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EFFECT OF GRANULAR 2,4-D ON SOME WATER-WEEDS AND ITS PERSISTENCE

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SUMMARY

Good control of *Azolla filiculoides* **var.** *rubra, Ceratophyllum demersum, Hydrilla verticillata, Hydrocharis morus-ranae, Nymphaea mexicana, Pistia stratiotes* **and** *Potamogeton crispus,* **but not of** *Marsilea brownii, Lemna oligorrhiza* **or** *Salvinia auriculata,* **was obtained by applying a granular formulation of the butoxy ethanol ester of 2,4-D at the rate of 1 lb of 20% w/w product per 200 sq ft.**

Bioassay, using cotton and tomato seedlings, showed that the 2,4-D persisted in the water for at least 22 days. No trace of 2,4-D could be detected at 29 days.

I. INTRODUCTION

Granular preparations of 2,4-dichlorophenoxyacetic acid (2,4-D) have been in use for some time in the United States of America (Grigsby, Hamilton, and Smith 1956; Haven 1963) for the control of aquatic vegetation but no reports are available of tests with formulations of this type under Queensland conditions.

The objectives of this experiment were to test under field conditions the effect of a granular preparation of 2,4-D on a number of common water plants, and to determine in the laboratory the persistence of 2,4-D in the water by bioassay.

II. FIELD TRIAL

(a) Materials and Methods

The site of the field trial was a pond in the Botanic Gardens, Brisbane, oval in shape, covering an area of approximately 254 sq yd and averaging about 3 ft in depth.

The material used was "Agserv Aqua Kleen", a 20% w/w granular formulation of the butoxy ethanol ester of 2,4-D on 8-13 mesh "Attaclay" granules.

A list of the water plants present in the treated area is given in Table 1.

At the southern end of the pond, two marginal strips each 50 sq ft in area (16 ft 8 in. x 3 ft with the long axis parallel with the bank) were treated on January 8, 1964, with Aqua Kleen at the rate of 1 lb of product per 200 sq ft (equivalent to 43·56 lb 2,4-D acid equivalent per acre). The granular material was sprinkled uniformly by hand over the surface of the water.

(b) Results

Observations were made each seventh day commencing on the day after treatment and continuing for 13 weeks. Notes on the response of each of the plant species which were thoroughly established in the pond prior to treatment are given in Table 1.

TABLE 1

Effect of Treatment

Species	Original Cover*	Cover at 13 Weeks*	Disappearance (days after treatment)	Reappearance and Comment
Entirely Floating				
Azolla filiculoides var. *rubra*	2	Nil	8	†
Lemna oligorrhiza	8	15	..	Never completely killed. Maximum effect after 2–3 weeks. Back to normal at 8 weeks
Pistia stratiotes	10	2	15	Starting to encroach after 8 weeks
Salvinia auriculata	10	80	..	Severely retarded, with many dead fronds. Maximum effect 3–4 weeks after treatment but fully recovered and almost completely covering treated area 8 weeks after treatment
Entirely Submersed				
Ceratophyllum demersum ..	5	Nil	15	†
Hydrilla verticillata ..	2	Nil	8	†
Potamogeton crispus ..	1	Nil	8	†
Rooted and Partly Emergent				
Hydrocharis morus-ranae ..	1	Nil	8	†
Nymphaea mexicana ..	60	Nil	15	†
Pontederia cordata ..	1	1	..	Older leaves browned. Young leaves distorted. Plant still showing slight effect 13 weeks after treatment

* Percentage of total water surface.

† No sign of recurrence 13 weeks after treatment.

In addition to these well-established species, three further species—*Marsilea brownii, Sagittaria lancifolia* and *Sagittaria latifolia*—were planted into the pond 2 days prior to treatment. After 15 days, the two *Sagittaria* species had disappeared but the *Marsilea* persisted. Although stunted for 7 weeks, it recovered and started to spread. This species is rooted in the mud but the leaves are emergent and horizontal.

(c) Discussion

All three submersed species—*Ceratophyllum demersum, Hydrilla verticillata* and *Potamogeton crispus*—were completely destroyed. Obviously these species were physiologically susceptible to the chemical and were able to absorb lethal amounts of 2,4-D from the water or the substrate.

Pontederia cordata is an emergent species rooted in the mud. It has some submersed leaves and emergent leaves. Although showing symptoms of injury, it did not apparently absorb sufficient 2,4-D to cause serious disruption of growth. However, it was unable to take advantage of the lack of competition after associated species died and it is possible that the 2,4-D had some retarding effect on growth.

Marsilea brownii, also an emergent species, was planted only 2 days prior to treatment of the pond. It exhibited only stunting and then began to spread.

Obviously these two emergent species are physiologically resistant, since lodgement of 2,4-D granules on the pond bottom ensured an adequate supply of 2,4-D in the water and the substrate. This is further evidenced by the good control of *Nymphaea mexicana.*

Of the free-floating forms, *Pistia stratiotes* and *Azolla filiculoides* var. *rubra* were killed initially but reinfestation occurred from plants outside the treated area. *Salvinia auriculata* and *Lemna oligorrhiza* were not killed but showed signs of injury after treatment. Maximum effect of the chemical on these two species was noted about 3 weeks after treatment, and this period coincides with the persistence of 2,4-D in the water as shown by the bioassay. This indicates that these plants are not completely resistant to 2,4-D and that the concentrations were sub-lethal.

Non-control of these free-floating forms could possibly be explained by the existence of a concentration gradient of 2,4-D through the depth of the water. Concentrations in the surface water could be expected to be fairly low, particularly since this granular product is formulated to give slow release of the chemical. Survival of plants of this type could then be accounted for by either an insufficient supply of 2,4-D in the substrate or non-susceptibility to the compound.

Some of the 2,4-D granules lodged in the leaves of *Pistia stratiotes* and could have caused the fairly sudden disappearance of this species. The fronds of the *Azolla* were too small to retain the large granules but this species was in fact eradicated.

With free-floating forms, better control could possibly be expected from an overall spray leading to direct absorption through leaf tissue.

In planning for long-term control, it would appear to be advisable to make provision for alternating application of granular material and overall spraying to avoid an increase in population of any particular species.

III. BIOASSAY FOR PERSISTENCE OF 2,4-D

(a) Materials and Methods

The test plants used were Grosse Lisse tomato and Dixie King cotton. Eight-inch terracotta pots were planted each with eight seeds of tomato and eight seeds of cotton and placed in a shade house. Planting was repeated each 7 days. Ten days were required for development of seedlings to the required stage where the first pair of true leaves were beginning to expand. Immediately prior to use, the seedlings were thinned to six plants, three of each species per pot.

A 500 ml sample of pond water was taken each 7 days commencing on the day after treatment of the pond. It was a composite sample taken at varying depths from the two treated areas. The water level was allowed to drop under natural evaporation to a depth of about 1–2 ft before refilling. Another 500 ml sample, to act as control, was taken from an adjacent untreated pond which overflows into the treated one.

Each 500 ml water sample was poured over the six plants in one pot to wet the plants completely. Excess water was allowed to run into the soil in the pots, which were then placed side by side in the open on a concrete floor.

Wetting of test plants was avoided when subsequent watering became necessary.

Fourteen days after treatment the width of the first pair of true leaves was measured in accordance with the technique described by Leonard, Weaver, and Kay (1962) for the quantitative assay of 2,4-D. Observations on the seedlings were also recorded.

(b) Results

Results of the bioassays are given in Table 2.

(c) Discussion

Under the conditions of the experiment, the width of the first two true leaves of cotton was not a particularly reliable guide, but the end-point of the effect of the 2,4-D was remarkably clear-cut.

Plants treated with the water sample taken 22 days after treatment of the pond showed unmistakable symptoms of 2,4-D injury. The sample taken 29 days after treatment did not cause any sign of abnormal plant response.

The manufacturer's recommendation for a minimum period of 3 weeks between treatment and use of water for irrigation appears to be too short and it is suggested that a period of 4 weeks would be advantageous where very susceptible crops are being irrigated.

TABLE 2

BIOASSAY RESULTS

Number of Days After Treatment of Pond	Treatment	COTTON: Mean Width of 1st Pair of True Leaves 14 Days After Treatment (in.)	COTTON: Observations 14 Days After Treatment	TOMATOES: Observations 14 Days After Treatment
1	Control	2·8	5–6 leaf stage	*
	Treated	0·2	Stunted and barely past cotyledon stage	All dead
8	Control	2·7	4–5 leaf stage	3–5 leaf stage
	Treated	0·0	1 dead, other two with stunted apex and no true leaves	All dead
15	Control	1·3	Showing contamination with 2,4–D; reduced lamina	4-leaf stage
	Treated	0·2	Very reduced lamina	All dead
22	Control	2·3	*	4–leaf stage
	Treated	2·2	Second pair of true leaves showing more marked effect than first pair. Veins bunched and lamina reduced	3 plants alive but stunted and with reduced lamina
29	Control	3·2	First pair true leaves on one plant aborted but plant otherwise normal	*
	Treated	3·1	*	*
36	Control	2·4	*	*
	Treated	2·7	*	*
43	Control	2·1	*	*
	Treated	2·2	*	*

* Plants normal.

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