

MICROPROJECTILE BOMBARDMENT FOR GENERATING TRANSGENIC OIL PALM

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The challenge that the oil palm industry will face in the 21st century is the ability to maintain profitability in the face of labour shortage and limited land resources. MPOB has identified genetic engineering as a promising technology to overcome the above limitations. Establishment of a reliable transformation and regeneration system is essential for genetic engineering. Transgenic oil palm has been successfully produced using the microprojectile bombardment method (Figure 1), which now makes it possible to produce oil palm with value-added fatty acids and novel metabolites through genetic engineering.

GENETIC TRANSFORMATION

Genetic transformation process involves the uptake of naked DNA (gene of interest) by competent cells, followed by integration into the chromosome and subsequent expression to produce the gene product. The process starts with the penetration of DNA into a cell through the cell wall and plasma membrane. The DNA eventually penetrates into the nucleus. One method for delivering foreign genes into plant cells is by microprojectile bombardment.

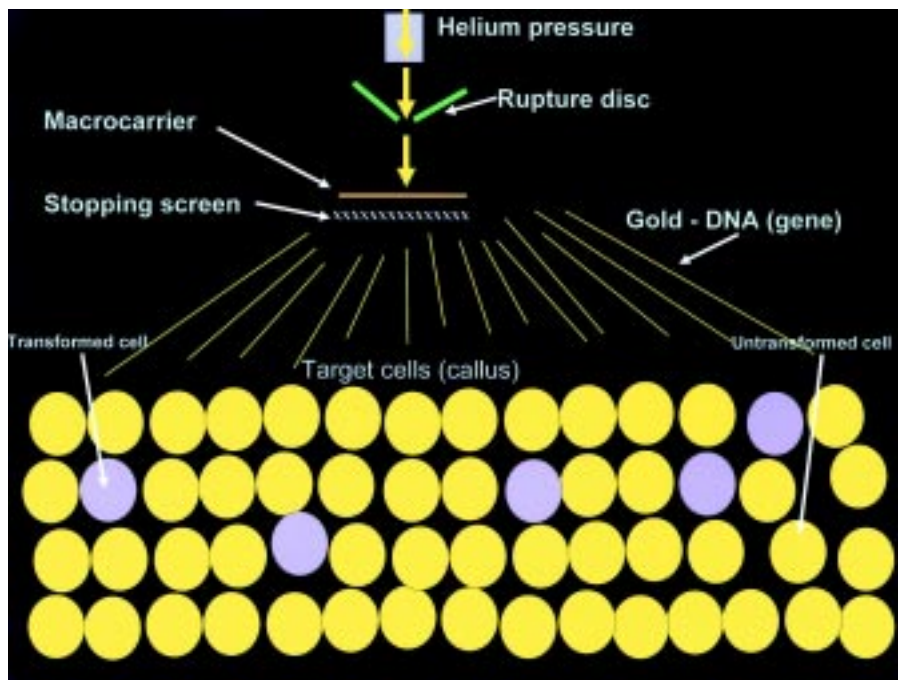


Figure 1. Microprojectile bombardment process.



TECHNIQUE OPTIMIZATION

Penetration of DNA into cells, via microprojectile bombardment, requires the optimization of physical and biological parameters. In oil palm, the conditions for delivering DNA into embryogenic calli have been optimized (Figure 2). Five different promoters were evaluated to identify the most suitable for use in oil palm (Figure 2). The effectiveness of four antibiotics and herbicide Basta™ as selection agents to inhibit growth of oil palm embryogenic calli was also evaluated.

REGENERATION OF TRANSGENIC OIL PALM

Bombarded embryogenic calli, using the optimum parameters, were exposed to Basta™ to isolate resistant embryogenic calli (Figure 3). Transgenic embryogenic calli were regenerated into whole plants (Figure 4) and their transgenic status were verified by molecular and protein analyses (Figure 5). The transgenic plants, which are almost five years old now, are still expressing the transgene. Using the established technique, hundreds of transgenic oil palm, carrying useful genes, is being produced routinely now (Figure 6).

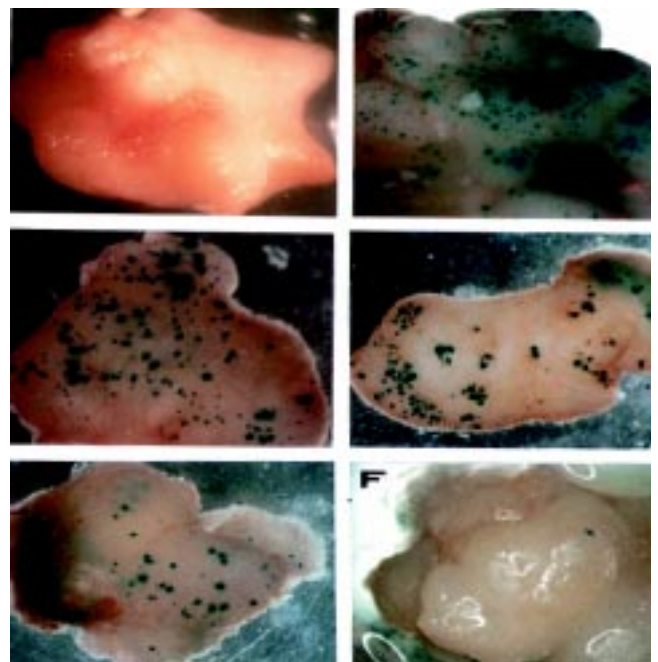
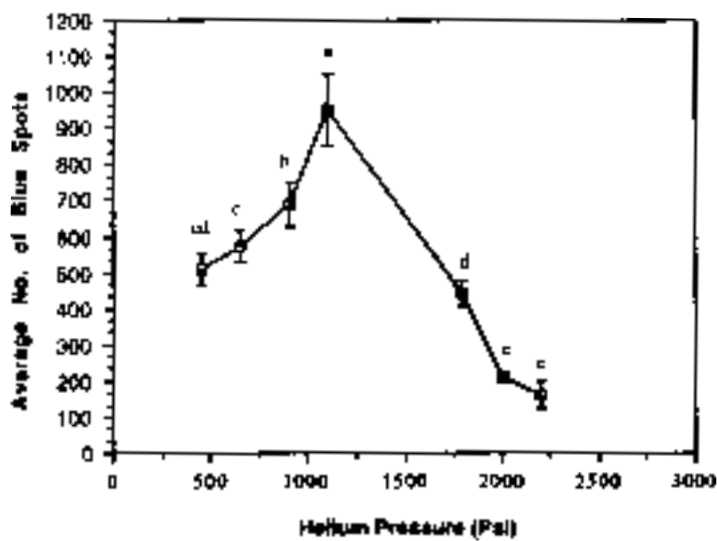


Figure 2. Optimization of physical parameter (left) and promoter analysis (right).

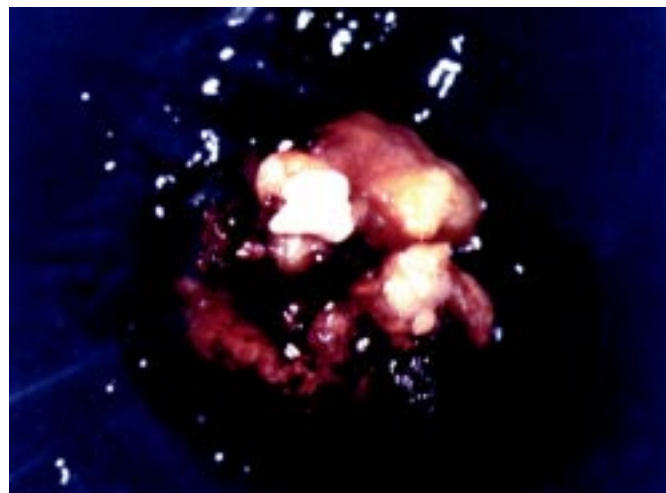


Figure 3. Basta™ resistant embryogenic calli.



Figure 4. Transgenic palm (4 years old).

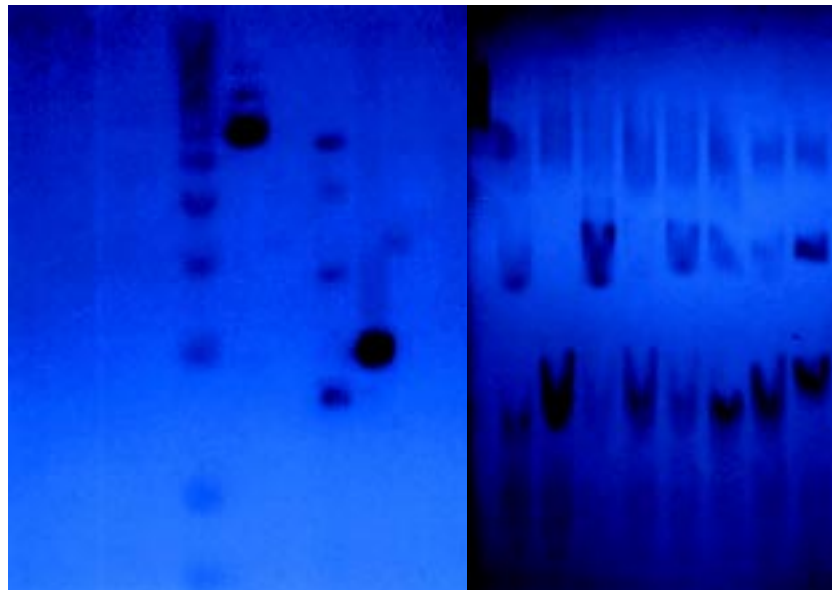


Figure 5. Molecular (left) and protein (right) analyses.

BENEFITS OF MICROPROJECTILE BOMBARDMENT TECHNOLOGY

Long generation time and open pollinated behaviour of oil palm contribute to the slowness of conventional genetic improvement. The above limitations make oil palm an ideal crop for improvement via microprojectile bombardment

technology. Approximately, four to five years are required to produce transgenic plantlets from initial date of explant culture. Taking into account the requirement of back-crossing in conventional breeding, microprojectile bombardment technology could save 70%-80% of the time required for introducing a new trait into oil palm.



Figure 6. Transgenic palms carrying useful genes.

WHO SHOULD BENEFIT

Oil palm industry, especially their tissue culturists and breeders could benefit from this technology by identifying trait(s) to be incorporated into oil palm. Depending on the availability of the desired gene(s), transformation vector(s) could be constructed and transformed into oil palm.

INTELLECTUAL PROPERTY

This microprojectile bombardment technique for producing transgenic oil palm has been filed for patent application - *Method and compositions for the production of transgenic plants*, in Malaysia (PI 20013795), Thailand (074550), USA (10/178,919), Indonesia (P-002002000474) Brazil (PI0202855-7) and Costa Rica (6671).

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