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Aquatic Weed Control With Endothall In A Salt River Project Canal

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ABSTRACT

Seven applications of the mono (N,N-dimethylalkylamine) salt of 7-oxabicyclo[2,2,1]heptane-2,3-dicarboxylic acid (Hydrothol 191) at 0.2 ppm (parts per million) active ingredient were made at 2-week intervals in the Salt River Project 10 mile Tempe Canal. The Tempe empties into the 14 mile Western Canal which, except for the first 0.5 mile, was treated with acrolein at the same 2-week intervals. The Hydrothol 191 calculated application rate of 0.2 ppm was in accordance with the Arizona EIFRA Section 24C label, and resulted in control of *Cladophora, Spirogyra,* and sago pondweed (*Potamogeton pectinatus* L.). A marked thinning of sago pondweed in one area and elimination in another occurred. No synergysm between Hydrothol 191 and acrolein was observed.

INTRODUCTION

The primary purpose of the study was to evaluate the aquatic weed control effectiveness of Hydrothol 191 in the Salt River Project 10 mile Tempe Canal, in South Central Arizona. Endothall derivatives have been proven effective for vascular weed and algae control in irrigation systems (1). The City of Tempe will have a domestic water filter plant going on stream in January 1982 obtaining its water at mile 9.9 of the canal.

The control of vascular aquatic weeds and algae is a major operation/maintenance task in the Salt River Project's 1,000 miles of channel, and is being complicated by the encroachment of urban development into the farming areas. Few methods of aquatic weed control are acceptable or practical where M and I (municipal and industrial) quality water is required, and the Salt River Project's past preventive treatments with acrolein is not EPA approved.

Hydrothol 191 is in the advanced stage of EPA label consideration for a 3 ppm unrestricted use in M and I water sources and is presently available for M and I water use in Arizona under EPA SLN label number AZ 790010, for applications at 0.2 ppm.

The canal turns 90° at mile 10.0, and is joined at that point by a lateral which carries up to 10 cfs (cubic feet per second). The Tempe becomes the 14 mile long Western Canal at this point. Acrolein was applied at mile .5 and mile 8.1 of the Western, hereafter referred to as mile 10.5 and mile 18.1 of the combined Tempe-Western system (Figure 1).

MATERIALS AND METHODS

The Tempe-Western canal system receives water from the Salt River Project dams on the Salt and Verde Rivers in South Central Arizona. Wells normally supplement the gravity water, but were not needed in 1980. The canal capacity at the head is 600 cfs, average width 45 feet, and water depth varies from a foot or so depending on water volume, to up to 6 feet before some control structures. The smaller Western canal averages 35 feet in width, with depths comparable to the Tempe. The canals are unlined in some sections, with one bank concrete lined, or both banks and bottom lined in others.

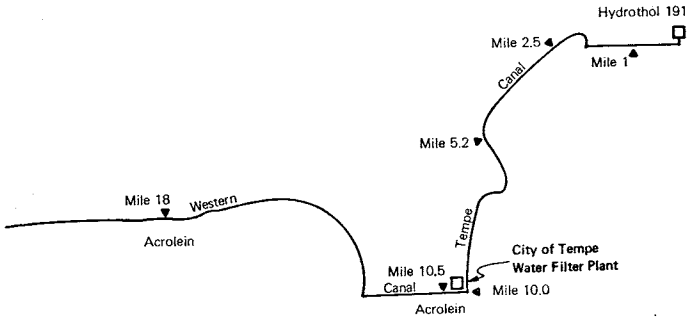

Diagram of Tempe-Western Canal, with Hydrothol 191 and Acrolein Application Points, and Filter Plant Locations Indicated.

Figure 1. Diagram of Tempe-Western Canal, with Hydrothol 191 and acrolein application points, and filter plant locations indicated.

A typical 1980 water analysis showed conductivity of 460 Micromhos, a pH of 8.0, 120 ppm as bicarbonate, and total hardness of 130 ppm. The average total dissolved solids over the season approximated 300 ppm.

Hydrothol 191 was transferred as needed from the 30 gallon shipping containers to a 500 gallon fiberglass tank at the head of the Tempe Canal. The tank is placed in the securely fenced compound that surrounds the canal control structures and automatic gates.

A piston/diaphram electric pump was used to meter Hydrothol 191 into the canal for the first four applications. The fifth application, only partially completed due to problems with the specially designed Salt River Project chemical delivery truck, and pump problems, was largely a gravity flow operation. The sixth and seventh applications were by gravity flow. The plastic discharge tube from the 500 gallon tank was suspended from the control structure several feet above the water. The turbulent head waters assured prompt mixing.

Water samples were taken on the 3rd day of each ap-

plication, except the fifth, for Hydrothol 191 residue analysis at the Pennwalt laboratory at Tacoma, Washington (2). The samples were taken at mile 1, 10, and 18 to 20, frozen in dry ice for storage so as to prevent microbial action from degrading the endothall. The samples were shipped frozen so as to arrive on a business day.

The acrolein applications, at mile 10.5 and 18.1, were made at 1 ppm, for approximately 20 hours.

RESULTS

The first application, June 16 to 20, of the seven resulted in satisfactory control of sago pondweed (hereafter referred to as sago) and filamentous algae in the 10 miles of the Tempe Canal. It did not control algae from mile 10.0 to 10.5, the one half mile of the Western Canal above the acrolein application site. (No vascular weeds were observed in that reach).

Five days after completion of the first application, algae mats clinging to canal lining above control structures had disappeared. At the heavily sago infested area at mile 2.5, weeds were no longer visible at the surface of the 5 foot depth, but flaccid 6 to 8 foot stems, largely devoid of leaves, were recovered from the moderately cloudy water. At mile 5.2 the fringe of sago extended from the low water line to some 10 feet out. It had been reduced in length by about 50 per cent, and averaged 4 to 8 inches long. The control of algae stopped abruptly at the right angle turn at mile 10, where the Tempe ends and the Western begins. It was determined that the sago beds at miles 2.5 and 5.2 would be special sites for continuing observations.

It seemed fairly obvious after the second treatment that applications at 4-week intervals instead of two would have provided adequate control for the balance of the season, but the Salt River Project chose to maintain a two week schedule so as to coincide with the acrolein applications in the Western Canal, and to determine if other benefits would occur.

The second, third and fourth applications controlled the light algae infestation which regenerated between treatments in the Tempe, and continued to deteriorate the sago beds at miles 2.5 and 5.2. Algae in the Western mile 10.0 to 10.5 stretch above the acrolein application site, and below the Hydrothol 191 controlled algae in the Tempe, continued to develop long filaments and medium to heavy concentrations, but did not require special control measures.

On August 4, 3 days after the completion of the fourth application, only a few short necrotic stems of sago were recoverable at miles 2.5 and 5.2. The algae behavior in the mile 10.0 and 10.5 remained the same and it was observed that by this time that the acrolein applications at mile 10.5 had only a suppressing effect on the sago at mile 18.0 above the acrolein application point there. Although the algae was nearly eliminated above the mile 18.1 application (to regenerate to approximately medium concentration in 2 weeks), the sago remained necrotic appearing for about one week and then started to regrow. It was never reduced to less than 6 to 10 inches in length in this area.

The fifth application, August 11 to 12, consisted of less than one half the required quantity of Hydrothol 191 for a 0.2 ppm 96 hour application.

Roots and rhizomes of sago were recovered on August 12 at mile 5.2 during the fifth application and placed in fresh water for 1 week. There was no recovery or evidence of life observed.

The sixth and seventh applications unexpectedly controlled algae from mile 10.0 to 10.5. A medium to heavy growth, of predominantly *Cladophora*, was for practical purposes eliminated.

A recapitulation of the Hydrothal 191 values as determined by the Pennwalt Tacoma laboratory is contained in Table 2.

The last two applications were made by gravity flow from the 500 gallon tank, as tank and pump had shown signs of clogging. The application rate of Hydrothol 191 exceeded the target rate of 0.2 ppm during part of the application, evidenced by the fact that in both treatments the Hydrothol ran out prior to 96 hours.

The annual 30 day dry up of canals for major construction and maintenance began on October 12, 1 month after the completion of the seventh application. The canal bottoms were carefully inspected a few days later. At mile 2.5 we found a few scattered sago plants with above ground portions several inches long and roots of 1 or 2 inches. At mile 5.2 no sago plants were found. In addition to walking 0.25 mile for surface observations, two 9-foot long trenches were made at right angles to the bank in the area where the heavy sago infestation had been under observation since June. No sago roots were recovered in the trenches.

At mile 18.0, immediately before the acrolein application point, the sago plants which were recovered on October 16, were dense, with typical matted rhizomes. Their healthy condition sharply contrasted with the plants found at mile 2.5 on the same date.

TABLE 1. SUMMARY OF THE SEVEN ENDOTHALL APPLICATIONS IN THE SALT RIVER PROJECT TEMPE-WESTERN CANAL.

Date	Total application time (hr)	Water flow (cfs)	Water temp (mile 10)	Gallons applied
June 16-20, 1980	98	440	75	860
June 30 - July 4	96	473	76	840
July 14-18	95	475	72	950
July 28 - Aug. 1	96	406	76	840
Aug. 11-12	24 (approx)	400 (approx)	77	300
Aug. 25-29	90	400	74	872
Sept. 8-11	72	338	75	690

TABLE 2. ENDOTHALL RESIDUES IN PPM, TEMPE-WESTERN CANAL TREATMENTS.

	Hours after treatment start	Mile 1	Mile 10	Mile 18 to 20
1st Treatment	58	0.15	0.12	0.13
2nd Treatment	65	0.03	0.03	0.03
3rd Treatment	65	0.11	0.11	0.32
4th Treatment	59	0.02	0.02	<0.01
6th Treatment	67	0.01	0.12	0.08
7th Treatment	68	<0.01	<0.01	0.09

DISCUSSION

The seven applications of Hydrothol 191 at 2-week intervals, and the acrolein applications downstream from the Hydrothol 191 afford the opportunity for some observations not previously possible under commercial application circumstances.

For example, no synergysm was observed, and this is best demonstrated at mile 18 of the system. Although levels of Hydrothol 191 averaged 0.11 ppm when water samples were taken at or below that point, and algae was controlled by acrolein in each application, the sago recovered and was growing vigorously by the time of each subsequent application. In contrast, the sago at the observation points of miles 2.5 and 5.2, subjected to a somewhat higher concentration of Hydrothol 191 and no acrolein, continued to regress throughout the season.

Not related to the 2-week application period, but important to emphasize, was the control of filamentrous algae between mile 10.0 and 10.5 as a result of the sixth and seventh applications. It seems clear that when algae was controlled in that reach the Hydrothol 191 concentration exceeded 0.2 ppm. In both the sixth and seventh runs, the application rate appeared during one or more instances to be somewhat greater than required to maintain 0.2 ppm. The sixth application, was completed in about 76 hours, and the seventh in 72 hours, instead of the planned 96 hours. The weed control observed strongly reinforces the 1979 test work[1] (unpublished) when algae in the Salt River Project Eastern Canal was not successfully controlled with any consistency beyond 10 miles, although vascular weed suppression or control extended to the end of the canal at mile 14. (Some vascular weed suppression in a lateral 17 miles from the application was noted.) Work done in prior years in Arizona and elsewhere at 3 ppm has shown no such limitation in algae control,[2] so that the low rate of 0.2 ppm is established as marginal for algae control in a mixed weed complex in long canal reaches. Also no vascular weeds were observed in the mile 10.0 to 10.5 reach during the season nor in the dry up period. The first sago found below mile 10.5 during the dry up was a very light stand at mile 12 in the forebay at a steam generating plant. In past years this area has been heavily infested, and it is likely that the Hydrothol 191 treatments are responsible for the present favorable condition.

Probably the most significant result to be considered is the reduction in sago stand obtained by the repeated 2-week applications. It seems likely that channel maintenance requirements would be satisfied by treatments every 4 weeks, but it is possible the near elimination of sago at mile 2.5 and apparent complete elimination at mile 5.2 had real operation and maintenance value regarding water flow. The canal bottom weed growth in 1981 will be of much interest. As a matter of comparison the acrolein treatments did not affect the stand or regrowth characteristics of sago at mile 18, 7.5 miles below its application point.

[1]Bowles, E. J. 1980. Personal communication. (Pennwalt).

ACKNOWLEDGMENTS

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[2]Bowles, E. J. 1981 Personal communication. (Pennwalt).