http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences, 1 (3): 241-243, 1998 Research Article

Aquatic Macrophytes as Biological Indicators for Pollution Management Studies III:Comparative Growth Analyses of *Eichhornia crassipes* and *Pistia stratioites* to Different Salts Commonly Present In Factory Effluents

M. Niaz and E. Rasul*
Department of Botany, Government College, Faisalabad and
**Department of Botany, University of Agriculture, Faisalabad-38040, Pakistan*

Abstract
E. crassipes and *P. stratioites* can be used as biological indicator in polluted aquatic habitats if the nature of the polluting salts from effluents is known, as both these plants showed selective responses to different salts. Low sodium salinity acted as growth promotor for both the plants. *P. stratioites* was more tolerant of HCO_3 and Na^+ but not NH_4 NO_3 and *E. crassipes* was sensitive to HCO_3 but tolerant of NH_4NO_3 induced eutrophication.

Key words: *Eichhornia crassipes*, *Pistia stratioites*, factory effluents, growth analysis, water hyacinth, water lettuce

Introduction
Growth suppression with increase in salt levels around rhizosphere is an established fact. Hanif and Daves (1998) reported a disturbance in apical dome of root meristem with increase in salt concentrations which ultimately interfered with growth of plants. While Ashraf and O'Leary (1997) studied a disturbed ionic relations at cellular and subcellular levels. These studies were mainly focused for the determination of the effects of salts on the growth of plants.
The idea of the use of biological indicators for the evaluation of pollution levels is very recent one. Schmedtje and Kohmann (1988) emphasized the importance of biological indicators for the study of pollution status of a water body on the grounds that chemical indicators can be applied on a limited and restricted scale while biological indicators respond to all the physical, chemical and biological factors and can safely be applied at broader scale for the evaluation of pollption in water reservoir. Danjun and Zujie (1987) emphasized on the use of *Eichhornia crassipes* as environmental regulator in polluted water reservoir according to these workers, water hyacinth reduced injurious factors in the vicinity of root zone at one hand and could be utilized as substitute fodder for milch and dairy animals on the other. This study will go a long way in the understanding of both the aquatic macrophytes as biological indicators and will pave the way for more complex studies in developing a model for pollution evaluation in aquatic habitats by using biological indicators.

Materials and Methods
Fifty six polyethylene lined ponds of 2ft x 2ft with uniform depth of 9 inches were made at the experiment site and were marked according to salt and treatment level. These ponds were filled with thirty five liters of solution. Each having a concentration level of 0, 100, 500 and 1000 ppm of either of the salts NaCl, NH_4Cl, Na_2CO_3, $NaHCO_3$, CaO Cl_2 and NH_4NO_3.
Eichhornia crassipes of uniform size and age were selected from a waste water body at Panjpulian near University of Agriculture, Faisalabad and *Pistia stratioites* from waste water body from Kamalpur, a suburb 11 km from Faisalabad. Thoroughly washed plants were immediately transferred to artificially constructed ponds at Botanical Gardens, University of Agriculture, Faisalabad.
Water level in the ponds was marked with indelible ink and water loss throughout the experiment was maintained by the addition of distilled water to the ponds. pH range of all the ponds was between 5.0-7.0 and maintained through out the experiment after following Nor and Cheng (1986). Fifteen days was taken as inter harvest period and five consecutive harvests were made by random sampling in triplicate from each pond. At each harvest after washing the whole plant parts, such as leaves, stems and roots were separately measured and weighted and were over dried for dry weight calculations. Following physical growth parameters were recorded.

i. Root fresh weight
ii. Root dry weight
iii. Shoot fresh weight
iv. Shoot dry weight
v. Leaf area

Net assimilation rate (NAR), relative growth rate (RGR), leaf area ratio (LAR) and relative leaf expansion rate (RLER) were calculated using the formulae. The data obtained was subjected to minitab computer programme (Minitab,1989) and the comparison of means was made by using Duncan's multiple range test.

Results
Some correlations were established between relative growth rate and NAR. LAR and RLER under different salts in both the plant species (Table 1). Under control conditions

Table 1: Comparison of RGR correlation values with NAR, LAR and RLER of *E. crassipes* and *P. stratioites*

	Control	NaCl	NH_4Cl	$NaHCO_3$	Na_2CO_3	$CaOCl_2$	NH_4NO_3
Eichhornia crassipes							
NAR	0.889**	0.002^{NS}	-0.667*	-0.624*	-0.548**	-0.394^{NS}	0.191^{NS}
LAR	0.732**	-0.503^{NS}	-0.746**	-0.268^{NS}	-0.870**	0.722**	0.161^{NS}
RLER	0.678*	-0.524^{NS}	-0.632*	-0.312^{NS}	-0.819**	-0.726**	0.216^{NS}
Pistia stratioites							
NAR	0.106^{NS}	0.271^{NS}	0.275^{NS}	0.244^{NS}	0.695^{NS}	0.666^{NS}	0.262^{NS}
LAR	0.697*	0.135^{NS}	-0.428^{NS}	0.155^{NS}	-0.447^{NS}	-0.483^{NS}	-0.908**
RLER	-0.037^{NS}	0.656*	0.044^{NS}	-0.036^{NS}	0.003^{NS}	-0.104^{NS}	-0.089^{NS}

RGR of *Eichhornta crassipes* was positively related to NAR, LAR and RLER. While in case of *Pistia stratioites* a negative correlation of RGR with LAR was found, whereas NAR and RLER indicated no relationship. RGR had no relationship with any of the growth parameters in case of *E. crassipes* exposed to various salts except for NH_4NO_3. Where it showed a non-significant correlation of RGR with NAR, LAR and RLER.

A positive correlation was observed between RGR and RLER of *P. stratioites*. *E. crassipes* indicated a positive correlation between RGR and rest of the parameters under NH_4Cl treatment but it was not recorded for *Pistia*. RGR of *E. crassipes* treated with $NaHCO_3$ was negatively related to NAR. While LAR and RLER of *E. crassipes* was negatively related to NAR under Na_2CO_3 and $CaOCl_2$, It was positive for *P. stratioites* for both the salts. However, RGR of *E. crassipes* was not related to NAR, LAR or RLER under NH_4NO_3 treatments. While in case of *Pistia stratioites* only LAR was negatively related to RCA.

Discussion

RGR values of both the plants and their correlations with other derived parameters i.e., LAR, NAR and RLER showed that *E. crassipes* is more tolerant of NaCl and $NaHCO_3$. A differential response of NH_4Cl and NH_4NO_3 is visible between the two plant species. When exposed to salt shocks plants showed disturbance in cell size and number in meristematic regions, which resulted in a suppressed growth of plants (Hanif and Daves, 1998). Einor *et al*. (1989) reported the involvement of NH_4 nitrogen source in the respiratory enzyme metabolism. Which may be the reason of this selective behaviour of NH_4-nitrogen in both the plants. Ashraf and O'Leary (1995) reported a changed ionic patterns within plant when it was exposed to higher concentration of salts. However, these results demand further elaborated biochemical studies.

E. crassipes. and *P. stratioites* showed a differential response towards bicarbonates. Similar responses of plants has already been reported by Overpeck *et al*. (1990). All these reports indicated a tendency of growth suppression with increasing pollution.

DeBusk *et al*. (1986) emphasized to need of a plant cover to the water pools in vicinity of industrial plants. The plant cover acts as water treatment system. Due to higher carbon assimilator rates, *E. crassipes* and *P. stratioites* are able to produce huge quantities of organic matter per unit area, which can be utilized for the generation of energy. Furthermore, these plants may be used as biological indicators if the nature and source of pollutants is known.

References

Ashraf, M. and J.W. O'Leary, 1995. Distribution of cations in leaves of salt tolerant and salt sensitive lines of sunflower under saline conditions. J. Plant Nutr., 18: 2379-2388.

Ashraf, M. and J.W. O'Leary, 1997. Ion distribution in leaves of salt-tolerant and salt-sensitive lines of spring wheat under salt stress. Acta Botanica Neerlandica, 46: 207-217.

Danjun, C. and C. Zujie, 1987. Water hyacinth as an environment-regulating plant and a feed grass. J. Shenyang Agric. Univ., 18: 93-97.

DeBusk, W.F., K.R. Reddy and J.C. Tucker, 1986. Management Strategies for Water Hyacinth Production in Nutrient Limited System. In: Biomass Energy Development, Smith, W.H. (Ed.)., Plenum Press, New York, pp: 275-286.

Einor, L.O., P.A. Kolesnikov, A.A. Mutuskin, E.M. Glinka, A.G. Melikhova and S.V. Zore, 1989. Characteristics of one enzyme of aquatic macrophytes in connection with formation of water quality. Water Resour., 15: 253-258.

Hanif, M. and M.S. Daves, 1998. Effects of NaCl on the maristan size and proximity of 1st root hair from the root cap boundary in root meristen of *Triticurr aestivum* L. CVs. Lyallpur 73, Pak 81 and LU-26-S. Pak. J. Biol. Sci., 1: 1-4.

Minitab Inc., 1989. Minitab Statistical Software. Minitab Inc., State College, Pennsylvania, USA.

Nor, Y.M. and H.H. Cheng, 1986. Chemical speciation and bioavailability of copper: Uptake and accumulation by *Eichornia*. Environ. Toxicol. Chem., 5: 941-947.

Overpeck, J.T., D. Rind and R. Goldberg, 1990. Climate-induced changes in forest disturbance and vegetation. Nature, 343: 51-53.

Schmedtje, V. and F. Kohmann, 1988. Bewertung von fliess gewaessern anssagekraft and grenzen biologische and chemisjcher indizas: (Assessment of water quality flowing water capacity and limits of biologica an chemical indicators). Wasser Boden Zeit Schrift fue die Geramate Wasserwirtschaft, 40: 610-612.