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NASA TECHNICAL MEMORANDUM

TM-X-72720

FEBRUARY, 1975

AQUATIC PLANTS FOR REMOVAL OF MEVINPHOS FROM THE AQUATIC ENVIRONMENT

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NASA

NATIONAL SPACE TECHNOLOGY LABORATORIES

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NSTL FORM 12 (JAN 1975)

TECHNICAL REPORT STANDARD TITLE PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
TM-X-72720		

4. TITLE AND SUBTITLE
Aquatic Plants for Removal of Mevinphos from the Aquatic Environment

5. REPORT DATE
February 5, 1975

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
B. C. Wolverton

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
National Space Technology Laboratories
Bay St. Louis, Mississippi 39520

10. WORK UNIT NO.

11. CONTRACT OR GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS
National Aeronautics and Space Administration
Washington, D. C. 20546

13. TYPE OF REPORT & PERIOD COVERED
Technical Memorandum

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Fragrant waterlily (Nymphaea odorata, Ait.), joint-grass (Paspalum distichum L.), and rush (Juncus repens, Michx.) were used to evaluate the effectiveness of vascular aquatic plants in removing the insecticide mevinphos (dimethyl-1-carbomethoxy-1propen-2-yl phosphate) from waters contaiminated with this chemical.

The emersed aquatic plants fragrant waterlily and joint-grass removed 87 and 93 ppm of mevinphos from water test systems in less than 2 weeks without apparent damage to the plants; whereas rush, a submersed plant, removed less insecticide than the water-soil controls. Water-soil controls still contained toxic levels of this insecticide, as demonstrated by fish bioassay studies, after 35 days.

EDITOR'S NOTE

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17. KEY WORDS

18. DISTRIBUTION STATEMENT
Unclassified - unlimited

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19. SECURITY CLASSIF. (of this report)	20. SECURITY CLASSIF. (of this page)	21. NO. OF PAGES	22. PRICE
Unclassified	Unclassified	8	NTIS

TECHNICAL MEMORANDUM X-72720

AQUATIC PLANTS FOR REMOVAL OF MEVINPHOS FROM THE AQUATIC ENVIRONMENT

INTRODUCTION

During the past few years, environmentalists have been taking a close look at the levels and distribution of pesticides, heavy metals, and other hazardous chemicals in our environment. The increased chemical waste disposal at the National Aeronautics and Space Administration's (NASA) National Space Technology Laboratories creates the need for a better understanding of the part vascular aquatic plants play in removing pesticides and other hazardous chemicals from polluted waters. Vescular aquatic plants are also potential sensors which can possibly be used to monitor the quality of water in which they grow by means of remote sensing.

The fact that vascular plants can absorb, translocate, and metabolize various chemicals has been used to great advantage by entomologists in controlling plant-eating insects. Insecticides that are capable of being absorbed and translocated in plants are known as systemic insecticides. The phenomenon involved in systemic uptake, translocation, concentration and/or metabolic breakdown of pesticides from soil should be taken advantage of in such important applications as removing chemicals from polluted waters. Experiments have demonstrated that the absorption of insecticides by plant roots from various media is greater from solution than from soil (1).

Recent experiments have also shown that while no cadmium was demonstrated in corn and turnip leaves grown in soil fertilized with superphosphate containing 7.25 ppm cadmium, these same plants grown in aqueous solutions containing 0.1 ppm cadmium concentrated 90 and 160 ppm of cadmium in their leaves (2, 3). Recent research has also demonstrated the ability of aquatic plants to assimilate nutrients and remove excess nitrates and phosphates from sewage effluent (4, 5). A system utilizing vascular aquatic plants to remove nutrients from sewage effluent is presently being evaluated on a large scale by the Institute of Water Research (IWR) at Michigan State University (6).

FISH TOXICITY STUDIES

Fish bioassay studies were conducted to verify ultraviolet spectrophotometric data. Mosquitofish (Gambusia affinis), seined from ponds and streams on the Eglin Air Force Base Reservation, were used as the test species. The fish, having a total length of 20 to 30 mm, were acclimated in the laboratory in 37.85×10^{-3} - m^3 (10-gal) holding tanks for a minimum of 10 days before they were used. Water temperatures were maintained at approximately 22° C. Test containers were 0.001 - m^3 (1-liter) beakers, each housing 10 fish. The fish were placed in the test water and observed for 24 hr. Data were taken on the number of fish alive after various time intervals.

RESULTS AND DISCUSSION

Ultraviolet spectrophotometric data demonstrated that joint-grass and fragrant water lily were capable of removing from 87 to 93 ppm of Mevinphos from water test systems in less than 2 weeks without apparent damage to the plants, whereas rush removed less insecticide than the water plus soil controls. Water controls contained averages of 43 and 58 ppm of Mevinphos, whereas water plus soil controls contained averages of only 4 and 5 ppm after 35 days (Table 1).

Bioassay data demonstrated the effectiveness of joint-grass and fragrant water lily in removing from 87 to 93 ppm of Mevinphos and/or any products toxic to mosquitofish from experimental water in less than 2 weeks, thus confirming the ultraviolet spectrophotometric data (Table 2).

The filtering capability of aquatic plants appears to be dependent on the active participation of the plant in four main processes; namely, absorption, translocation, concentration, and detoxification (metabolic breakdown). Emersed aquatic plants appear to be more effective in removing mevinphos from aqueous solution than submersed species. This might be explained by the fact that the emersed plants transpire considerable amounts of water through their leaves behaving much like a wick.

TABLE 2. MOSQUITOFISH (Gambusia affinis) BIOASSAY OF EXPERIMENTAL MEVINPHOS SOLUTIONS

12th-Day Bioassay[a]	Number of Test Fish Surviving					
	5 min.	10 min.	1 hr	2 hr	4 hr	24 hr
Control	10	10	10	10	10	10
Fresh Water Only	0	0	0	0	0	0
Brackish Water Only	0	0	0	0	0	0
Nymphaea odorata, Ait.	10	10	10	9	9	9
Juncus repens, Michx.	6	1	0	0	0	0
Paspalum distichum L.	10	10	10	10	10	10
Paspalum distichum L. (Brackish Water)	10	10	10	10	10	10
Mevinphos — Water Control	6	0	0	0	0	0
Fresh Water and Soil	0	0	0	0	0	0
Brackish Water and Soil	10	0	0	0	0	0
27th-Day Bioassay[b]						
Control	10	10	10	10	10	10
Fresh Water Only	0	0	0	0	0	0
Brackish Water Only	0	0	0	0	0	0

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