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Experimental Evaluation of Fluridone Effectiveness on Fish Productive Aquatic Ecosystems

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ABSTRACT

A man-made pond containing water from the nearby lake Mitrikou (N. Greece) populated with carp (*Cyprinus carpio* L) was sprayed with an aqueous formulation of fluridone. Shortly after application, Cyanophycae decreased drastically and they disappeared after two months. Fluridone levels in pond water decreased rapidly from 2891 ng/L to a value below its detection limit after the 60th day. Residues of fluridone in edible parts of fish reached a maximum of 484 μg/kg on the 13th day and decreased steadily thereafter to 30.7 μg/kg on the 84th day after application. No fluridone metabolite was detected in any fish sample. Although neither pathological findings nor histological features were observed in fish, further experiments appear necessary to establish whether fluridone may adversely affect carp eggs and fry.

Key words: Trapa natans, Phragmites, carp, residues, water chemistry, dissipation, phyto- and zooplankton.

INTRODUCTION

It has been reported (Kamarianos *et al.* 1988) that fluridone (1-methyl-3-phenyl-5-[3-(trifluoro-methyl)]-4(1H)-pyridinone) is an effective agent in controlling the growth of the aquatic weeds water chestnut (*Trapa natans* L.) and spire reed (*Phragmites communis* Trin.) since it inhibits carotenoid synthesis (Bartels and Watson, 1978).

Although a rapid dissipation of fluridone by photolysis is usually expected in outdoor aquatic environments (West *et al.*, 1979, 1983), it appears that its persistence can be affected by environmental parameters, such as water chemistry and biota (Hamelink *et al.*, 1986, Langeland and Warner, 1986). Hence, the potential impact of fluridone residues to non target organisms should not be ignored.

The purpose of this project was to evaluate fluridone persistence in the water, to estimate its bioconcentration in the carp (*Cyprinus carpio* L.) and to examine the effects caused by this compound to the phyto-, zooplankton and on other physicochemical parameters of the water in a pond treated by this herbicide.

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MATERIALS AND METHODS

A man-made pond (8 m width x 70 m length x 1 m depth), alongside lake Mitrikou (Northern Greece, 20 Km S.E. of the city of Komotini) was used for this study. One hundred and twenty nine (129) carp, weighing from 0.5 to 1.5 Kg, were brought to this pond from Evros river (North-Eastern Greece) during the period from July the 6th to 18th 1984. The pond was then fenced and covered with fishing net to keep out fish predators. On July 20th, an aqueous suspension formulation (Sonar 4AS), containing 48% fluridone, was sprayed over the water surface, producing a concentration of 0.042 mg/L of the active ingredient in the pond water.

Measurements of the temperature, dissolved oxygen and conductivity of the pond water started two days before fluridone application and were continously monitored, with a Martek recorder-analyzer until the end of the trial. Samples of water, plankton and fish were taken at various time intervals throughout the trial period for laboratory analysis. Samples of plankton were collected 6 times from the pond, whereas 3 similar samples were taken from the lake Mitrikou for purpose of comparison. These samples were preserved by adding Lugol solution and the phyto- and zooplankton species were indentified microscopically (inverse microscope). Samples of water were collected 8 times from the pond and 4 times from the lake. Measurements of the various physicochemical parameters of the water were made according to APHA (1975) procedures.

Samples of water and fish for fluridone determination were collected 11 and 9 times respectively. The determination was conducted by electron capture gas chromatography using the methods suggested by Lilly Research Laboratories (Procedures 5801694 and AM-AA-CA-R003-AC-755). Muscle samples taken from the edible part of carp were used in the analysis.

RESULTS AND DISCUSION

Hygienic condition and histpathlogy ot the carps. A total of 32 carps were examined; 3 of them before and 29 after fluridone treatment.

Carp were under observation throughout the trial. No clinical signs or mortality were observed. The general body condition, swimming movements and behaviour of the fish were normal. Gross pathological features of the skin, gills and fins were not evident. Sections of gill tissue, stained with haematoxylin-eosin, hyperplasia of gill lamellae, redness, haemorrhage or anaemia were not observed.

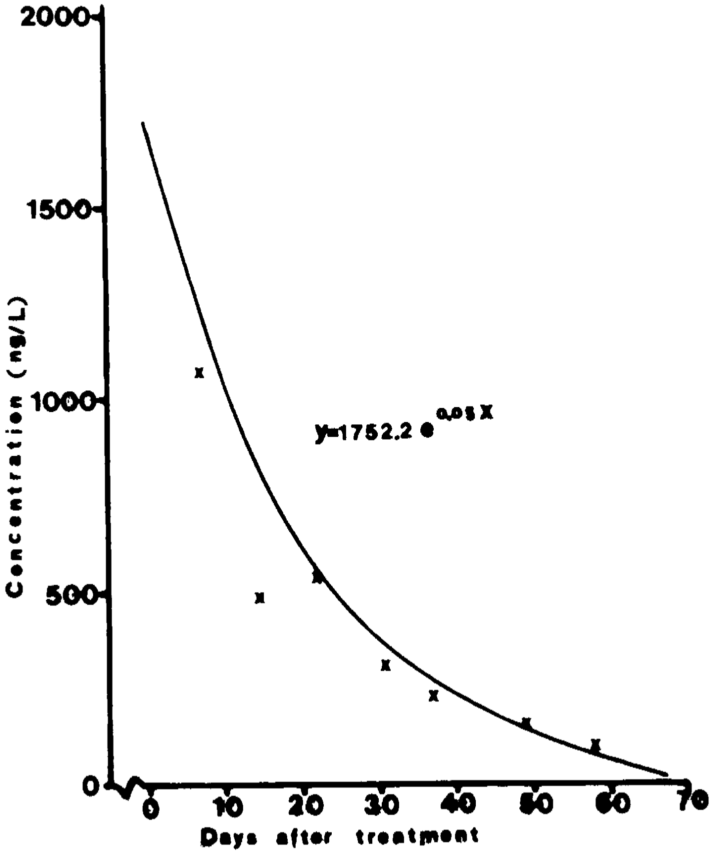

Figure 1. Dissipation of fluridone from a pond located alongside lake Mitrikou (Northen Greece). The value of 2891 ng/L for the day 1 is not included in the figure but is included in the statistical analysis.

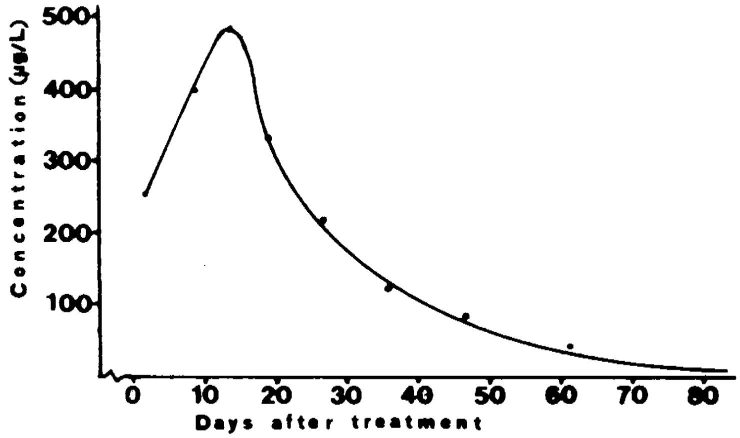

Figure 2. Variation of fluridone concentration in the muscle of carp. Values are the means of 2-5 samples in dublicate analysis.

Changes in water chemistry. The physicochemical parameters of the pond water were measured before and after fluridone treatment.

In brief, it can be stated that conductivity increased within 2 hours after fluridone application, but it was completely restored within 72 hours. The D.O. content decreased to a minimum of 3.9 mg/L 24 hours after application, but increased gradually thereafter to normal levels after 9 days. Likewise, substantial, though not consistent, changes of the other water parameters were evident, with the exception of pH. A slight pH decrease was also observed soon after fluridone application; however pH returned to its normal values within a month.

Dissipation of fluridone in water. The results of fluridone determination in the pond water are presented in figure 1. From this curve it becomes evident that fluridone levels in water decreased at a high rate during the first days after application. No fluridone was detected after a period of two months. These results are in agreement with those observed by Langeland and Warner (1986).

Accumulation of fluridone in fish. The variation of fluridone concentration in the muscle of the carp with respect to time is depicted in figure 2. Fluridone levels in fish reached a maximum of 484 µg/kg on the 13th day after treatment and decreased steadily thereafter to 30.7 µg/kg on the 84th day after treatment. Fluridone major metabolite 1-methyl-3-(4-hydroxyphenyl)-5-[3-(trifluoromethyl) phenyl]-4(1H)-pyridinone. was not detected in any fish sample.

Effect of fluridone on phyto- and zooplankton. The major phytoplankton groups recognised (Table 1) in the samples of pond and lake water were: Cyanophyceae (*Anabaena, Oscillatoria*), Diatomaceae (*Amphiprora, Cyclotella*), Euglenineae (*Euglena, Phacus*) in the pond water and Diatoms (*Amphiprora, Pleurosigma, Gyrosigma*) Chlorophyceae (*Chroomonas*) in the lake water. Cyanophyceae and Euglenineae species were identified in both the pond and the lake water. Zooplankton groups identified in the pond and lake water were Rotifera, Copepoda and Cladocera at population densities presented in Table 2.

Table 1. Population densities (No. x 10^3/L) of phytoplankton in pond and lake water in 1984.

Algal family	Pond						Lake		
	Sampling date						Sampling date		
	July 6	July 20	Aug. 3	Sept. 5	Sept. 20	Oct. 12	July 6	Aug. 3	Oct. 12
Cyanophyceae	2028.8 (95.3)*	6996.2 (99.3)	100.2 (11.0)	31.9 (3.6)	0	0	3120.5 (88.3)	6094.9 (99.2)	6277.5 (89.1)
Diatomaceae	97.9 (4.6)	47.0 (0.7)	811.2 (89.0)	525.5 (59.3)	320.0 (53.0)	260.4 (41.6)	409.9 (11.6)	12.3 (0.2)	7.0 (0.1)
Clorophyceae	0	0	0	255.2 (28.8)	224.6 (37.2)	314.8 (50.3)	0	30.7 (0.5)	718.6 (10.2)
Dinophyceae	0	0	0	71.8 (8.1)	50.6 (8.4)	34.4 (5.5)	3.5 (0.1)	6.1 (0.1)	42.3 (0.6)
Euglenineae	2.1 (0.1)	2.2 (0.1)	0	1.8 (0.2)	8.6 (1.4)	16.3 (2.6)	0	0	0
Total	2128.8	7045.4	911.4	886.2	603.8	625.9	3533.9	6144.0	7045.4

*Values in parenthesis are percentages of the total.

TABLE 2. RANGE OF POPULATION DENSITIES (No/L) OF ZOOPLANKTON IN POND AND LAKE WATER.

Group	Pond water	Lake water
Rotifera	867-1913 (94-83)*	660-1475 (94-87)
Copepoda	17-271 (2-12)	11-147 (2-9)
Cladocera	34-113 (4-5)	36-80 (5)
Total	919-2297	706-1702

*Values in parenthesis are persentages of the total.

A drastic reduction of phytoplankton species was observed shortly after fluridone application. The population of Cyanophyceae disappeared after about 2 months. This finding is of great importance, since the proliferation of these species is associated with the phenomenon of water bloom that affects the productivity of aquatic ecosystems. On the contrary, the persentage of diatoms increased substantialy, especially the epiphytic and benthic species. This increase suggests that they were released from the decomposed aquatic vegetation which was affected by fluridone.

In view of these encouraging results it seems that no detrimental effects occur in fish productive aquatic ecosystems treated with fluridone. However, further experiments are needed to establish whether this agent may adversely affect carp eggs and fry.

LITERATURE CITED

A.P.H.A. 1975. Standard methods for the examination of water and wastewater. American Public Health Association. Washington, D.C.

Bartels, P. G. and C. W. Watson. 1978. Inhibition of carotenoid synthesis by fluridone and norflurazon. Weed Sci 26:198-203.

Hamelink, J. L., D. R. Buckler, F. L. Mayer, D. U. Palawski, and H. O. Sanders. 1986. Toxicity of fluridone to aquatic invertebrates and fish. Env. Toxic. and Chem. 5:87-94.

Kamarianos, A., X. Karamanlis, G. Fotis, J. Altiparmakis, and S. Kilikidis. 1988. Effect of fluridone on the aquatic plants *Trapa natans* and *Phragmites communis*. J. Aquat. Plant Manage. 26:69.

Langeland, K. A. and J. P. Warner. 1986. Persistence of Diquat, endothall and fluridone in ponds. J. Aquat. Plant Manage. 24:43-46.

West, S. D., E. W. Day, Jr., and R. O. Burger. 1979. Dissipat!on of the experimental aquatic herbicide fluridone from lakes and ponds. J. Agric. Food Chem. 27:1067-1072.

West, S. D., R. O. Burger, G. M. Poole, and D. H. Mowrey. 1983. Bioconcentration and field dissipation of the aquatic hericide fluridone and its degradation products in aquatic environments. J. Agric. Food Chem. 31:579-585.

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Effects of Potassium Ricinoleate on Water Quality, Phytoplankton, and Off-Flavor in Channel Catfish Ponds

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ABSTRACT

Potassium ricinoleate (Solricin 135®) was marketed as an algicide to selectively inhibit the growth of blue-green algae in ponds and eliminate off-flavor of channel catfish, *Ictalurus punctatus* (Rafinesque). The algicide was evaluated in catfish culture ponds at the Auburn University Fisheries Research Unit from March through October of 1986. Potassium ricinoleate, in weekly applications of concentrations up to 1.00 ppm, did not significantly inhibit the growth of blue-green algae or positively affect the phytoplankton community structure in ponds with waters of low hardness (20-30 mg/l as $CaCO_3$). The compound did not eliminate off-flavor in channel catfish nor did it improve water quality of the ponds.

Key words: Algae control, Solricin 135®, blue-green algae, catfish culture, aquaculture.

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INTRODUCTION

Channel catfish, *Ictalurus punctatus* (Rafinesque), farmers normally supply large amounts of feed (39-67 kg/ha/d) to ponds to enhance production. In ponds which receive applications of fish feed, roughly 75% of the nutrients in the feed eventually reaches the water in excretory products (Boyd 1973b). These nutrients stimulate the growth of aquatic plants, particularly phytoplankton which, within limits, is desirable for optimum fish production. Phytoplankton produce dissolved oxygen during photosynthesis, remove and recycle toxic metabolites and waste nutrients, and contribute to the production of fish food organisms. However, unlimited proliferation of phytoplankton, especially blue-green algae (Cyanobacteria) can result in serious environmental deterioration of the pond.

Dense blooms of phytoplankton exert an excessive oxygen demand at night or during prolonged periods of cloudy weather, leading to low dissolved oxygen levels in ponds which stress or kill fish (Boyd et al. 1978). During periods of warm, calm weather, buoyant blue-green algae often accumulate to depths of several centimeters over the