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Effect of Plant Species on Biomass Accumulation, Nutrient Uptake and Water Quality in a Constructed Wetland for Wastewater Treatment in Viet Nam

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Abstract

So far, biological wastewater treatment in constructed wetlands focused on a reduction of organic carbon compounds in the rizosphere of reed grasses. Particularly in developing countries, it may be of interest to cultivate plant species that can efficiently remove nutrients from wastewater and concentrate them in their biomass. Such approaches are seen to avoid the eutrophication of water bodies, increase the efficiency of wastewater cleaning and to provide a nutrient-rich substrate for use in agriculture.

An eight-week experiment was conducted in a horizontal sub-surface flow wetland at Can Tho University, Viet Nam in 2008. The system was supplied with domestic wastewater from a student dormitory at two loading rates. It compared an unplanted control with filter compartments planted to either *Phragmites australis* (standard crop in biofilters) or *Sesbania rostrata* (stem-nodulating legume). At bi-weekly intervals we assesed plant characteristic (biomass, nutrient uptake and nitrogen fixation by δ^{15}N natural abundance method, using *Phragmites* as non-fixing reference plant) and changes in waste water properties (pH, EC, COD, N, and P) at four positions between the wastewater inlet and the filter outflow. The daily nutrient addition was 900 mg N m^{-2} and 4 mg P m^{-2} in the full and 400 mg N m^{-2} and 3.6 mg P m^{-2} in the reduced wastewater loading rate.

The N and P elimination from the wastewater as well as its chemical oxygen demand (COD) varied with the type of the species as well as with the plant age and was more efficient with *Sesbania* than with *Phragmites*. Nitrogen depletion from wastewater was significantly higher with *S. rostrata* (90–92 %) compared to reed grass (30–38 %) or the unplanted control (14–20 %). *Sesbania rostrata* accumulated up to 1.5 kg N m^{-2}, irrespective of the wastewater loading rate or position in the filter and compensated a reduced N supply from the water with an increasing N_2 fixation. In contrast to *Phragmites*, *S. rostrata* provided an organic substrate of high and constant quality (biomass, C:N and C:P ratio) in addition to an effective cleaning of the wastewater (COD, Nmin), and may be the prefered plant species for horizontal filter systems under tropical climatic conditions.

Keywords: Chemical oxygen demand, nitrogen fixation, Phragmites, Sesbania

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