Uptake of Nitrate and Phosphate by Hydrilla verticillata and Vallisneria spiralis

K.K.C.K. Karunarathna, S.C. Jayamanne, M. Bambaranda
Uva Wellassa University, Badulla, Sri Lanka

and

R. Bandaranayake
Department of National Zoological Garden, Dehiwala, Sri Lanka

Introduction

The phosphate and nitrate are major inorganic components which are directly and indirectly accumulate in water bodies (Boundless, 1997). High concentrations of phosphates and nitrates present in the wastewater causes eutrophication that severely affects natural water bodies (Kenneth, 2006). To avoid accumulation of nitrate and phosphate in waterbodies, water purification systems should be established with P and N removal facilities. The cost of the advanced instruments that can purify water is not affordable by the developing countries such as Sri Lanka and water purification by aquatic plants is considered as a suitable method. The present study was carried out to evaluate the ability of two fresh water aquatic plants, *Hydrilla verticillata* and *Vallisneria spiralis* in removing nitrate and phosphate from the waste water. The main objective of the study was to identify the best plant which can absorb a large amount of nitrate and phosphate from the wastewater.

Methodology

The research was conducted in two stages to investigate the fluctuation of nitrate and phosphate in the wastewater with aquatic plants. The first experiment was conducted to investigate the changes of nitrate and phosphate by using *Hydrilla verticillata* and *Vallisneria spiralis* in equal biomass. The *Hydrilla verticillata*, *Vallisneria spiralis, a* combination of *Hydrilla verticillata* and *Vallisneria spiralis* and control treatment were used as different treatments and the same biomass was provided for each treatment units (16 g) except for the control. Then water samples were collected daily in the morning (8.00 a.m.) and used to estimate the nitrate and phosphate concentration. The experimental design was completely randomized design. The data was analyzed using one-way ANOVA and general liner model in Minitab 14.

The second experiment was conducted to compare the ability of two aquatic plants *Hydrilla verticillata* and *Vallisneria spiralis* in removing nitrate and phosphate from wastewater and the appropriate density that can be used for controlling eutrophication. Different biomasses of 8 g, 16 g, 24 g and 32 g of *Hydrilla verticillata* and *Vallisneria spiralis* were used as treatments and the nitrate and phosphate concentration were measured daily following AOAC standard methods (1985). Two factor factorial design was employed as the experimental design and two-way ANOVA in Minitab 16 was used to analyze the data.

Result and Discussion

According to the Figure 1, T1 (*Hydrilla*) and T2 (*Valisneria*) could reduce phosphate concentration in the wastewater than T3 (combined plants) and T4 (Control). T1 and T2 had shown approximately same phosphate removal ability. Phosphate concentration in the water is significantly different between the treatments except T1 and T2 ($p<0.05$). Figure 2 shows that nitrate concentration of the T1 was lower than T2, T3, and T4. Nitrate concentration is significantly different between the treatments ($p<0.05$). The concentrations of the Nitrate and phosphate in the water has reduced in T1, T2 and T3. In T4, reduction of nitrate and phosphate in the water was lower than in treatment tanks with aquatic plants. According to Figure 3 the highest nitrate absorption was recorded in T1 with 8 g of biomass by absorbing 76 %. The

nitrate absorption is significantly different between treatments and the level of biomass. The interaction among the plant type and biomass is also significantly affected on the nitrate absorption ($p<0.05$). Figure 4, shows the highest phosphate absorption in T1 with 32 g biomass and it absorbed only 40% in 5 days. Phosphate absorption is significantly different between treatment and the amount of biomass ($p<0.05$). The interaction among the plant species and biomass were also significantly affected on the phosphate absorption.

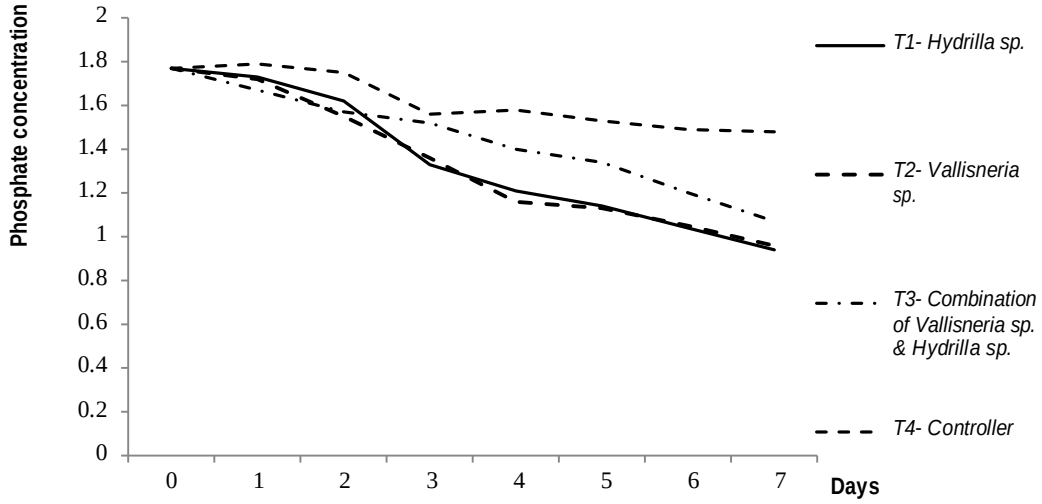

Figure 1. Phosphate concentration in the water.

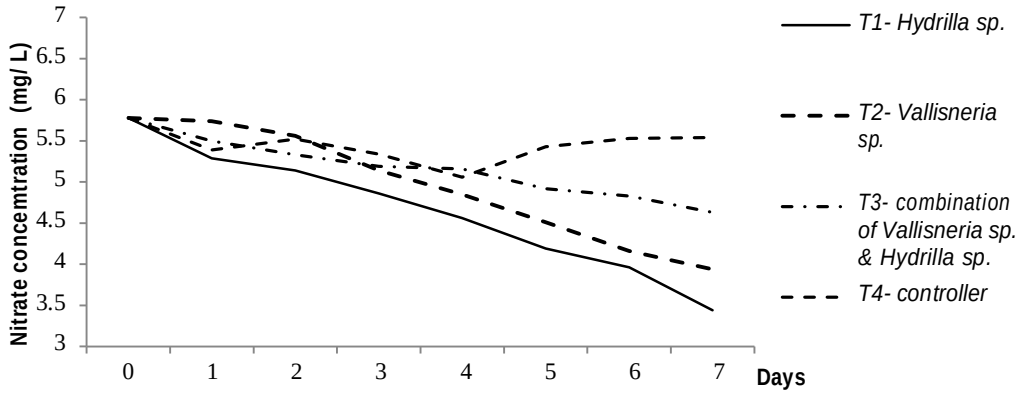

Figure 2. Nitrate concentration in the water.

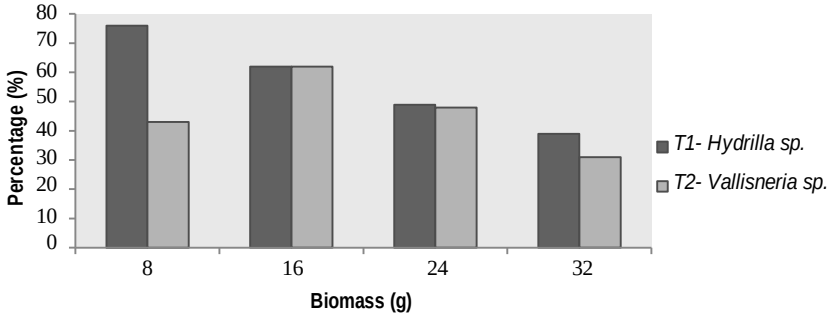

Figure 3. Nitrate absorption percentage by T1 and T2 with different levels of biomass.

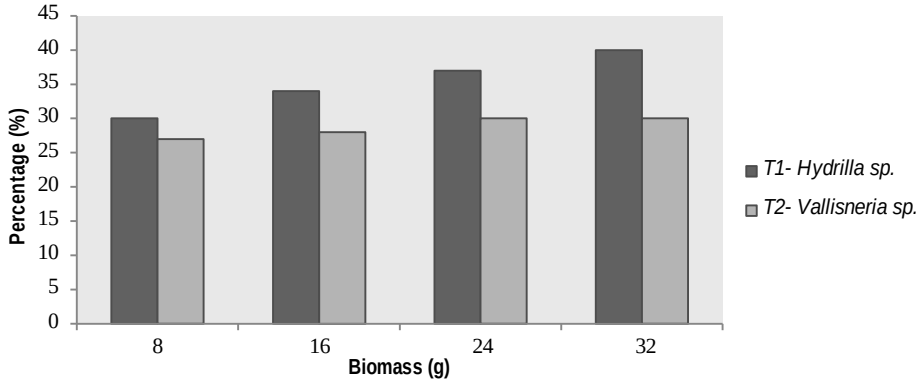

Figure 4. Phosphate absorption percentage by T1 and T2 with different levels of biomass.

Conclusion

Most effective aquatic plant for nitrate absorption is *Hydrilla verticillata*. The most suitable density of *Hydrilla verticillata* for nitrate absorption is 0.67 g L^{-1} and for phosphate absorption it is 2.67 g L^{-1} of *Hydrilla verticillata.*

References

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