Pertanika 11(2), 191-194 (1988)

Effect of Aquathol K on *Hydrilla verticillata* (L.F.) Royle

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Key words: Hydrilla verticillata; Aquathol K. herbicide.

ABSTRAK

Suatu racun rumpai yang baru disintesis Aquathol K telah diuji kepada rumpai Hydrilla verticillata. *Hasil daripada ujian makmal menunjukkan bahawa Aquothol K dengan kepekatan yang berjulat antara 1.0 mg/1 sampai 2.0 mg/1 dapat membunuh rumpai ini. Terbukti bahawa kecederaan 100% telah dicapai dalam masa 10 hari umtuk tumbuhan yang diuji dengan 2.0 mg/1 Aquathol K. Kadar kecederaan 100% telah dicat lebih perlahan dengan 1.0 mg/1 racun rumpai. Pada kepekatan yang rendah iaitu 0.5 mg/1 dan 0.1 mg/1. Kecederaan 100% tidak tercapai dalam jangka masa 25 hari. Oleh yang demikian, racun rumpai ini tidak begitu berkesan pada kepekatan yang lebih rendah.*

ABSTRACT

A recently synthesized herbicide Aquathol K was tested on the water weed Hydrilla verticillata. Results from the laboraoty tests indicated that Aquathol K with concentrations ranging from 1.0 mg/1 to 2.0 mg/1 can kill this weed. Evidently, 100% injury was achieved within 10 days for the plants treated with the highest concentration., 2.0 mg/1 of Aquathol K. The rate of 100% injury was recorded much slower with 1.0 mg/1. With lower concentration 0.5 mg/1 and 0.1 mg/1, 100% injury was never achieved within 25 days. Therefore, the herbicide was not very effective at lower concentrations.

INTRODUCTION

Hydrilla is a submerged aquatic weed and according to Haller (1978) it originated from Central Africa. Currently, this weed has spread widely to most countries in the tropics and is known to cause severe problems in waterways.

Accordings to Mahler (1979), hydrilla is considered to be the number one problem in Floridian waterways. In Peninsular Malaysia, it is a menace to irrigation and drainage canals particularly in rice growing areas (Mansor, 1985). Evidently, works on the problems caused by hydrilla to the aquatic ecosystem are well documented, particularly from several Southern States of the United States of America (Steward and Van, 1987).

Aquathol K is an aquatic herbicide manufactured by Penwalt Corporation, Philadelphia, USA. This herbicide is approved for use in water systems by the United States Environmental Protection Agency (Registration no. 4581-204). It constitutes active gradient dipotassium salt of endonthall 40.3% and inert ingredients 59.7%. According to Reiner and Rogers (1986), the potassium salt exhibits lower organism toxicity and is much preferred to other herbicides in controlling the aquatic weeds, particularly at the localities where fish population density is relatively high. Some important properties of this herbicide are shown in Table 1.

Evidently, there are also no apparent effects on any genera of cladeocera or sub orders of

TABLE 1
Aquathol K properties based on Anon. (1984).

Name/Property	Explanation
Aquathol K	Dipotassium salt of endothall
Endothall	i) 7 – oxabicyclo (2.2.1) heptanc – -2, 3 – dicarboxylic acid ii) Molecular weight 186.2
Common name	Endothall (ANSI, WSSA), endothall (BSI), and endothall sodium (ISO)
Product name	Endothall technical (acid)
Manufacturer	Pennwalt, USA
Physical state	crystalline, white solid and odorless
Melting point	When heated rapidly, melts at about 144C decomposing into the anhydride and water
Light	Stable to light
Solubility	Solvent g/100 g i) Acetone 7.0 ii) Methane 28.0 iii) Water 10.0
Herbicide use	Premergence and post emergence herbicide. The compound is selectively toxic to plants.
Microbial	Disappears from soil and water by break down microbiological breakdown at rates, dependent upon soil temperature, moisture, type and microbiological activities.
Mode of action	It kills by contact; foliage, stem, and root tissues are affected. It is readily obsorbed by roots and translocated to a limit extent to the foliar plant parts to activation with ammonium sulfate its must penetrate the cuticle as the undissociated parent molecule. It has no formative effects and its toxication consists of rapid penetration, desiccation, and browning of the foliage.

copepoda (Serns, 1975).Langeland and Warner (1986) found that endothall was non-persistent in water of ponds treated in their studies, because the concentration in the water would approach zero, 25 days after treatment.

Based on the above evidences, it appears that the usage of Aquathol K in controlling the massive growth of hydrilla is a viable management option. Furthermore, there is no economical alternative method which is efective enough to overcome the massive infestation of this undesirable weeds particularly in the waterways of tropical countries.

MATERIALS AND METHODS

Several colonies of fresh and healthy hydrilla plants were collected from Manatee Springs, Chiefland, Florida. Plants were cut from the apical tips approximately 15 cm in length. Subsequently three plants were planted in each small pot. The base of stem was placed in 90% potting soils and covered with 10% sand. Each pot was then placed in a jar containing 3.8 liter of tap water (pH - 8). Fifteen jars were used for all treatments.

After two weeks, except for the control, the jars were treated accordingly with Aquathol K at concentrations of 0.1 mg/1, 0.5 mg/1, 1.0 mg/1 and 2.0 mg/1 respectively. Each treatment was replicated three times. The experiment was conducted in a growth chamber with a constant water temperature ($25^{o}C + 1^{o}C$) and a photo-period of 14 light and 10 dark hours.

Initial fresh weights were measured from several lengths of similar plants and the data were used to calculate the initial dry weights of the experimental plants. For dry weights, the plants were left in a constant temperature cabinet (Blue M) at $,5^{o}C$ for 24 hours. Visual observation on the effect of the herbicides on hydrilla was made every five days (recorded % injury). A rating scale of 0 - 100% was used in which 0 = no effect and 100% = complete kill.

RESULTS

Hydrilla verticillata harvested from Manatee Spring were robust and healthy. They were found growing at more than 50 cm (length). *Figure 1* shows the effect of various concentrations of Aquathol K on *Hydrilla verticilla.* With 2 mg/1, 50% injury was observed in 5 days. Subsequently, 100% kill was observed in 10 days. It should be noted that 100% kill was also observed for 1.0 mg/1 after 20 days. However, only 70% injury was recorded for 0.5 mg/1 with no 100% kill at this concentration. Slight injury (about 5% to 10%) was observed for 0.1 mg/1 Aquathol K.

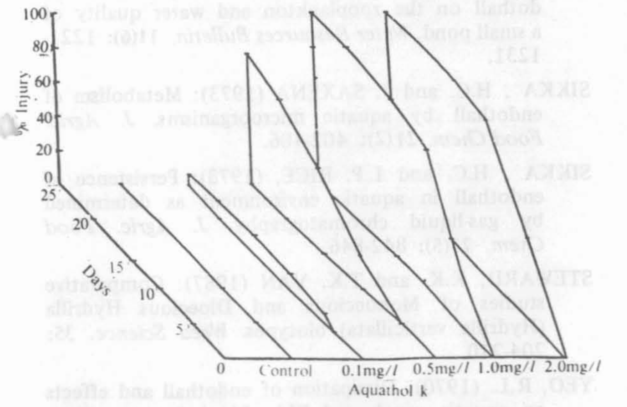

Fig. 1 : The effect of various concentrations of aquathol- k on Hydrilla verticillata *(mean value of nine readings)*

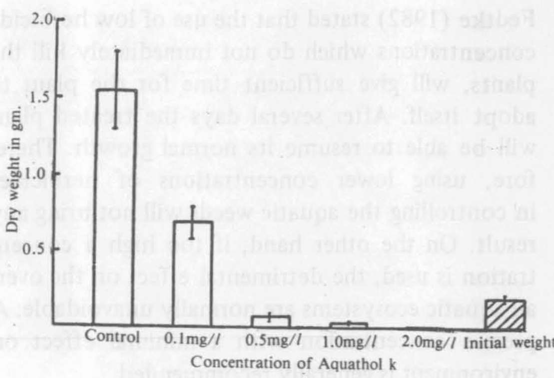

Fig 2 : The dry weights of Hydrilla verticillata *after 25 days of treatment with Aquathol k (mean ± S.D.)*

Figure 2 shows the comparative measurements of dry weights of the plants after being treated for 25 days with the four concentrations of the herbicide. It seemed that there was an increase in weights for the 0.1 mg/1 treated plants. However, for the treatments with 2 mg/1 and mg/1 Aquathol K, a significant reduction in dry weights was observed.

DISCUSSION

According to Blackburn and Weldon (1970), only 37 herbicides out of 800 herbicides evaluated in the laboratory warranted further field evaluation for controlling aquatic weeds. In their experiments with hydrilla, they recorded 100% injury or complete kill after two weeks of treatment with 5 mg/1 and 10 mg/1 of endothall. These concentrations were relatively high compared with the concentrations used in this experiment. *Figure 1* shows that within 10 days, 100% injury was recorded for the plants treated with 2 mg/1 of Aquathol K. With 1 mg/1, the 100% injury level was achieved at a slower rate; it took about 20 days. Evidently, with the lower concentrations, the 100% injury was not achieved and in fact with 0.1 mg/1, the plants were able to survive and subsequently increase in weight.

Fedtke (1982) stated that the use of low herbicide concentrations which do not immediately kill the plants, will give sufficient time for the plant to adopt itself. After several days the treated plant will be able to resume its normal growth. Therefore, using lower concentrations of herbicides in controlling the aquatic weeds will not bring any result. On the other hand, if too high a concentration is used, the detrimental effect on the overall aquatic ecosystems are normally unavoidable. A precise concentration with a minimal effect on environment is generally recommended.

From the analysis of the variance of the data, it can be concluded that there is no difference in plants' injuries between the concentration of 1 mg/1 and 2 mg/1 $p > 0.05$). It appears that 1 mg/1 of Aquathol K. was sufficient to kill the plant.

According to Reinert *et al* (1986), the usage of this herbicide in natural water will result in rapid biotransformation and biodegration. Therefore, it can be considered a non-persitent herbicide. A biotransformation half-life of 8.45 days coupled with dilution, dispersion and other dynamic rate processess that occur in an aquatic environment, suggest that endothall could be applied in an aquatic environment where water-used is quite critical.

Although this herbicide has been widely tested in tha laborataries and also in the fields in developed countries (Frank and Comes, 1967; Yeo, 1970; Sikka and Saxena, 1973; Sikka and Rice, 1973; Rodgers *et al* 1983 and Steward and Van, 1987) there are relatively few works done on the usage of this herbicide in third world countries. Therefore, in addition to the work done in the laboratary, it should be interesting if this herbicide can be tested in the field in a tropical country like Malaysia.

ACKNOWLEDGEMENT

This research was conducted at the Center for Aquatic Plant, IFAS, University of Florida. The first author wishes to thank the Fulbright foundation for giving him the fellowship and also Universiti Sains Malaysia (USM) for granting sabbatical leave.

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(Received 28 October, 1987)