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The Growth of Giant Clams Juvenil is Influenced by Nutrient Addition

Pengaruh Penambahan Nutrien Terhadap Pertumbuhan Juvenil Kima

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Abstrak

Ekosistem karang merupakan daerah yang memiliki produktivitas tinggi namun kandungan nutrient anroganiknya sangat rendah. Sehingga dapat diduga bahwa kenaikan nutrient anorganik dalam ekosistem ini akan mempengaruhi kehidupan organisme yang ada di dalamnya. Penelitian ini bertujuan untuk melihat pengaruh peningkatan nutrien yakni N dan P terhadap pertumbuhan juvenil Kima. Hasil penelitian menunjukkan bahwa dengan penambahan nutrien N secara signifikan meningkatkan pertumbuhan juvenil Kima tersebut. Di lain pihak penambahan P tidak berpengaruh terhadap laju pertumbuhan juvenil Kima. Hasil ini menunjukkan bahwa penambahan ammonium seharusnya dilakukan di hatchery untuk meningkatkan pertumbuhan dan produksi Kima.

Kata kunci: Kima, *Tridacna squamosa,* nutrien, ammonium, fosfat

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Introduction

There is an important fact that coral reef ecosystem is known to have high productivity, although the concentrations of inorganic nutrients within the waters are very low. The nutrient recycling between zooxanthellae (sigle cell dinoflagelate algae live in association with many marine invertebrates) and their hosts is thought to be the one which responsible this contradictive condition.

Zooxanthellae and their hosts (such as corals, anemone, giant clams, etc) are known to be able to absorb nutrients from their surrounding waters (Miller and Yellowlees, 1989). The existance of absorbsion capability by zooxanthellae and their host and the fact that coral reef ecosystems are known to have low concentration of nutrients, expectation that increasing nutrient concentrations in the water should have a significant impact on the invertebrate-zooxanthellae symbiosis. Increasing the concentration of inorganic nutrients leads to changes in the biochemistry, physiology and morphology of symbiotic invertebrates (Dubinsky *et al*., 1990; Fitt *et al*., 1993; Hoegh-Guldberg, 1994).

The changes due to increasing nutrient concentration occurred in zooxanthellae alone or in both the zooxanthellae and the host (Hoegh-Guldberg and Smith, 1989; Hastie *et al*., 1992; Belda *et al*., 1993a,b; Achituv *et al*., 1994; Muller-Parker *et al*., 1994a,b). One of the important effects of high nutrient concentration worth mention is increasing number of zooxanthellae within the host (Ambariyanto, 1999).

Since the growth of giant clams, known as a member of coral reef community, is influenced by zooxanthellae through photosynthes translocation, therefore it suggests that increasing nutrient concentration would improve giant clams growth. The present study aims to investigate the effects of nutrient addition on the growth of juvenile of giant clams (*Tridacna squamosa*).

Material and Methods

Tweleve glass aquariums (1 L) were used in the present study. These aquariums were throughly cleaned using mild concentration of chlorin and were rinsed with clean fresh and seawater for at least ten times before being used for the experiment. These aquariums then were filled with filtered seawater (using filter bag) and also 10 of three months old giant clams juvenil with approximately 5 mm shell length. Aeration was given during the experiment in order to alleviate dissolved oxygen content within the water.

Three treatments (inorganic nutrient addition i.e. N, P and N+P) and control (without any nutrient addition) were carried out with three reaplicates. Final concentration of nutrient given were 20µM for N (ammonium; NH_4Cl) and 2µM for P (phosphorus; KH_2PO_4). Giant clams shell length were measured using callipers to the nearest of 0.1 mm before and after the experiment. This experiment was carried out for seven days.

Analysis of variance (ANOVA) was used to analyse data of percentage giant clam growth (ahell length). Normality and homogeneity of variances was tested prior to ANOVA. Differences among the means were tested using the Student-Newman-Keuls test (Underwood 1981).

Results and Discussions

The results of the present study show that addition of inorganic nutrient, especially N (ammonium) increased the shell length of giant clams juvenil. Compared with control, the shell length increment of N treated clams were almost seven times higher. The influenced of the addition of P (phosphorus), however, was much less than that of N addition (almost 9 fold less).

Inorganic nutrient addition, especially N, increase the growth rate of giant clams juvenil. Figure 1. shows juvenile which grown in the water added with N have significantly longer shell length compared with those other treatments and control (P= 4.6E-06).

Coral reef ecosystem, where giant clam populations can be found has low concentration of inorganic nutrients, although this ecosystem is known to be very productive. Therefore, changes in the consentration of these nutrients would change the biological processes of the organisms which live in the ecosystem.

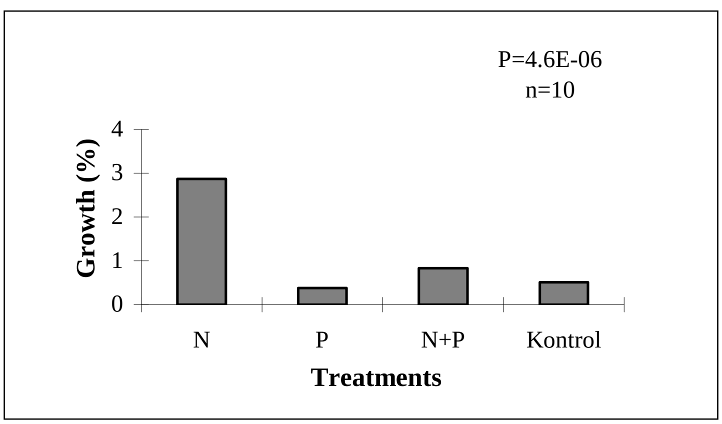

Figure 1. Mean ± SD percentage of giant clams growth (shell length) treated with different nutrient addition

Giant clams biological processes are influenced by the concentration of anorganic nutrients N (ammunium) and P (phosphate) in the water. Scientists have found that higher the growth rate of zooxanthellae within the mantle of the clams was found on the clams added by nutrients especially N. On the other hand, the concentration of P did not significantly influenced zooxanthellae growth rate (Ambariyanto and Hoegh-Guldberg, 1997), but affects the structure of giant clams shells (Belda *et al*., 1993b). Several authors have found that increasing the concentrations of inorganic nutrients does not influence coral biomass characteristics, but changes a number of aspects of zooxanthellae biomass, such as population density, mitotic index, chlorophyll *a* content, and C:N ratio of zooxanthellae (Hoegh-Guldberg and Smith, 1989; Muscatine *et al*., 1989; Stambler *et al*., 1991).

The results of the present study show that higher concentration of nutrient (N) increased giant clam juvenil growth rate (P=4.6E-06). See Figure 1. This result is in accordance with other reports which showed that nutrient addition in the water have increased the number of corals zooxanthellae (Hoegh-Guldberg 1994), as well as adult giant clams, *Tridacna maxima* (Ambariyanto and Hoegh-Guldberg, 1997).

Other reports showed that giant clam, *Tridacna gigas* responds to inorganic nutrient enrichment through an increase in zooxanthellae density, chlorophyll *a* content, and also soft tissue weight, C:N and C:P ratio of the soft tissue, and the growth rate of the clams (Braley *et al*., 1992; Belda *et al*., 1993b; Fitt *et al*., 1993). Similar results were found in coral, *Pocillopora damicornis* exposed to elevated ammonium concentrations showed increased in zooxanthellae density, chlorophyll *a* content and protein content of the coral (Muller-Parker *et al*., 1994b). However, in the same experiment, Achituv *et al*., (1994) found no changes in the biochemical composition of the coral tissue due to ammonium enrichment, but it changed the lipid and protein content of zooxanthellae**.**

Ambariyanto (1996) found that, nutrient enrichment resulted in an increase in zooxanthellae density and chlorophyll *a* concentration, and by changes in the ultrastructure of zooxanthellae. No changes were observed on the animal biomass parameters measured (*ie*. soft tissue weight, C:N ratio and protein content of the mantle of the clam). A similar phenomenon has been reported by Muller-Parker *et al*., (1994b) who found changes in C:N ratio of zooxanthellae but not in the tissue of the coral *Pocillopora damicornis* due to ammonium enrichment.

Increasing the number of zooxanthellae has resulted in the increment of giant clams growth rate due to higher amount of photosynthates being translocated into the host. The results of the present study suggests that nutrient addition into the medium (seawater) where the juvenile are grown should be done in the hatchery before outgrow in the ocean.

Conclusion

Increasing inorganic nutrient especially N (ammonium) significantly improved the growth (in shell length) giant clams juvenil. It is suggested that in daily operational of giant clams hatchery, nutrient enrichment should not only be done during larval development (until metamorphoses), but also at juvenil stage.

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