

The effects of shading on dioecious, pistillate *Hydrilla verticillata* (L.f.) Royle transplants from Lake Okeechobee, Florida, U.S.A.

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With 3 figures and 5 tables

Abstract: The effect of shading on morphometric and meristic characteristics of dioecious, pistillate *Hydrilla verticillata* (L.f.) Royle was investigated in a large outdoor tank using water, sediment, and plants from Lake Okeechobee, Florida. These data were needed for a hydrologically integrated submersed aquatic vegetation model being developed to assess the effects of restoration activities on Lake Okeechobee. Plants were grown in peat sediment and lake water, under ambient temperature (27.0–30.8 °C) and photoperiod (13 L: 11D to 14 L: 10 D). Treatments were established by differentially shading plants with varying numbers of layers of fiberglass window screen. Photon flux density (PFD) measured 0.27 m above the sediment surface ranged from 8 to 154 $\mu\text{mole photons m}^{-2} \text{s}^{-1}$, or 1.1 to 21.6 % of average incident photosynthetically active solar radiation (PAR), based on percent transmittance in the tank and averaged continuous daytime measurements from a mid-lake PAR sensor.

Plant characteristics examined included ash-free dry mass (AFDM), leaf, node, shoot, and branch numbers, leaf area, cumulative shoot length, and the number of leaves on the upper third of all shoots; all of which decreased linearly with decreasing PAR, and had statistically significant treatment effects. No statistically significant treatment effects were found for maximum shoot and mean and maximum internodal lengths, or when the number of leaves or branches on the upper third of all shoots were expressed as a percentage of their totals, indicating that significant treatment-induced internodal elongation and canopy formation had not occurred. Mean absolute and relative growth rates of *H. verticillata* were estimated to be $11.6 \pm 1.9 \text{ mg AFDM plant}^{-1} \text{ d}^{-1}$ (mean \pm SE) and $0.04 \pm 0.003 \text{ d}^{-1}$, respectively. Estimated photosynthetic PFDs for no net growth (NNG) was negative, with an upper 95 % confidence limit of $13 \mu\text{mole photons m}^{-2} \text{ s}^{-1}$, or 1.8 % of mean incident PAR for absolute, and $7 \mu\text{mole photons m}^{-2} \text{ s}^{-1}$, or 0.9 % of mean incident PAR for the mean relative growth rate. These results demonstrate that *H. verticillata* has a high growth rate and can grow in very low light, which may impart an important adaptive advantage given the poor light climate typical of much of Lake Okeechobee and many other disturbed, culturally hypereutrophic waterbodies.

Key words: Macrophyte biomass, macrophyte growth, dioecious pistillate transplants, sediment nutrient concentrations, hypereutrophic subtropical lake, low-light adaptations, lake restoration.

Introduction

Light is considered to be the most important factor regulating the distribution of submersed aquatic vegetation (SAV) in eutrophic lakes (Strand 1999). However,

in shallow eutrophic water bodies, parameters affecting the distribution and abundance of SAV are not as well-understood (Scheffer 1998, Jeppesen 1998). This is also true for disturbed, hypereutrophic subtropical lakes and surface water reservoirs like Lake Okee-

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