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Micropropagation's Huge Growth Potential

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Introduction

Production of high quality planting materials is expected to grow by 5% to 10% a year. This growth is fueled by two developments: the increase in global demand for tissue-cultured industrial crops and food crops, like tropical fruits and berries, and the need for high quality planting materials. Yet, total demand for high quality planting materials far exceeds production capacities and necessitates even higher production growth rates, which are currently inhibited by the increasing (labor) costs of micropropagation. However, research conducted at Rabobank and supported by thesis research at InHolland University of Applied Sciences reveals that further automation could eventually solve this.

Demand for Clean Planting Material Exceeds Supply

Plant tissue culture seedlings significantly outperform conventional vegetative propagation materials in terms of uniformity, earliness, yield, pace, and quality. The superior performance of tissue culture plantlets and rising global food demand have boosted demand for rapid micropropagation systems of planting materials, including tissue culture.

For instance, global consumption of tropical fruits and berries is growing, increasing demand for planting materials and encouraging plantations to scale up operations. An example to illustrate the potential for tissue culture is banana production in India. India has the largest cultivation area and production for banana crops (about 830,000 hectares). If one-third of the banana plants could be propagated by tissue culture, a minimum of 900 million plantlets would be needed. However, the current annual production is only 40 million to 80 million plantlets. The Department of Biotechnology in India expects the annual growth in demand for tissue-cultured banana plants to increase at a rate of 25%.

Currently, the global demand for clean, healthy planting material for agriculture, horticulture, forestry, and floriculture is estimated at more than 16 trillion plants, which equals USD 4 trillion. However, the annual production of tissue culture plants is only about 1.5 billion to 2 billion, with an expected annual growth rate between 5% and 10%. The huge gap between the total demand for planting material and current supply of tissue culture products will encourage the industry to expand.

Labor Costs Constrain Further Growth

Compared to conventional propagation, the high production costs per unit seem to be the main challenge for extending tissue culture applications. Labor is the main factor to be considered. To reduce the labor costs of tissue culture, many micropropagation operations have moved firms eastward (mainly to Southeast Asia) and southward (mainly to Latin America). However, it should be noted that labor costs in these regions are also increasing. Therefore, players are looking for other ways to reduce costs per plantlet, like automation. It is becoming increasingly important to develop low cost, automated, mass propagation systems for producing in vitro plantlets and to develop automated, robotized, and efficient transplant production methods.

The need for efficient production methods has also led many firms to construct their own nurseries for acclimatization of in vitro plantlets. This development makes sense considering client expectations for shorter production cycles. Besides, the acclimatization of in vitro plantlets requires specialized facilities, and the survival rate of in vitro plantlets depends largely on the success rate during this phase.

The Next Step

Somatic embryogenesis is a potential technology for micropropagation that is better suited to scaling up and automating operations. Currently, somatic embryogenesis is used in robusta coffee, sugarcane, and forestry (date palm and conifers). Bioreactors have been applied in commercial somatic embryogenesis of banana and sugarcane. However, the use of a bioreactor has some disadvantages including: more complicated operations when using a sophisticated bioreactor, the occurrence of physiological disorders, a high risk of microorganism contamination, increased maintenance costs, and the technical expertise required. If these problems can be solved, automation would be further realized, production costs would decline, and the use of somatic embryogenesis could increase significantly.

Imprint

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