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Research article

Salinity would be an option to control *Eichhornia crassipes* (Mart.) Solms [Water Hyacinth]: Sri Lanka perspective

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Abstract: *Eichhornia crassipes*, commonly known as Water hyacinth, is an aquatic plant. It has been listed as one of the worst weeds mostly in the tropics and subtropics and listed as Invasive Alien Species (IAS) in Sri Lanka. Many efforts had been made to eradicate this species using both manual and biological control methods over the last 100 years, but *Eichhornia* still shows wide distribution, posing a tremendous threat to aquatic biota in many inland water systems. The study would investigate to control of the species by using salinity as a tool. Experiments were set up to study the growth of the species and to study the role of salinity on the growth and survival of the species. The growth of the species was measured in terms of the production of leaves in fresh water tanks for a period of three months. Salinity values of 1, 2, 3, 4, 5, 6, 7, 10, 15 and 20 ppt was made up and plants were placed. The control treatment was the water with zero salinity. Two plants were placed in each tray and observed over the next 16 days. The number of leaves increases with time up to 40 days. It showed a sudden declined in the production of leaves, 55 days onwards. Leaves that were produced were getting rotten after 40 days onwards. The experiment showed that the *E. crassipes* survive at 0 ppt saline water throughout the experiment, the appearance of the percentage of green shoots existed as 100%. The shoots were becoming brown and subsequently dead after 4 days of the experiment at the salinity level 7 ppt. While the plants showed a gradual decline in their appearance of green shoot between 0 and 6 ppt with the increasing salinity over time.

Keywords: Survival - Growth - Impact - Invasive plants - Salinity.

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INTRODUCTION

Eichhornia crassipes (Mart.) Solms, commonly known as water hyacinth, is an aquatic plant, which is on the IUCN's list of the 100 most dangerous invasive species (Fig. 1). It can spread rapidly through the waterways of catchments, populations to double in size in as little as 6 to 18 days (Gettys 2014), likely to be 400–700 tons per hectare per day (Parson & Cuthbertson 2001) and four times the loss of water from normal water surface evaporation due to its high rates of transpiration during summer (Téllez *et al*. 2008). It reduces temperature, pH, biological oxygen demand (organic load), and nutrient levels (Rai & Datta 1978). It is a major global challenge that requires urgent action (Xu *et al*. 2012).

Eichhornia crassipes (Mart.) Solms [Water hyacinth] - Sri Lankan context

Sri Lanka is reported to be a biodiversity hotspot in which over 30 invasive alien species (IAS) has been recorded. Water hyacinth is listed as one of the worst invaders in aquatic ecosystems in Sri Lanka (Pradeepa *et al*. unknown). The dry zone water tanks have been invaded or under threat of invasion of water hyacinth (Villamgna & Murphy 2010) and also can affect the functions of these freshwater tanks. Water Hyacinth has been introduced in 1905 and has spread in all parts of the country mainly in the dry zone and has become a significant weed in the aquatic ecosystems. The water hyacinth reaches the lagoons/rivers from freshwater tanks in the catchments or from irrigation channels. During the rainy periods flood water to move the plants across the area and spread it to the entire region. An ordinance was declared for the eradication of same in 1909 called the

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'water hyacinth ordinance, an ordinance 4 of 1909. This has been manually removed in many water bodies, which have been expensive. Biological control also has been tried by using *Neochetina eichhorniae* Warner, which was introduced in 1988 and this beetle is breeding well but its effectiveness against water hyacinth is unlikely to be evident before 1994 (Room & Fernando 1992).

Figure 1. Habit of *Eichhornia crassipes* (Mart.) Solms.

Many efforts had been made to eradicate this species using both manual and biological control methods over the last 100 years, but *Eichhornia* still shows wide distribution, posing a tremendous threat to aquatic biota in many inland water systems. The study would investigate to control of the species by using salinity as a tool.

MATERIALS AND METHODS

Data collection

A reconnaissance visit was made to the entire district of Batticaloa (Eastern region of Sri Lanka). Sites with high abundance of Water Hyacinth, more than 50% of cover, were chosen (nine sites) for collecting water and the plants. Readings were recorded in two ways: (i) amidst the plants; (ii) open waters where *Eichhornia* present. Salinity, pH and temperature were measured on site.

Growth experiment

Experiments were set up to study the growth of the species. Units of single plants (SP) and units of two plants linked by stolen/off-set (DP) were used as treatments for the study. Plants were placed in freshwater tanks and observed daily for a period of three months. Plants were floated in triplicates in the tank. The setup was in the open and was subjected to temperature changes and rainfall as in the field. The tank was large enough, and not to be affected considerably by the heat from the sunlight. The growth of water hyacinth was measured in terms of production of leaves.

Effect on salinity on growth

An experiment was set up with three replicates each, to study the role of salinity on the growth and survival of the species. The design was completely randomized. Salinity values of 1, 2, 3, 4, 5, 6, 7, 10, 15 and 20 ppt were made up using sodium chloride in 4 litres of water taken from the water bodies in the field, with zero salinity. The control treatment was the water taken as zero salinity. Two plants were placed in each tray and observed over the next 16 days. The recording was done at 4-day intervals. Percentage of green in the shoots was recorded in these trays. The experiment was conducted in a shaded place to avoid direct overheating of water by the sunlight.

RESULTS AND DISCUSSION

Eichhornia crassipes (Mart.) Solms distribution is mainly identified in the lagoon, water bodies and irrigation channels. The temperature of the study sites ranges between 27–32°C, pH between 6–8. Both the temperature and pH gives optimum and tolerance ranges for the *Eichhornia* respectively (James 1983). Salinity showed variation between 0 and 32 ppt. The growth of *E. crassipes* was recorded in sites where the salinity was 0 ppt (sites 6, 7 and 8) whereas dead plants were noted in sites where the salinity was above 2 ppt (Fig. 2) (James 1983, Muramoto *et al.* 1991).

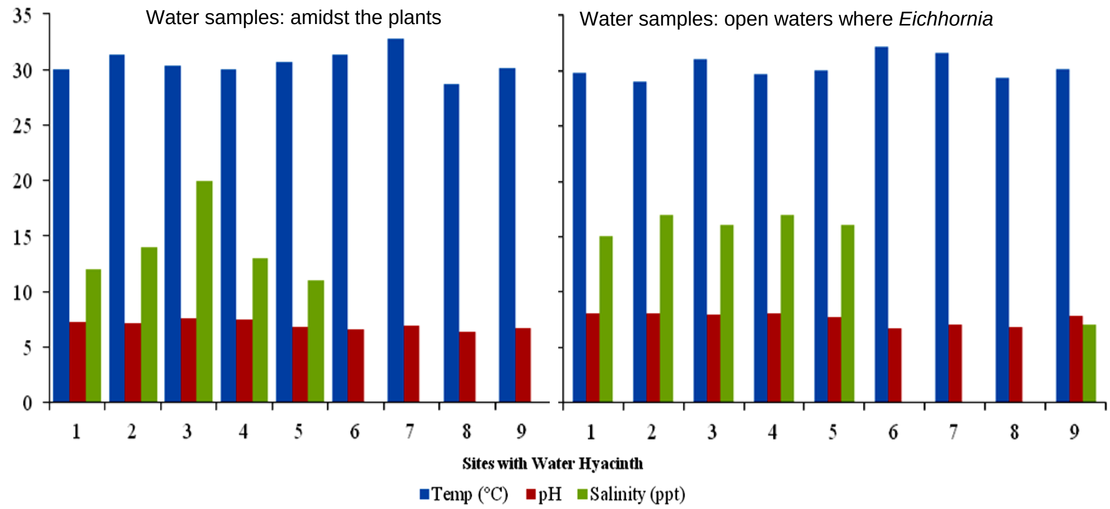

Figure 2. Variation of Temperature, pH and Salinity of the water where *Eichhornia crassipes* (Mart.) Solms. noticed. [The plant was noticed in places where the salinity less than 1ppt]

Growth experiment

The number of leaves increases with time up to 40 days. It showed a sudden declined in the production of leaves, 55 days onwards. Leaves that were produced were getting rotten after 40 days onwards (Fig. 3).

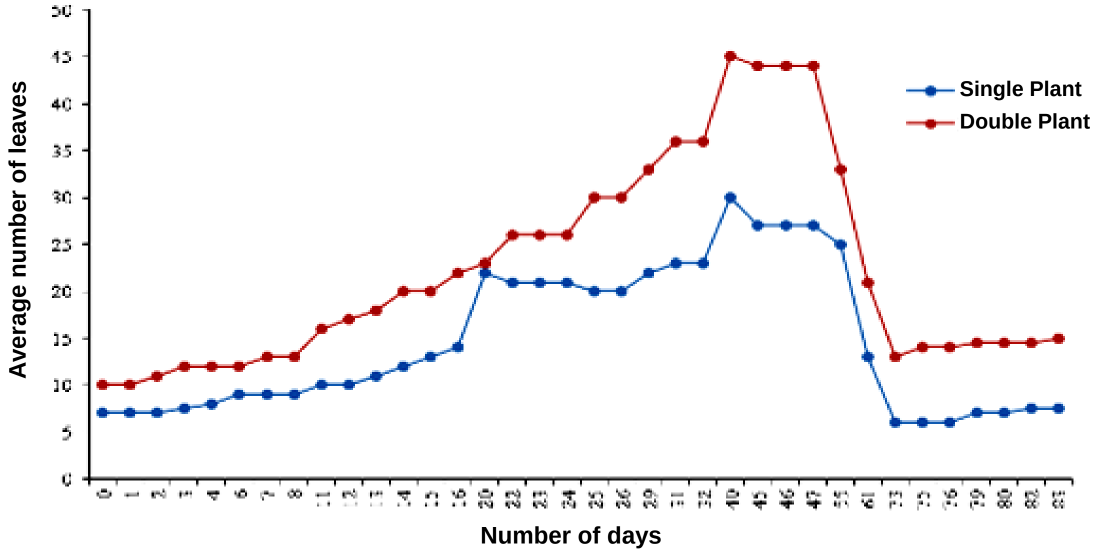

Figure 3. A comparison of the growth of *Eichhornia crassipes* (Mart.) Solms: Plants were grown as single plant and double plants (where two plants are connected by a stolon).

The plant grew in terms of a number of leaves to a larger level and then they rescued themselves to around 5 leaves per plant. As there were no new offsets produced and there was no addition of nutrients in the tank the only possible explanation would be intraspecific competition, very similar to self-thinning where the number of leaves reduces for survival. This is similar to the reduction of tillers certain plants under a competitive environment. It could also be a check based on its morphology where more stem leaves could not be accommodated without expansion. This is also similar to branches in a tree where when one grows the other is seen to reduce or arrested growth, forming the architecture of the plants that are seem in trees. The culm seems to be happy with around 5 leaves per plant in individuals and pairs.

Effect of salinity on growth

The experiment showed that the *E. crassipes* survives at 0 ppt saline water throughout the experiment, the appearance of the percentage of green shoots existed as 100%. The Results of the performance of the species under different salinity levels are given at 4, 8, 12 and 16 day periods are given in graphs 1,2,3,4 respectively (Fig. 4). The shoots were becoming brown and subsequently dead after 4 days of the experiment at the salinity level 7 ppt. While the plants showed a gradual decline in their appearance of green shoot between 0 and 6 ppt with the increasing salinity over time.

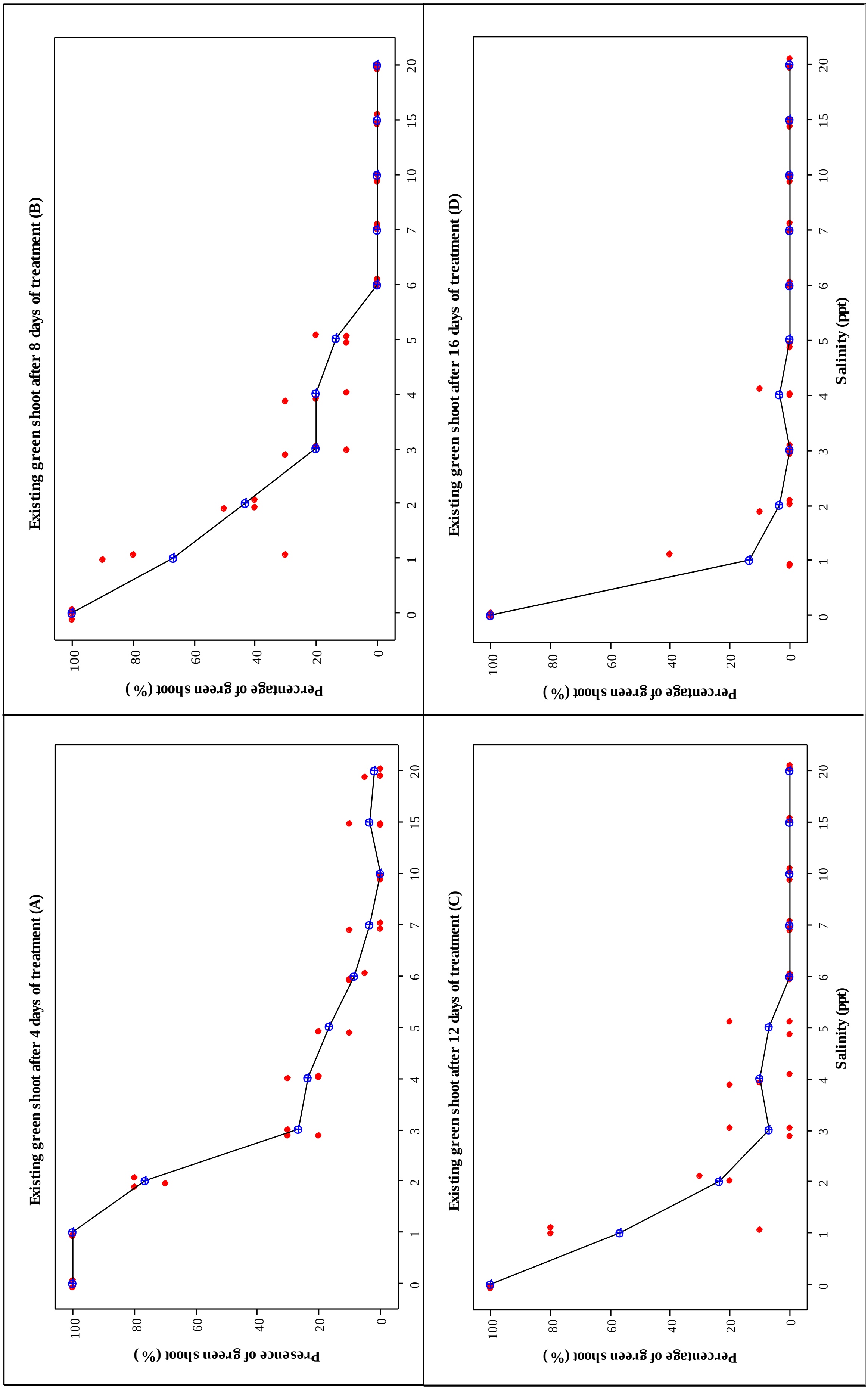

Figure 4. The performance of *Eichhornia crassipes* (Mart.) Solms in different salinity strengths at different time intervals. [A mean connect line is showing the general trend of declining green shoot with salinity changes over time]

There is a sharp decrease of survival (% green) to the salinity of 3 ppt and then a gradual decrease is seen up to 6 ppt where almost all are dead (yellow), in 4-day period itself. One ppt concentration seems to have no different from control. But with time, even 1ppt and 2 ppt decrease in survival. It had been shown in our study that they cannot survive beyond 3 ppt and even at 1 ppt they seem the whiter off faster.

CONCLUSION

The salinity experiment confirmed that the *Eichhornia* seems to be affected by salinity levels as low as 3 ppt itself and even in levels below. Therefore, the salinity would be an option to control the water hyacinth but its practical applicability in the larger water bodies would make a great challenge when considering the ecosystem and its biodiversity.

ACKNOWLEDGEMENT

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