

Plant Tissue Culture Market - Global Industry Size, Share, Trends, Opportunity, and Forecast, Segmented By Component (Media, Reagents, Equipment & Containers), By Plant Type (Annual Plants, Biennial Plants, Perennial Plants), By End Use (Agriculture, Forestry and Botanical Garden, Gardening & Decoration, Research, Others), By Region and Competition, 2019-2029F

<https://marketpublishers.com/r/P13C1DA3138DEN.html>

Date: July 2024

Pages: 185

Price: US\$ 4,900.00 (Single User License)

ID: P13C1DA3138DEN

Abstracts

Global Plant Tissue Culture Market was valued at USD 382.75 Million in 2023 and is anticipated to project steady growth in the forecast period with a CAGR of 6.65% through 2029. The global plant tissue culture market is experiencing remarkable growth, driven by advancements in biotechnology, rising demand for high-quality crops, and increasing awareness about sustainable agricultural practices. This sector, pivotal in modern agriculture, provides innovative solutions for plant propagation, genetic modification, and conservation.

Plant tissue culture is a technique used to grow plants under sterile conditions on a nutrient culture medium. This method allows for the production of large numbers of plants from a single explant, ensuring genetic uniformity and disease-free propagation. The primary applications of plant tissue culture include micropropagation, genetic engineering, and the conservation of endangered species.

The advent of sophisticated biotechnological tools and techniques has revolutionized plant tissue culture. Innovations such as CRISPR-Cas9 and advanced cloning methods have enhanced the efficiency and precision of genetic modifications, enabling the

development of crops with desirable traits like improved yield, disease resistance, and environmental adaptability.

The growing global population and increasing food security concerns have escalated the demand for high-quality crops. Plant tissue culture offers a reliable method to produce superior crops that meet the stringent quality standards required by both consumers and regulatory bodies.

With the escalating awareness of environmental sustainability, there is a significant shift towards sustainable agricultural practices. Plant tissue culture supports this transition by reducing the need for chemical inputs, conserving genetic resources, and promoting the use of disease-free planting material.

Despite the promising growth, the plant tissue culture market faces challenges such as high initial investment costs, technical complexities, and stringent regulatory frameworks. These challenges also present opportunities for market players to innovate and streamline processes.

Developing cost-effective tissue culture techniques and affordable media formulations can make this technology accessible to small and medium-sized enterprises. Providing specialized training and knowledge transfer can address the technical challenges, ensuring a skilled workforce to support market growth. Adhering to international regulatory standards and obtaining necessary certifications can facilitate market expansion and acceptance.

Key Market Drivers

Increasing Demand for Disease-Free Plants

Plant diseases pose a substantial threat to global agriculture, causing significant yield losses and economic damage. Traditional methods of disease control, such as chemical treatments and breeding for disease resistance, have proven insufficient to address these challenges comprehensively. This has led to a growing interest in plant tissue culture techniques, which offer a reliable solution for producing disease-free plants.

Plant tissue culture involves the *in vitro* cultivation of plant cells, tissues, or organs under sterile conditions. This method allows for the propagation of plants that are free from pathogens, ensuring that the resultant plants are healthy and robust. By utilizing tissue culture, farmers and growers can significantly reduce the risk of disease

transmission and improve crop yields.

The benefits of plant tissue culture extend beyond disease control. This technique enables the rapid multiplication of plants, making it possible to produce large quantities of uniform and genetically identical plants in a relatively short period. Such uniformity is crucial for large-scale agricultural and horticultural operations, where consistency in plant quality is essential.

Plant tissue culture facilitates the preservation of endangered plant species and the conservation of genetic resources. By maintaining cultures of rare and valuable plants, tissue culture laboratories contribute to biodiversity conservation and the sustainability of agricultural systems.

One of the significant opportunities in the plant tissue culture market lies in the production of high-value crops, such as fruits, vegetables, and ornamental plants. These crops are particularly susceptible to diseases, and the use of tissue culture ensures the production of healthy and high-quality plants. The growing demand for organic and non-GMO (genetically modified organism) products is further boosting the market, as tissue culture aligns with the principles of organic farming by minimizing the use of chemical inputs.

Rising Demand for Genetically Uniform Plants

One of the primary reasons for the increasing demand for genetically uniform plants is the need for consistency in agricultural production. Farmers and commercial growers aim to produce crops that have uniform growth rates, size, and quality. This uniformity not only simplifies the harvesting process but also ensures that the final product meets market standards, thereby enhancing profitability. Plant tissue culture techniques facilitate the production of genetically identical plants, ensuring that each plant in a batch exhibits the same desirable traits.

The agriculture sector, facing the challenges of a growing global population and limited arable land, requires innovative solutions to boost productivity. Genetically uniform plants play a critical role in this context. By using tissue culture methods, farmers can rapidly propagate high-yielding and disease-resistant plant varieties. This leads to increased crop productivity and sustainability, addressing food security concerns. The ability to produce large quantities of uniform plants also allows for more efficient use of resources, such as water, fertilizers, and pesticides, further contributing to sustainable agricultural practices.

According to the 2023 analysis from the European Parliament, there are currently over 500 products under development worldwide using CRISPR technology, spanning various stages from basic research to advanced R&D and nearing commercialization. In 2021, a Japanese company achieved a milestone by commercializing the first CRISPR-edited food—a genetically modified tomato containing elevated levels of gamma-aminobutyric acid, aimed at potentially reducing blood pressure. The same year witnessed the genetic modification of two fish species to enhance growth. In 2023, Conscious Greens, a line of green leafy vegetables modified to enhance flavor and color, is anticipated to enter the US market.

The horticulture industry, which includes the cultivation of flowers, ornamental plants, and landscaping plants, significantly benefits from the uniformity provided by tissue culture techniques. For instance, florists and garden centers demand plants that are not only aesthetically pleasing but also consistent in appearance. Genetically uniform plants ensure that all plants within a batch have similar color, shape, and size, which is crucial for maintaining high standards in the horticulture market. This uniformity enhances the visual appeal of gardens, parks, and other landscaped areas, driving consumer demand for such plants.

The research and development (R&D) sector also relies heavily on genetically uniform plants for various scientific studies. Uniformity in plant genetics allows researchers to conduct controlled experiments and obtain reliable results. Tissue culture techniques provide a stable platform for generating identical plants, which is essential for studies related to plant physiology, genetics, and breeding. The ability to produce large quantities of uniform plants also accelerates the development of new plant varieties with improved traits, such as enhanced nutritional content or resistance to environmental stressors.

Commercial plant nurseries and seed companies are increasingly adopting tissue culture methods to meet the rising demand for genetically uniform plants. These businesses require reliable and efficient propagation techniques to produce plants that meet the high standards of their customers. Tissue culture provides a solution by enabling the mass production of plants with uniform characteristics, ensuring customer satisfaction and repeat business. Moreover, the ability to produce plants year-round, independent of seasonal variations, offers a competitive advantage to commercial growers.

Key Market Challenges

Shortage of Skilled Labor

Plant tissue culture involves the in vitro cultivation of plant cells, tissues, or organs under sterile conditions on a nutrient culture medium. The process is highly technical and requires a deep understanding of plant physiology, microbiology, and biotechnology. From the initiation of cultures to the acclimatization of plants, each step demands precision and expertise. The intricate nature of these procedures means that even minor errors can lead to contamination, poor growth, or the complete failure of cultures.

The expertise required in plant tissue culture extends beyond basic laboratory skills. Professionals need to be proficient in sterilization techniques, media preparation, and the manipulation of plant material under sterile conditions. Moreover, they must be capable of troubleshooting and optimizing protocols to enhance the efficiency and effectiveness of culture systems. This specialized knowledge is typically acquired through advanced education and extensive hands-on experience, making skilled labor both rare and valuable.

The shortage of skilled labor in the plant tissue culture market is a global phenomenon. Many regions, particularly in developing countries, lack the educational infrastructure and training programs necessary to produce a sufficient number of qualified professionals. As a result, companies struggle to find and retain skilled technicians and scientists, leading to operational inefficiencies and increased costs.

The lack of skilled labor can lead to slower production rates and increased incidences of contamination, both of which reduce overall productivity. Companies may need to invest heavily in training and development to equip their workforce with the necessary skills. Additionally, the scarcity of skilled professionals often drives up salaries, further increasing operational costs. Regions with a shortage of skilled labor may struggle to compete in the global market. This can lead to a reliance on imported expertise and technology, which may not be sustainable in the long term.

Key Market Trends

Automation and Robotics

The plant tissue culture market has seen a paradigm shift with the integration of automation and robotics, revolutionizing the way plants are propagated in vitro. This

trend is driven by the need for increased efficiency, scalability, and consistency in producing high-quality plant material. As the market is projected to grow at a significant rate, the adoption of advanced technologies is crucial in meeting the demands of a burgeoning global population and the challenges posed by traditional agricultural practices.

Automation in plant tissue culture utilizes automated systems to manage processes such as media preparation, inoculation, incubation, and tissue harvesting. These systems reduce manual labor and minimize human error, ensuring consistent and reliable outcomes. One of the key benefits of automation is its scalability. Traditional tissue culture methods are laborious and slow, restricting plant production volumes. Automated systems can handle large quantities of plant tissues concurrently, meeting the robust demand for disease-free, genetically uniform plants. This scalability is especially advantageous for commercial enterprises aiming to expand production capacity while maintaining high quality.

According to the May 2023 findings by Azo Robotics, Cytogration has developed a robotic system that conducts both cell culture and high throughput screening assays. This system can manage up to 504 multi-well plates across three incubators. It also automates processes such as plate coating, seeding, cell feeding, and incubation assays, all of which are essential for compound selection in drug discovery.

Robotic systems significantly enhance the efficiency of tissue culture processes by executing delicate tasks with exceptional precision. They are adept at handling the intricate manipulations involved in cutting, transferring, and culturing plant tissues, tasks that are typically prone to human error. This precision guarantees consistent treatment of each plant tissue, resulting in higher success rates in tissue culture experiments.

Additionally, the integration of robotics contributes to maintaining sterile conditions, which are crucial in tissue culture to prevent contamination. Robots can operate within controlled environments autonomously, minimizing the need for frequent human intervention and thereby reducing the risk of introducing contaminants. This capability is particularly vital for preserving culture integrity and ensuring the production of healthy plants.

The integration of automation and robotics in plant tissue culture not only enhances efficiency and precision but also yields substantial economic advantages. Automated systems diminish reliance on skilled labor, addressing scarcity and cost issues. This reduction in human intervention enables businesses to lower operational costs and

enhance profit margins.

These technologies facilitate improved resource management. Automated systems optimize the utilization of culture media, energy, and other inputs, thereby minimizing waste and promoting sustainability. This aligns with the increasing preference for sustainable agricultural practices and the demand for environmentally friendly production methods.

Segmental Insights

Component Insights

Based on Component, Media have emerged as the dominating segment in the Global Plant Tissue Culture Market in 2023. Media components serve as the foundational support system for plant tissue culture processes. They provide essential nutrients such as sugars, vitamins, amino acids, and minerals that are necessary for the growth and development of plant tissues under sterile conditions. Additionally, growth regulators like auxins and cytokinins are incorporated into media formulations to regulate cell division, differentiation, and organogenesis, enabling the production of healthy and vigorous plants.

The precise composition of media components is tailored to meet the specific nutritional requirements of different plant species and stages of growth. This customization ensures optimal growth conditions and enhances the efficiency of tissue culture techniques, thereby contributing to higher success rates in plant propagation and regeneration.

As the global demand for disease-free, high-quality plant material grows, the reliance on media components to produce uniform and healthy plants intensifies. Tissue culture techniques offer a reliable method for mass propagation of plants with desirable traits, and media components are essential for maintaining the health and vigor of propagated plants.

Ongoing advancements in biotechnology and plant science have led to the development of specialized media formulations that enhance the efficiency and efficacy of tissue culture processes. These innovations include the use of advanced growth regulators, synthetic media alternatives, and supplements that promote enhanced plant growth and development.

End Use Insights

Based on End Use, Agriculture have emerged as the fastest growing segment in the Global Plant Tissue Culture Market during the forecast period. One of the primary reasons for the increasing integration of plant tissue culture in agriculture is its ability to enhance crop productivity and quality. By leveraging tissue culture techniques, farmers can propagate high-quality plants with desirable traits such as disease resistance, improved yield, and uniformity. This precision in plant propagation minimizes the risks associated with traditional seed planting methods, ensuring a more consistent and reliable harvest. As global food demand escalates, particularly in regions experiencing population growth and dietary shifts, the demand for high-yield and resilient crop varieties becomes increasingly critical. Tissue culture enables the rapid multiplication of superior plant genetics, thereby supporting sustainable agricultural practices and food security initiatives worldwide.

Plant tissue culture plays a pivotal role in accelerating plant breeding programs and genetic improvement efforts. Traditional breeding methods often entail lengthy processes to develop new crop varieties with desired traits. In contrast, tissue culture offers a faster and more efficient alternative. By cultivating plant cells in controlled environments, researchers and breeders can expedite the selection and propagation of genetically superior plants. This agility in breeding programs allows for the timely development of crops tailored to specific environmental conditions, market preferences, and nutritional requirements. As agricultural producers strive to adapt to climate variability and optimize resource use, tissue culture emerges as a transformative tool for enhancing agricultural resilience and sustainability.

Beyond its applications in commercial agriculture, plant tissue culture contributes significantly to the conservation of genetic diversity and rare plant species. Many plant species face threats from habitat loss, climate change, and disease outbreaks. Tissue culture offers a viable strategy for preserving and propagating endangered plant species, thereby safeguarding biodiversity and supporting ecosystem resilience. Botanical gardens, conservation organizations, and research institutions utilize tissue culture techniques to establish ex-situ conservation programs and reintroduce endangered plants into their native habitats. This dual role of tissue culture in agriculture and conservation underscores its broader impact on environmental stewardship and biodiversity conservation efforts globally.

Regional Insights

Based on Region, Asia Pacific have emerged as the dominating region in the Global Plant Tissue Culture Market in 2023. Asia Pacific benefits from a strategic geographic advantage that supports its leadership in the plant tissue culture market. The region encompasses diverse climates and ecosystems, providing a rich biodiversity that serves as a valuable resource for plant tissue culture research and production. This diversity allows for the cultivation of a wide range of plant species, catering to both local and international market demands.

The region boasts a strong agricultural base with countries like China, India, and Southeast Asian nations playing pivotal roles in global food production. The increasing demand for high-yielding and disease-resistant crop varieties has spurred the adoption of advanced agricultural technologies, including plant tissue culture. This growing demand drives the expansion of plant tissue culture facilities and research institutions across Asia Pacific.

Asia Pacific has witnessed rapid technological advancements and infrastructure development, particularly in biotechnology and agriculture. Countries like Japan, South Korea, and Singapore are at the forefront of scientific research and innovation, investing heavily in biotechnological research and development. This investment fosters the growth of advanced tissue culture laboratories equipped with state-of-the-art facilities and skilled personnel.

The region offers cost-efficient production capabilities, making it an attractive destination for plant tissue culture operations. Lower labor costs, coupled with favorable regulatory environments in some countries, contribute to cost competitiveness. Additionally, the scalability of operations allows companies in Asia Pacific to meet large-scale production requirements efficiently, catering to both domestic and international markets.

Key Market Players

HiMedia Laboratories Pvt. Ltd

3R Biotech

Merck KGaA

Labland Biotech Private Limited

Melford Laboratories Ltd.

RUBI LABORATORIES, INC.

Phytoclone Inc

PhytoTech Labs, Inc.

Caisson Labs Inc.

Thomas Scientific LLC

Report Scope:

In this report, the Global Plant Tissue Culture Market has been segmented into the following categories, in addition to the industry trends which have also been detailed below:

Plant Tissue Culture Market, By Component:

- o Media
- o Reagents
- o Equipment & Containers

Plant Tissue Culture Market, By Plant Type:

- o Annual Plants
- o Biennial Plants
- o Perennial Plants

Plant Tissue Culture Market, By End Use:

- o Agriculture
- o Forestry and Botanical Garden
- o Gardening & Decoration
- o Research
- o Others

Plant Tissue Culture Market, By Region:

- o North America

- United States

- Canada

- Mexico

- o Europe

- France

- United Kingdom

- Italy

- Germany

- Spain

- o Asia Pacific

- China

India

Japan

Australia

South Korea

o South America

Brazil

Argentina

Colombia

o Middle East & Africa

South Africa

Saudi Arabia

UAE

Competitive Landscape

Company Profiles: Detailed analysis of the major companies present in the Global Plant Tissue Culture Market.

Available Customizations:

Global Plant Tissue Culture Market report with the given market data, Tech Sci Research offers customizations according to a company's specific needs. The following customization options are available for the report:

Company Information

Detailed analysis and profiling of additional market players (up to five).

Contents

1. PRODUCT OVERVIEW

- 1.1. Market Definition
- 1.2. Scope of the Market
 - 1.2.1. Markets Covered
 - 1.2.2. Years Considered for Study
 - 1.2.3. Key Market Segmentations

2. RESEARCH METHODOLOGY

- 2.1. Objective of the Study
- 2.2. Baseline Methodology
- 2.3. Key Industry Partners
- 2.4. Major Association and Secondary Sources
- 2.5. Forecasting Methodology
- 2.6. Data Triangulation & Validation
- 2.7. Assumptions and Limitations

3. EXECUTIVE SUMMARY

- 3.1. Overview of the Market
- 3.2. Overview of Key Market Segmentations
- 3.3. Overview of Key Market Players
- 3.4. Overview of Key Regions/Countries
- 3.5. Overview of Market Drivers, Challenges, Trends

4. IMPACT OF COVID-19 ON GLOBAL PLANT TISSUE CULTURE MARKET

5. GLOBAL PLANT TISSUE CULTURE MARKET OUTLOOK

- 5.1. Market Size & Forecast
 - 5.1.1. By Value
- 5.2. Market Share & Forecast
 - 5.2.1. By Component (Media, Reagents, Equipment & Containers)
 - 5.2.2. By Plant Type (Annual Plants, Biennial Plants, Perennial Plants)
 - 5.2.3. By End Use (Agriculture, Forestry and Botanical Garden, Gardening & Decoration, Research, Others)

- 5.2.4. By Region
- 5.2.5. By Company (2023)
- 5.3. Market Map

6. ASIA PACIFIC PLANT TISSUE CULTURE MARKET OUTLOOK

- 6.1. Market Size & Forecast
 - 6.1.1. By Value
- 6.2. Market Share & Forecast
 - 6.2.1. By Component
 - 6.2.2. By Plant Type
 - 6.2.3. By End Use
 - 6.2.4. By Country
- 6.3. Asia Pacific: Country Analysis
 - 6.3.1. China Plant Tissue Culture Market Outlook
 - 6.3.1.1. Market Size & Forecast
 - 6.3.1.1.1. By Value
 - 6.3.1.2. Market Share & Forecast
 - 6.3.1.2.1. By Component
 - 6.3.1.2.2. By Plant Type
 - 6.3.1.2.3. By End Use
 - 6.3.2. India Plant Tissue Culture Market Outlook
 - 6.3.2.1. Market Size & Forecast
 - 6.3.2.1.1. By Value
 - 6.3.2.2. Market Share & Forecast
 - 6.3.2.2.1. By Component
 - 6.3.2.2.2. By Plant Type
 - 6.3.2.2.3. By End Use
 - 6.3.3. Australia Plant Tissue Culture Market Outlook
 - 6.3.3.1. Market Size & Forecast
 - 6.3.3.1.1. By Value
 - 6.3.3.2. Market Share & Forecast
 - 6.3.3.2.1. By Component
 - 6.3.3.2.2. By Plant Type
 - 6.3.3.2.3. By End Use
 - 6.3.4. Japan Plant Tissue Culture Market Outlook
 - 6.3.4.1. Market Size & Forecast
 - 6.3.4.1.1. By Value
 - 6.3.4.2. Market Share & Forecast

- 6.3.4.2.1. By Component
- 6.3.4.2.2. By Plant Type
- 6.3.4.2.3. By End Use
- 6.3.5. South Korea Plant Tissue Culture Market Outlook
 - 6.3.5.1. Market Size & Forecast
 - 6.3.5.1.1. By Value
 - 6.3.5.2. Market Share & Forecast
 - 6.3.5.2.1. By Component
 - 6.3.5.2.2. By Plant Type
 - 6.3.5.2.3. By End Use

7. EUROPE PLANT TISSUE CULTURE MARKET OUTLOOK

- 7.1. Market Size & Forecast
 - 7.1.1. By Value
- 7.2. Market Share & Forecast
 - 7.2.1. By Component
 - 7.2.2. By Plant Type
 - 7.2.3. By End Use
 - 7.2.4. By Country
- 7.3. Europe: Country Analysis
 - 7.3.1. France Plant Tissue Culture Market Outlook
 - 7.3.1.1. Market Size & Forecast
 - 7.3.1.1.1. By Value
 - 7.3.1.2. Market Share & Forecast
 - 7.3.1.2.1. By Component
 - 7.3.1.2.2. By Plant Type
 - 7.3.1.2.3. By End Use
 - 7.3.2. Germany Plant Tissue Culture Market Outlook
 - 7.3.2.1. Market Size & Forecast
 - 7.3.2.1.1. By Value
 - 7.3.2.2. Market Share & Forecast
 - 7.3.2.2.1. By Component
 - 7.3.2.2.2. By Plant Type
 - 7.3.2.2.3. By End Use
 - 7.3.3. Spain Plant Tissue Culture Market Outlook
 - 7.3.3.1. Market Size & Forecast
 - 7.3.3.1.1. By Value
 - 7.3.3.2. Market Share & Forecast

- 7.3.3.2.1. By Component
- 7.3.3.2.2. By Plant Type
- 7.3.3.2.3. By End Use
- 7.3.4. Italy Plant Tissue Culture Market Outlook
 - 7.3.4.1. Market Size & Forecast
 - 7.3.4.1.1. By Value
 - 7.3.4.2. Market Share & Forecast
 - 7.3.4.2.1. By Component
 - 7.3.4.2.2. By Plant Type
 - 7.3.4.2.3. By End Use
- 7.3.5. United Kingdom Plant Tissue Culture Market Outlook
 - 7.3.5.1. Market Size & Forecast
 - 7.3.5.1.1. By Value
 - 7.3.5.2. Market Share & Forecast
 - 7.3.5.2.1. By Component
 - 7.3.5.2.2. By Plant Type
 - 7.3.5.2.3. By End Use

8. NORTH AMERICA PLANT TISSUE CULTURE MARKET OUTLOOK

- 8.1. Market Size & Forecast
 - 8.1.1. By Value
- 8.2. Market Share & Forecast
 - 8.2.1. By Component
 - 8.2.2. By Plant Type
 - 8.2.3. By End Use
 - 8.2.4. By Country
- 8.3. North America: Country Analysis
 - 8.3.1. United States Plant Tissue Culture Market Outlook
 - 8.3.1.1. Market Size & Forecast
 - 8.3.1.1.1. By Value
 - 8.3.1.2. Market Share & Forecast
 - 8.3.1.2.1. By Component
 - 8.3.1.2.2. By Plant Type
 - 8.3.1.2.3. By End Use
 - 8.3.2. Mexico Plant Tissue Culture Market Outlook
 - 8.3.2.1. Market Size & Forecast
 - 8.3.2.1.1. By Value
 - 8.3.2.2. Market Share & Forecast

- 8.3.2.2.1. By Component
- 8.3.2.2.2. By Plant Type
- 8.3.2.2.3. By End Use
- 8.3.3. Canada Plant Tissue Culture Market Outlook
 - 8.3.3.1. Market Size & Forecast
 - 8.3.3.1.1. By Value
 - 8.3.3.2. Market Share & Forecast
 - 8.3.3.2.1. By Component
 - 8.3.3.2.2. By Plant Type
 - 8.3.3.2.3. By End Use

9. SOUTH AMERICA PLANT TISSUE CULTURE MARKET OUTLOOK

- 9.1. Market Size & Forecast
 - 9.1.1. By Value
- 9.2. Market Share & Forecast
 - 9.2.1. By Component
 - 9.2.2. By Plant Type
 - 9.2.3. By End Use
 - 9.2.4. By Country
- 9.3. South America: Country Analysis
 - 9.3.1. Brazil Plant Tissue Culture Market Outlook
 - 9.3.1.1. Market Size & Forecast
 - 9.3.1.1.1. By Value
 - 9.3.1.2. Market Share & Forecast
 - 9.3.1.2.1. By Component
 - 9.3.1.2.2. By Plant Type
 - 9.3.1.2.3. By End Use
 - 9.3.2. Argentina Plant Tissue Culture Market Outlook
 - 9.3.2.1. Market Size & Forecast
 - 9.3.2.1.1. By Value
 - 9.3.2.2. Market Share & Forecast
 - 9.3.2.2.1. By Component
 - 9.3.2.2.2. By Plant Type
 - 9.3.2.2.3. By End Use
 - 9.3.3. Colombia Plant Tissue Culture Market Outlook
 - 9.3.3.1. Market Size & Forecast
 - 9.3.3.1.1. By Value
 - 9.3.3.2. Market Share & Forecast

- 9.3.3.2.1. By Component
- 9.3.3.2.2. By Plant Type
- 9.3.3.2.3. By End Use

10. MIDDLE EAST AND AFRICA PLANT TISSUE CULTURE MARKET OUTLOOK

- 10.1. Market Size & Forecast
 - 10.1.1. By Value
- 10.2. Market Share & Forecast
 - 10.2.1. By Component
 - 10.2.2. By Plant Type
 - 10.2.3. By End Use
 - 10.2.4. By Country
- 10.3. MEA: Country Analysis
 - 10.3.1. South Africa Plant Tissue Culture Market Outlook
 - 10.3.1.1. Market Size & Forecast
 - 10.3.1.1.1. By Value
 - 10.3.1.2. Market Share & Forecast
 - 10.3.1.2.1. By Component
 - 10.3.1.2.2. By Plant Type
 - 10.3.1.2.3. By End Use
 - 10.3.2. Saudi Arabia Plant Tissue Culture Market Outlook
 - 10.3.2.1. Market Size & Forecast
 - 10.3.2.1.1. By Value
 - 10.3.2.2. Market Share & Forecast
 - 10.3.2.2.1. By Component
 - 10.3.2.2.2. By Plant Type
 - 10.3.2.2.3. By End Use
 - 10.3.3. UAE Plant Tissue Culture Market Outlook
 - 10.3.3.1. Market Size & Forecast
 - 10.3.3.1.1. By Value
 - 10.3.3.2. Market Share & Forecast
 - 10.3.3.2.1. By Component
 - 10.3.3.2.2. By Plant Type
 - 10.3.3.2.3. By End Use

11. MARKET DYNAMICS

- 11.1. Drivers

11.2. Challenges

12. MARKET TRENDS & DEVELOPMENTS

12.1. Recent Developments

12.2. Product Launches

12.3. Mergers & Acquisitions

13. GLOBAL PLANT TISSUE CULTURE MARKET: SWOT ANALYSIS

14. PORTER'S FIVE FORCES ANALYSIS

14.1. Competition in the Industry

14.2. Potential of New Entrants

14.3. Power of Suppliers

14.4. Power of Customers

14.5. Threat of Substitute Product

15. COMPETITIVE LANDSCAPE

15.1. HiMedia Laboratories Pvt. Ltd

15.1.1. Business Overview

15.1.2. Company Snapshot

15.1.3. Products & Services

15.1.4. Financials (As Reported)

15.1.5. Recent Developments

15.2. 3R Biotech

15.3. Merck KGaA

15.4. Labland Biotech Private Limited

15.5. Melford Laboratories Ltd.

15.6. RUBI LABORATORIES, INC.

15.7. Phytoclone Inc

15.8. PhytoTech Labs, Inc.

15.9. Caisson Labs Inc.

15.10. Thomas Scientific LLC

16. STRATEGIC RECOMMENDATIONS

17. ABOUT US & DISCLAIMER

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