The effect of NPK fertilizer with different dosage on the growth rate seaweed (Caulerpa racemosa)

Riyadi Subur¹, Muhammad Irfan², Nebuchadnezzar Akbar³

¹ Department of Aquatic Resources Management, Faculty of Fisheries and Marine, Khairun University, Ternate, Indonesia.
² Department of Aquaculture, Faculty of Fisheries and Marine, Khairun University, Ternate, Indonesia.
³ Department of Marine Sciences, Faculty of Fisheries and Marine, Khairun University, Ternate, Indonesia.

**ABSTRACT**

NPK is a type of fertilizer that plays a role in increasing growth and survival in plants such as seaweed. This study aims to determine the effect of different NPK fertilizer doses on the growth rate of seaweed (Caulerpa racemosa), and to determine which NPK fertilizer dosage has the best effect on the growth rate of C. racemosa. Research begins with collecting samples of seaweed in coastal waters. Ternate Island District Kastela, and the cultivation process is carried out on Jalan Jan, Tabona Village, South Ternate City. The time of the research was two months from August to October, 2020. This study used 12 units of cool box in the form of cork with a size of 90 x 30 cm, which is used as a container for maintaining of C. racemosa. In each treatment using a seed weight of 50 grams. The NPK fertilizer dosage treatment tested was 4 doses, with 3 replications, namely: treatment A: 40 ml NPK fertilizer; B: 60 ml NPK fertilizer; C: 80 ml NPK fertilizer; D: 0 ml NPK fertilizer (control). Research containers using random placement. The design used was a completely randomized design (CRD), using analysis of variance (ANOVA). The results obtained showed that NPK fertilizer with different doses the effect is not significantly different on the growth rate of C. racemosa with the highest average growth rate in treatment C amounting to 8.725%, followed by treatment B of 8.178%, treatment A of 7.761%, and the lowest was treatment D of 6.519%.

**Introduction**

One of the most promising types of seaweed is Caulerpa racemosa or sea grapes. This species is widely known by coastal communities because several types of seaweed are used directly or indirectly as a source of natural daily food. This commodity has also been cultivated in Indonesia and has been proven to increase foreign exchange and income (Susilowati et al., 2012).

Caulerpa is an export commodity as a food product, medicine, cosmetics and other food products (Razai and Putra, 2020). Currently, the development of Caulerpa cultivation in Indonesia continues to increase. Ferdiansyah et al. (2019) stated that in Indonesia, this species of seaweed has a potential development of 1.11 million ha, and the resulting production value is 167,937 tons per year.

In order to increase production, it is necessary to provide NPK fertilizer (Ginting et al., 2015). Application of fertilizers can increase production and survival, because fertilizers determine the availability of nutrients for plants/plants (Suniti and Suada, 2012). The availability of adequate nutrients leads to optimal plant growth through photosynthesis. Conversely, if the nutrients are lacking, then the addition of fertilizers is an alternative that can be used. absolutely must be done (Nurfebriani et al., 2015). The fertilizer given to seaweed is usually through immersion, but the fertilizer used must be in accordance with the required dose (Sari et al., 2012; Yuliana et al., 2013).

NPK is a type of fertilizer that plays a role in increasing growth and survival in plants such as seaweed (Setiaji et al., 2012). This type of fertilizer is widely distributed, and plays an important role for
plants for their growth (Akmal et al., 2015). This study aims to determine the effect of different NPK fertilizer doses on the growth rate of *C. racemosa*, and to determine which NPK fertilizer dosage has the best effect on the growth rate of *C. racemosa*.

Materials and Methods

Location and time of research

This research begins with the collection of seaweed samples in the coastal waters of Kastela, Ternate Island District, and the cultivation process is carried out on Jan street, Tabona Village, South Ternate City. The research starts from August to October, 2020.

Tools and materials

This study used 12 (twelve) units of cool box in the form of cork with a size of 90 x 30 cm, which is used as a container for maintaining *C. racemosa*. In each treatment using a seed weight of 50 grams. The volume of water and sand substrate per experimental unit as a medium for cultivating seaweed as much as 4 liters. The layout of this experiment as follows:

![Figure 1. The Layout of this research.](image)

Research Procedure

This study used a dose of NPK fertilizer. The treatments tested were four treatments with three replications, namely:

- **Treatment A**: NPK fertilizer at a dose of 40 ml
- **Treatment B**: NPK fertilizer at a dose of 60 ml
- **Treatment C**: NPK fertilizer at a dose of 80 ml
- **Treatment D**: NPK fertilizer at a dose of 0 ml (control)

The research container used is filled with seawater and a sandy substrate from the seaweed habitat when collected. The volume of water and the thickness of the sand substrate per treatment unit about 4 liters and 1 cm. The seaweed thallus to be used is cut using scissors. Furthermore, the thallus is tied and stretched using fine threads in each treatment. Fertilizer given according to the prescribed dose for 60 days. The interval and frequency of NPK fertilizer application during the studies is every week. The growth rate was observed during the maintenance period. The growth rate parameter measured is only weight thallus. Supporting data in this study were the conditions of the aquatic environment including: temperature, salinity, pH, and dissolved oxygen, with interval for measuring once a week.

Data analysis

Growth data in this case the relative growth rate is calculated using the formula from Takeuchi (1988), namely:

\[
RGR = \frac{\ln(Wt - Wo)}{t} \times 100\%
\]

Where: RGR = Relative growth rate (%), Wo = Weight at the beginning of the study (gr), Wt = Weight at the end of the study (gr), t = Duration of study (60 days).

The design used was a completely randomized design (CRD), using analysis of variance (ANOVA) (Steel and Torrie, 1993).

Results

Growth rate

The results of the analysis of the relative growth rate of *C. racemosa* can be seen in Table 1. The results of the analysis (Table 1) show that treatment C (NPK fertilizer 80 ml) has yields a relative growth rate of 8.725%, followed by treatment B (NPK fertilizer 60 ml dose) 8.178%, treatment A (NPK fertilizer 40 ml dose), 7.761%, while the lowest was found in D (control) at 6.519%. The diversity of the effects of treatment on the growth rate, the results can be seen in Table 2.

<table>
<thead>
<tr>
<th>Repeat</th>
<th>Treatment</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>7,803</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td>7,772</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td>7,708</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>23,283</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>7,761</td>
</tr>
</tbody>
</table>

Table 2. Analysis of diversity effect of treatment on growth rate of *C. racemosa*.

<table>
<thead>
<tr>
<th>Source of diversity</th>
<th>Free degrees</th>
<th>The Sum of the squares</th>
<th>Middle Square</th>
<th>F_count</th>
<th>F_tab 5%</th>
<th>F_tab 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>3</td>
<td>2,661</td>
<td>0.887</td>
<td>0.0047</td>
<td>4.07</td>
<td>7.39</td>
</tr>
<tr>
<td>Error</td>
<td>8</td>
<td>1479.764</td>
<td>185.305</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
<td>1482.445</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The data in Table 2, shows F count < F table at the 5% and 1% levels. This indicates that the effect is not significantly different on the growth rate of *C. racemosa*. The difference in the value of the growth rate of each treatment occurred because of the NPK fertilizer dosage used. Utilization of NPK fertilizer
with the right dose during maintenance causes NPK fertilizer to work optimally which can increase its growth rate.

**Water quality**

The results of water quality measurements during the study including temperature, salinity, pH, and DO are presented in Table 3.

Table 3. Result of measurement of water quality during the study.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Standard value of quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>28.9-30.0</td>
<td>28 - 31</td>
</tr>
<tr>
<td>Salinity (ppt)</td>
<td>30.3-32.9</td>
<td>20-50</td>
</tr>
<tr>
<td>pH</td>
<td>7.5-8.0</td>
<td>7-7.8</td>
</tr>
<tr>
<td>DO (ppm)</td>
<td>3.6-4.0</td>
<td>4.7-5.2</td>
</tr>
</tbody>
</table>

**Discussion**

The high growth rate in treatment C (fertilizer dose 80 ml) was due to the *C. racemosa* being able to utilize and absorb the fertilizer properly so that it affected its growth. Thus, the increase in the quality of the growth rate increases at a fertilizer dose of 80 ml. This is because the available nutrients can increase growth which can lead to increased cell length in the seaweed (Akmal et al., 2015). This condition is related to the function and role of phosphate which affects growth because of its role as a source of nutrients. The nature of phosphate which is easily decomposed, can accelerate the growing thallus and cause the young thallus to quickly become an adult. For control (treatment D) it has a low growth rate.

Each treatment indicated that the NPK fertilizer dosage was well absorbed by the seaweed. Excess nutrients, resulting in stunted growth (Guo et al., 2014). Furthermore, it is said that seaweed has different nutrient requirements for each species. Containing nutrients and growth hormones in NPK fertilizers, the growth activity of seaweed seeds increases and increases rapidly (Ismail et al., 2014).

The high and low growth rate values obtained are closely related to the absorption capacity of fertilizers given to seaweed (Setiaji et al., 2012). The high growth value in treatment C is due to the high dose content compared to other treatments. The higher the fertilizer dose, the better the results obtained. It can be proven that the application of fertilizer at a dose of 80 ml (treatment C) can be properly absorbed by *C. racemosa* so that it can increase its growth rate.

Basically, the element needed by seaweed is the element N, which plays a role in supplying energy for photosynthesis, thereby spurring growth, increasing response to pest and disease attacks (Ismail et al., 2014). If a deficiency of this element N, it will inhibit growth. Apart from the N element, there are also P and K elements which play a role in balancing growth. If the availability of element P is lacking, it can cause stunted symptoms, few shoots, stunted growth in seaweed. For element K, if its availability is not enough, it will cause the thallus to become brittle, the plant will wilt, and be attacked by disease (Setiaji et al., 2012).

Water temperature plays an important role in the processes of photosynthesis, respiration, metabolism, growth and reproduction (Ismianti et al., 2013). Temperature affects growth. Temperature with a range between 31.5-32.5°C, can increase the growth of seaweed (Uskabi et al., 2015). Rabia (2016) states that *Caulerpa* sp. lives in temperatures between 28-31°C. Therefore, the range of water temperatures obtained in this study is suitable for the survival and growth of *C. racemosa*.

Each aquatic organism has a different tolerance limit to salinity (Damandiri, 2013). The high salinity range can result in photosystem reactions and inhibit electron transfer in marine algae (Susilawati et al., 2017). In general, seaweed lives in the salinity range between 25-40 ppt (Pereiera et al., 2017). *Caulerpa* sp. can live in a salinity range of around 20-50 ppt, with optimal photosynthetic activity at a salinity of 25-45 ppt, optimum growth of *Caulerpa* occurs at a salinity that does not exceed 35 ppt (Gua et al., 2015).

Murillo and Salamanca (2016) reveal that the range of salinity for *Caulerpa* sp. growth is between 25-30 ppt, in that salinity range *Caulerpa* has added biomass and stolon development.

Salinity measurements during the study ranged from 30.3 to 32.9 ppt. According to Sunaryo et al. (2015), the proper salinity for the cultivation of *C. racemosa* is a salinity of 26-33 ppt. The salinity during the study was still suitable for the growth of *C. racemosa*.

The proper pH for cultivation of *C. racemosa* ranges from 7-7.8 (Sunaryo et al., 2015). Meanwhile, the pH value which is alkaline with a range of 7-9 is a productive pH value for the growth of seaweed (Susilawati et al., 2012). Ruslani and Iba (2011) suggest that if the pH is less than 4.0, it can cause death in grass the sea. In this study, a pH of 7.5-8.0 was obtained. The pH value obtained still supports the growth of *C. racemosa*.

Dissolved oxygen is needed by all aquatic organism. Dissolved oxygen ranges from 3-8 mg/l suitable for seaweed cultivation (Ismianti et al., 2013). The dissolved oxygen obtained during the study ranged from 3.6 to 4.0 mg/l. According to Sunaryo et al. (2015) dissolved oxygen > 3.5 mg/l, is still good...
for the cultivation of *C. racemosa*. Dissolved oxygen that is suitable for the life of the *Caulerpa* sp. ranges from 4.7-5.2 mg/l (Zuldin *et al.*, 2015). Thus, the presence of dissolved oxygen is still suitable for the growth of *C. racemosa*.

**Conclusion**

NPK fertilizer with different dosages the effect is not significantly different on the growth rate of *C. racemosa*. The 80 ml dose of NPK fertilizer was able to increase the growth rate of *C. racemosa* the highest, that is 8.725%.

**Acknowledgments**

This research was funded by DIPA Khairun University in 2020 through Postgraduate Higher Education Competence Research (PKUPT). We would like to express our deep gratitude to the Chairperson of the LPPM and the Director of the Postgraduate Program at Khairun University for all their support for this research.

**References**


---

How to cite this paper: