

## Development of a temporary immersion bioreactor prototype for regeneration and multiplication of banana (*Musa* spp.)

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Banana (*Musa* spp.) is an economically important fruit crop traditionally propagated in Sri Lanka through conventional tissue culture, which is labour-intensive, costly, and prone to contamination. Temporary Immersion Bioreactor (TIB) systems offer a more efficient alternative by automating the culture process through periodic immersion of plant tissues in nutrient media under sterile conditions. These systems use air pressure to transfer media between containers, reducing manual handling and simplifying plant tissue propagation. This study aimed to develop a cost-effective autonomous TIB prototype and evaluate its performance by comparing multiplication and contamination rates with the conventional tissue culture system. The system was tested using seedling explants of banana variety “Ambun” under controlled laboratory conditions. The TIB was developed using 1.5 L glass bottles and electro-pneumatic components, with timer-controlled valves programmed to open every 3 hours for 10 minutes, enabling sterile, automated immersion and nutrient exchange cycles. Sub-culturing in the TIB involved transferring explants into the reactor and regulating nutrient flow (MS medium) using timers. Banana explants from the fifth subculture were adapted in the two culture systems in a completely randomized design, and growth and contamination parameters were statistically compared using independent sample t-test. Results showed that the TIB system outperformed conventional methods. The average number of shoots in the TIB system was significantly higher ( $48.33 \pm 1.453$ ;  $p=0.007$ ), compared to the conventional system ( $32.67 \pm 2.728$ ). Contamination was absent in the TIB system compared to the conventional method ( $8.84 \pm 0.38\%$ ;  $p=0.002$ ). Other growth parameters, such as average seedling canopy width ( $0.67 \pm 0.067$  cm;  $p=0.039$ ), average root length ( $4.70 \pm 0.041$  cm;  $p=0.009$ ), and the average number of leaves ( $45.67 \pm 1.764$ ;  $p=0.021$ ), also demonstrated greater performances by TIB. These findings confirm that the TIB system is more effective than conventional tissue culture for banana propagation under the tested conditions.

**Keywords:** *Banana explants, Tissue contamination, TIB system, Tissue culture*