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Modelling Phytoremediation Rates of Aquatic Macrophytes in Aquaculture Effluent

Authors : E. A. Kiridi, A. O. Ogunlela

Abstract : Pollutants from aquacultural practices constitute environmental problems and phytoremediation could offer cheaper environmentally sustainable alternative since equipment using advanced treatment for fish tank effluent is expensive to import, install, operate and maintain, especially in developing countries. The main objective of this research was, therefore, to develop a mathematical model for phytoremediation by aquatic plants in aquaculture wastewater. Other objectives were to evaluate the retention times on phytoremediation rates using the model and to measure the nutrient level of the aquaculture effluent and phytoremediation rates of three aquatic macrophytes, namely; water hyacinth (Eichornia crassippes), water lettuce (Pistial stratoites) and morning glory (Ipomea asarifolia). A completely randomized experimental design was used in the study. Approximately 100 g of each macrophyte were introduced into the hydroponic units and phytoremediation indices monitored at 8 different intervals from the first to the 28th day. The water quality parameters measured were pH and electrical conductivity (EC). Others were concentration of ammonium–nitrogen (NH_4^+ -N), nitrite- nitrogen (NO_2^- -N), nitrate- nitrogen (NO_3^- -N), phosphate –phosphorus (PO_4^{3-} -P), and biomass value. The biomass produced by water hyacinth was 438.2 g, 600.7 g, 688.2 g and 725.7 g at four 7–day intervals. The corresponding values for water lettuce were 361.2 g, 498.7 g, 561.2 g and 623.7 g and for morning glory were 417.0 g, 567.0 g, 642.0 g and 679.5g. Coefficient of determination was greater than 80% for EC, TDS, NO_2^- -N, NO_3^- -N and 70% for NH_4^+ -N using any of the macrophytes and the predicted values were within the 95% confidence interval of measured values. Therefore, the model is valuable in the design and operation of phytoremediation systems for aquaculture effluent.

Keywords : aquaculture effluent, macrophytes, mathematical model, phytoremediation
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