

# EFFECTS OF DIFFERENT SOURCES OF WATER ON WATER HYACINTH GROWTH PERFORMANCE

F. DADDY\*, S. ABUBAKAR\*\* and S. OWOTUNSE\*

*\*National Institute for Freshwater Fisheries Research (NIFFR)  
PMB 6006, New Bussa, Nigeria*

*\*\*Ministry of Agriculture and Natural Resources, Fisheries Department,  
Lokoja, Kogi State.*

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## ABSTRACT

The experiment was designed to evaluate water hyacinth growth performance using water sources with varied physico-chemical characteristics. The sources were distilled water, sewage water, lake water, bore hole water and tap water. Water hyacinth was grown for 12 weeks at the National Institute for Freshwater Fisheries Research, New Bussa in the different media. The distilled water hydrogen ion concentration (pH) was neutral (pH 7.0) while sewage and lake water were slightly acidic (pH 6.4 and 6.7) but bore hole and tap water samples were slightly alkaline (pH 7.9 and 8.3, respectively). There was a significant difference ( $CD > 1$ ) in the conductivity of samples from different sources. The experiment indicated that the higher nutrient content of the sewage water as shown by conductivity levels was responsible for the higher growth responses of water hyacinth than the rest of the samples. Plants grown in sewage water showed an increase in leaf and stalk length of 45% and 39%, respectively. There was a positive significant ( $p < 0.05$ ) relationship between the conductivity of the different water sources and weight gained by the plant grown in them ( $r = 0.87$ ). Similarly, between conductivity and vegetation reproduction  $r = 0.95$  ( $p < 0.05$ ).

## INTRODUCTION

Water hyacinth, *Eichhornia crassipes* (Martius) Solms, has perhaps been a subject of more intensive study than any other aquatic plant in recent years. Much efforts and funds have been devoted to the control of this prolific weed (Bates and Hentges, 1976). And yet, many investigators have directed their research endeavours to the utilization of the water hyacinth. Several scientists (Rogers and Davis, 1972; Cornwell *et al*, 1977; Socrjani, 1984) reported, that water hyacinth has been utilized as livestock feed, bio-fertilizer, sewage purifier and biogas production, paper and fiber (Bagnall *et al*, 1974), and dried hyacinth can be used as animal feed for cows, pigs, goats, etc (CWSCB, 1982).

Although water hyacinth weed constitutes ecological and environmental problems that require high capital and human resources to control, but recent findings confirm the weed have enormous potentials. A clear knowledge of culturing the weed in controlled environments would enhance availability during harvesting without constituting further inherent plant harmful characteristics. Therefore, there must be a concerted effort at harnessing this beneficial biological resource rather than committing huge financial and human resources at just eradicating it.

The experiment was aimed at evaluating most appropriate growth media to

boost water hyacinth biomass accumulation as industrial raw material.

## MATERIALS AND METHODS

The experiment was carried out at the National Institute for Freshwater Fisheries Research, New Bussa. Water samples were collected from five different sources namely distilled water, sewage, lake water (Kainji), bore hole water and pipe borne water. Water from each source was collected directly by filling a thoroughly washed 40-litre plastic container and transported to the laboratory. The pipe borne water was aged for 3 days to allow the available chlorine to escape before use in the laboratory. The physico-chemical characteristics of each water sample were taken. The hydrogen ion concentration (pH) was determined with a pH meter. A measure of the nutrient status of the water samples was assessed by determining the level of electrical conductivity. This was measured with a conductivity meter calibrated to read values at a standard temperature of 25°C.

Water hyacinth plant was collected from the concrete culturing tanks located within the Institute and acclimatized for 2 days. Plastic containers (16-litre) properly washed with the respective water sample, labeled and arranged on 6 x 3m<sup>2</sup> table according to treatments were used in the experiments. Each treatment had three replicates making a total of 15 containers. Water hyacinth plant weighing approximately 10 grammes was introduced in

each of the containers in which were placed 10 litres of the appropriate water sample. Treatment A was distilled water, B sewage water, C lake water, D bore hole water and E tap water. Before introducing the plants into culture media the initial measurements of the plant stalk length, leaf width and length of leaf were taken using measuring ruler.

Subsequent measurements were taken weekly to estimate the plant's growth rate in the different culture media. Each appropriate water sample was added weekly to maintain the water level in each plastic container. After 12 weeks culture period, the total harvest of the plants was made by hand removal of the stalks from the floated roots. Final measurement of the plant was taken before harvesting from each treatment. Harvested leaves, stalks and whole plant were oven dried at 80°C for 24 hours (to a constant weight). After 24 hours the dry matter from each was removed from the oven and weighed.

The number of off-shoots (daughter plants) were also counted in each culture media every week to provide data on rate of recruitment potentials of the plants.

## RESULTS AND DISCUSSION

Table 1 shows the pH and conductivity level of the water samples. The distilled water was neutral (pH 7.0) but sewage and lake water samples were slightly acidic. The bore hole and tap water samples were slightly alkaline. However, there was no significant

difference in the pH of the sample ( $CD < 1.0$ ).

There was significant difference in the conductivity of the samples from different sources ( $CD > 1$ ). The sewage water sample had the highest conductivity while the distilled water had the lowest (Table 1). Lake water was almost 2 times more conductive than the bore hole and tap water. According to Mbagwu (1994), conductivity can be used as a measure of the potential nutrient level of a water source and therefore, a measure of the total dissolved solids (TDS). Essential plant nutrients such as phosphate, nitrogen and potassium, which are abundantly dissolved in water from household waste, contribute highly to the fertility of sewage system than other water sources. Also, the dissolved nutrient carried from used agrochemicals and from the extensive drainage network of the basin contributed to the high conductivity of the lake water (Adeniji et al, 2001).

Weight gained by the water hyacinth plants after 12 weeks in the different treatment is shown in Table 2. Weight gained (626.7 g) was highest in the plants grown in sewage water sample but followed by lake water (592.0g). The lowest weight gained was obtained from the distilled water (222.6g). There was a significant difference in the weight gained of the plant grown in the different water media ( $CD > 1$ ).

**Table 1. Hydrogen Ions Concentration (pH) and Conductivity Values of Water from the Different Sources**

Treatment	pH	Conductivity ( $\mu\text{hm/cm}$ )
A Distilled Water	7.0	18
B Sewage Water	6.4	720
C Lake Water	6.7	80
D Bore Hole	7.9	35
E Tap Water	8.2	30
CD = $S^2/X$	0.14	525.64

*CD = Coefficient of Dispersion*

**Table 2. Biomass Production (gm) of Water Hyacinth Grown in Different Sources of Water**

Treatment	Initial Wt.	Final Wt.	% Moisture content	% Dry matter content
A. Distilled water	9.8	232.4	90	10
B. Sewage water	10.2	636.9	91	9
C. Lake water	9.7	561.7	91	8.4
D. Bore hole water	10.4	289.7	90	10
E. Tap water	10.1	341.8	91	8.3
CD = $S^2/x$	0.008	82.25	0.001	0.08

Plant grown in sewage water showed an increase in leaf and stalk length of 49% and 39% respectively. Also, plant grown in lake water exhibited a high increase (40%) in stalk length from an initial length of 16.6 cm to a final length of 27.7 cm. The leaf length showed similar increase from 5.4 cm to 7.4 cm (27%). Figures 1 and 2 show increases in stalk length and leaf length, respectively.

However, the higher nutrient content of the sewage water as shown by conductivity level was responsible for the higher growth responses of water hyacinth than those observed in the rest of the treatments. The observation agreed with Brij (1984) maximum growth of water hyacinth obtained in sewage water. Also, Richards (1982) reported that water hyacinth plant grown in distilled water produced small leaves with inflated petioles. However, sources of water did not have any effect on the dry matter content of either whole plant or its component since the dry matter content of any biological organisms is a distinct natural characteristics of that organism.

Water was not limited at any time in the culture media thus all plants had enough water to satisfy their natural physiological requirement and as such the dry matter content remained relatively constant.

Table 2 shows that the dry matter content of plant grown in distilled and bore hole water samples had the highest

dry matter content of 10% each; followed by sewage water (9%) but tap and lake water samples had the least dry matter contents of 8.3% and 8.4% respectively. Analysis of coefficient of dispersion indicated that there was no difference ( $CD < 1$ ) in the dry matter content of the plants grown in the different sources of water. Table 3 shows the number of daughter plants produced in the different treatments. There was a significant difference ( $CD > 1$ ) in daughter plants production by water hyacinth grown in the different media.

Generally, weight gained and vegetative reproduction of the water media increased. Plants growing in enriched water usually have sufficient nutrients to grow and reproduce. On the other hand, plant growing in nutrient poor media (bore hole or distilled water) strive to remain active and so utilizes the little nutrients available for this purpose. Data on vegetative reproduction, weight gained and conductivity were further subjected to regression analysis. Figure 3 shows the scatter diagram of  $\log_{10}$  values of the conductivity versus the final weight of  $\log$  – transformed to control the variances. There was a high, positive and significant ( $p < 0.05$ ) relationship between the conductivity of the different water sources and weight gained of the plant grown in them ( $r = 0.87$ ).

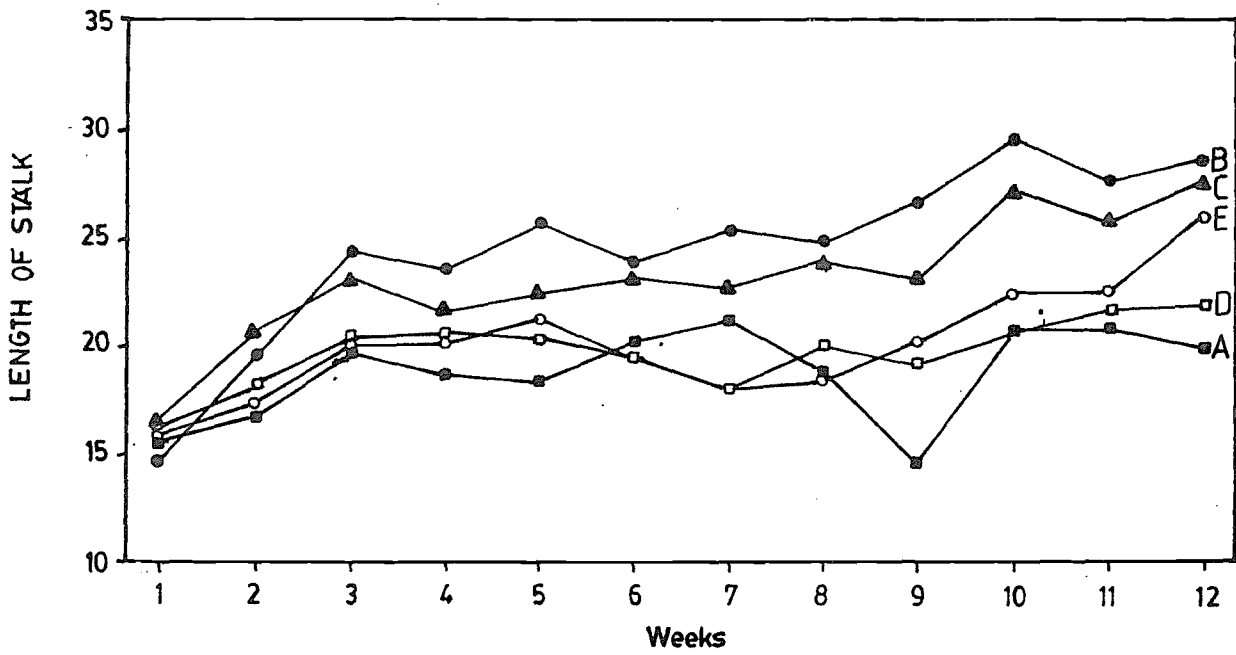


Fig. 1. Increase in stalk length of water hyacinth plants grown in different sources of water over 12 weeks.

**KEY**

- A = DISTILLED WATER
- B = SEWAGE WATER
- C = LAKE WATER
- D = BOREHOLE WATER
- E = TAP WATER

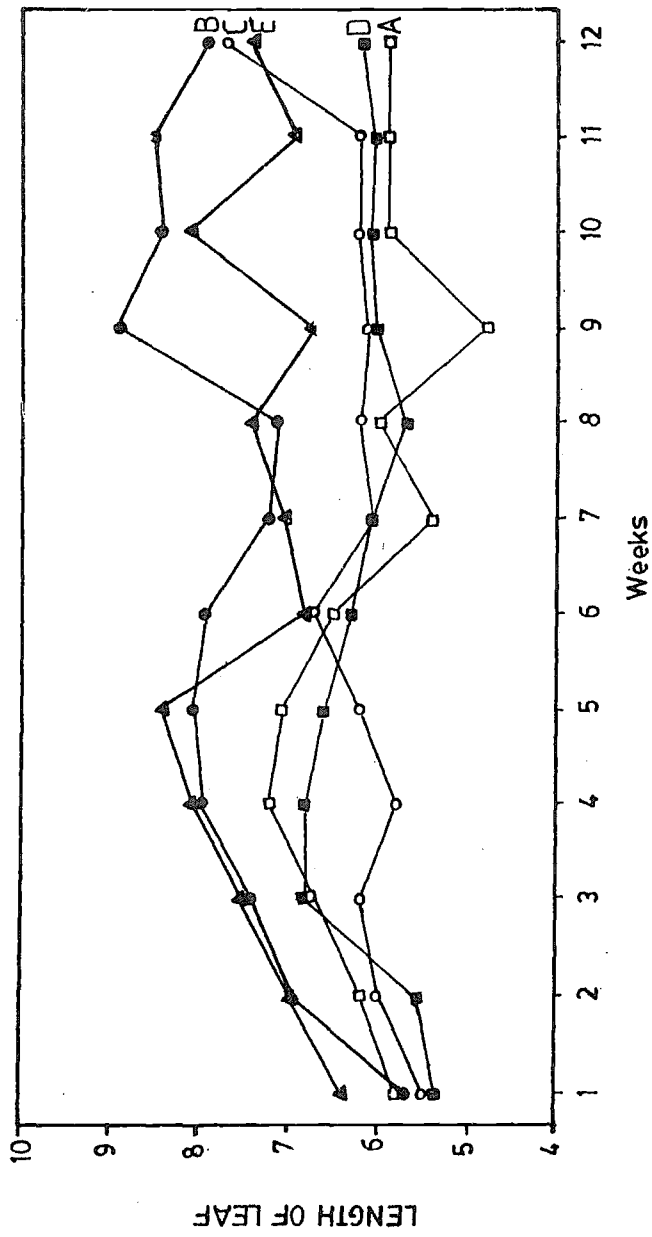


Fig. 2. Increase in leaf length of water hyacinth plant grown in different sources of water over 12 weeks

KEY

- A = DISTILLED WATER
- B = SEWAGE WATER
- C = LAKE WATER
- D = BOREHOLE WATER
- E = TAP WATER

**Table 3. Vegetative Reproduction of Water Hyacinth Grown in Different Water Sources**

Treatment	No. of Daughter Plants at Week 0	No. of Daughter Plants at Week 12
A. Distilled water	0	14
B. Sewage water	0	28
C. Lake water	0	23
D. Bore hole water	0	15
E. Tap water	0	17
CD = S <sup>2</sup> /X	0	1.82

There was also a similarly significant relationship  $r = 0.95$  ( $p < 0.05$ ) between conductivity and vegetative reproduction (Fig. 4). The relatively high mineral content as indicated by the high conductivity levels of sewage water suggests high efficiency of nutrient removal by water hyacinth. Thus water hyacinth can be grown and periodically harvested. Ideally, the harvested plant materials could be utilized as food supplement for cattle (Baldwin et al 1974) and soil additive (Wolverton and McDonald, 1976) for economic benefit.

#### CONCLUSION

The result of this study indicates that sewage and lake water samples have the required conductivity that support the luxuriant growth and reproduction of water hyacinth.

Generally, the highest growth characteristic and reproduction of daughter water hyacinth plant was observed in sewage water, which was followed by lake water. The biomass produced from such a system like sewage water, can be tremendous and potentially serve as raw materials for improved agriculture, wealth generation and employment. The biomass produced can be periodically harvested and utilized as livestock feed, bio-fertilizer, mushroom cultivation among others.

#### ACKNOWLEDGEMENTS

Authors sincerely acknowledge the contribution of Dr. I.G. Mbagwu who painstakingly analysed the data. Also, the Institute management is acknowledged for funding and allowing the publication of the results.



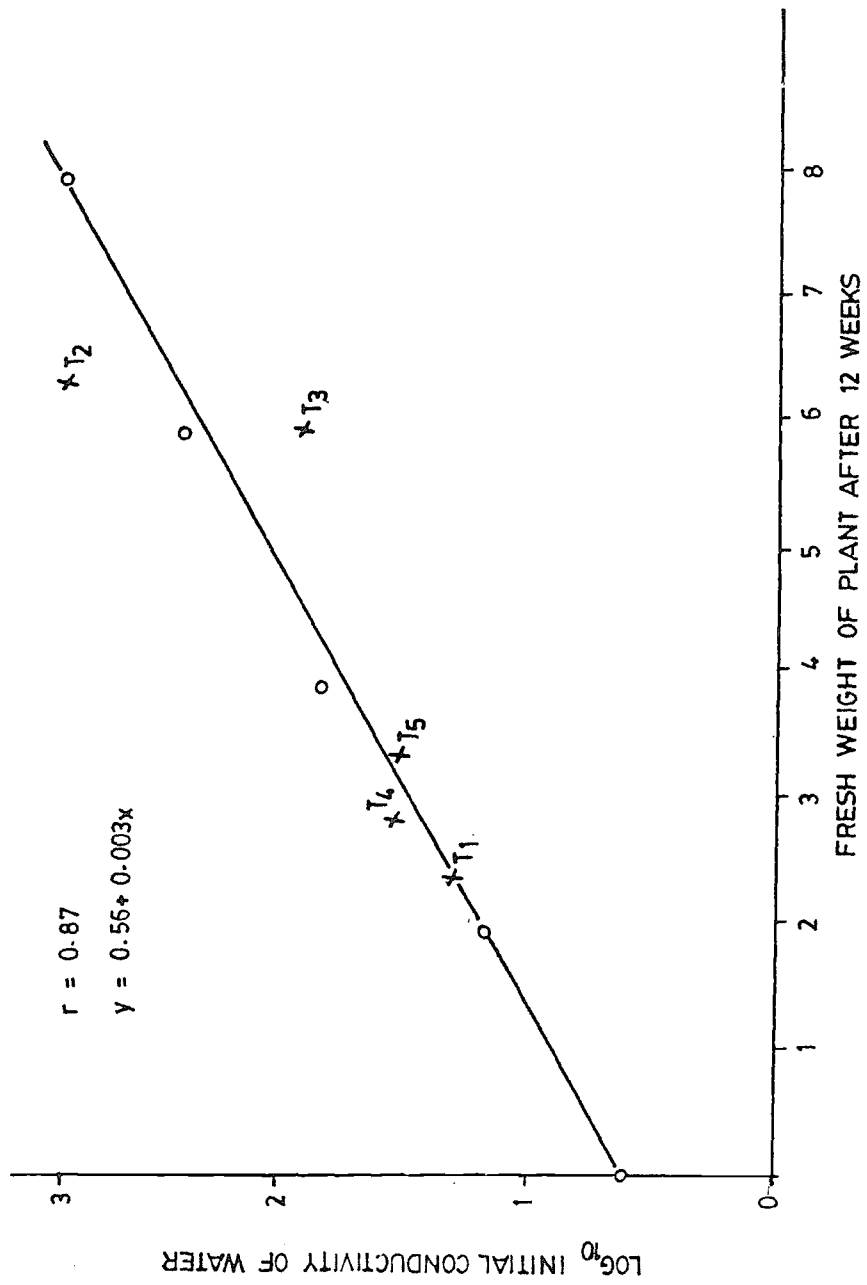


Fig 3 Scatter Diagram showing the relationship between conductivity of water and production of biomass by water hyacinth

T<sub>1</sub> to T<sub>5</sub> = Treatments 1-5

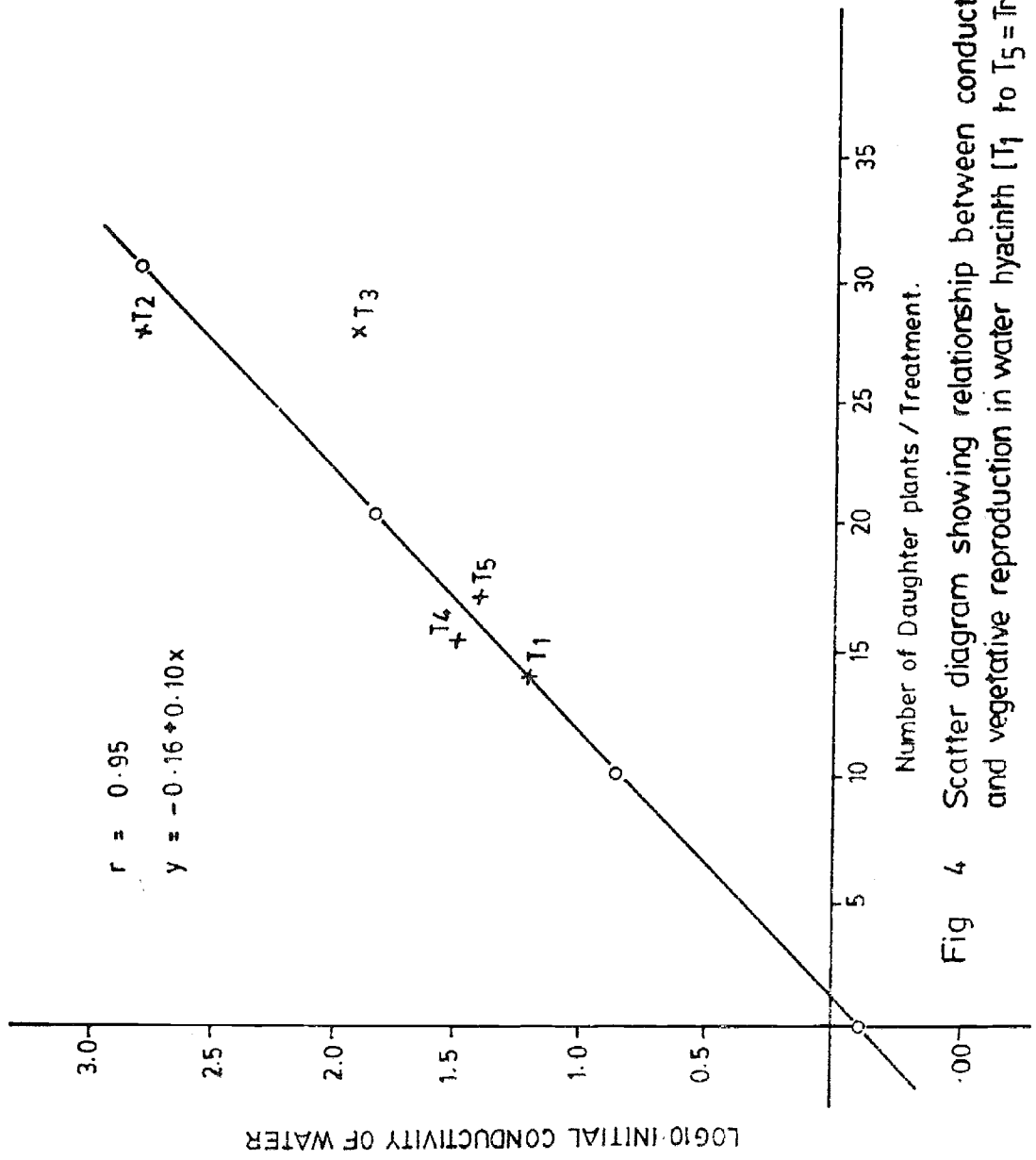


Fig 4 Scatter diagram showing relationship between conductivity and vegetative reproduction in water hyacinth (T<sub>1</sub> to T<sub>5</sub> = Treatment 1-5)

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