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RELATIONSHIP BETWEEN THE GROWTH OF *EURYALE FEROX* SALISB. AND SOME LIMNOLOGICAL PARAMETERS

MD. ALMUJADDADE ALFASANE[1], MONIRUZZAMAN KHONDKER AND Z.N. TAHMIDA BEGUM

Department of Botany, University of Dhaka, Dhaka-1000, Bangladesh

Key words: Euryale ferox, Growth, Limnological parameters

Abstract

Euryale ferox was grown in meso-scale culture by using mature fresh fruits. Seeds kept dry for a few days were found completely non-viable. A two year *ex situ* study on the growth and the associated limnological parameters of *E. ferox* showed some distinct relationship. Among these petiole length of *E. ferox* positively correlated with photosynthetic active radiation (PAR), day length, rainfall, humidity, air temperature, water temperature, pH, total dissolved solids (TDS), conductivity, nitrate-nitrogen (NO_3-N) and soluble reactive phosphorus (SRP). Among these parameters positive correlation between petiole length and rainfall was found to be significant at 1% level. Leaf area of *E. ferox* showed positive correlation with PAR, day length, rainfall, humidity, air temperature, water temperature, pH, TDS, conductivity, NO_3-N, SRP and planktonic phaeopigment concentrations. Among these parameters positive correlation between leaf area and day length was found to be significant at 5% level. However, both leaf area and petiole length of *E. ferox* showed negative correlation with alkalinity, DO, soluble reactive silicate (SRS) and chlorophyll *a*.

Introduction

In different wetland habitats of Bangladesh, about 100 Angiosperms commonly occur.(1) *Euryale ferox* Salisb. (Common name Makhna) is an important wetland macrophyte which grows naturally in different Haor ecosystems of greater Sylhet and Kishoreganj districts of Bangladesh. Nearly 800 tonnes of fresh fruits from this species are annually harvested from Hail Haor alone (Personal communication local inhabitant). The harvest is fully dependent on natural populations which are frequently damaged by other ongoing activities in the Haor such as fishing, boating, agriculture, etc. In Bangladesh, very few works on macrophytic vegetation have been carried out.(2-5) Recently biochemical composition of the seeds of *E. ferox* and *Nelumbo nucifera* Gaertn. were studied by Alfasane *et al.*(6,7) Effects of some limnological factors on the growth of *N. nucifera* were also studied by Alfasane *et al.*(8) Almost no research work on the relationship between growth rate and limnological factors of *E. ferox* has been carried out. The present study has therefore been undertaken to carry out an *ex situ* growth performance and its relationship with some limnological factors for *E. ferox*.

[1]Corresponding author.

Materials and Methods

The present research was carried out in the arboretum of Department of Botany, University of Dhaka between 2003 and 2005. *Euryale ferox* Salisb. is one of the most bizarre tropical deep water aquatics for the water garden which propagates via seeds. Best *ex-situ* regeneration of the plant can be achieved by mature fresh fruits and their seeds. For better results seeds should be sown immediately. A preservation for a few days make the seeds completely non-viable. Collection and germination of seeds of *E. ferox* were described by Khondker *et al.*[5] The rate of seed germination was 50%. Seedlings of *E. ferox* was obtained via seeds sown in 1:1 cow-dung compost and loamy soil. After germination of the seeds the young seedlings were transferred to a concrete tank of 2 × 1 m. The growth measurement was carried out on randomly selected petioles (n = 12) and leaves (n = 32) of the plants and limnological data were collected fortnightly.

Photosynthetic active radiation (PAR) was determined with a quantum meter (Li- Cor Quantum Meter, LI-185B, USA) and air and water temperature were measured with the help of a mercury centigrade thermometer. pH was measured with the help of a Griffin pH meter (PHJ-260-V-pH-meter, Model 50, UK). Total dissolved solids (TDS) and conductivity were measured with the help of field meters (Hanna instrument HI9034W, UOM EA, D/N 413377, URN 330067T, S/N: 1391748, Singapore and Hanna instruments HI9033W, UOM EA, D/N 048053, URN 315625Y, S/N: 1414153, Singapore). Methods described in Wetzel and Likens [9] were used to determine the dissolved oxygen (DO) and soluble reactive silicate (SRS). Alkalinity was measured after Mackereth *et al.*[10] while Müller and Wiedemann [11] was followed for the determination of nitrate-nitrogen (NO_3-N). Soluble reactive phosphorus (SRP) was measured using the methodology described in Murphy and Riley.[12] Phytoplankton biomass of the tank-water was measured following Marker *et al.*[13] Climatic data on relative humidity, total rainfall and day length of Dhaka Metropolis were collected from Bangladesh Meteorological Department, Dhaka. Seasonal mean values and ranges of the data have been presented in Figs. 1-2. Pearson correlation study was made (SPSS program) to find the relationships between the measured limnological variables and the growth of petiole and leaf area (Table 1).

Results and Discussion

The *Euryale ferox* plant is medium in size and about 1.5 m in height. It is evergreen in winter, summer and monsoon. However, the foliar parts become yellow and starts decomposing during autumn. The leaf area showed its average highest growth 490.10 ± 290.36 cm^2/day in summer (Fig. 1). A medium range growth rate was observed during the monsoon (424.88 ± 206.30 cm^2/day). In winter the growth

rate was 5.72 ± 2.71 cm^2/day whereas autumn showed a very poor growth of the plant (3.97 ± 2.92 cm^2/day; Fig. 1). Another aquatic macrophyte *N. nucifera* showed that growth rate of leaf area increased in summer which was similar to this study.[8] But the growth rate of *E. ferox* was c 22 times higher than that of *N. nucifera* (21.84 ± 2.89 cm^2/day).[8] This adaptation might be due to their highest solar radiation capturing capacity in summer.

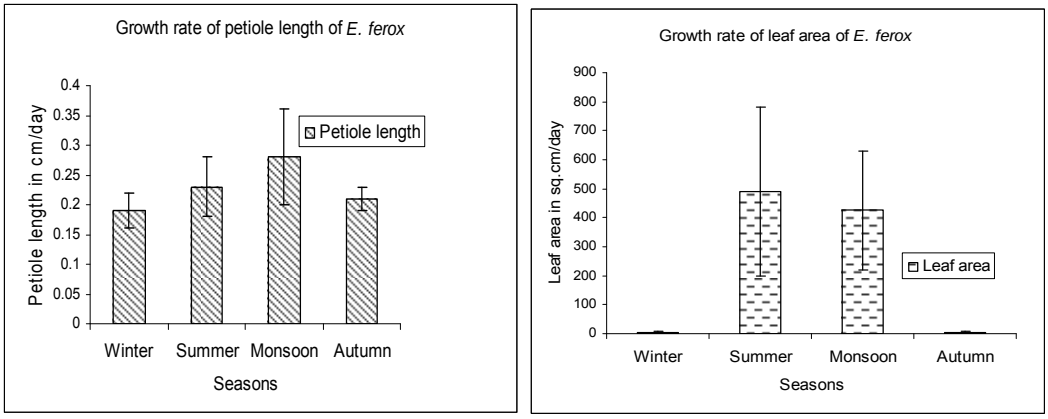

Fig. 1. Growth rate of *Euryale ferox* in different seasons (Petiole length in cm/day, leaf area in cm^2/day).

Table 1. Pearson correlation between limnological parameters and growth rate of *Euryale ferox* (data extracted from SPSS programme).

Limnological parameters	Growth rate		Limnological parameters	Growth rate	
	Petiole length	Leaf area		Petiole length	Leaf area
PAR	+0.048	+0.642	TDS	+0.835	+0.287
Day length	+0.771	+0.987*	Conductivity	+0.745	+0.095
Rainfall	+0.998**	+0.698	DO	−0.910	−0.684
Humidity	+0.872	+0.265	NO_3-N	+0.593	+0.677
Air temp.	+0.664	+0.754	SRP	+0.117	+0.788
Water temp.	+0.844	+0.809	SRS	−0.838	−0.918
pH	+0.517	+0.282	Chl-a	−0.738	−0.999*
Alkalinity	−0.728	−0.954*	Phaeopigment	−0.506	+0.005

*Correlation is significant at p = 0.05 level (2-tailed). **Correlation is significant at 0.01 level (2-tailed).

Petiole length showed highest growth 0.28 ± 0.08 cm/day in monsoon (Fig. 1). The summer season showed a medium growth in the length of the petiole (0.23 ± 0.05 cm/day). In autumn, the petiole length grew at a rate of 0.21 ± 0.02 cm/day. Least growth rate of the petiole was observed in winter (0.19 ± 0.03 cm/day, Fig. 1). Similar

type of results was also recorded in *N. nucifera*.[8] From this study it is clear that in *E. ferox* and *N. nucifera* the highest growth of the petiole occur in monsoon and this adaptation is because of their adjustment towards increasing water depth in monsoon. A significant reduction in the growth of leaf area and petiole length occurred under a reduced water depth of 20 cm of the culture pit.

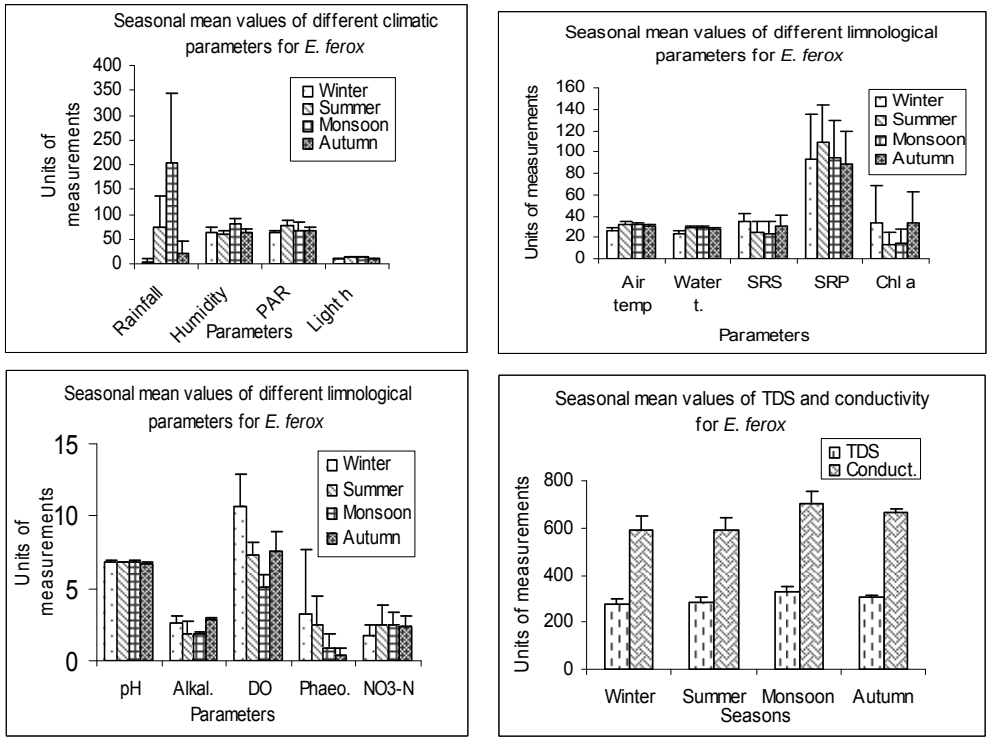

Fig. 2. Seasonal mean values of different limnological parameters for *Euryale ferox*.

The present study reveals that the seasonal highest growth rate of petiole length associated with the seasonal average highest mean value of day length: 12.84 ± 0.65; total rainfall 204.9 ± 138.9 mm; humidity: 80.41 ± 9.51%; TDS: 327.55 ± 21.45 mg/l; conductivity: 701.25 ± 52.57 µS/cm and pH: 6.87 ± 0.05 (Fig. 2). Maier[14] showed that under extreme condition of relative air humidity (30%) the drying turios of *Utricularia vulgaris* was able to survive at least for two months. In the present investigation, correlation studies between the growth of petiole length of *E. ferox* and the limnonological parameters showed a positive correlation with PAR, day length, rainfall, humidity, air temperature, water temperature, pH, TDS, conductivity, NO_3-N and SRP. Among these parameters positive correlation between petiole length and rainfall was found to be significant at 1% level (Table 1). Similar relationship was also observed in case of *N. nucifera*.[8]

The rounded mature leaves were found to be flat, prickly and 1.0 - 1.5 m in diameter having maximum leaf area c 9000 cm^2. Seasonal highest growth rate of leaf area coincided with the seasonal average highest mean value of PAR: 776.83 ± 107.21 $\mu E/m^2/sec$, water temperature: 29.37 ± 1.23°C, air temperature: 32.29 ± 2.33°C, nitrate-nitrogen: 2.53 ± 1.35 mg/l and soluble reactive phosphorus: 108.96 ± 35.41 µg/l (Fig. 2). Maier[14] showed that under full light condition the growth of *Utricularia* spp. were increased and maximal standing crop were found during this time.

Correlation studies between the growth of leaf area of *E. ferox* and the limnonological variables showed a positive correlation with PAR, day length, rainfall, humidity, air temperature, water temperature, pH, TDS, conductivity, NO_3-N, SRP and planktonic phaeopigment concentrations. Among these parameters positive correlation between leaf area and day length was found to be significant at 5% level (Table 1). Pearson correlation matrix showed that leaf area of *N. nucifera* positively correlated with air temperature, water temperature, PAR, day length, rainfall, humidity and NO_3-N.[8] However, leaf area and petiole length of *E. ferox* showed negative correlation with alkalinity, DO, SRS and chlorophyll *a* (Table 1). Petiole length and leaf area of *N. nucifera* showed also negative correlation with alkalinity, DO, SRS and SRP.[8]

The limnological conditions of meso-scale culture pits for *E. ferox* and *N. nucifera*[8] were almost similar except the concentration of nitrate-nitrogen, phosphorus and silicate.

E. ferox showed significant relationship with limnological factors in respect to their growth and regeneration. Scopes still exist to carry out similar meso-scale growth studies on threatened aquatic macrophytes of Bangladesh. The observation of the very high growth rate in the leaf of *E. ferox* suggests that further study may be carried out to find the relationship of the growth of *E. ferox* with the atmospheric CO_2 consumption.

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