CULTURE OF SEAGRASS, Halophila major (Zoll.) Miquel ON DIFFERENT SUBSTRATES

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FP 2018 24

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FACULTY OF AGRICULTURE

UNIVERSITI PUTRA MALAYSIA SERDANG, SELANGOR

2017/2018

CERTIFICATION OF APPROVAL

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FACULTY OF AGRICULTURE

UNIVERSITI PUTRA MALAYSIA

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This is to certify that I have examined the final project report and all corrections have been made as recommended by the panel of examiners. This report complies with the recommended format stipulated in the AKU4999 project guidelines, Department of Aquaculture, Faculty of Agriculture, Universiti Putra Malaysia.

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ACKNOWLEDGEMENTS

Alhamdulillah, all praises and grateful to the Almighty Allah, the Merciful and the beneficent for giving me the strength, will and blessing to complete this study. I would like to express my deepest appreciation and gratitude to my final year project supervisor, Prof. Dr. Muta Harah binti Zakaria and Prof. Dr. Japar Sidik Bujang as my co-supervisor, not only for her guidance and assistance throughout my Aquaculture Sciences degree project, but most of all, for her complete faith in my ability.

Specials thanks goes to Mrs. Shafika Maulad Abdul Jalil, Laboratory Assistant, Department of Aquaculture. A token of appreciation to my senior and friends, Ms. Farahin, Ms. Najihah, Mr. Muhammad Azhar, Ms. Wan Hazma, Mr. Afiq Busrah, Ms. Dyg. Nurul Ainiah and Ms. Nurliyana for uncountable help, advice and assistance along this journey of study and also to other staff and lecturer at Department of Aquaculture, Universiti Putra Malaysia are also to be commended for their help and worthwhile suggestions throughout the year.

Finally, my heartiest appreciation to my beloved parents, Mr. Kamaruzaman and Mrs. Siti Zakiah for their pray and endless support. Also, for my siblings: Mr. Aiman Syahmi, Mr. Afiq Syazwan, Ms. Fatin Nur Nabilah, Ms. Fatin Nur Nadhirah and Mr. Khairil Imran, thank you so much for their words of wisdom and encouragement throughout my studies. Last but not least, special tribute to Mr. Nor'Afifie bin Mohd Noor who are always being on my side and be a reason for my strong determination in every hardship.

ABSTRACT

Seagrass is a valuable primary producer in marine environment. Unfortunately, population of seagrass is declining worldwide including population in Malaysia. The seagrass in Merambong and Tanjung Adang Laut shoals also facing diminishing of seagrass beds in the area due to reclamation activities. *Halophila major* is new record discovered in the area thus study on this species was performed. Seagrass was propagated using rhizome in different substrates, native substrate from Merambong shoal A, Teluk Kemang and Blue Lagoon and study was conducted at i-Aquas (International Institute of Aquaculture and Aquatic Sciences), Port Dickson. Observation on morphological characteristics and growth performance of *Halophila major* cultured in different substrates was done in 20 weeks. Water parameter in culture tank was higher than in Merambong A and Tanjung Adang Laut shoals which temperature (31.0.0±0 ºC), Total Dissolved Solid (32045.00±54 mg/L), salinity (32.10±0.14 psu), pH (8.25±0.18), visibility (1.0±0.2 m), and nitrate (84.2±0.4 mg/L). Soil analysis of the substrate showed that the native substrate (Merambong shoal A) can be categorised as loamy sand while the substrate from Teluk Kemang and Blue Lagoon are sand. Morphology of *Halophila major* from wild and cultured showed similar characteristics of oval shape, rounded leaf tip and green in colour. Through observation during culture period, the plant has covered almost 50% of the substrate area and growth performance was suitable in the native substrate. Growth performance of *Halophila major* cultured in different substrates showed significant differences in each treatment ($p<0.05$). The first 4 weeks of cultured *Halophila major* showed increased in leaf length for each 2 weeks. The plant shed their leaf and produce new shoot within 2 weeks. Leaf dimensions of the seagrass plants showed greater growth and development in the native substrate (control) with the highest leaf length (2.98±0.06 cm) and leaf width (1.85±0.05 cm).

ABSTRAK

Rumput laut adalah pengeluar utama yang berharga dalam persekitaran marin. Malangnya, populasi rumput laut menurun di seluruh dunia termasuk di Malaysia. Rumput laut di beting Merambong dan Tanjung Adang Laut juga menghadapi penurunan hamparan rumput laut akibat kegiatan penambakan tanah. *Halophila major* adalah rekod baru yang ditemui di kawasan itu dengan demikian kajian untuk spesies ini dilakukan. Rumput laut ditanam menggunakan rizom dalam substrat berlainan; Substrat asli dari beting Merambong A, Teluk Kemang dan Blue Lagoon digunakan dan kajian dijalankan di i-Aquas (Institut Akuakultur Antarabangsa dan Sains Akuatik), Port Dickson. Pemerhatian untuk prestasi morfologi dilakukan dalam 20 minggu. Parameter air dalam tangki kultur adalah lebih tinggi daripada beting Merambong A dan Tanjung Adang Laut iaitu masing-masing suhu (31.0.0±0 ºC), TDS (32045.00±54 mg/L), kemasinan (32.10±0.14 psu), pH (8.25±0.18), visibiliti (1.0±0.2 m), dan nitrat (84.2±0.4 mg/L). Analisis tanah substrat menunjukkan bahawa substrat di (beting Merambong A) dikategorikan sebagai pasir berlumpur manakala substrat Teluk Kemang dan Blue Lagoon adalah pasir. Morfologi *Halophila major* dari kawasan semulajadi dan yang dikultur menunjukkan ciri daun yang sama iaitu berbentuk bujur, tip daun yang bulat dan daun berwarna hijau. Melalui pemerhatian semasa tempoh kultur, tumbuhan telah meliputi hampir 50% daripada kawasan substrat dan prestasi pertumbuhan sangat baik di substrat semulajadi. Prestasi pertumbuhan kultur *Halophila major* dalam substrat yang berbeza menunjukkan perbezaan yang signifikan dalam setiap rawatan ($p < 0.05$). Empat minggu pertama menunjukkan *Halophila major* yang dikultur meningkat panjang daun untuk setiap 2 minggu. Dalam kajian ini, tumbuhan menggugurkan daun dan menghasilkan pucuk baru dalam masa 2 minggu. Dimensi daun tumbuhan menunjukkan pertumbuhan dan perkembangan yang lebih bagus di substrat semulajadi (kawalan) dengan panjang daun (2.98 ± 0.06 cm) dan lebar daun (1.85 ± 0.05 cm) yang tertinggi.

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LIST OF ABBREVIATIONS AND SYMBOLS

Symbol	Meaning
DO	Dissolved Oxygen
TDS	Total Dissolved Solid
%	Percent
N/A	Not available
km	Kilometer
m	Meter
cm	Centimeter
L	litre
ml	Millimeter
psu	Practical salinity unit
^{o}C	Celcius
SD	Standard deviation
Mg/	Milligram

CHAPTER 1

INTRODUCTION

Seagrass communities are one of the major components in the marine ecosystem and environment that served as nursery and habitat for many marine animals. The organism provides key ecological service, improved biodiversity, and trophic exchanges to nearby environments in tropical and temperate regions (Orth et al., 2006). Additionally, seagrass also contribute to filtration for suspended sediment, stabilize sediments and nutrients from coastal waters and deplete wave energy (Koch, 2001; Orth et al., 2006). Seagrasses are not genuine grasses because they are submersed monocotyledonous plants that have adjusted to living in marine and estuarine ecosystem, often submerged and form patches to coastal beds or meadows (Japar Sidik et al., 2006). Seagrasses grow in salty and brackish waters around the world, typically along gently sloping, protected coastlines.

Globally, there are about 12 major divisions, consisting approximately 60 species of seagrass (McKenzie, 2008). In Malaysia, Japar Sidik et al. (2016) has recorded 16 major species of seagrasses: *Enhalus acoroides* (L.*f.*) Royle, *Thalassia hemprichii* (Ehrumb.) Aschers., *Halophila beccarii* Aschers, *Halophila decipiens* Ostenfeld, *Halophila major* (Zoll.) Miquel, *Halophila minor* (Zoll.) den Hartog, *Halophila ovalis* (R. Br.) Hook. f., *Halophila spinulosa* Aschers., *Halophila* sp., *Cymodocea rotundata* Ehremb. & Hempr. ex Aschers., *Cymodocea serrulata* (R. Br.) Aschers. & Magnus, *Halodule pinifolia* (Miki) den Hartog, *Halodule uninervis* (Forssk.) Aschers., *Syringodium isoetifolium* (Aschers.) Dandy,

Thalassodendron ciliatum (Forsskal) den Hartog, and *Ruppia maritima* L. scattered at 78 sites in the west and east coasts of Peninsular Malaysia and in Sabah and Sarawak in East Malaysia.

Seagrasses play a key role in the marine ecosystem and have many benefits towards the ecosystem such as involvement in the epibenthic and benthic production that provide nutrient, filtrate of contaminants, supply of oxygen and as nutrient recycler (Orth et al., 2006).

According to Freeman et al. (2008), despite the benefits that seagrass contribute towards the ecosystem, there are threats on seagrass habitat that causes on seagrass losses such as environmental, biological, and extreme climatological events. Seagrass meadow biomass, area and species composition are influenced by various factors, including: physical disturbance, herbivory, intraspecific competition, nutrients pollution and sediment laden flood waters (Unsworth et al., 2014). Example of environmental threats are global climate change which has cause rise of sea level and temperature increase that affecting water quality in seagrass area. Japar Sidik et al. (2006) claimed that other factor is increase of human population and human activity in seagrass area which also directly affect seagrass meadows and their surrounding environment (Short et al., 2007). Study by Waycott et al. (2009), Green and Short (2003) and Orth et al. (2006) proves that the distribution, status and trends of seagrass habitat, and seagrasses are declining globally. Waycott et al. (2009) states that seagrass habitat was disappeared worldwide at rate of 110 km^2 per year between 1980 and 2006. Thus,

over the recent year, a blend of research works showed up, displaying different strategies for preservation, recovery administration of the seagrass living environment in the nation, together with the living beings related with them and it is really important that more information is gathered regarding on seagrass ecology and biology in order to preserve seagrass resources that is remain. The research conducted should be pointed for better understanding of process involved in seagrass ecosystems so that better management strategies for seagrass can be applied and successful restoration protocol is implement.

However, natural growth and development for extension of most seagrass meadows happen at a very slow rate for its slow rate recovery (Henry, 1998). Study conducted by Shepherd et al. (1989) in South Australia in an area mined for *Posidonia* fibre in 1917 state that even after five decades, recovery of *Posidonia australis* beds still visibly identified by the lack of regrowth. Thus, restoration of seagrass that has been established is primarily through transplanting which it is proven that it has shorten the time for colonising period (Clarke and Kirkman, 1989; Kirkman and Walker, 1989). Moreover, success of the restoration still influences by many factors which include growth rate, planting configuration and the species to be restored. Transplanting such as in-vitro culture and tank culture is done in artificial condition to speed up the process of restoration.

Culture of seagrass also one of practice that can help to manage the problem and by experimenting different substrate can determine suitable substrate to culture this seagrass species of *Halophila major*. Patches of mixed seagrasses are found

grow in different substrates such as calcareous sandy-mud subtidal shoals of Merambong A, Johor and sand-covered coral reefs platforms at Teluk Kemang (Japar Sidik and Muta Harah, 2011). Substrate are determined by its size frequency and particle size distribution as each substrate has own physical characteristics and properties to be identified and distinguish from other substrate (Kenworthy and Fonseca, 1977).

There are unclear and less investigations on detail of characteristics about *H. major* as there are few investigations for its morphological (Piyalap et al., 2015). A thorough understanding of this species and the effect of substrate on its growth will enable the marine botanist to carry out a culture project successfully.

Details of *H. major* on the characteristics, morphological, sexual reproductive features, flowers and fruits still not complete established (Piyalap et al., 2015), thus this study will further discuss about the details. Besides that, determining suitable substrate for the seagrass was done by culturing seagrass on different substrate and that explain why study of substrate for seagrass is also important to identify seagrass-substrate relationship (Kenworthy and Fonseca, 1977). The aim of this present study is to determine the morphology and characteristics of *Halophila major* and to identify the growth performance of *Halophila major* in different substrates.

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