International Journal of Research in Agriculture, Biology & Environment (ijagri.org)

Vol 1 No 1 March-2020

www.ijagri.org

HALOPHYTIC POTENTIALS OF MORNING GLORY (*Ipomea Asarifolia*) FOR PHYTO-DESALINATION OF BRACKISH WATER

Kiridi, E. A and Zalmon, G. P

Department of Agricultural and Environmental Engineering,

Niger Delta University, Bayelsa State

Nigeria

ABSTRACT

This research investigates the halophytic potentials of morning glory (Ipomea Asarifolia) for phytodesalination of brackish water. Approximately 100 g of morning glory were placed in a plastic trough containing 10 litres of brackish water (salinity 7.69 ppt) in three replicates and studied daily for 6 days. The treatment means of the electrical conductivity (EC), pH, total dissolved solids (TDS) and salinity were calculated. Results showed that maximum reductions of most of the water parameter were observed after 3 days of the research and a phytodesalination rates of +0.026 ppt/g/day for EC, +10.27 ppt/g/day for TDS and +0.051 ppt/g/day for salinity were recorded. The morning glory started showing signs of nutrient starvation and desalination rate after 3 days declined. Anova shows that there was no significant difference between the control and morning glory treatment means at 95 percent confidence level for pH, EC, TDS and salinity. This research can be optimised by continuously removing spent morning glory and re-introducing fresh ones in 3 days intervals until desalination is complete. An optimised phytodesalination method using morning glory can be useful in developing a cost-effective management technique for reducing salt loading in freshwater streams.

Keywords: Phytodesalination, Morning Glory, Salinity, Brackish Water.

1.0 INTRODUCTION

Halophytes in coastal and arid regions are known to be able to grow on salinized water and soils because of the specific mechanism of salt tolerance developed during their phylogenetic adaptation. Salinisation refers to the total concentration of inorganic ions dissolved in water or soil and is therefore a natural water component [1]. Surface water can be graded as follows, based on their salt content: freshwater < 0.5 g/l; oligohaline 0.5 – 4.0 g/l; mesohaline water 5.0 – 18.0 g/l; polyhaline water 18.0 – 30.0 g/l; euhaline water 30.0 – 40.0 g/l and hyperhaline water > 40.0 g/l [[2]. The salinization of freshwater streams and rivers is rising globally through practices such as mining, agriculture, drainage of saline wastewater [3], and the use of defrosting salts [4]. High salinity affects plants in two main ways: high salt concentrations in the soil disrupt the ability of the roots to absorb water, and high salt concentrations within the plant itself can be toxic, thus inhibiting many physiological and biochemical processes such as nutrient uptake and assimilation [5], [6], [7], [8]. These results inhibit plant growth and survival

Morning Glory (*Ipomea Asarifolia*) is a perennial long-trailing herbaceous and sometimes twining weed usually seen in sandy areas and dumps of waste. In nutrient-rich ponds, it is found to grow very well and can infest agricultural areas. This was also used to treat aquaculture effluent phytoremediation [9], [10].

Ninety seven percent (97%) of the world water distribution is seawater and brackish and the remaining three percent (3 %) is freshwater. Of this freshwater, only 1 % are accessible as 79 % and 20 % are ice caps/glacier and groundwater respectively. Brackish water is water with more salinity than fresh water, but no more salinity than seawater, and is usually found in the estuaries. It is difficult to access freshwater in most communities along estuaries such as the Niger Delta region of Nigeria, as the soil and groundwater around it are higher in salinity than acceptable standards. Developing a cost-effective management technique to reduce the salt loading of freshwater streams or desalinate brackish water so that it can be used for farming practices is imperative. Desalination plants are energy-consuming and expensive to run, so it will be cheaper and also an environmentally friendly option to use morning glory for desalination.

Email: ebizimor.kiridi@gmail.com

The objectives of this research are to determine the salinity level of brackish water and the effects of morning glory on the brackish water for six days duration and to determine its halophytic potentials on desalination.

2.0 MATERIALS AND METHODS

2.1 Experimental site

The experimental site was an open space in front of the laboratory of the Department of Agricultural and Environmental Engineering, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. Located in the vegetative mangrove swamp area, the University has a tropical climate with two seasons: the wet season from March to October and the dry season from November to April.

2.2 Experimental apparatus and procedure

The experimental apparatus consists of a plastic water storage tank, a weighing scale, 1000 ml measuring cylinder, pH meter (Testo 206-PH3), electric conductivity meter/TDS meter/thermometer (LT Lutron YK-22CT) and salt meter (KADY Salt meter MT-8071). Brackish water on was obtained from Ozuboko River (4.7715913^0 N, 7.0427778^0 E) in Abuloma community in Rivers State, Nigeria and transported down to the experimental site. Some of the physico-chemical characteristics of the brackish are presented in Table 1

The experiment was conducted as described by [9]. Appropriate quantities of young morning glory (*Ipomea Asarifolia*) plants in their natural habitats were carefully harvested from within and around Niger Delta University campus. Approximately 100 g of the morning glory were then placed in three replicates of plastic trough containing 10 litres of brackish water and a control. This makes the stocking density to be 10 g/L. Each trough was analysed on a 24 hrs interval for 6 days on the desalination potentials of the morning glory on the selected water parameters which were pH, electrical conductivity (EC), total dissolved solids (TDS) and salinity

3.0 Results and Discussions

Table 2 shows that the pH of the morning glory treatment means ranged from 6.10 to 6.98 and morning glory was able to gradually reduce the concentrations of EC within the first three days of its introduction, thereafter, an increase in concentration levels was observed which indicated

Table 1. Some physico-chemical characteristics of the brackish water

Parameters	Value
pH	6.1
Conductivity (S/m)	13.19
Temperature (^{0}C)	27
T.D.S (ppt)	8801
Salinity (ppt)	7.690

Table 2. Mean effects of the Morning glory treatment on some physicochemical characteristics of the brackish water for the 6 days intervals

Brackish water parameters	Phytodesalination Interval (Days)						
	0	1	2	3	4	5	6
pH	6.10	6.76	6.34	6.75	6.40	6.98	6.60
EC (S/m)	13.19	12.89	12.47	12.40	12.98	12.31	12.90
Temp (^{0} C)	27	29	30	26	27	31	30
TDS (ppt)	8801	8647	7993	8493	8653	8120	8680
Salinity (ppt)	7.69	7.52	6.26	6.16	5.33	5.93	6.91

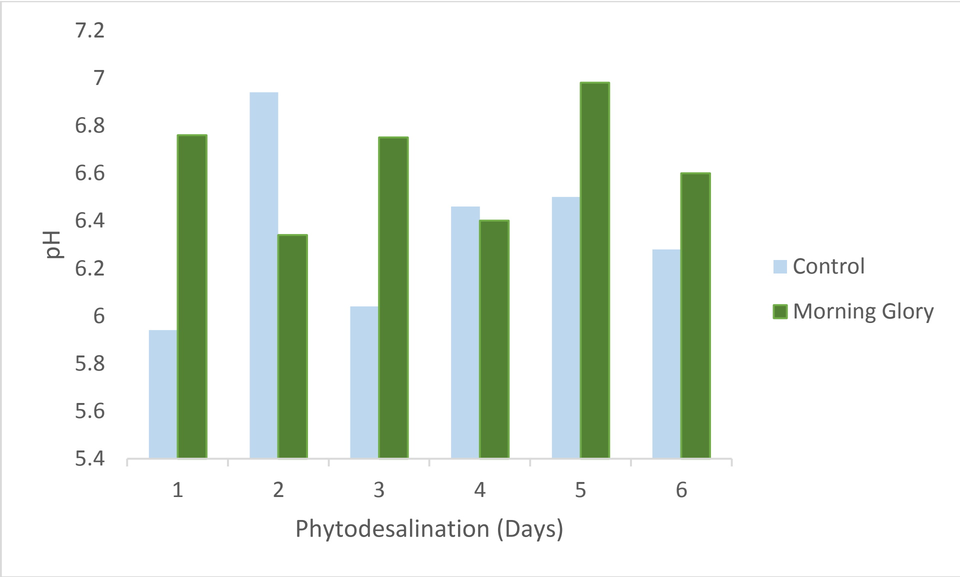

Figure 1. Comparison between control and morning glory treatment means with respect to pH

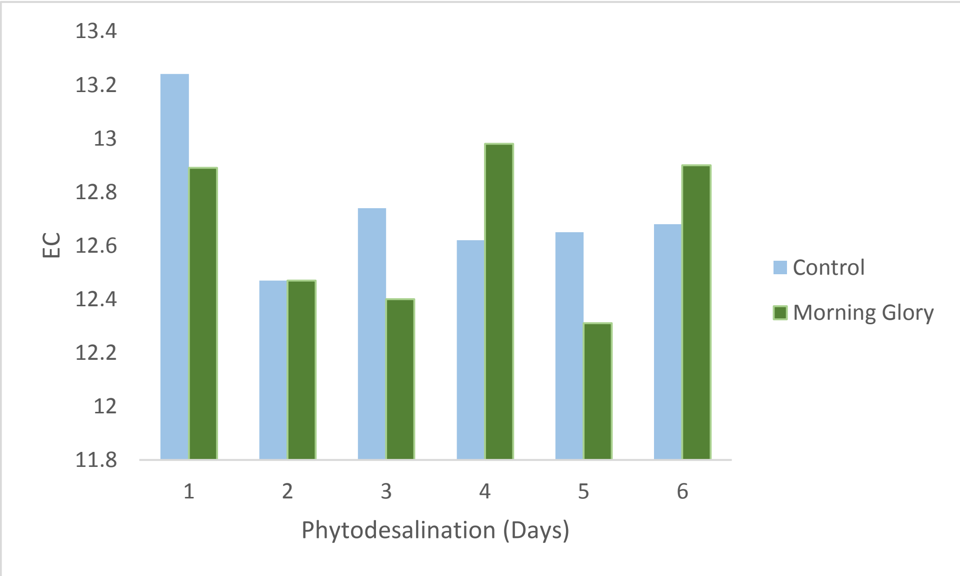

Figure 2. Comparison between control and morning glory treatment means with respect to EC

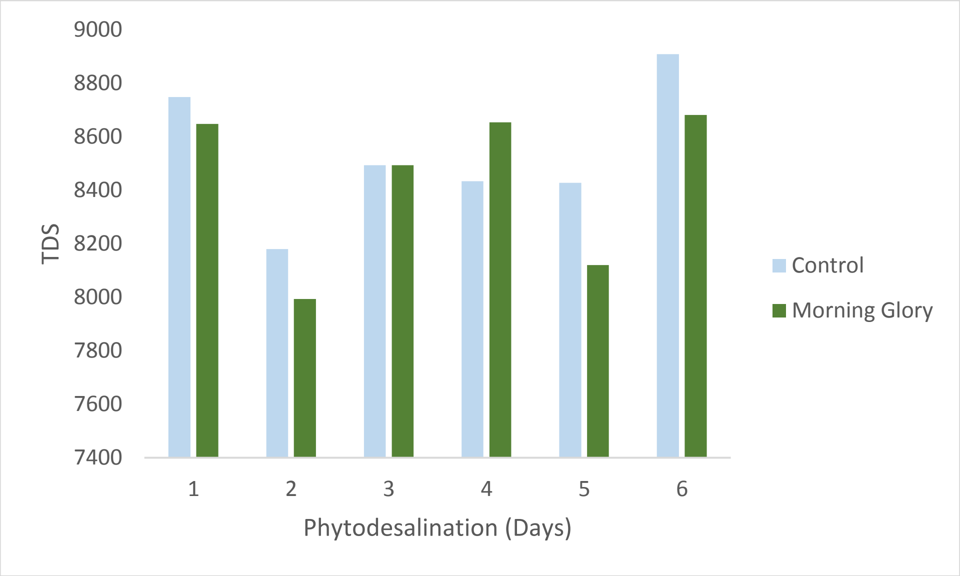

Figure 3. Comparison between control and morning glory treatment means with respect to TDS

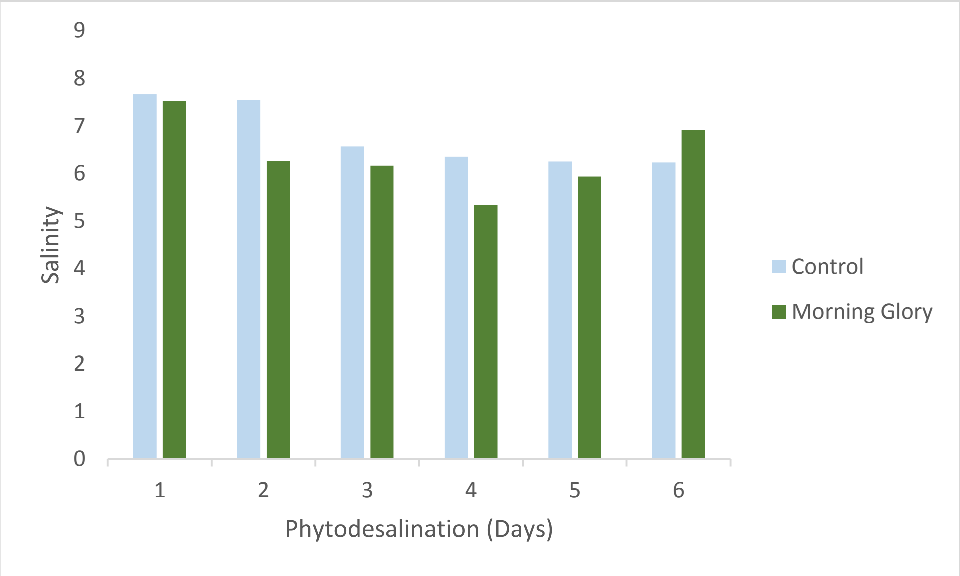

Figure 4. Comparison between control and morning glory treatment means with respect to salinity

Table 3. Phytodesalination rates by morning glory treatment of the brackish water after 3 days

Parameter	*PI (days)	Treatment	Influent	Effluent	Reduction	Desalination rate/day	Desalination rate/g/day
pH	3	**MG	6.10	6.75	-0.65	-0.22	-0.022
EC (S/m)	3	MG	13.19	12.40	+0.79	+0.26	+0.026
TDS (ppt)	3	MG	8801	8493	+308	+102.67	+10.27
Salinity (ppt)	3	MG	7.69	6.16	+1.53	+0.51	+0.051

*PI = Phytodesalination interval; **MG = Morning Glory

Table 4. Anova summary between the control and morning glory treatment on the brackish water

Parameter	Control mean	Treatment mean	Control variance	Treatment variance	F (Cal)	F (Crit)	P (value)	*Treatment Remarks
pH	6.36	6.64	0.13024	0.058257	2.47	4.96	0.147	NS
EC(S/m)	12.73	12.66	0.069747	0.087817	0.21	4.96	0.653	NS
TDS (ppt)	8531.17	8431.0	66619.37	900070.0	0.38	4.96	0.549	NS
Salinity (ppt)	6.77	6.35	0.43347	0.588697	1.00	4.96	0.34	NS

*Treatment Remarks: NS = Not significant

re-introduction of the EC. TDS reduction was recorded for 2 days thereafter, a gradual increase was observed in the remaining days. There was a continuous reduction of the concentration levels of salinity as the phytodesalination days increases. Figures 1 to 4 show the comparisons between the effects the morning glory treatment with respect to the selected water parameters and control in bar charts.

Table 3 show the phytodesalination rates by morning glory of the brackish water after 3 days of the research. A desalination rates of +0.026 ppt/g/day for EC, +10.27 ppt/g/day for TDS and +0.051 ppt/g/day for salinity were observed. The morning glory started showing signs of nutrient starvation and a reduced rate of desalination. This is because the essential nutrients for plant survival in brackish water have been used up.

A summary of the variance analysis (Anova) between the control and morning glory treatment on brackish water shows that F (cal) is greater than F (crit) and the P value is > 0.05, so it can be statistically concluded that there was no significant difference between morning glory treatment and pH, EC, TDS, and salinity control (Table 4). This can be attributed to the reversed absorption of some salts from the morning glory to the brackish water after 3 days of phytodesalination.

4.0 Conclusions and Recommendations

The conclusions of this research are that; morning glory was able to reduce the concentration levels of the selected brackish water parameter; the maximum reduction of concentration was at day 3 of the research except for salinity and the concentration levels of the selected brackish water parameter began to increase after day 3 except for salinity.

The recommendation for this research is optimised by removing the spent morning glory plants after 3 days to prevent re-introduction of the absorbed salts and fresh morning glory be introduced to continue the phytodesalination process in 3 days interval until desalination is complete.

This research if optimised, may show that phytodesalination using morning glory is a cheaper alternative and should be employed in the desalination of brackish surface water.

REFERENCES

[1] William, W. D and Sherwood, J (1994) Definition and measurement of salinity in salt lakes. International Journal of Salt Lake Research.3 (1) 53-63

[2] Vernice System (1959). The final resolution of the symposium on the classification of brackish waters. Archives Oceanography and Limnology. 11 (Suppl). 243-248

[3] Williams, W. D. (2001). Anthropogenic salinization of inland waters. Hydrobiologia, 466, 329 –337.

[4] Kaushal, S. S., Groffman, P. M., Likens, G. E., K. T. Belt, K. T., Stack, W. P., V. R. Kelly, V. R., L. E. Band, L. E and Fisher, G. T. (2005). Increased salinization of fresh water in the Northeastern United States. Proceedings of the National Academy of Sciences of the United States of America 102:13517– 13520.

[5] Munns, R., Schachtman, D., and Condon, A. (1995). The Significance of a Two-Phase Growth Response to Salinity in Wheat and Barley. Functional Plant Biology, 22(4), 561-569.

[6] Hasegawa, P. M., Bressan, R. A., Zhu, J. K., and Bohnert, H. J. (2000). Plant cellular and molecular responses to high salinity. Annual Review of Plant Physiology and Plant Molecular Biology, 51, 463-499

[7] Munns, R. (2002). Comparative physiology of salt and water stress. Plant, Cell & Environment, 25(2), 239-250

[8] Munns, R., and Tester, M. (2008). Mechanisms of salinity tolerance. Annual Review of Plant Biology, 59, 651-681.

[9] Kiridi, E. A and Ogunlela, A, O (2016). Modelling the phytoremediation rates of aquatic macrophytes in an aquaculture effluent. International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering. Vol 10, No 3. pp 332-339

[10] Kiridi, E. A and Ogunlela, A. O (2019) Phytoremediation rates of Morning Glory (*Ipomea Asarifolia*) in an aquaculture effluent hydroponic system. 20th International Conference & 40th Annual General Meeting of the Nigerian Institution of Agricultural Engineers (NIAE). Omuaran. Vol 40: 788-795