KARMEX HERBICIDE WITH FERTILIZATION AND AERATION TO CONTROL FILAMENTOUS ALGAE IN HATCHERY PONDS[1]

by

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ABSTRACT

Six 0.10-acre (0.04 ha) hatchery ponds containing striped bass fingerlings were treated with Karmex herbicide in an effort to control filamentous algae composed mainly of the genera *Pithophora* and *Spirogyra*. Ponds treated were fertilized and aerated immediately after application of Karmex. Shortly after treatment with Karmex, large mats of filamentous algae floated to the surface, decayed, and were broken into fragments by agitation from aerators. The fragments settled to the pond bottoms. Dissolved oxygen concentrations dropped rapidly for several days following treatment, but remained above critical levels and then increased slowly. After 11 to 13 days dissolved oxygen concentrations at sunrise were above 8.0 mg/l and aeration was discontinued. Dense phytoplankton blooms, believed to be a result of both fertilization and release of nutrients tied up in the filamentous algae, developed 13 to 17 days after treatment with Karmex, and prevented new growths of filamentous algae. Draining of ponds 44 to 97 days after treatment revealed no significant growths of filamentous algae.

INTRODUCTION

Many problems often result from filamentous algae in fish culture ponds. Pelleted or other supplemental feeds thrown to fish land on floating mats of filamentous algae and therefore are not utilized. However, filamentous algae, mainly of the genera *Pithophora* and *Spirogyra*, are most troublesome when ponds are drained for harvest of fish. Wire screens placed on drain pipes to prevent escape of small fish become clogged by filamentous algae, causing delay in draining. Fish are trapped in mats of algae in seines and become stressed and die before they can be found and removed. This is especially true when harvesting fingerling fish. Fingerlings of some species, such as striped bass, *Morone saxatilis* (Walbaum) are more easily stressed than others. As pond water levels drop during draining, fish are stranded on dense growths of *Pithophora*, *Spirogyra*, and stoneworts such as *Chara*, and die or are eaten by predatory birds. Also, in fish culture experiments where periodic growth samples of fish are seined from ponds, fish are stressed and often killed in mats of algae in the seines, affecting final results of the experiment.

Filamentous algae and higher aquatic plants undesirable in fish culture ponds can be prevented by beginning fertilization of pond waters during winter months and fertilizing as needed throughout the year to maintain a phytoplankton bloom of sufficient density to shade underwater macrophytes (Smith and Swingle, 1942). Unfortunately, year-round control of multi-use experimental ponds is not always possible. Ponds may be used during winter months only for maintaining and overwintering fingerlings of various species and often are not fertilized. Filamentous algae is allowed to grow and reproduce uncontrolled. When the ponds become available for research in the spring the pond bottoms may already have dense growths of macrophytes. Ponds are usually drained and allowed to dry several days before being refilled and stocked with experimental fish. While the pond bottoms are drying, dense mats of algae can be raked out. However, algal spores and fragments present in the bottom muds can generate new growths of filamentous algae before fertilization can take effect once the ponds are refilled.

Furthermore, pond management procedures can often result in low phytoplankton density and thus increased light penetration which is favorable to filamentous algae. Although liming of pond waters increases production (Swingle and Smith, 1939), lime precipitates suspended particles when first added, increasing light penetration (C. E. Boyd, personal communication). Organic matter such as hay or manures placed in ponds to stimulate zooplankton production also precipitates various particles in pond waters (Irwin, 1946). Increased sodium chloride concentrations in pond waters have been observed to inhibit phytoplankton production and increase visibility or light penetration. Conditions are thus sometimes favorable for growth of filamentous algae long after ponds are stocked with fish. There is an obvious need for a rapid method to control filamentous algae that will not be detrimental to water quality or fish.

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METHODS AND MATERIALS

Karmex (Diuron) was applied at a rate of 1.0 lb/acre (Grizzel, 1966) to six 0.10 acre (0.04 ha) striped bass fingerling ponds containing dense growths of filamentous algae. Ponds were treated in September and October of 1974. Karmex powder was mixed with water in a wash tub, and the solution scattered over the pond surface with a metal dipper. Portable aerators were placed in ponds immediately following treatment with Karmex in an attempt to maintain dissolved oxygen concentrations above critical levels. Only two aerators were available, therefore only two ponds were treated at one time (Table 1). Immediately following Karmex applications ponds were fertilized with superphosphate at 50 lb/acre and ammonium nitrate at 20 lb/acre to aid in the development of a phytoplankton bloom. Dissolved oxygen was measured at sunrise and sunset daily with a YSI oxygen meter. Aeration of the ponds was discontinued when dissolved oxygen concentrations measured at sunrise exceeded 8.0 mg/l (11 to 13 days after treatment with Karmex). Measurements of total alkalinity, carbonate alkalinity, bicarbonate alkalinity, total hardness, and sodium chloride concentration of the pond waters were made (A.P.H.A., 1971) periodically before and after treatment with Karmex. Total alkalinity in the ponds ranged from 42.9 mg/l to 65.3 mg/l. Total hardness ranged from 37.4 mg/l to 54.3 mg/l. Sodium chloride concentration in the ponds ranged from 100 mg/l to 130 mg/l. Mean water temperatures for the three 17-day treatment periods were 27 C, 22.9 C, and 18 C in chronological order.

Table 1. Treatment of 0.10-acre fingerling striped bass production ponds with Karmex herbicide.

Pond Number (E-series)	*Date Treated*	*No. Days From Treatment To Draining*	*Mean Water Temperature For 17-day period*	*Dates of Fertilizer Application after Treatment*
25	Sept. 3, 1974	97	27 C	Sept. 4, 1974 Sept. 21, 1974 Oct. 26, 1974
26	Sept. 3, 1974	97	27 C	Sept. 4, 1974 Sept. 21, 1974 Oct. 26, 1974
27	Sept. 21, 1974	80	22.9 C	Sept. 21, 1974 Oct. 26, 1974
28	Sept. 21, 1974	80	22.9 C	Sept. 21, 1974 Oct. 26, 1974
29	Oct. 26, 1974	44	18 C	Oct. 26, 1974
30	Oct. 26, 1974	44	18 C	Oct. 26, 1974

* Each fertilizer application consisted of 50 lb/acre superphosphate (18% P_2O_5) and 20 lb/acre ammonium nitrate (35% N).

RESULTS AND DISCUSSION

Treatment with Karmex resulted in lowered dissolved oxygen concentrations (Table 2), and without aeration critical oxygen levels might have been unavoidable. Visibility increased within 72 hours after each Karmex treatment and large mats of filamentous algae floated to the surface and died. These mats were broken into fragments by agitation from aerators. Fragments settled to the pond bottoms. After 5 to 10 days, visibility decreased slowly with a simultaneous increase in dissolved oxygen. Within 11 to 13 days, dissolved oxygen measurements taken at sunrise were 8.0 mg/l or above, and aeration was discontinued. Dense phytoplankton blooms, believed to be a result of both fertilization and release of nutrients that were tied up in filamentous algae, developed 13 to 17 days after treatment with Karmex, and prevented new growths of filamentous algae. Visibility was 8 to 12 inches and oxygen concentrations at the end of each day exceeded 15.0 mg/l. Shortly after the plankton blooms developed, phytoplankton density decreased. Dissolved oxygen also decreased but stabilized, remaining within the range of 9.0 to 15.0 mg/l (recorded at sunset) for the duration of the experiment. Continued fertilization maintained satisfactory phytoplankton density in all ponds until the experiment was terminated.

Table 2. Effects of Karmex herbicide on dissolved oxygen concentrations in 0.10-acre fingerling striped bass production ponds with aeration and fertilization.

Number of Days Following Karmex Treatment	*Dissolved Oxygen Concentration at Sunrise (Mg/l)*					
	Pond (E-series)					
	25	26	27	28	29	30
0	7.8	7.9	12.2	10.9	12.9	11.4
1	5.4	7.1	10.4	9.0	10.1	9.2
2	5.0	6.3	8.1	8.4	5.0	5.7
3	4.8	5.0	6.9	7.0	5.2	5.4
4	4.6	4.2	5.9	6.4	4.9	4.9
5	4.5	4.3	4.9	6.1	5.0	5.2
6	4.2	4.3	5.2	5.0	5.0	5.2
7	4.0	5.7	5.8	5.4	5.0	5.0
8	4.0	6.1	6.0	5.7	4.8	4.9
9	3.9	6.3	6.9	5.9	4.8	5.2
10	4.2	6.8	7.0	6.6	5.9	6.9
11	6.1	7.1	7.5	7.5	7.9	8.1
12	7.8	8.0	8.2	8.2	8.7	8.0
13	8.2	8.1	8.6	8.2	9.1	8.4
14	9.9	9.2	9.0	9.0	9.6	8.9
15	10.2	9.0	9.9	10.2	10.0	9.1
16	11.0	11.1	10.1	9.7	10.0	10.8
17	12.0	12.2	9.9	9.5	10.1	10.2
Mean water temperature for 17-day period following treatment	27 C	27 C	22.9 C	22.9 C	18 C	18 C

Some small floating mats of *Pithophora* reappeared in pond E-25 but did not increase in size, and were so few that they were removed with a seine during sampling. The time that elapsed from treatment until ponds were drained ranged from 44 to 97 days and draining of the ponds revealed no significant growths of macrophytes. The ponds drained quickly and fingerlings were removed from all six in approximately 3 hours with no observed mortality. Previous attempts to harvest fish from the six ponds (before treatment) required several days.

Total alkalinity, total hardness, and sodium chloride concentration in pond-waters were apparently not affected by the treatment, however no alkalinity in carbonate form was found in water samples taken just after treatment with Karmex.

LITERATURE CITED

American Public Health Association. 1971. Standard methods for the examination of water and wastewater. 13th ed. A.P.H.A. Washington, D. C.: 874 p.

Grizzel, R. . 1966. Diuron as an aquatic herbicide. Proc. 19th Ann. Conf. S. E. Assn. Game and Fish Comm. (1965):194-197.

Irwin, W. H. 1946. Some successful methods of clearing impounded waters of turbidities due to silt. Proc. and Trans. Tex. Acad. Sci. 29 (1945):241-243.

Smith, E. V. and H. S. Swingle. 1942. The use of fertilizer for controlling several submerged aquatic plants in ponds. Trans. Am. Fish. Soc. 71 (1941):97-102.

Swingle, H. S. and E. V. Smith. 1939. Fertilizers for increasing the natural food for fish in ponds. Trans. Am. Fish. Soc. 68 (1938):126-135.