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Current Trends in Large-Scale Plant Tissue Culture Propagation and Domestic Market in India

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Abstract

Plant tissue culture is the technique of growing plant cells, tissues, or organs on a nutrient medium under sterile conditions. It is based on totipotency and permits rapid production of uniform, disease-free plants. It is an efficient alternative to conventional propagation and supports large-scale multiplication of superior plants. Current trends include automation, bioreactors, somatic embryogenesis, genetic transformation, and CRISPR. It is widely used in banana, sugarcane, ornamental, medicinal, and forestry crops. In India, the segment is growing due to demand for quality planting material, horticulture expansion, and government support. Despite challenges like high cost, contamination, and skill gaps, the industry is expanding. Plant tissue culture plays a key role in improving productivity and sustainable agriculture.

Introduction

Plant tissue culture (PTC) is a biotechnology method. It is used to grow plant cells, tissues, and whole plants in sterile laboratory conditions. It produces large numbers of genetically identical plants. This technique is based on totipotency. A single plant cell can develop into a complete plant. The concept was first proposed by Haberlandt in 1902. PTC is an effective alternative to conventional propagation. Traditional methods are slower and more disposed to to disease infection. Major tissue culture techniques include micropropagation, meristem culture, somatic embryogenesis, embryo culture, another culture, and protoplast culture. These methods are widely used in plant propagation, crop improvement, and biodiversity conservation. Over the last three years, PTC has moved from research labs to commercial production. It is now an important part of modern agriculture and horticulture in India. Tissue culture helps produce disease-free plants. It also enables large-scale production of uniform and high-quality planting material. In India, demand for quality planting material is

increasing. Expansion of horticulture crops and government support for biotechnology have boosted PTC adoption. Globally, the plant tissue culture market is growing rapidly. More than 80% of commercial micropropagation labs in 45 countries use advanced techniques. These include callus induction, somatic embryogenesis, organogenesis, and micropropagation. Over 1.1 billion plantlets are produced each year. About 62% of biotechnology companies use in vitro culture for genetic stability and disease resistance. Around 38% of horticulture companies use it for large-scale propagation. The United States is a major contributor to this market. It accounts for about 19% of global micro propagated plant production. More than 140 commercial labs operate across 32 states. They produce around 85 million plantlets annually. Major centres include California, Florida, Oregon, and North Carolina. Tissue culture is widely used in U.S. nurseries and commercial plant production.

Importance of plant tissue culture in large-scale propagation

Large-scale micropropagation offers numerous compensations compared with predictable propagation methods, including rapid multiplication of exclusive planting material and production of disease-free and virus-free plants, uniform growth and yield, year-round accessibility of planting material, higher efficiency, and early maturity of crops.

1. Current trends in large-scale plant tissue culture propagation

Automation and bioreactor-based micropropagation

Tissue culture labs use automation and bioreactors to increase production and reduce labor. Bioreactors can produce over 10,000 plantlets per cycle in crops like banana and sugarcane. Automation improves efficiency and reduces errors. Types include TIS, bubble, wave, column, and ebb-and-flow systems. They support growth of shoots, embryos, and other propagules. These systems improve nutrient supply, aeration, and overall plant growth.

Production of disease-free and genetically uniform plants

Production of disease-free, genetically uniform plants is a key trend. Certified protocols ensure virus-free planting material. In India, about 80% of tissue culture plants are virus-free. This method is widely used in banana, sugarcane, potato, strawberry, and ornamental crops. It improves yield and ensures uniform traits across plants.

High adaptation in fruits and plantation crops

Fruits and plantation crops dominate large-scale tissue culture. Fruit crops make up about 44% of applications, with banana. In India, banana and sugarcane rely heavily on tissue culture plantlets. In some regions, up to 90% of planting material comes from this method. It improves productivity and farmer income.

Expansion in Floriculture and Medicinal Plants

Floriculture (orchids, carnations, and lilies), medicinal and aromatic plants, and forestry species. Around **70% of ornamental plants used in floriculture are propagated through tissue culture,** supporting export-oriented horticulture industries.

Plant tissue culture market latest trends

Integration with Advanced Biotechnology

Recent research trends include integration with genetic transformation, somatic embryogenesis, double-haploid technology, and CRISPR gene editing. These techniques help develop improved cultivars with higher yield, disease resistance, and stress tolerance.

Plant tissue culture market latest trends

The plant tissue culture market is growing fast. Demand for micropropagation is increasing. Automation is widely used. About 47% of labs use advanced systems. Bioreactors have increased by 52%. They help faster plant multiplication. Machine vision reduces contamination. It improves success rates by 33%. Around 61% of labs use stable methods like somatic embryogenesis.

Domestic Market of Plant Tissue Culture in India

Growth of Commercial Tissue Culture Laboratories

The Indian tissue culture industry has grown from a few laboratories in the 1980s to dozens of commercial facilities producing hundreds of millions of plantlets annually. Production capacity exceeds 200 million plantlets per year in India. Around 78 companies are recognized under national certification programs for tissue culture plants. Major production clusters are located in Maharashtra, Karnataka**,** Andhra Pradesh**,** Gujarat, and Kerala.

Crop growth and locality in India

- **Banana:** Tamil Nadu, Maharashtra, Gujarat, Andhra Pradesh
- **Sugarcane:** Uttar Pradesh, Maharashtra, Karnataka
- **Potato:** Punjab, Haryana, Himachal Pradesh
- **Ornamentals (orchids, gerberas):** Karnataka, Tamil Nadu, West Bengal
- **Strawberry:** Maharashtra (Mahabaleshwar), Himachal Pradesh

Government Support and Certification Programs

Government initiatives such as the National Certification System for Tissue Culture Elevated Plants (NCS-TCP) ensure quality control and traceability of planting materials. Over 1.4 billion tissue culture plants have been certified since 2006 under this program. Certification

helps prevent distribution of diseased or low-quality planting material.

Market Size and Economic Importance

India is an important part of the global plant tissue culture market. The consumables market is about USD 41.6 million, growing at 6–7% annually. Asia-Pacific, including India, holds around 40% of the global market. Growth is driven by demand for high-yield planting material, export of horticultural crops, and expansion of the horticulture and floriculture industries.

Challenges in Large-Scale Propagation in India

Despite rapid growth, numerous constraints still affect the sector: high production cost of culture media and equipment; contamination risks, which can destroy up to 25–30% of culture batches; shortage of skilled technicians trained in aseptic culture techniques; and regulatory and certification costs affecting small-scale laboratories.

Future Prospects

The future of plant tissue culture in India is promising due to increasing demand for high-quality planting material, expansion of protected cultivation and horticulture exports, adoption of automation and bioreactor technologies, and integration with genetic engineering and precision agriculture. These developments are expected to further strengthen India's position in the global plant tissue culture industry.

Conclusion

Plant tissue culture is an important technology for large-scale plant propagation. It helps produce uniform, disease-free, and high-quality plants rapidly. Advanced methods like automation and bioreactors have improved productivity and reduced labor. This has increased the production of crops like bananas, sugarcane, and ornamental plants. In India, the industry is growing due to high demand for quality planting material and government support. Certification systems ensure the supply of healthy plants. However, challenges such as high costs, contamination, and lack of skilled workers still exist. In the future, better technologies and increased adoption will further expand the sector. Plant tissue culture will play a key role in improving crop productivity, supporting sustainable agriculture, and strengthening India's position in the global market.

Reference

Cognitive Market Research. (2026). *Plant tissue culture market size, share, growth, and industry analysis, by type (consumables, reagent, instrument), by application (agriculture, scientific research), regional insights, and forecast to 2034.* Retrieved March 22, 2026, from https://www.marketreportsworld.com/market-reports/plant-tissue-culture-market-14722484

Government of India. (2021). *National certification system for tissue culture raised plants (NCS-TCP) guidelines.*

Indian Council of Agricultural Research. (2020). *Annual report.* Government of India.

Kumar, S., & Rani, S. (2022). Plant tissue culture in India: Current status and future prospects. *Biotech Today*, 12(2), 111–120. https://doi.org/10.5958/2322-0996.2022.00026.6

Mahajan, M., Pradeep, & Sharma, V. (2022). Commercialisation of plant tissue culture in India: A review. *International Journal of Current Microbiology and Applied Sciences*, 11(5), 1–10. https://www.ris.org.in/sites/default/files/2022-12/ABDR%20July%202022.pdf

National Horticulture Board. (2022). *Indian horticulture database.* Ministry of Agriculture & Farmers Welfare.

Sugimoto, K., & Iwase, A. (2013). Plant callus: Mechanisms of induction and repression. *The Plant Cell*, 25(9), 3159–3173. https://doi.org/10.1105/tpc.113.116053

V. B. Chandana Kumari, V. B., Sumana, K., Sujay, S., Tejaswini, M., Shirahatti, P. S., & Ramu, R. (2021). Sustainable development of the plant tissue culture industry: The Indian scenario. *Journal of Applied Biology & Biotechnology*, 9(2), 18–27. https://doi.org/10.7324/JABB.2021.9202