ULTRAHIGH-FREQUENCY ELECTROMAGNETIC RADIATION UTILIZED FOR AQUATIC VEGETATION CONTROL

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ABSTRACT

An ultrahigh-frequency electromagnetic field (2,450 ± 20 megahertz) is lethal to floating aquatic plants. Preliminary experiments indicate specie sensitivity varies within the duckweeds. Laboratory experiments indicate their Median Tolerance Limit is approximately 16.7 joules/ml, for our experimental conditions. However, field simulated experiments with soil banked test containers indicate higher energy levels will be necessary for field control.

INTRODUCTION

Aquatic biologists today are beginning to realize that aquatic vegetative growth has reached epidemic proportions in some of our lakes and reservoirs. Increased eutrophication in recent years greatly accelerated the rate of normal succession of littorial aquatic plants to such an extent that expensive chemical or mechanical treatments are necessary to keep waterways open for recreational (fishing or boating) or transportational uses. The chemicals utilized are usually expensive and have residual components or slowly biodegradable intermediates. Mechanical treatment is usually a submerged grass cutter which harvests the top portions of the rooted plants and has to be conducted at regular intervals. Both methods have advantages. Chemical treatment is longer lasting, while mechanical treatment, by removing the plants, does not create a large BOD which is harmful to other organisms present. Chemical treatment is usually recommended in winter when high oxygen levels are present and organisms have lower metabolic rates. Champ, *et al.*, (1972) have utilized anhydrous ammonia for aquatic vegetation control in an attempt to find simple naturally occurring compounds which are biodegradable and do not leave persistent residues. Idealistically, ecologists are seeking compounds which offer the most vegetation control with the least side effects to the community treated.

Ultrahigh-frequency (UHF) electromagnetic radiation has been utilized for weed control (Davis, *et al.*, 1971) with very favorable results. UHF electromagnetic radiation has also been used for insect control in grain storage (Nelson, 1966) and for control of nematodes in soil (O'Bannon and Good, 1971). This paper investigates the utilization of electromagnetic UHF fields to control duckweeds. Specific objectives investigated pertained to establishing energy levels necessary for control of duckweeds.

METHODS AND MATERIALS

Duckweeds were placed in petri dishes filled with 50 ml of pond water and exposed to various energy levels of UHF electromagnetic radiation in a cavity-type chamber (38 x 30 x 23 cm). The power source was a magnetron operating at 2,450 + 20 Mhz, with a nominal power output of 600 watts. Energy intensities are reported as energy absorbed by an equivalent volume of water. The petri dish to be treated was placed on an inverted petri dish centrally located in the chamber

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to facilitate exact duplication of treatment location within the chamber. Preliminary experiments were conducted using various numbers of duckweeds and various grid counting schemes. It was found for convenience of time and reproducibility that 20 plants per petri dish would facilitate the use of replications within treatment levels.

RESULTS AND DISCUSSION

Table 1 gives percent survival of *Wolffia punctata*. The median tolerance limit (the treatment level which kills 50% of the plants) was eight seconds or approximately 16.7 joules/ml. All the plants in the ten second treatment group were dead and decaying seven days following treatment. It is interesting to note that the slow death of the plants could be significant in preventing a high build up of BOD following treatment. Joules/ml units are used because the test cavity reflects radiation from all sides, whereas in the field the radiation is transmitted only to the surface of the water and the units of energy would be joules/cm^2. By using 50 mls of water as a test volume, there was only a 4.0°C rise in the temperature of the water for an eight second exposure time.

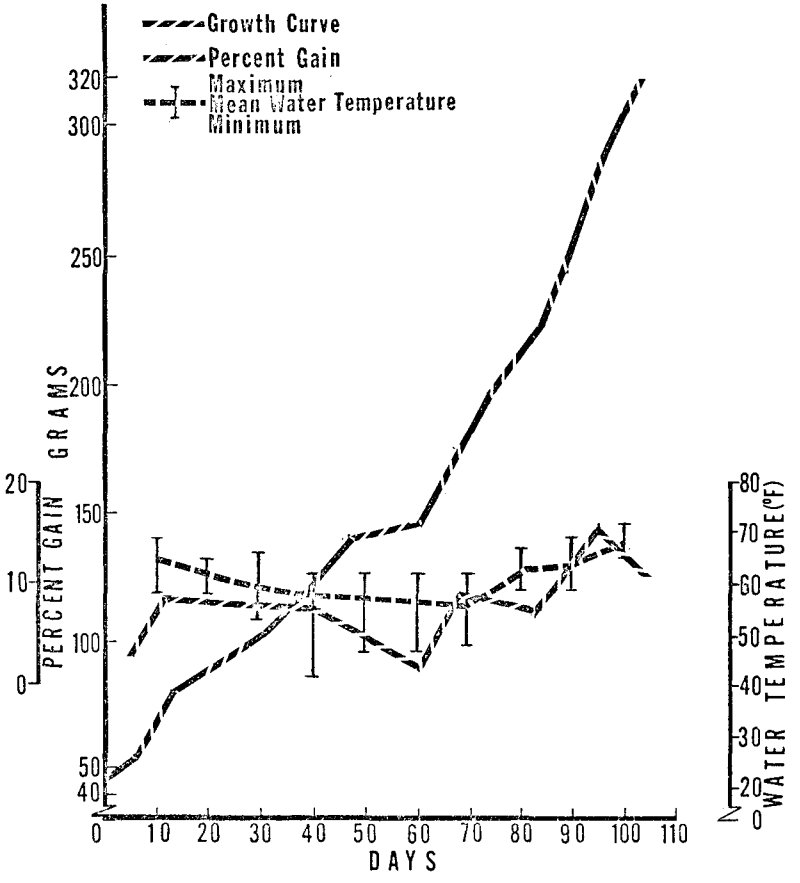
Some field simulated tests were conducted using a specially designed prototype radiator. Duckweeds *Spirodela* sp., *Wolffia punctata* and *Wolffia columbiana* were tested. Results indicate that specie sensitivity varies and that higher energy levels will be necessary for field erradication due to the presence of other energy absorbing parameters.

Preliminary results indicate that UHF electromagnetic radiation demonstrates potential for aquatic vegetation control. Our results with the duckweeds indicate that floating plants can be erradicated. Continued research is needed with other aquatic plants (water hyacinths and water lilies) to verify our predictions. UHF electromagnetic radiation could be used in municipalities, farming communities, for treatment of drainage ditches and for treatment of irrigation ditches.

Table 1. Daily percent survival of *Wolffia punctata* following exposure to indicated treatments of ultrahigh-frequency electromagnetic radiation.

Day	1.0*	2.0*	4.0*	6.0*	8.0*	10.0*	Controls
1	100	100	100	100	50	45	100
2	100	100	100	100	40	35	100
3	100	100	100	100	25	25	100
4	100	100	100	100	60**	0	100

*seconds of exposure
**increase in number due to separation of plants



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