ABSTRACT

The Light Related Physiology of Zooxanthellae

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A new technique developed for producing action spectra and PI curves of zooxanthellae is described in this dissertation. A monolayer of algae is deposited on a gridded millepore filter. Different areas of the grid are illuminated, in a sea-water medium containing ^{14}C bicarbonate, with different wavelengths (a spectrum) of light, or with a range of light intensities. Photosynthetic production in each area is determined by counting the ^{14}C that has been incorporated.

Algal pigments were analysed and action spectral peaks were related to light quality, pigments, pigment complexes and the two photosystems. PI curves fitted closely the hyperbolic tangent relationship but with more than a monolayer of algae the relationship changes. Diurnal cycles and the effects of algal density, light quality, temperature, salinity, pH, dissolved CO_2, O_2, and host tissue on the PI relationship were explored. Mean daily and monthly irradiances were determined for the sites and depths from which hosts were obtained. Algal size and structure were recorded and the correlationships of P_{max} I_k and Alpha with depth, irradiance, algal size and pigments were determined. The role of UV-A and host pigments in photosynthesis was also studied.

Many structurally and physiologically different forms of *Symbiodinium microadriaticum* were discovered in the 27 hosts species studied. Some host species contained several forms, and some host individuals, mixtures of algae, and some algae were found in several host species. Strong correlationships between the pigments, P_{max}, Alpha and algal size were found. If size is factored out, peridinin is inversely related to irradiance. High levels of xanthophylls are found in shallow, high light situations. Two main antenna pigment complexes were present, one with chlorophyll *a*-peridinin, the other with chlorophyll *a*-chlorophyll *c*. the latter is dominant in small algae from meandrinid and related corals. Zooxanthellae are able to function at temperatures up to 35°C but photosynthesis is strongly inhibited by dissolved oxygen. CO_2 in solution appears to be the source of carbon for zooxanthellae.