Botanica Marina
Vol. XXVIII, pp. 427–435, 1985

Photosynthesis of *Gracilaria tikvahiae* McLachlan (Gigartinales, Rhodophyta) from the Great Bay Estuary, New Hampshire[1])

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(Accepted July 10, 1985)

Abstract

Net photosynthesis was measured for *Gracilaria tikvahiae* from the Great Bay Estuary, New Hampshire, U.S.A. using manometric and dissolved oxygen techniques. Comparisons were made between summer- and winter-acclimated plants. The net photosynthesis of *G. tikvahiae* was light-saturated at 200–600 $\mu E\ m^{-2}\ s^{-1}$ depending upon the season and incubation temperature. No light inhibition was observed up to the maximum experimental irradiance, 1440 $\mu E\ m^{-2}\ s^{-1}$. *Gracilaria tikvahiae* had increasing photosynthetic rates between 5 ° and 25 °C. Maximum net photosynthesis occurred between 25 ° and 35 °C, while rates decreased at 37.5 °C. The net photosynthetic responses at 25 ° and 30 °C were stable after acclimation times of one to four days, but declined after three days at 35 °C. *Gracilaria tikhaviae* had an euryhaline net photosynthetic response between 5‰ and 40‰.

Introduction

The red algal genus *Gracilaria* is an important source of the phycocolloid agar (Jensen 1979). Although it is not currently exploited commercially, *Gracilaria tikvahiae* is a major component of the estuarine flora of the northwest Atlantic (Conover 1958, C. Bird *et al.* 1976, 1977b, Mathieson *et al.* 1981). Several investigators have studied the growth of *G. tikvahiae* in culture (Edelstein 1977, N. Bird *et al.* 1979, LaPointe *et al.* 1984a, b) and in natural conditions (C. Bird *et al.* 1977a, Edelstein *et al.* 1981, Penniman 1983), but few reports are available concerning its photosynthetic responses to environmental variables (Fralick and DeBoer 1977, Ramus and van der Meer 1983, LaPointe *et al.* 1984a, b). At present the documented distribution of *G. tikvahiae* extends from Nova Scotia to New Jersey (Chapman *et al.* 1977, McLachlan 1979), with its occurrence farther south being somewhat ambiguous (van den Hoek 1982). Several photosynthetic studies of other *Gracilaria* species have been conducted (e. g. Rosenberg and Ramus 1982, Beer and Levy 1983). Dawes *et al.* (1978) and Hoffman and Dawes (1980) found that Florida plants of *G. verrucosa* were tolerant of a broad range of irradiance, salinity, and temperature in accordance with the plants' estuarine distribution. Similarly, Adriatic *G. verrucosa* (as *G. confervoides*) showed broad photosynthetic tolerance to temperature and salinity conditions (Simonetti *et al.* 1970). The present research was initiated to characterize the effects of quantum irradiance, temperature and salinity on the net photosynthesis of *G. tikvahiae*.

In the Great Bay Estuary of New Hampshire-Maine, *Gracilaria tikvahiae* occurs predominantly at inner estuarine sites, attached in subtidal beds where sufficient substrata (e. g. rocks, sunken logs, bivalve shells) are available (Penniman 1983). In these habitats, the plants are exposed to a wide range of salinity (5–30‰) and temperature (−1.9 ° to 27 °C) regimes, while available light may be limited by extreme turbidity changes (Emerich Penniman *et al.* 1985). As these fluctuations may occur over a relatively short time (i. e. hours-days) similar acclimation periods were employed in this study.

[1]) Scientific Contribution Number 1305 from the New Hampshire Agricultural Experiment Station and Jackson Estuarine Laboratory Contribution Number 174.