

An Empirical Model of Ammonia Uptake by Duckweed, *Lemna perpusilla*

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To establish an empirical model of ammonia uptake by duckweed, *Lemna perpusilla* under various ammonia concentrations and duckweed densities, an experiment of a 5×5 factorial arrangement of treatments; 5 initial ammonia-N concentrations 0.0, 0.25, 0.5, 1.0 and 2.0 mg/l, by 5 duckweed densities 0.0, 0.5, 1.0, 2.0, and 4.0 g/l were conducted to measure the ammonia-N concentration at 9 durations from 0 to 96 hours. In the presence of duckweed, ammonia-N decreased in a decaying exponential fashion; $C_t = C_0 \times \exp(-K \times t)$ and an optimal second order multiple regression model was obtained as the following:

$$K = 9.5242 \times 10^{-3} + 2.8252 \times 10^{-3} \times \ln(C_0) + 3.0327 \times 10^{-2} \times D \\ - 6.1993 \times 10^{-3} \times D^2 \quad (R^2 = 0.7689)$$

where C_t is the ammonia-N concentration (mg/l) at time t (hr), C_0 the initial ammonia concentration, K the uptake coefficient, and D the duckweed density (g/l). The model demonstrated duckweed density at 2.44 g/l was most efficient in ammonia uptake; at densities either higher or lower than 2.44 g/l the uptake coefficient K decreased. K increased with initial ammonia concentration. The change of K was most sensitive to $\ln(C_0)$, followed by D^2 and D . There was a 64 to 69% decrease in ammonia when duckweed was placed at a density 2.44 g/l in solution of ammonia concentration 0.25 to 2.0 mg/l after 24 hours.

Key words: Duckweed, Ammonia uptake, Model.

關鍵詞：浮萍、氨的吸取、模式。

INTRODUCTION

Removal of excess ammonia from an aquaculture system is important since ammonia is toxic to aquatic animals. The acute toxicity of ammonia-N for freshwater fish is around 0.2 to 2.0 mg/l (EIFAC 1970). Duckweeds are the smallest and simplest of flowering plants, a worldwide family (Lemnaceae) of floating monocotyledons. Duckweeds are suitable as a component in treatment of organic and inorganic wastes. Firstly, they are capable of extracting large quantities of nutrients that contribute to deterioration of water quality. The plants remove a significant quantity of nitrogen from wastewaters (Stanley, 1977; Sutton and Ornes, 1977; Culley *et al.*, 1978; Culley and Meyers, 1980). In organically enriched waters nitrogen tends to be concentrated in the $\text{NH}_4\text{-N}$ form at pH levels below 9 and duckweed growth response is better to $\text{NH}_4\text{-N}$ than to $\text{NO}_3\text{-N}$ or $\text{NO}_2\text{-N}$

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