* and *Cleidodiscus* spp. Parasitic copepods were effectively controlled by weekly applications of 0.25 ppm except during periods of hot weather. Five species of leeches proved susceptible to single applications of 0.5 ppm Dylox.

Factors affecting the decomposition of Dylox in ponds are discussed along with their relevance toward the treatment of ponds. Limited data concerning residues following various application rates are presented.

INTRODUCTION

The control of ectoparasites of fish is an integral part of modern fish culture. Parasitic protozoans, monogenetic trematodes, copepods, and leeches may attack fish in hatchery or rearing ponds. Unless controlled, these parasites may cause losses of epizootic proportions. If not directly responsible for the death of fish, parasitism debilitates and disposes them to secondary bacterial or fungal infections.

Chemicals in current use for the control of ectoparasites present numerous problems resulting from their effects upon pond biota or the effect of water conditions on the action of the chemical.

Formalin has long been the chemical of choice for treating ectoparasites. Treatments of 250 ppm for one hour (1:4000) have been recommended for this purpose (Davis, 1956; Fish, 1940). Applications have been made in ponds at rates varying from 15 to 35 ppm (Allison, 1957; Hoffman, 1959). Many workers have reported a toxicity to fish when formalin was used at the 250 ppm level. Heavily parasitized fish are often killed if left for one hour and lower concentrations often give limited control (Meyer, 1966b). Repeat treatments for shorter periods have permitted use of 250 ppm as a tank treatment.

Use of formalin as a pond treatment has likewise presented problems. Allison (1962) found that applications of formalin frequently resulted in oxygen depletions and subsequent losses of fish during hot weather. Helms (1967) found that dissolved oxygen was reduced by 1 ppm for every 5 ppm formalin applied. This reduction occurred approximately 30 hours after treatment. Lowering pond levels prior to treatment, followed by pumping of fresh water 24 hours after the application of formalin has enabled workers to avoid most of the oxygen depletion problems but valuable time is lost before treatment can begin. Others have successfully avoided oxygen deficiencies by adding 3 ppm potassium permanganate at the same time or soon after formalin was applied (Allison, 1962). This technique drastically increases the cost of treatments with formalin.

Although the above problems concerning the use of formalin have not detracted from its use, workers have needed other effective controls for ectoparasites. Malachite green, copper sulphate, and potassium permanganate have been used in ponds, but all have limited effectiveness, are toxic under varying conditions of pH or water hardness, or are toxic to certain species. Tank treatments have included sodium chloride, potassium dichromate, PMA, and acriflavin. These compounds also have limitations on their use.

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During recent years, Dylox was extensively studied at the Fish Farming Experimental Station, Stuttgart, Arkansas. Some of the uses indicated by this work have already been reported (Meyer, 1966b; Hornbeck, White, and Meyer, 1965). Further studies have revealed additonal uses for this compound. This paper will discuss how Dylox may prove helpful in treating ectoparasites of fish without serious adverse effects on the pond biota.

The reader is reminded that Dylox has not been approved by the FDA and it should not be used on fish intended for human consumption.

MATERIALS

Dylox is an organophosphate insecticide Dimethyl (2,2,2-trichloro-1-hydroxyethyl) phosphonate produced by Chemagro Corporation, Kansas City, Missouri. It is widely used as an agricultural insecticide for controlling pests on vegetables, fruits, and field crops.

Dylox is readily soluble in water and decomposes rapidly at high temperatures (80 – 90°F) under alkaline conditions. Mammalian toxicity is in the range of 450-500 mg/kg expressed as oral LD/50 for rats. Workers should maintain normal safety precautions when handling the compound since absorption may occur through the skin.

Toxicity to fish is low (See Table 1). The compound has been used in ponds containing bluegills, bass, buffalo, and carp in addition to those species listed in the table.

Dylox was applied to parasitized fish or to parasitic organisms after removal from fish. Each group will be discussed separately and special techniques used to test each will be described. Concentrations listed are ppm active ingredient.

TABLE 1

Approximate 48-hour tolerance values for four species of fish subjected to concentrations (ppm) of Dylox.

Species	*LC/0*	*LC/50*	*LC/100*
Goldfish	40	45	50
Golden shiners	50	70	90
Fathead minnows	40	80	110
Channel catfish	40	60	70

PROTOZOANS

Dylox was tested against fish infected with *Trichodina* and *Ichthyophthirius* on separate occasions. Studies on the control of *Trichodina* were inconclusive. Although the parasites were eliminated in some tests, the results could not be duplicated in subsequent studies. Control was achieved at low levels in certain aquariums whereas some parasites survived at higher levels. Observations made in ponds treated with 0.25 ppm Dylox indicated no control of trichodinids on golden shiners.

A report (USDI, Division of Fish Hatcheries, Quarterly Biologist's Reports, July 1-Sept. 1, 1967, p. 8, mimeo.) indicates that 0.25 ppm Dylox provided good control of *Trichodina* on fathead minnows under experimental conditions in a three-replicate test.

Channel catfish infected with *Ichthyophthirius* were treated in aquariums. Dylox was used singly at rates of 0.25, 1.0, and 2.0 ppm, and in combination with copper sulphate at levels of 1.0 and 2.0 ppm. Dimethyl sulfoxide (DMSO) was also used in combination with Dylox in the hope that DMSO might aid penetration of the compound.

Catfish used in the study were taken from the same lot of fish, all exposed to *Ichthyophthirius* four days previous to treatment. Losses occurred in all experimental lots of fish. Control groups and treated groups sustained similar losses even though

the survival in treated groups was from one to three days longer. Increasing or decreasing dosage rates had no beneficial effects.

Pending further study, it appears that Dylox may have limited effectiveness against protozoans.

MONOGENETIC TREMATODES

Dylox has shown marked effectiveness against monogenetic flukes. *Gyrodactylus, Dactylogyrus,* and *Cleidodicus* can be effectively controlled at concentrations of 0.25 ppm and above. Testing against *Gyrodactylus* was done using 10 infected golden shiners in each 15 gallon aquarium containing aerated wellwater. Duplicate tests were made at levels of 0.125, 0.25, 0.5, and 1.0 ppm. Checks for parasites were made by observing live fish under a dissecting microscope. Forty-eight hours after application of Dylox, fish from each lot were killed and examined for *Gyrodactylus*. Results are summarized in Table 2.

Gyrodactylus sp. was reported killed on fathead minnows in 24 hours following application of 0.25 ppm Dylox in tests by the Division of Fish Hatcheries (USDI, Division of Fish Hatcheries, Biologist's Quarterly Report, July 1 — September 1, 1967, pg. 8, Mimeo). In these tests Dylox gave control equal to formalin, copper sulfate, and malachite green. Elimination was not achieved but a 99 percent reduction in incidence resulted.

TABLE 2

Effects of Dylox on *Gyrodactylus* infections on golden shiners.

Dosage	*24 hrs.*	*48 hrs.*	*Control*
0.125	++[1]	+	Partial
0.250	---	---	Complete
0.5	---	---	Complete
1.0	---	---	Complete
25 ppm Formalin[2]	---	---	Complete
Control	+++	+++	---

[1] +Organisms present in low numbers; ++Organisms present in moderate numbers; +++Heavy infection of organisms; ---no organisms present.
[2] 25 ppm Formalin used as standard of comparison.

Studies on *Dactylogyrus* were made using infected fathead minnows in the same aquarium system described for *Gyrodactylus*. Applications of 0.25 ppm or more effectively controlled the parasites in all replicates within 24 hours. These results are in agreement with those of Sarig, *et al.* (1965) who found Dipterex (Dylox) to be highly effective in controlling *Dactylogyrus vastator* on carp fingerlings.

Dylox was applied for 48 hours to 6-inch channel catfish fingerlings infected with *Cleidodiscus* sp. Six fish per aquarium were used in a study similar to the above. Control was again achieved at 0.25 ppm or more of Dylox.

Field tests against *Gyrodactylus* and *Dactylogyrus* have included ponds ranging from 1 acre to 80 acres. With one exception, single applications of 0.25 ppm Dylox effectively controlled the parasites. A second application was made in one 40-acre pond where uniform application was not achieved in the first treatment. The second application was effective.

Field trials of Dylox against *Cleidodiscus* indicate that this organism is equally susceptible. Parasites were removed from catfish adults and fingerlings in ponds ranging in size from 0.5 to 12 acres.

PARASITIC COPEPODS

The use of Dylox as a control for the anchor parasite, *Lernaea cyprinacea*, was reported by Meyer (1966a), Rogers (1966), and Lahav, *et. al.* (1964). Recent studies

have provided additional information concerning this use of the chemical. Dylox is most effective against the anchor parasite if applied when water temperatures are below 80°F. Applications during July and August may give only moderate control, perhaps due to rapid decomposition of the compound under existing water conditions. Should treatment be necessary during summer months, it appears that the effective life of the insecticide might be extended if applications could be made soon after daybreak when water temperatures and pH values are lowest.

Increasing the dosage from 0.25 ppm to 1.0 ppm afforded better control during periods of hot weather but eradication of the parasite was not achieved. Farmers report that treating twice weekly instead of weekly has also improved control.

Treatments of up to 20 ppm Dylox for 4 hours failed to kill all adult *Lernaea cyprinacea* and *Achtheres micropteri* on goldfish and catfish in holding tanks. While many of the parasites were killed by this technique, eradication was not achieved.

Achtheres micropteri on channel catfish was successfully controlled in ponds by weekly applications of 0.25 ppm Dylox. Four applications were usually required to remove all parasites.

While opportunities to treat fish infected with *Ergasilus* and *Argulus* have not occurred, because of its effectiveness against other copepods, it is expected that Dylox will also be effective against these parasite species.

LEECHES

Although heavy infections are rare, leeches are commonly found attached to broodstock catfish. Treatment includes hand-picking each parasite from the host and chemical dips. Dylox was used in 1964 to control *Illinobdella moorei*, the fish leech, by Herbert Reichelt at the Millen, Georgia, National Fish Hatchery Aquarium (personal communication). Applications of 0.25 ppm Dylox provided complete control of the parasite in the closed water system at the aquarium.

Since then we have tested Dylox against *Theromyzon* sp., *Placobdella parasitica, Erpobdella punctata, Illinobdella moorei,* and *Piscicola salmositica*. All were tested in aquariums after removal from their hosts. Single applications of Dylox at 0.5 ppm killed all species in 96 hours. Opportunities to evaluate the effectiveness of Dylox against leeches while attached to their hosts or under pond conditions have not been available. It is anticipated that control can be achieved by an application of 0.5 ppm Dylox.

DISCUSSION

Dylox is an insecticide with an apparent low toxicity to fish but high toxicity to a wide variety of target organisms. Limited studies of Dylox residues have been made. During 1967, samples of water, mud and fish tissues were collected from ponds treated one or four times at rates of 0.25 and 1.0 ppm. These samples were analyzed by the Chemagro Corporation using a technique which involved the conversion of Dylox to DDVP (2,2 dichlorovinyl dimethyl phosphate).

No residues were found in any of the samples of pond water or bottom mud. Bluegill offal contained 0.02 ppm DDVP when collected 4 hours after a single application of 1.0 ppm. bluegill flesh showed no residues. Catfish offal contained 0.05 ppm DDVP 4 hours after the fourth weekly application of 1.0 ppm. Flesh from the same lot of fish contained 0.02 ppm DDVP.

A study was made of the conversion of Dylox to DDVP in pond water at pH 8.5 in the laboratory of the Chemagro Corp. This study revealed that when 1.0 ppm Dylox was added under these conditions only 0.06 ppm DDVP was present after four hours at room temperature.

Since the limit of sensitivity of testing apparatus was 0.01 ppm, the levels found indicate threshold values for nearly all samples. The breakdown to DDVP indicates that Dylox rapidly decomposes at pH 8.5 at room temperature and that 4 hours after application, little residue remains in water. Residues of Dylox, therefore, are apparently non-cumulative. These limited data suggest that contamination of the aquatic environment will not result from the use of Dylox. Recovery rates of zooplankton reported by Meyer (1966a) provide additional support to this assumption.

The rapid decomposition rate at pH 8.5 may also explain the reduced effectiveness of Dylox during hot summer months. This condition, coupled with water temperatures of 85°F and above, would speed decomposition.

Apparently parasites acquire a lethal dose of Dylox shortly after its application. The rapid disappearance of the compound from the water suggests that its action must be irreversible, since parasites may die from 24 to 120 hours post-treatment. A need for repeated treatment, as in the case of *Lernaea*, is based upon the continued emergence of nauplii from eggs rather than a lack of effectiveness of the compound.

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