SEAWEED ABILITY TOWARDS ORGANIC SUBSTANCE DECLINE IN TIGER SHRIMP (PANAEUS MONODON) CULTIVATION

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SEAWEED ABILITY TOWARDS ORGANIC SUBSTANCE DECLINE IN TIGER SHRIMP (PANAEUS MONODON) CULTIVATION

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ABSTRACT
Objective of this study is to evaluate how effective seaweed is in reducing organic substance in semi-intensive tiger shrimp cultivation. This study used Sargassumsp, Gracilaria sp. and Caulerpa sp. seaweed which is spread 50 grams/m^2. The tiger shrimp density is 30 shrimps/m^2. Each treatment is repeated three times for 68 days. The finding showed that the treatments had significant influence towards both organic substance and seaweed growth. However, the treatment did not have significant influence towards the tiger shrimp. The seaweed reduces percentage of the organic substance. The seaweed does not have any influence towards Panaeus monodon growth and biomass. Each treatment results in different seaweed growth and biomass. Caulerpa sp. has higher biomass and better growth level compared to Sargassum sp. and Gracilaria. Seaweed can reduce organic substance in the tiger shrimp cultivation and as the result, increase its productivity as well as income of tiger fish farmers.

KEY WORDS
Organic substance, quality of water, shrimp cultivation, Sargassumsp, Gracilaria sp., Caulerpa sp., Panaeus monodon.

Additional shrimp feed plays pivotal role in stimulating growth of the biota. However, there is some amount of shrimp feed that goes to waste either directly and indirectly. Shrimp feed that is not consumed is categorized as direct waste while one that is digested and excreted in the form of feces is called indirect waste. Shrimp feed is the main source of organic substance in shrimp farm (Li and Boyd, 2016). Excessive organic substance in the water will produce toxic nitrite (NO2) and ammonia (NH3) (Wulandari, et.al, 2015). Seaweed has indirect influence towards growth and productivity of both shrimp farm and the environment as it can absorb nutrients and act as physical filter. Besides that, being a profitable commodity, seaweed may become an additional source of income for fish farmers (Buschmann, 1996; Neori, et.al, 1996; Chow, et.al, 2001; Hernandez, et.al, 2002; Martinez-Aragon, et.al, 2002; Msuya, et.al, 2006; Knovitvadhi, et.al, 2008, Chaitanawisuti, et.al, 2011). Objective of this study is to analyze ability of seaweed in decreasing decrease organic substance and how much influence seaweed has towards growth of tiger shrimp. This study involved three types of seaweed, namely *Sargassum* sp, *Gracilaria* sp and *Caulerpa* sp.

MATERIALS AND METHODS OF RESEARCH

This study lasted for 68 days between May and July in Tambak Bulusan village, Demak. The study used a 100cm x 100cm fiber tub, which is filled with 6,000 liters of water and sand substrate. The tiger shrimp density was 30 shrimps/m2 and the tiger shrimp weighed between 0.2 and 0.5 grams. The tiger shrimp was fed commercial shrimp feed of which protein substance is between 30 and 42% three times a day. The water parameter test was conducted in Faculty of Fisheries and Marine Science, Diponegoro University laboratory.

Furthermore, this study used three types of seaweed, namely *Sargassum* sp, *Gracilaria* sp, *Caulerpa* sp and the control. Each treatment was repeated three times.

Water parameter consists of total organic matter, sediment organic substance and ammonia. The analysis method was APHA et al, 1998. Seaweed and tiger shrimp parameters are biomass production, Specific Growth rate (SGR) and tiger shrimp Survival Rate (SR). Effendi (2001)'s formula was adapted to measure Specific Growth rate (SGR) and Survival Rate (SR) of the tiger shrimp.

$$SGR = \frac{\ln Wt - \ln Wo}{t} x\ 100\%$$

Where:

Wt: Tiger shrimp weight at the end of the study (gram);
Wo: Tiger shrimp waste at the beginning of the study (gram);
t: time.

$$SR = \frac{Nt}{No} x\ 100\%$$

Where:

Nt: number of tiger shrimp at the end of the study (shrimp);
No: number of tiger shrimp at the beginning of the study (shrimp).

SPSS version 17 was the software used to analyze data on biomass, tiger shrimp and seaweed SGR, tiger shrimp SR and organic substance. One-way Analisis of Variance (ANOVA) was used to evaluate interaction between the treatments and parameter; when it resulted in difference, the researchers proceeded to Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Figure 1 showed amount of organic substance, ammonia (NH_3) and nitrite (NO_2) in the shrimp farm for 68 consecutive days with different kinds of seaweed. The organic substance concentration was significant ($p<0.05$) between treatments.

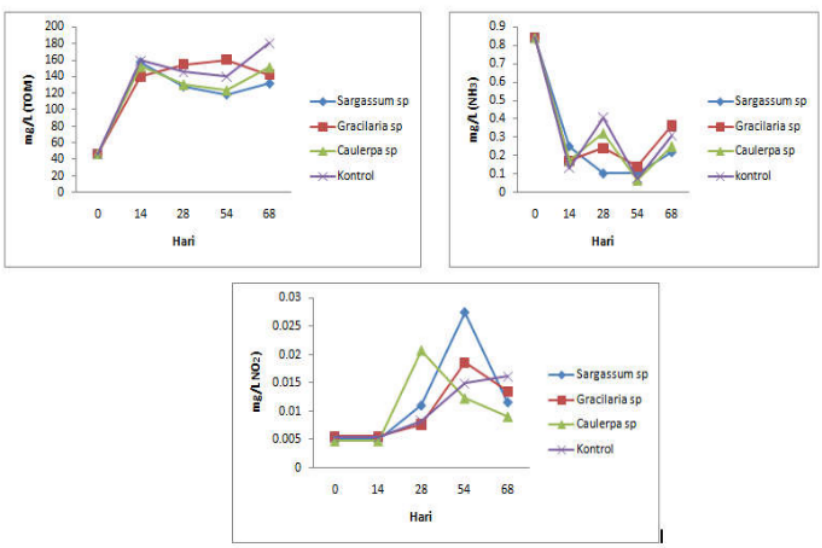

Figure 1 – Total Organic Matter (TOM), Ammonia (NH_3) and Nitrite (NO_2)

Based on Duncan multiple range test, the treatment with *Sargassum* sp resulted in the lowest concentration of organic substance. The amount of organic substance was between 46.74 and 191.88 mg/L. Ammonia (NH_3) and nitrite (NO_2) concentration were not significant ($p>0.05$) between the treatments. The amount of ammonia and nitrite (NO_2) was 0.002-0.839 mg/L, and 0.0034-0.839 mg/L consecutively. The amount of ammonia and nitrite was high at the beginning of the study.

Table 1 showed some parameters showing quality of water in the tiger shrimp, for example temperature, dissolved oxygen, salinity and pH.

Table 1 – Quality of Water in the Tiger Shrimp

Water Parameter	Average
Temperature (^{0}C)	29.4 – 33.8
Dissolved oxygen (mg/L)	3.4 – 6.87
Salinity	29 – 38
pH	8.46 – 9.55

Tiger Shrimp Production. Table 2 showed production of tiger shrimp. One way ANOVA showed that there was no significant difference between the variables in all of the treatments ($p>0.05$). The overall biomass of the tiger shrimp was 289 – 323.2 grams. The Specific Growth Rate (SGR) and Survival Rate (SR) of the tiger shrimp were 3.35-3.61% and 83-92% consecutively.

Table 2 – Production of Tiger Shrimp

Treatment	Biomass (g)	SGR (%)	SR (%)
*Sargassum*sp	289 ± 10.76	3.35 ± 0.21	83 ± 8.88
Gracilaria sp	321.5 ± 10.86	3.35 ± 0.16	87 ± 6.80
Caulerpa sp	320.5 ± 10.02	3.61 ± 0.32	92 ± 3.46
No seaweed	323.2 ± 19.64	3.59 ± 0.33	89 ± 9.07

Seaweed Production. Table 3 showed growth of *Sargassum* sp, *Gracilaria* sp and *Caulerpa* sp seaweed in the semi-intensive tiger shrimp cultivation for 68 consecutive days. The one way ANOVA described significant difference in biomass and SGR of the seaweed ($p<0,05$). DMRT showed that the biomass and SGR of *Caulerpa* are the highest of all of the treatments.

Table 3 – Seaweed Production

Treatment	Biomass (g)	SGR (%)
Sargassum sp	236.6 ± 16.81	0.62 ± 0.29
Gracilaria sp	326.2 ± 13.6	1.11 ± 0.18
Caulerpa sp	385.8 ± 9.37	1.36 ± 0.1

The objective of this study is to analyze ability of seaweed in reducing organic substance in the semi-intensive tiger shrimp cultivation using three types of seaweed (*Sargassum* sp, *Gracilari*a sp and *Caulerpa* sp) while comparing the result with no seaweed treatment. The treatment with seaweed has influence towards the total organic matter (TOM) compared one with no seaweed. Seaweed that can absorb organic substance and thus, reducing percentage of organic materials harmful for tiger shrimp (Rahmaningsih, 2012). *Sargassum* sp is the type of seaweed that can reduce the organic substance the most (119.8 mg / L). As an addition, *Sargassum* is suitable for poly-culture seaweed cultivation. *Sargassumhenslowianum* can absorb heavy metals and accumulates nutrient biocumulation in the aquaculture in Shenzhen, South China Sea (Yu, et.al, 2014). In this study, the TOM concentration is high due to increasing dosage of shrimp feed, age and weight. On the 14th day, the TOM concentration increased but it declined on the 28th day. However, the TOM concentration goes back up until the 68th day. The analysis reported that the TOM concentration in the tiger shrimp cultivation is <90 mg/L (KKP, 2016). Seaweed can inhibit accumulation of the organic material more effectively than the treatment without seaweed.

The average concentration of ammonia is between 0.304 and 0.352 mg/L, while that of nitrite ranges is between 0.176 and 0.179 mg/L. It happened due to high ammonia content in the water (tiger shrimp cultivation. Furthermore, the concentration of ammonia (NH_3) and nitrite in the tiger shrimp cultivation is <0.1 mg/L and <1 mg/L (KKP, 2016).

There is no difference between biomass, Specific Growth Rate (SGR) and Survival Rate (SR) of *P. monodon* tiger shrimp in the treatment with seaweed and those of *P. monodon* tiger shrimp in the treatment without seaweed. In general, individual weight of the tiger shrimp at the end of the treatment was considered low (0.62-1.36 grams/shrimp). Several factors, such as high salinity, inhibit optimum growth of the tiger shrimp. Despite being euryhalin, maximum salinity tolerance for tiger shrimp growth is between 15 and 25 ppt (Gunarto, et.al, 2006); salinity during the treatment was twice of the maximum tolerance (between 28-39 ppt). There is significant difference in seaweed production during the treatment ($p<0.05$). Seaweed is able to accumulate and absorb organic substance and more importantly use the substance as nutrients (Saputra, et.al, 2017). *Caulerpa* has higher average production compated to *Sargassum* and *Gracilaria*. Each type of seaweed has different growth rate depend on some factors, such as environment and physiology of the seaweed.

CONCLUSION

Based on the finding, *Sargassum* sp and *Caulerpa* sp have positive influence towards decline of organic substance. On the other hand, ammonia (NH_3), nitrite (NO_2), biomass and shrimp SGR do not have any influence towards the decline. Biomass and SGR of the seaweed are different in which average biomass and SGR of *Caulerpa* seaweed are 128.6 grams and 1,363 grams consecutively. The implication is that poly-culture is the most suitable aquaculture system for both seaweed and tiger shrimp.

7

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