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Boosting Palm Oil Yield: Harnessing Microbial Power to Enhance Gene Expression in Oil Palm Production

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Justification and Objective

1) Palm oil is one of the most widely used vegetable oils, with significant economic importance.
2) Increasing palm oil production sustainably without expanding plantation areas is crucial.
3) One promising approach is using plant-associated microbes to upregulate genes involved in lipid biosynthesis, thereby enhancing oil yield.
4) This proposal explores the potential of microbial inoculation to stimulate oil biosynthesis-related gene expression in oil palm (*Elaeis guineensis*).

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Objectives

1) To identify and characterize beneficial microbes that influence lipid biosynthesis in oil palm.
2) To evaluate different microbial delivery methods for effective plant colonization.
3) To assess changes in gene expression and oil content in treated palm plants.
4) To compare oil yield between treated and control plants.

Methodology

1. Microbial Selection and Preparation

- Screen naturally occurring plant growth-promoting microbes (PGPMs) from oil palm rhizosphere and endosphere.
- Select strains known for producing plant hormones (e.g., auxins, gibberellins) and other bioactive compounds.
- Alternatively, genetically engineer microbes to express signaling molecules that enhance lipid metabolism.

2. Microbial Delivery Methods

- Seed Coating: Seeds will be treated with microbial suspension before germination.
- Soil Inoculation: Microbes will be introduced into the rhizosphere.
- Foliar Spray: Microbial cultures will be applied to leaves to induce systemic responses.
- Trunk Injection: Microbial solutions will be injected into the palm trunk for direct uptake.

Methodology

3. Evaluation of Gene Expression and Oil Production

- Molecular Analysis: RNA extraction from leaf and fruit tissues followed by RT-qPCR/RNA-Seq to measure lipid biosynthesis gene expression.
- Metabolomics & Lipid Profiling: GC-MS/LC-MS will be used to analyze oil composition.
- Microscopy & Histology: Oil body formation will be examined using fluorescence and electron microscopy.
- Yield Assessment: Fresh fruit bunches (FFB) and oil content per bunch will be compared between treated and control groups.

4. Expected Outcomes

- Identification of effective microbes that enhance lipid biosynthesis gene expression.
- Optimized microbial delivery methods for oil palm application.
- Increased oil yield in treated plants without genetic modification of the plant itself.
- A sustainable, eco-friendly approach to improving palm oil production.

Budgeting

No	Item		Allocation cost (IDR)
1	Personnel	Main Researchers	135000000
		Research Assisstant	22500000
2	Research Activity	Microbial Screening and Selection	26500000
		Field Application and Optimization	40000000
		Final Analysis and Reporting	25000000
3	Accomodation and Transportation		48000000
4	Miscellaneous items		3000000
Total			300000000

Timeline

Activity	Year 1	Year 2	Year 3
Microbial isolation & screening	✓		
Laboratory-scale microbial testing	✓		
Optimization of microbial culture conditions	✓		
Field inoculation trials		✓	
Evaluation of microbial delivery methods		✓	
Mid-term assessment (gene expression, oil yield)		✓	
Final assessment (yield, oil profiling)			✓
Advanced metabolomic and lipid profiling			✓
Data analysis and statistical evaluation	✓	✓	✓
Report preparation and stakeholder dissemination			✓

Expected Outcome

1) Identification of effective microbes that enhance lipid biosynthesis gene expression.
2) Optimized microbial delivery methods for oil palm application.
3) Increased oil yield in treated plants without genetic modification of the plant itself.
4) A sustainable, eco-friendly approach to improving palm oil production.

Projected Benefits

Projected Benefits:

- Increased Oil Yield: A projected 10-20% increase in palm oil production.
- Higher Profitability: Enhanced oil production translates to a higher return on investment for plantation owners.
- Sustainability: Reducing the need for land expansion while maximizing current plantation productivity.
- Market Advantage: Improved oil quality may attract premium pricing in international markets.
- Economic Impact: Strengthening the palm oil industry by reducing dependency on synthetic growth stimulants and fertilizers.

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Thank you!

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