

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

The findings from the metagenomic Whole Genome Sequencing (mWGS) analysis revealed a diverse distribution of bacteria indicates the presence of a rich and varied microbial community in the mangrove soil, potentially playing essential roles in plant growth promotion and ecosystem functioning. Moreover, through culture-dependent techniques, several bacterial species were successfully isolated and identified from the selective media. These include nitrogen-fixing bacteria such as *Acinetobacter radioresistens*, *Brachy bacterium paraconglomeratum*, and *Enterobacter cloacae*. In addition to nitrogen-fixing bacteria, potassium solubilizing bacteria were also isolated, comprising *Klebsiella quasipneumoniae*, *Bacillus tropicus*, and *Paenibacillus pasadenensis*. Furthermore, the research identified phosphate solubilizing bacteria, including *Bacillus cereus* and *Bacillus thuringiensis*. Overall, the combination of metagenomic whole-genome sequencing and 16S rRNA gene sequencing provided valuable insights into the diverse bacterial community present in the mangrove soil of Sungai Lukut. The isolation and identification of specific plant growth-promoting bacteria through mWGS further enriched the understanding of their functional roles in the ecosystem.

Next, the research on applying biofertilizer to duckweed has shown promising results, indicating that the use of biofertilizer can significantly enhance the growth of duckweed. The positive outcomes were observed through the multiplication of duckweed fronds within a relatively short period of 15 days. The study demonstrated that all of the biofertilizer sets used in the experiment were capable of promoting duckweed growth, suggesting that the isolated bacteria (*Acinetobacter radioresistens*, *Brachybacterium paraconglomeratum*, *Enterobacter cloacae*, *Klebsiella quasipneumoniae*, *Bacillus tropicus*, *Paenibacillus pasadenensis*, *Bacillus cereus* and *Bacillus thuringiensis*) contained plant growth promoting traits. This finding highlights the potential of using biofertilizers as a sustainable and environmentally friendly alternative to conventional chemical fertilizers in duckweed cultivation. Among the different biofertilizer sets tested, it was evident that each set had varying effects on enhancing soil nutrients. Set C stood out as the most effective in increasing soil nitrogen content, which is crucial for promoting overall plant growth. On the other hand, Set C also exhibited a significant capability in increasing phosphorus content in the soil, an essential nutrient for robust plant development. However, it is noteworthy that Set B did not demonstrate a substantial impact on increasing soil nutrient levels. Furthermore, the research indicated that the use of Set C as a biofertilizer had an additional advantage, leading to the highest protein yield in duckweed. This finding suggests that applying Set C not only enhances growth but also contributes to the nutritional value of the cultivated duckweed.

Future research could focus on understanding the mechanisms and interactions of these bacteria with plants to harness their full potential in promoting crop productivity

and ecosystem health. Ultimately, this research represents a crucial step towards harnessing the beneficial properties of bacteria from mangrove soil to foster sustainable agriculture and environmental conservation. Next, further research can focus on optimizing the composition of the best-performing biofertilizer set (Set C) to maximize its effectiveness in promoting duckweed growth. This could involve adjusting the ratio of beneficial bacteria or incorporating additional plant growth-promoting microorganisms to enhance the biofertilizer's overall performance. Besides, the best biofertilizer set (Set C) can be taken from the laboratory to large-scale field trials in real-world agricultural settings. Its efficacy, economic feasibility, and environmental impact when applied to duckweed cultivation can also be assessed on a larger scale. This data will be valuable for commercializing the biofertilizer and implementing it in practical farming systems. Lastly, the potential of the best biofertilizer (Set C) should be investigated for promoting growth in other plant species beyond duckweed. The interaction of the biofertilizer with different plants can also be studied and evaluate its versatility in enhancing growth across various crops.