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Rates of inorganic nitrogen uptake by the estuarine green macroalgae *Enteromorpha intestinalis* and *Ulva* expansa

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ABSTRACT

Rates of nitrogen (N) uptake by *Enteromorpha intestinalis* and *Ulva expansa* were investigated in two separate experiments. To measure uptake rates over a range of conditions, we varied initial water column NO_3 concentrations (low, medium, and high) and initial algal tissue nutrient status (enriched versus depleted). Uptake rates were determined by measuring the disappearance of NO_3 from solution over time (1, 2, 4, 8, 12, and 24 h). *E. intestinalis* and *U. expansa* exhibited a high affinity for N. In the low water column concentration treatments, *E. intestinalis* and *U. expansa* removed all measurable NO_3 from the water within 8 h and 12 h, respectively. Nutrient-depleted algae consistently removed more NO_3 than enriched algae over each sampling interval. For *E. intestinalis,* maximum rates of NO_3 uptake increased with increasing initial water column nutrient concentrations, indicating a relationship between uptake and external substrate concentration. The same was true for *U. expansa* in the low and medium water column nutrient treatments. Maximum rates of NO_3 uptake exceeded 200 μmoles g dry wt^{-1} h^{-1} by *E. intestinalis* and 125 μmoles g dry wt^{-1} h^{-1} by *U. expansa*. Nutrient uptake rates were highly variable over 24 h, indicating surge, internally controlled, and externally controlled phases of nutrient uptake. Uptake by *E. intestinalis* varied from the maximum rate measured to a negative rate over the first 2 h, indicating a release of N from algal tissues. Similarly, *U. expansa* NO_3 uptake rates were greatest in the first hour, decreased to 0 in the second hour, and then returned to normal. Depleted algae showed greater increases in tissue N concentration in response to water column nutrient supplies than enriched algae did, and these increases were concentration dependent. Generally, macroalgae did not grow measurably in these 24-h experiments, indicating a temporal decoupling between nutrient uptake and growth. Critical factors in the process of nutrient uptake by macroalgae are: (1) nutrient concentration in the water column, (2) algal nutrient status, and (3) the various phases of nutrient uptake.

Full Text

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