

Effect of Glyphosate on Different Densities of Water Hyacinth

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ABSTRACT

Water hyacinth is a problem in rivers and reservoirs in Mexico and appropriate control methods need to be evaluated. The phytotoxic effects of the herbicide glyphosate were determined on water hyacinth in the reservoir Endho, State of Hidalgo, Mexico. Duplicate 1m² areas initially containing 10, 20, 30 and 40 kg/m² densities of water hyacinth were randomly established. After a 2 week acclimatization period, two doses of glyphosate (Rodeo² at 5 l/ha and 7 l/ha) were applied to the plots and plots were evaluated at 9, 19, 33, 51, 72 and 94 days after treatment. Glyphosate at 5 l/ha (2.38 kg/ha acid) effectively controlled densities of 10 and 20 kg/m² in 51 days. At higher plant densities (30 and 40 kg/m²), a second application of glyphosate at day 51 of 2 l/ha (0.95 kg/ha) was necessary to achieve plant control. The response of the plants indicated that a second application 20 to 30 days after the first would provide good results in high density areas.

Key words: macrophytes, *Eichhornia*, chemical control, plant density, glyphosate.

INTRODUCTION

In Mexico, many natural water bodies and hydraulic works such as dams, irrigation channels and drainage systems have been seriously affected by the excessive growth of water hyacinth (*Eichhornia crassipes* (Mart.) Solms). Water hyacinth control through mechanical methods has been useful to control weeds in reservoirs with eutrophication problems. Nevertheless, in order to reduce the cost of this procedure and increase its efficiency, chemical control is an alternative.

The mechanism of action of glyphosate [N-(phosphonomethyl) glycine] makes it suitable for control of broadleaf weeds since it is easily absorbed and translocated to all plant structures (Sprinkle et al. 1975, Barrett 1985). Translocation may be an advantage in water hyacinth control due to linking of these plants by stolons.

Pieterse and Van Rijn (1974) stated that water hyacinth dies with a 2 kg/ha dose in 8 weeks and Widyanto (1976) found that with the same dose, 75% control was attained within a 14 day period. However, Guritno and Pheang (1975) showed that treatment at this rate only retarded growth. Singh and Muller (1979) were able to obtain 100% control with 2 kg/ha in three weeks and noted that most

plants decayed 56 days after treatment. Fernandes (1978) obtained good control with 5.4 kg/ha and Evans (1978) used 1.18-1.44 kg/ha in South America and 3.36 kg/ha in the United States of America. The variability in these reported results may be related to differences in plant density.

The choice of glyphosate was based not only on herbicide effectiveness, but on positive environmental characteristics such as a low toxicity, minimum impact to non-target organisms and rapid degradation. Sacher (1978) reports that glyphosate is degraded in water and, in general, there is no waiting period between product application and water use for irrigation. Bronstad and Friestad (1985) stated that it is difficult for glyphosate to affect aquatic organisms at the concentrations reached in the field after it is applied and that it is not bioaccumulated in fish tissues.

The purpose of this study was to evaluate the effect of glyphosate herbicide (Rodeo) on different water hyacinth densities and to determine the effective dose for weed control.

MATERIALS AND METHODS

A weed confining device was needed which would allow both product application and evaluations of the phytotoxic effects. Special confinement areas were built using metal enclosures with a floating device (200 l drums), which enclosed a total area of 4 m² with internal divisions separating 1 m² areas (Figure 1).

Endho dam is located in the State of Hidalgo approximately 80 km NW of Mexico City. It is used to store the waste water from Mexico City, which is then used for irrigation. The region, 2100 m above sea level, is semi-arid with only summer rains. This dam was selected due to its accessibility, the infestation of approximately 400 ha with water hyacinth and its constant water level that allows easy long-term maintenance of the plots. The water hyacinth infestation at Endho dam is representative of the water hyacinth problem in Mexico.

Three pairs of enclosures were made, each pair serving as an experimental plot, by dose, with its duplicate. The structures were arranged along a nylon cable which crossed from one out-cropping to another at a distance of 10 m from each other. In each experimental plot of 4 m², the biomass was randomly distributed by treatment weights of 10, 20, 30 and 40 kg/m². These amounts correspond to the most commonly recorded biomass values in the study area. Aside from weight, plant morphometric characteristics were determined such as laminar area, maximum length of the photosynthetic part, and petiole and plant numbers. These estimates were obtained from 17 kg of sample on a kilo-by-kilo analysis.

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²Rodeo is a registered trademark of Monsanto Agricultural Products Inc. N. Lindberg Ave, St. Louis, Mo., USA.

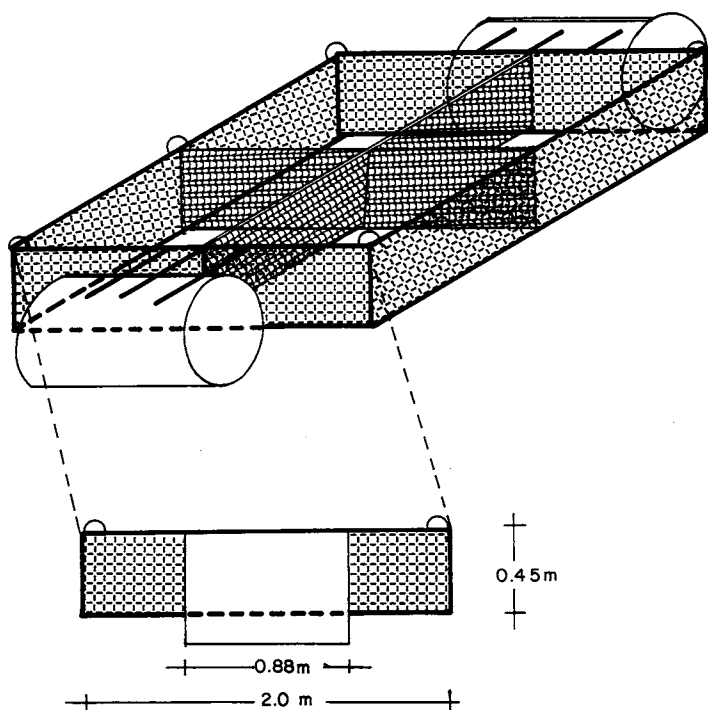


Figure 1. Structure used to confine water hyacinth to evaluate effects of the herbicide glyphosate at 5 and 7 l/ha.

Once the plants had been introduced into the experimental system they were allowed to remain for a two week period in order to acclimate to test conditions. Two treatments were carried out, one corresponding to 5 l/ha (2.38 kg/ha of the acid) and the other of 7 l/ha (3.36 kg/ha). A series was left as a control without herbicide application. Application concentrations were prepared based on label specifications and AGRI-DEX³ surfactant were prepared with tap water before application to the experimental plots. The product was applied using a manual sprayer calibrated to provide 8-ml of test solution for every m². The control plots were covered with plastic sheets during treatment applications. After the application, evaluations of the herbicide effects were performed at day 9, 19, 33, 51, 72 and 94 of the study.

The effects were evaluated using the classification system for effectiveness and tolerance proposed by the Australian Weed Committee (1979). This system is made up of 11 possible categories with different effect percentages where the lowest points show no phytotoxic effect or no control, the highest, complete mortality or 100% control.

RESULTS AND DISCUSSION

The plants used in the study had a maximum length of 50.0 ± 14.6 cm, 6.0 ± 2.0 petioles per individual with a 83.8 cm² laminar area and 5.0 ± 2.0 individuals per kg, resulting in a laminar area of approximately 2514.3 cm² per kg. The plants were in a phase of rapid growth. At

densities of 10, 20, 30 and 40 kg/m², there is a theoretical leaf area for herbicide absorption of 2.5, 5.0, 7.5 and 10.1 m², respectively. It became evident that the potential treatment area was greater than that estimated from the proportion of space covered by the plants as seen from above, due to the screening effect of one plant over another.

The effects produced by glyphosate on the different densities of water hyacinth are shown in Figure 2. For the 10 kg/m² density, the time needed for 100% control was 33 days for both 5 and 7 l/ha (Figure 2A). For a density of 20 kg/m², 100% control was obtained in 51 days at both application rates (Figure 2B). However, for densities of 30 and 40 kg/m² only 90% plant control was obtained after 51 days, with no difference noted between application rates (Figure 2C and D). The effects observed were mainly decoloration, to a light yellow color similar to straw, deformation or loss of turgor, lack of strength, and necrosis as the tissue decomposed. The overlaying effect at high plant densities makes control almost impossible to achieve with only one application. This observation was supported by the fact that in treatments with high densities, only a 90% control was obtained 51 days after the application, and regrowth was observed by this time in the form of young and healthy daughter plants.

The previously mentioned considerations lead us to carry out a second application 51 days after the first at a dose of 2 l/ha (0.95 kg/ha). Total control was obtained following this second glyphosate application (Figure 2C and 2D). The time interval between treatments may have been shortened if the second application had been performed between 20 and 30 days after the first one, because this was the time required for 100% control at a 10 kg/m² density. This earlier second application would have also

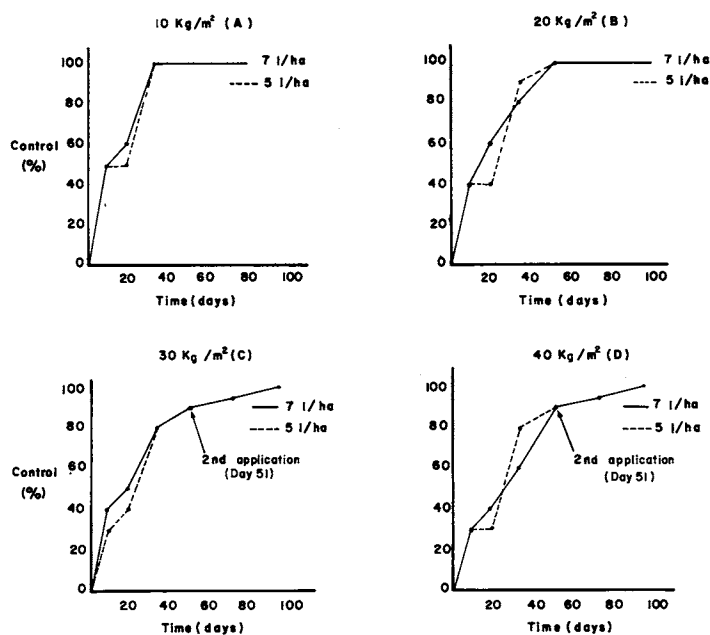


Figure 2. Percentage of water hyacinth control at four biomass densities and two treatment levels of glyphosate. Densities of 30 and 40 kg/m² (C and D) required a second treatment on day 51 at both treatment levels for 100% control.

³AGRI-DEX is a registered trademark of Helena Chemical Company Memphis, TN 38137, USA.

avoided the observed regrowth 51 days after the initial treatment.

It was possible to determine qualitatively the decay and disappearance of treated plants. Plants with a 10 kg/m² density showed a 95% loss of plant biomass after 51 days for both doses applied. Only traces of water hyacinth were observed for all densities 95 days after the initial applications.

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