

## EFFECT OF TEMPERATURE ON 'N' UPTAKE OF *CHAETOMORPHA LINUM* (MULLER) AND *PADINA TETRASTOMATICA* (HAUCK)

One of the most important environmental factors controlling the growth of macroalgae is temperature. Severe effects of temperature may lead to reduction in growth, abundance, number of species and decline in reproductive rate in the intertidal flora of the tropics. The algae growing in the shallow intertidal region and tide pools are affected by temperature variations throughout the day. At higher levels on the shore, the pools remain uncovered by the sea long enough leading to significant changes in temperature during the day. But at successively lower levels on the shore, the temperature effects may be less significant. However, thermal stratification would occur near the surface and it is important to know how the uptake rates of different N species at different temperatures vary in different species of algae. Therefore a study to determine the effect of temperature on the N uptake rates of macroalgae in a coral atoll was undertaken. Even though the present study was carried out on the macroalgae of a coral atoll, the *in situ* measurements conducted at different temperatures could be considered as the representative temperature existing in the tide pools during low tides of the intertidal region in oligotrophic or eutrophic waters.

Macroalgal species (*Chaetomorpha linum* and *Padina tetrastomatica*) collected from the Kavaratti lagoon (lat. 10°33'16" N and long. 72°38'34" E) were brought to the laboratory and cleaned with filtered seawater. 0.5 g of algal thallus was placed in the beakers with 50 ml of seawater to which ammonium, nitrate and urea were added separately at the concentrations of 2, 5 and 10  $\mu\text{M}$  in the form of  $\text{NH}_4\text{Cl}$ ,  $\text{KNO}_3$  and urea respectively. Measurements of uptake of N as a function of temperature were tested at 4 different temperatures (20, 25, 30 and 35°C). The irradiance measured during the incubation period was 276  $\mu\text{E m}^{-2} \text{s}^{-1}$ . The duration of each experiment was 1 h. The experiments were carried out in duplicates. At the end of the experiment the algae were retrieved, oven dried at 70°C and weighed. Technicon II autoanalyser was used for ammonium, nitrate and urea measurement using methods described by Koroleff (1970), Wood *et al.* (1967) and Aminot

and Keroule (1982) respectively. Uptake was calculated based on the depletion of added nutrient from the experimental medium.

Under all the combinations of temperature and N species, the uptake rate of  $\text{NH}_4^+$  was greater than that of  $\text{NO}_3^-$  and urea.

### Effect of temperature on ammonium uptake rates

In *C. linum* (Fig. 1a), the ammonium uptake rates at 2  $\mu\text{M}$   $\text{NH}_4^+$  increased from 20 to 25°C by 5.46  $\mu\text{M (g dry wt)}^{-1}\text{h}^{-1}$  and then decreased upto 35 °C by 6.13  $\mu\text{M (g dry wt)}^{-1}\text{h}^{-1}$ , whereas at 10  $\mu\text{M}$   $\text{NH}_4^+$  the uptake rates decreased with the increase in temperature from 20 to 35° by 20  $\mu\text{M (g dry wt)}^{-1}\text{h}^{-1}$ , thus showing that as the temperature increases the uptake decreases. However, the ammonium uptake rates at 5  $\mu\text{M}$  ammonium was almost constant at all the temperatures suggesting that *C. linum* behaves independently at different concentrations irrespective of temperatures. *P. tetrastomatica* (Fig. 1b) exhibited dissimilar behavior in the ammonium uptake rates at different concentrations. At low concentration (2  $\mu\text{M}$ ) of ammonium, the uptake increased from 20 to 35°C. At 5  $\mu\text{M}$ , it was constant at all the concentrations and at 10  $\mu\text{M}$  decrease in the uptake rates was observed from 20 to 35°C.

### Effect of temperature on nitrate uptake rates

Almost similar uptake rates at all the 3 concentrations at 20°C were observed for *C. linum* (Fig. 1c). Nitrate uptake rates at 2 and 10  $\mu\text{M}$  increased from 20 to 35°C by 8 and 14  $\mu\text{M (g dry wt)}^{-1} \text{h}^{-1}$  respectively whereas at 5  $\mu\text{M}$  the uptake increased by 8  $\mu\text{M (g dry wt)}^{-1} \text{h}^{-1}$  upto 30°C and thereafter was constant upto 35°C. *P. tetrastomatica* (Fig. 1d) showed decrease in the uptake rates at 2 and 5  $\mu\text{M}$  with the increase in temperature. However at 10  $\mu\text{M}$  the uptake rates decreased upto 30°C and later increased with the increase in temperature.

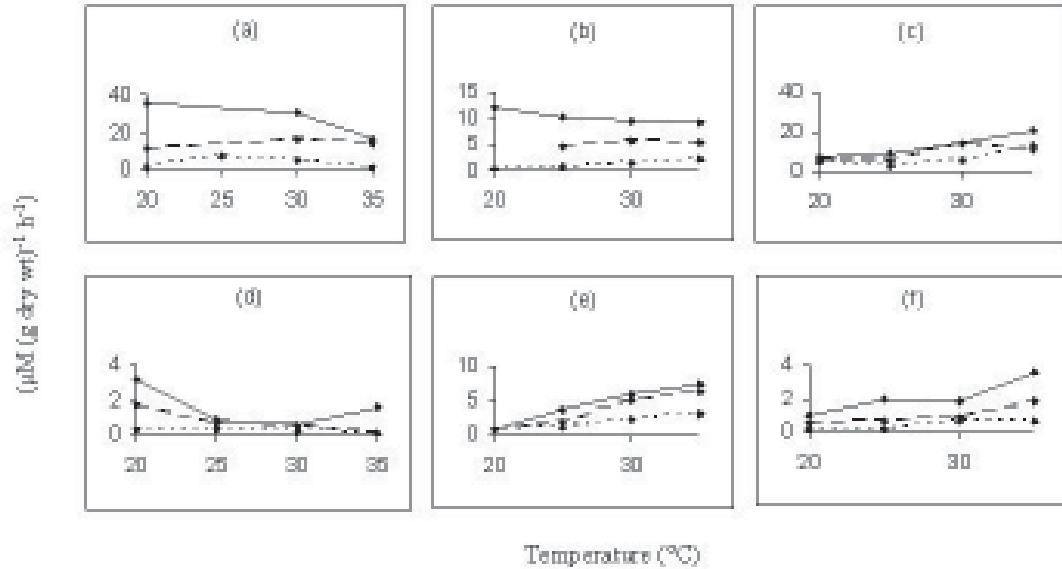
### Effect of temperature on urea uptake rates

Both the species showed increase in the urea uptake at the temperatures and concentrations studied (Fig.1e & f).

Relatively little is known about the temperature sensitivity of N uptake on macroalgae (Hanisak and Harlin, 1978; Asare and Harlin, 1983; Pedersen *et al.*, 2004). The results of this study showed that the ammonium uptake rates are temperature independent and have no response to the increase in temperature. The nitrate uptake rates are temperature dependent with *C. linum* and *P. tetrastomatica* showing positive and negative response respectively whereas both

the species showed increase in the urea uptake rates with the increase in temperature.

No study has been reported so far on the effect of temperature on the urea uptake rates and this study is the first of its kind to be reported. The uptake of N from the medium at all the temperatures suggests that these species are highly competitive in harvesting N nutrients from the water column (especially urea).



**Fig.1. Average uptake rates of ammonium (a, b), nitrate (c, d) and urea (e, f) in *Chaetomorpha linum* and *Padina tetrastomatica* respectively at different concentrations (2 µM ..... , 5 µM - - - - , 10 µM —) and temperatures (20, 25, 30, 35°C).**

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