CHAPTER 2
PROSPECTS OF PLANT TISSUE CULTURE IN MALAYSIA

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2.1 INTRODUCTION

Plant tissue culture is a regenerative technology based on the totipotency and pluripotency nature of plant cells. Totipotency enables complete plant regeneration from tissue or organ, unorganised calli and single cells whereas pluripotency allows differentiation of tissues or organs from cells (Verdeil et al., 2007).

Plant regeneration in tissue culture technique has been utilised for micropropagation, molecular breeding, genetic transformation, gene-function research and crop improvement programmes. However, the adoption of these technologies for agriculture and other industries is limited by the ability of plant regeneration which is dependent on genotypes and plant species (Maren et al., 2022). Model plants such as tobacco (*Nicotiana tabacum*) and *Arabidopsis thaliana* are more amenable in culture than palms, forest species and other important cash crops. Among Solanaceae, tomatoes are responsive but hot peppers are recalcitrant in culture. Even though it is vital to regenerate commercially important hybrids, wild types seem to be more responsive to culture conditions.

Hence, it is crucial to unravel the insight mechanisms controlling plant regeneration in tissue culture to develop crops with plug and play traits, especially to address biotic and abiotic problems. The future focus on plant

regeneration research in tissue culture must relate the interaction between molecular mechanism and external environment factors such as media, explants, cultural conditions. It is hoped that in the future, plant tissue culture may adopt computer modelling for customised protocols with specified regeneration pathways and types of explants (Long et al., 2022).

2.2 ECONOMIC VALUE

From Polaris market research analysis (2022), the plant tissue culture global market size was USD390 million in 2021 with an upward trajectory increase by 2030 as shown in Figure 2.1.

The major players in the plant tissue culture market are North America followed by Europe. In Asia Pacific region, micropropagation protocols of numerous plant species have been developed but not taken up for commercialization. However, with the participation of private sectors, the technology transfer, dissemination, adaptation of the established plant tissue culture techniques for commercial ventures is growing rapidly especially in Indonesia, Thailand, and India. With the increasing world population and limited availability of arable land, plant tissue culture will remain relevant and competitive in the agriculture industry. This technique promises the production of superior planting materials which is crucial for food, feed and as a source of botanic drugs.

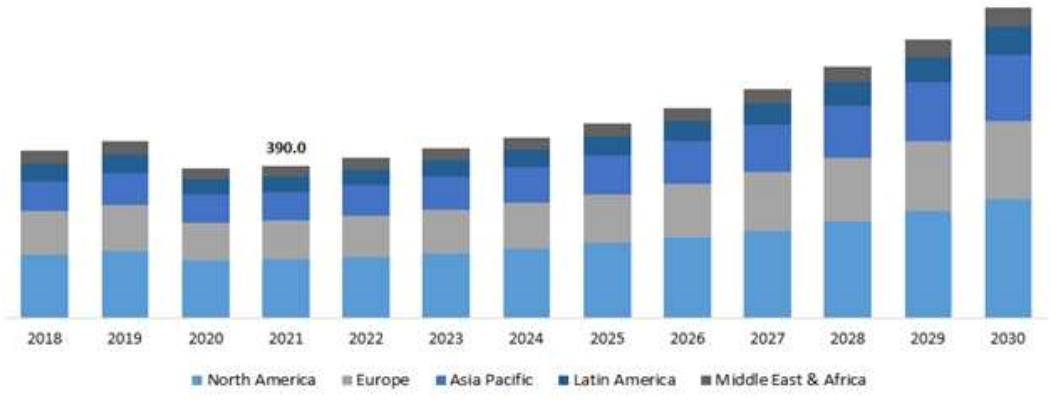

Figure 2.1 The projection of plant tissue culture market size by region (2018–2030), is expected to grow in an uptrend manner globally (Source: Polaris Market Research, 2022)

2.3 STATUS OF PLANT TISSUE CULTURE AND RELATED TECHNOLOGIES APPLICATION IN MALAYSIA

In Malaysia, plant tissue culture laboratories are owned by government organisations, government-linked corporations, private, and public companies for research and commercial activities. One of the prevalent plant tissue culture commercial activities is micropropagation of plants with high agronomic value as planting materials. However, the micropropagation process is limited to a few species because some plants are recalcitrant to culture, and industries have been slow to adopt the established protocols developed by universities and research institutes. Similar scenarios were observed in the adoption of molecular breeding, genetic transformation, and gene-function research for commercial implementation.

According to the Malaysian National Biotechnology Policy 2.0 (Bioeconomy corporation, 2022), agriculture has been identified as the lagging sector compared to health and industry sectors with the least uptake of technology that has been developed. This could be due to a continuous mismatch between research carried out in universities and research institutes and the demands of the industries. Many relevant technologies and products that have been developed and patented remained with the technology generators and not commercialised. Most of the players in this industry are small holders that do not have the capacity either to acquire licenses or embark on research. On the other hand, corporations and conglomerates, for example Sime Darby, Boustead, and Felda Global Ventures carry out research to cater to their own needs. Various policies and strategies were established to bridge the gap between research output and commercialisation.

2.4 PROSPECTS OF PLANT TISSUE CULTURE IN MALAYSIA

Based on the expanding global interest in plant-based products as one of the economic engines of growth, there are many opportunities in plant tissue culture and related technologies to be capitalised. Being the