

PHYTOREMEDIATION POTENTIAL OF THREE GRASS SPP. IN A CONSTRUCTED WETLAND SYSTEM

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ABSTRACT

Many of the natural systems have been polluted by direct discharge of waste water to the water bodies that causes environmental and health hazards. The surface water resource mainly the tank water gets polluted due to waste water discharge to the tanks without proper treatment in Vavuniya district which consists of many tanks polluted due to the direct discharge of storm and runoff water. Natural wetland system is believed to be a most preferable secondary treatment system to treat the waste water before discharge into the water bodies. The natural grasses and sedge species are the basis of phytoremediation technique to remove the pollutants. Objective of this study was to assess the pollution reduction ability of these grass spp. The waste water was collected in between the grid and oxidation pond in Vavuniya tank in two weeks interval and passed it through the constructed wetland system with three different spp. of grasses such as *Eleusine indica* (Goose grass), *Dactyloctenium aegyptium* (Crowfoot grass) and a sedge namely *Cyperus iria* (umbrella sedge) and the control without any grass were operated continuously by inlet valve from tank filled with waste water. The physicochemical parameters such as pH, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), and Total Solids (TS), concentration of phosphate and nitrate of water were measured for the inlet wastewater and the outlet water after passing through the wetland system in two weeks interval. Results of the physicochemical parameters showed that the grass spp. and the sedge reduces the pH, COD, BOD, TS and the concentrations of phosphate and nitrate and increases the DO significantly. Further the results also revealed that among the three species tested, the sedge *Cyperus iria* is more effective in reducing the pollution level of waste water.

Key words: Phytoremediation, Pollution level, Waste water, Wet land system

INTRODUCTION

Constructed wetlands have been used for treatment of wastewater in a cost effective manner by using naturally available plant species. These wetlands are now being constructed worldwide particularly in developing countries (1). Many of the natural systems have been polluted by direct discharge of waste water to the water bodies that causes environmental and health hazards. In Vavuniya district, the surface water resource mainly the tank water gets polluted due to waste water discharge to the tanks without proper treatment. Vavuniya is under the dry zone of Sri Lanka consisting many tanks polluted due to the direct discharge of waste water from the town area and other natural runoff water. Natural wetland system is believed to be a most preferable secondary treatment system to treat the waste water before discharge into the water bodies (2). The study aims to assess the pollution reduction ability of a constructed artificial wetland system with natural grass species. Usage of these natural grasses and sedge species are the basis of phytoremediation technique to remove the pollutants (3).

METHODOLOGY

The subsurface constructed wetland systems were constructed and then segregated as three treatments and one control. The dimension of each system was 4 feet length, 2 feet width and 2.5 feet height. The bottom and around of wetlands were built with brick and plastered with concrete. The inlet part was directly connected with surface of the waste water tank whereas each system has three outlets separately started from 0.5 feet depth with 0.5 feet distance at downward. The samples were collected from each depth. The treatment and control systems were filled orderly with bigger gravels up to 0.25 feet height, then sand, small gravel and fertile soil mixture (2:1:7) up to 1.25 feet height and then the fertile soil was filled up to 1.75 feet height. The waste water from Vavuniya town area discharges to the Vavuniya tank. This storm water goes through the grid to remove the large particle then reach to the oxidation pond which was not in working condition and directly discharge to the tank. For this research, the inlet waste water was collected in between the grid and oxidation pond. Two grass spp such as *Eleusine indica* (Goose grass), *Dactyloctenium aegyptium* (Crowfoot grass) and a sedge namely *Cyperus iria* (umbrella sedge) were selected for the wetland system to carry out this research. 40 plants were planted in each treatment. The sample collection was started after three weeks of establishment of the grass species.

Constructed wetland was operated continuously by inlet valve from tank filled with waste water. The physicochemical parameters such as pH, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total solids (TS), concentration of phosphate and nitrate of water were measured for the inlet wastewater and the outlet water after passing through the wetland system in two weeks interval from September to November, 2015. The paired t test was conducted between the waste water at inlet and the water collected at the outlet for each treatment.

RESULTS AND DISCUSSION

The results revealed that pH of the water collected in the outlet showed a slight change, slightly lesser than that of inlet waste water and also varied among plant species. *Cyperus iria* had the greater ability to reduce the pH level whereas the pH reduction was very less in *Dactyloctenium aegyptium*, DO of inlet waste water was around 1.2 mg/L. *Cyperus iria* has high ability to increase the DO level but the increasing DO level was varied among plant species at initial depth. COD of inlet waste water varied from 20 to 35ppm. *Cyperus iria* had the greater ability to reduce COD level whereas the COD reduction was very less in *Dactyloctenium aegyptium*. BOD of inlet varied from 13 to 21 ppm. *Cyperus iria* had the greater ability to reduce the BOD level whereas the BOD reduction was very less in *Dactyloctenium aegyptium*. The results revealed that TS in outlet water was lesser than that of inlet waste water and also varied among plant spp. *Cyperus iria* had the greater ability to reduce the TS level. Phosphate concentration at inlet waste water was 7.5 ppm. The results indicated that *Cyperus iria* had the greater ability to reduce the phosphate level whereas it was minimal in *Dactyloctenium aegyptium*. Nitrate concentration at inlet waste water was nearly 23 ppm. *Cyperus iria* had greater ability to reduce the nitrate level whereas it was very low in *Dactyloctenium aegyptium*. A significant difference between the inlet waste water and the water collected at out let was observed in each plots with the grass species respectively.

CONCLUSION

Constructed wetland with two different spp. of grasses such as *Eleusine indica* (Goose grass), *Dactyloctenium aegyptium* (Crowfoot grass) and a sedge namely *Cyperus iria* (umbrella sedge) and the control without any grass were operated

continuously by inlet valve from tank filled with waste water. The physicochemical parameters such as pH, DO, COD, BOD, TS, concentration of phosphate and nitrate of water were measured for the inlet wastewater and the outlet water after passing through the wetland system in two weeks interval. Results of the physicochemical parameters showed that the grass spp. and the sedge reduces the pH, COD, BOD, TS and the concentrations of phosphate and nitrate and increases the DO. Further the results also revealed that among the three grass species tested the sedge *Cyperus iria* is more effective in reducing the pollution level.

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