異なるタイプの褐虫藻の温度および光ストレスに対する生理学的応答

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ABSTRACT

The widespread coral bleaching, which is defined as loss of *Symbiodinium* cells or its pigmentation (Fitt et al., 2001; Lesser, 2011) in response to global climate change, threatened coral reef ecosystems. *Symbiodinium* tends to lose its photosynthetic activity under conditions where the amount of absorbed light energy exceeds the capacity for utilization by photosynthesis. The reduction of photosynthetic activity due to strong light, which is referred as photoinhibition, is observed prior to coral bleaching. Therefore, the survivorship of corals may be determined by the susceptibility and adaptive capacity of its symbionts under environmental stress conditions. The objectives of this thesis; (1) to investigate the changes in photochemical efficiency (F_v/F_m) and growth rate of *Symbiodinium* phylotypes at thermal stress, (2) to examine the relationship between F_v/F_m and photosynthetic activity measured as photosynthetic O_2 production rate under thermal and light stress.

The present results demonstrated that, based on the relationship between the growth rate and photochemical efficiency of PSII at elevated temperatures, the six strains of *Symbiodinium* were categorized into three groups; (1) thermally sensitive strains, in which both photochemical efficiency and growth rate decreased in parallel at high temperature, (2) a thermally tolerant strain, in which both parameters remained relatively stable at high temperature, and (3) strains that showed decreased growth rate but maintained relatively high photochemical efficiency at high temperature (uncoupling between the growth rates and photochemical efficiency of PSII). The strains in category (3) may reallocate energy from growth to the repair of damaged photosynthetic machineries or protection pathways.

The second part of this study revealed that photosynthetic O_2 production rate decreased only in severe photoinhibition. The non-linear relationship between photochemical efficiency and photosynthetic O_2 production rate at strong light intensity might indicate that there are extra PSII in each cells that are not instantly become dysfunctional from the damage. In addition, it is likely that damage in PSII may be induced by thermal stress in complete darkness.

This study advances our understanding of diverse physiological characteristics among *Symbiodinium* phylotypes. Two strains showing uncoupling between photochemical efficiency and growth rate will become useful models for future research into different stress susceptibilities among diverse phylotypes of *Symbiodinium*. The present study also suggests that measurement of the F_v/F_m decline is useful to study the photoinhibition sensitivity of *Symbiodinium* but it does not always correspond with the decline of photosynthetic activity.