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COMPARISON OF DOMESTIC WASTEWATER TREATMENT USING WATER HYACINTH (*EICHHORNIA CRASSIPES*) AND WATER CONVOLVULUS (*IPOMOEA AQUATICA*)

by

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ABSTRACT

The performance of two types of local floating aquatic plants i.e. water hyacinth (Eichhornia crassipes) and water convulvulus (Ipomea aquatica) in treating domestic wastewater were studied in a small laboratory-scale experiment with a detention time of 5 days. Although both plants showed the ability to remove organic and inorganic pollutants, the average percent removal of water hyacinth was greater than that of water convolvulus for all parameters (BOD5, COD, Fe, Mg, Cu). This difference in removal performance may be due to the difference in the length of the plant roots.

INTRODUCTION

Wide ranges of aquatic plants have been claimed to have the ability to treat wastewaters. This includes *Eichhornia crassipes* (Water Hyacinth), *Lemna* sp. (Duckweed), *Phragmites australis* (Common Reed), *Scirpus acutus* (Bulrush), *Typha latifola* (Cattail) and many others (Reed et al. 1988, Kingsley et al. 1989, Selvapathy & Babu 1995, Mungur et al. 1997,).

Water hyacinth is a type of freshwater macrophyte (water tolerant vascular plant) with rounded, upright, shiny green leaves and spikes of lavender flowers. The petioles of the plant are spongy with many air spaces and contribute to the buoyancy of the plant. The root length varies with the nutrient-status of the water but is normally more than 10 cm.

Similar to water hyacinth, *Ipomea Aquatica* or water convolvulus is also a type of perennial, freshwater aquatic macrophyte which can normally be found growing in nutrient rich aquatic systems such as streams, ponds and also oxidation ponds.

The plant usually spreads horizontally on the water surface and floats using perforated stems, unlike the water hyacinth which floats using spongy petioles. The root of the plant is also slightly shorter normally reaching to approximately 6-8 cm in length.

Although many studies have established water hyacinth as being effective in wastewater treatment (Reddy & Sutton 1984, Reed et al. 1988), studies on the effectiveness of water convolvulus in treating wastewater have been scarcely reported. This study was designed as a preliminary effort to determine and compare the effectiveness of water hyacinth and water convolvulus in treating domestic wastewater.

MATERIALS AND METHODS

The study was conducted using 3 plastic buckets each filled with 45 l wastewater to a depth of 0.35 m. The wastewater was taken from an oxidation pond at UTM campus. Two of the buckets were filled with approximately 450 g water hycinth and 450 g water convolvulus, respectively. The amount of plants were sufficient to cover 70 % - 80 % of the surface area of both buckets. The third bucket was not filled with any plants and served as control. The detention time for the experiment was set for 5 days and samples from each bucket was taken on the first and fifth day. Parameters measured on the first and fifth day were BOD, COD, Fe, Mg, Cu. The experiment was conducted 4 times in which new plants and wastewater were used for each new experiment.

RESULTS

The average percent removal efficiency for both plants studied for 5 days detention time are shown in Table 1 A and B. From the Table, it is evident that water hyacinth performed better in removing organic and inorganic pollutants when compared to water convolvulus. Unlike water hyacinth which showed a remarkably high average percent removal of all parameters, water convolvulus only performed well in removing BOD and COD. The average percent removal of metals (Fe, Mg & Cu) by water convolvulus was approximately 25.7 % lower than that of water hyacinth.

DISCUSSION

As reported in previous studies (Reddy & Sutton 1984, Reed et al. 1988) water hyacinth are capable of high organic and inorganic removal. The known mechanisms involved in the removal processes are the microbial activities near the plant surface especially the root area, plant uptake of metals and nutrients, and also chemical precipitation and adsorption on substrate and on plant surfaces.

Similar to water hyacinth, water convolvulus also showed a relatively high average percent removal of BOD and COD. However, its performance in removing the three types of metals were about 25.7 % lower than that of water hyacinth. Although it is assumed that the removal mechanisms of metals by water convolvulus are similar to those of water hyacinth, there are limited data and information available pertaining to its capability. Nevertheless, it is possible that the shorter length of the root of water convolvulus may be one of the factors affecting its performance in metal removal. However, as the health of the plant was not affected after 5 days immersion in wastewater it is possible that a further extension of the detention period would probably result in better removal efficiencies.

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Table 1: Removal efficiencies of (A) Water Hyacinth
(B) Water Convulvulus (C) Control.

(A) Water Hyacinth

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD5 (mg/l)	Exp. 1	110	22	80 %
	Exp. 2	100	16	
	Exp. 3	100	22	
	Exp. 4	110	22	
COD (mg/l)	Exp. 1	190	25	85.5 %
	Exp. 2	180	31	
	Exp. 3	200	24	
	Exp. 4	190	30	
Fe (mg/l)	Exp. 1	0.799	0.079	91.1 %
	Exp. 2	0.762	0.080	
	Exp. 3	0.680	0.083	
	Exp. 4	0.950	0.042	
Mg (mg/l)	Exp. 1	0.108	0.031	67.6 %
	Exp. 2	0.113	0.027	
	Exp. 3	0.125	0.047	
	Exp. 4	0,098	0.042	
Cu (mg/l)	Exp. 1	0.510	0.070	85.6 %
	Exp. 2	0.550	0.080	
	Exp. 3	0.440	0.080	
	Exp. 4	0.580	0.070	

(B) Water Convolvulus

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD5 (mg/l)	Exp. 1	110	26	72.4 %
	Exp. 2	100	26	
	Exp. 3	100	28	
	Exp. 4	110	36	
COD (mg/l)	Exp. 1	190	37	80.1 %
	Exp. 2	180	39	
	Exp. 3	200	40	
	Exp. 4	190	35	
Fe (mg/l)	Exp. 1	0.799	0.154	68.4 %
	Exp. 2	0.762	0.125	
	Exp. 3	0.680	0.145	
	Exp. 4	0.950	0.587	
Mg (mg/l)	Exp. 1	0.108	0.053	52.3 %
	Exp. 2	0.113	0.049	
	Exp. 3	0.125	0.066	
	Exp. 4	0.098	0.047	
Cu (mg/l)	Exp. 1	0.510	0.270	46.7 %
	Exp. 2	0.550	0.290	
	Exp. 3	0.440	0.240	
	Exp. 4	0.580	0.310	

(C) Control (no plants)

Parameter	Experiments	Day 1	Day 5	Average Removal
BOD5 (mg/l)	Exp. 1	110	84	22.8 %
	Exp. 2	100	80	
	Exp. 3	100	86	
	Exp. 4	110	74	
COD (mg/l)	Exp. 1	190	150	30 %
	Exp. 2	180	125	
	Exp. 3	200	185	
	Exp. 4	190	72	
Fe (mg/l)	Exp. 1	0.799	0.092	17.1 %
	Exp. 2	0.762	0.092	
	Exp. 3	0.680	0.103	
	Exp. 4	0.950	0.082	
Mg (mg/l)	Exp. 1	0.108	0.512	35.8 %
	Exp. 2	0.113	0.468	
	Exp. 3	0.125	0.378	
	Exp. 4	0.098	0.687	
Cu (mg/l)	Exp. 1	0.510	0.450	13.5 %
	Exp. 2	0.550	0.480	
	Exp. 3	0.440	0.420	
	Exp. 4	0.580	0.450	