# CHAPTER 5
# *IN VITRO* PROPAGATION OF BANANA

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## 5.1 INTRODUCTION OF BANANA INDUSTRY

Bananas (*Musa* spp.) are a members of the Musaceae family and thrive in regions across Asia, Latin America, and Africa. Bananas play a vital role as a cash crop, substantially bolstering global food security, particularly in regions where they serve as a dietary staple. Bananas are highly favoured in developing countries due to their affordability and nutritional richness. They are packed with essential nutrients like carbohydrates, proteins, and minerals such as potassium, calcium, magnesium, and manganese, as well as vitamins A, C, and B6 (Justine et al., 2022).

According to Dadrasnia et al. (2020), the Food and Agriculture Organisation (FAO) has identified bananas as the eighth most important food crop globally. In terms of production volume, bananas rank fourth after rice, wheat, and maize. In 2009, worldwide banana production was 96 million tons across 49 million hectares. In recent years, global banana production has surged to approximately 114 million tonnes (Mathew et al., 2020).

In Malaysia, bananas have been identified as one of the priority crops under the National Agrofood Policy (2011–2020). With the consumption of 10 kg per capita, bananas are rated to be highly consumed in Malaysia with its popular varieties namely pisang berangan, pisang mas, and pisang rastali. Besides its low price, the banana is favoured due to its high carbohydrate

content, vitamins, and minerals, which fulfils the criteria for quality breakfast (Sidhu & Zafar, 2018).

In terms of planting areas in Malaysia, bananas rank as the second most extensively grown fruit crop after durian, followed by pineapple and rambutan. In 2022, more than 15% of the total fruit crop area, accounting for 27,577 hectares out of 179,886 hectares, are planted with bananas with a total production reaching 330,601 tonnes. Major production hubs in Malaysia are situated in Johor, Sabah, Pahang, Sarawak, Perak, and Kelantan (Jabatan Pertanian Malaysia, 2022). Despite their potential as profitable crops, local banana production often faces challenges from climatic fluctuations and the infestation of pests and diseases such as bacteria, viruses, fungi, and nematodes (Tripathi et al., 2019), which can significantly impede long-term productivity.

## 5.2 PROPAGATION OF BANANA PLANT

Traditionally, bananas are planted by using suckers as the source of planting materials. However, propagation through suckers from the mother plants is inefficient due to its low propagation efficiency and it is highly risky as it could spread soil-borne diseases that could affect the banana production. Therefore, the usage of suckers as planting material is not practical for large scale banana cultivation.

In recent years, there has been an increasing interest in growing healthy and important banana cultivars for commercial purposes. However, there is a huge gap between the demand and the supply of healthy planting materials. To overcome this, *in vitro* propagation techniques have been used in many countries to produce healthy, disease-free banana plants throughout the year that perform better under field conditions (Abdalla et al., 2022). Therefore, plant tissue culture plays an important role in providing superior disease-free banana planting materials in large quantity.

## 5.3 *IN VITRO* BANANA PROPAGATION

Currently, *in vitro* propagation of various types of banana cultivars such as Grand Naine, Robusta, Berangan, Cavendish, FHIA-17, Rastali, Embun, and Mas, have been reported (Saravanan et al., 2017. The propagation can be done through direct or in direct organogenesis through callus phase. Direct organogenesis is the favoured pathway used by commercial banana tissue culture companies in which the propagation of plantlets was achieved from the meristems without going through callus induction. This pathway presents an opportunity to generate a large number of uniforms, disease-free, and genetically identical plants (Justine et al., 2002).

The *in vitro* propagation of banana begins with the selection of explant from healthy mother plants, followed by sterilisation of explant, explant culture and multiplication, and finally rooting of plantlets (Figure 5.1). Prior to planting in the field, the plantlets need to be acclimatised in the nursery. The success of *in vitro* banana propagation depends on the optimisation of the *in vitro* propagation protocol which can be categorised into four distinct stages such as (i) Shoot initiation, (ii) Shoot multiplication, (iii) *In vitro* rooting of shoots, and (iv) Hardening of plantlets. *In vitro* banana propagation could be established mainly through shoot tips and meristem culture, scalp culture, somatic embryogenesis, cell suspension and protoplast culture (Jafari et al., 2013; Jalil et al., 2008).

### 5.3.1 Meristem/Shoot Tip Culture

For banana *in vitro* propagation, it can be achieved through direct and indirect organogenesis. The favoured route for commercial mass propagation is through direct regeneration via shoot tips or meristem culture (Figure 5.2(b)). In recent decades, shoot tip culture has become a standard method for rapid clonal propagation of bananas. Compared to conventional propagation techniques, *in vitro* propagation offers significant advantages, including rapid multiplication, the production of disease-free and uniform planting materials, and the ability to mass propagate plants in minimal space (Dagnew et al., 2012).