Symbiont mutagenesis and characterization as a potential method to mitigate climate change impacts on holobionts: a study on green hydra *Hydra viridissima*

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INTRODUCTION

Endosymbiosis, usually considered as a mutually beneficial interaction among distinctive species, strongly couples the host and the endosymbiont fitness

Previous studies show significant impacts of the endosymbionts on the holobiont (host-endosymbiont unit) stress tolerance, but it is unclear whether symbiont selection could alter host stress toleance. Here I use green hydra (*Hydra viridissima*) to address following questions.

QUESTIONS

1) Can we induce algae mutation in vitro?

2) Do mutated algal strains vary in their stress tolerance?

3) How does algae mutagenesis affect hydra stress tolerance?

MODEL SYSTEM

Green hydra is a freshwater cnidarian that forms stable endosymbiosis with green algae (*Chlorella*). The green hydra can still survive even when they are deprived of the algae, and it is able to re-establish endosymbiosis with the algae when the latter is introduced into the body.

METHODS

1) A clonal strain of symbiotic green algae was mutated independently for multiple times under UV-C.

2) Algae were then subjected to UV-B selection for two months.

3) Algale UV-B stress tolerance was tested by measuring their optical density after exposure.

4) Algae were injected into hydra and, then tested for hydra UV-B tolerance by recording their survival under UV-B .

RESULTS

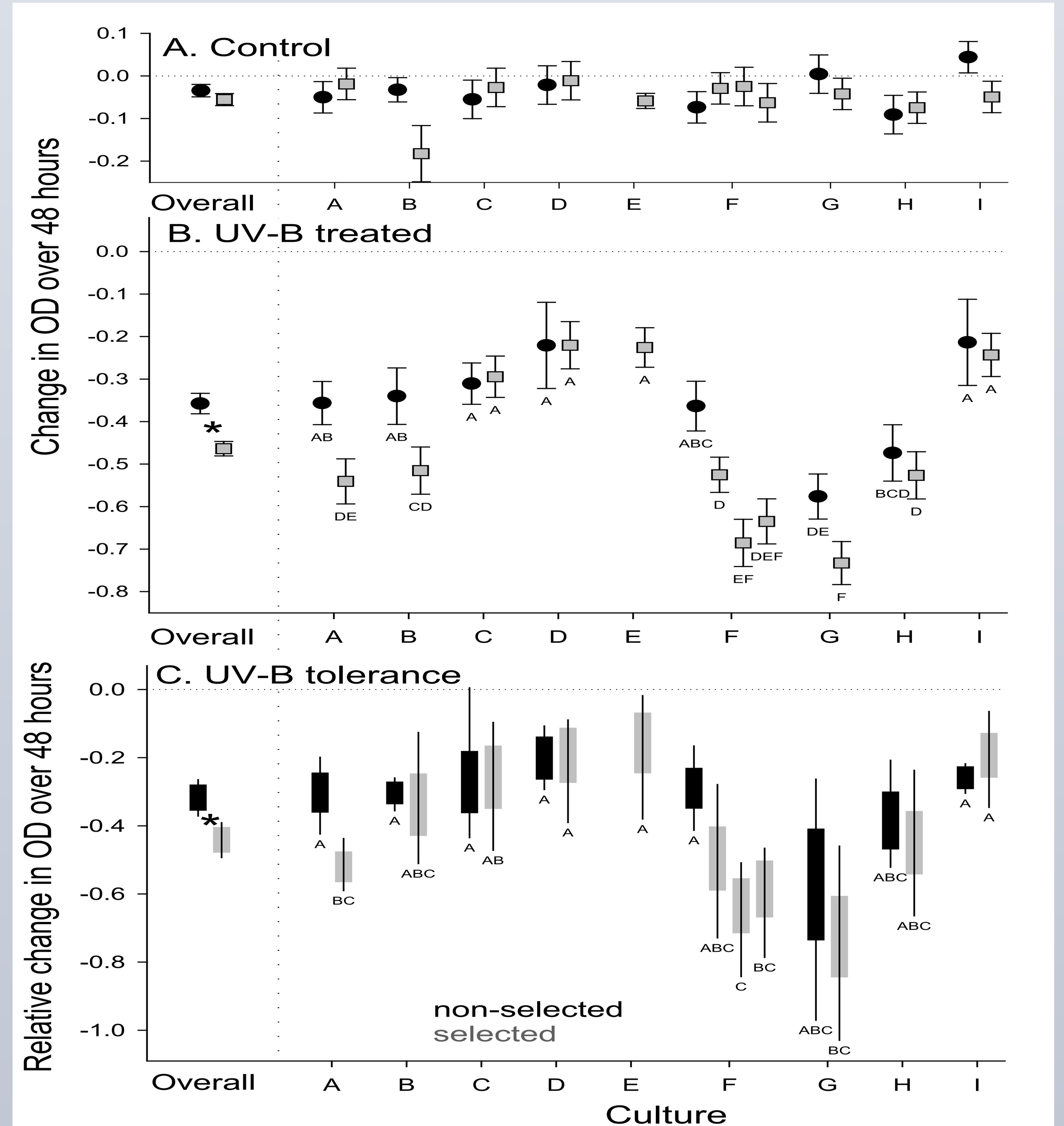

Fig 1. The change in OD at 663 nm (ln $[OD_{t=48hrs} / OD_{t=0hrs}]$) for different non-selected (dark symbols or lines) or selected (light symbols or lines) populations of algae from different cultures in (A) control and (B) UV-B test conditions. Means ± se. Means with the same letters did not differ in post-hoc tests. * indicates $p<0.05$. (C) Algal tolerance to UV-B in test conditions (ln $([OD_{UVB,t=48hrs} / OD_{UVB,t=0hrs}] / ([OD_{con,t=48hrs} / OD_{con,t=0hrs}]))$ estimated by randomization. Thick bars indicate quartiles. Thin lines indicate the 95% CI. * indicates 95% CI that do not overlap for non-selected vs. selected algal populations from the same culture. A,B = 0 min UV-C (non-mutated), C = 15 min, D = 20 min, E,F,G,H= 30 min, I = 35 min. Overall indicates the average of cultures with both selected and non-selected populations (excludes E).

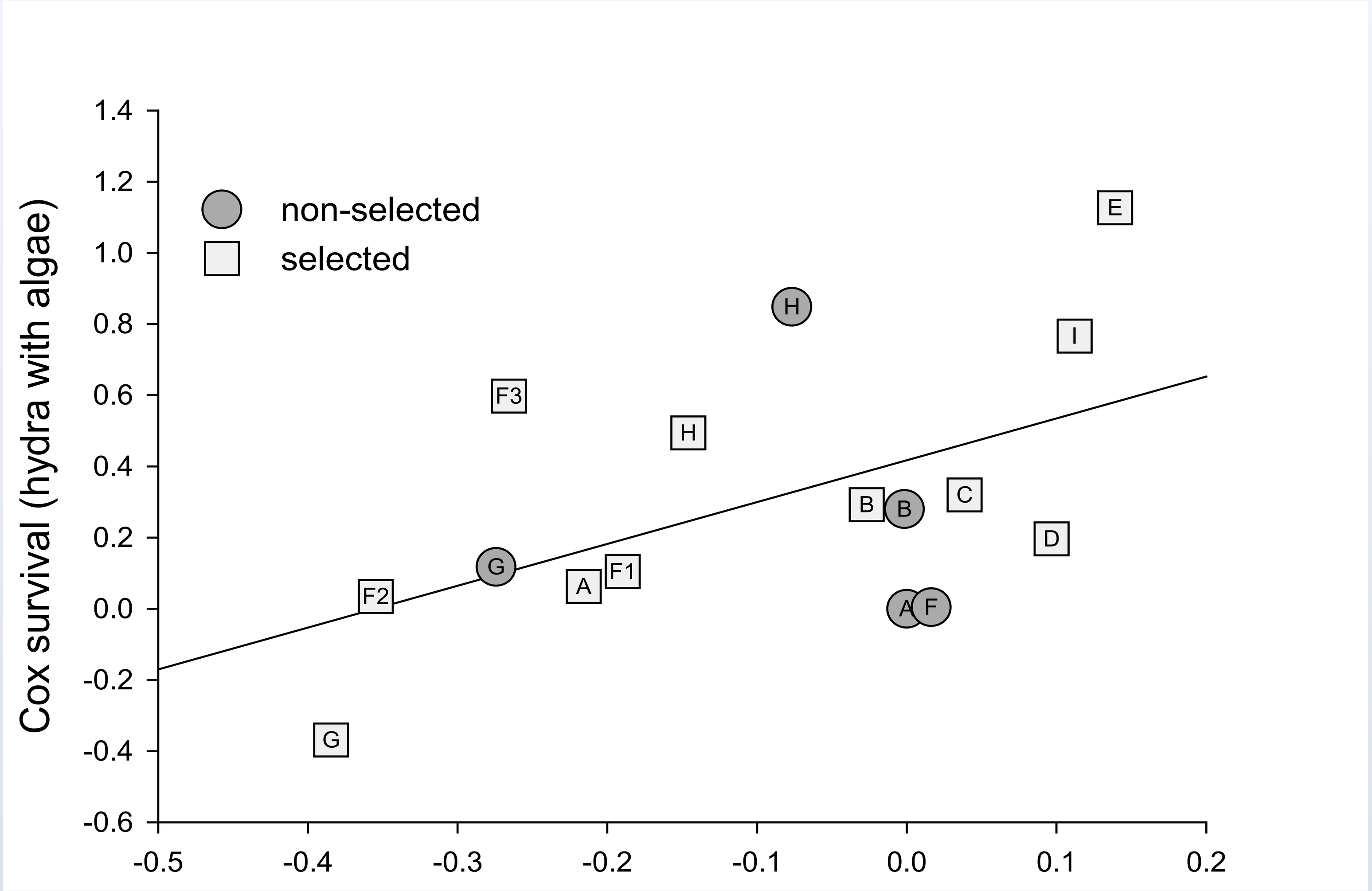

Fig 2. The correlation (line) between algal change in OD in UV-B (Fig 2B) and Cox survival coefficient for different non-selected (dark circles) or selected (light squares) populations of algae. A,B = 0 min UV-C (non-mutated), C = 15 min, D = 20 min, E,F,G,H= 30 min, I = 35 min. Non-selected culture A set at the origin.

CONCLUSION

- Algae mutagenesis generated variation in algal UV-B tolerance, which could either improve or decrease their tolerance.
- Such tolerance was conferred to the hydra host, and there was a positive correlation between algal and hydra tolerance.
- Selection had no positive impact in this experiment.
- Our results suggest mutagenesis on symbionts could be effective in modifying host stress tolerance, and could have potential application in agriculture, forestry management, etc.

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