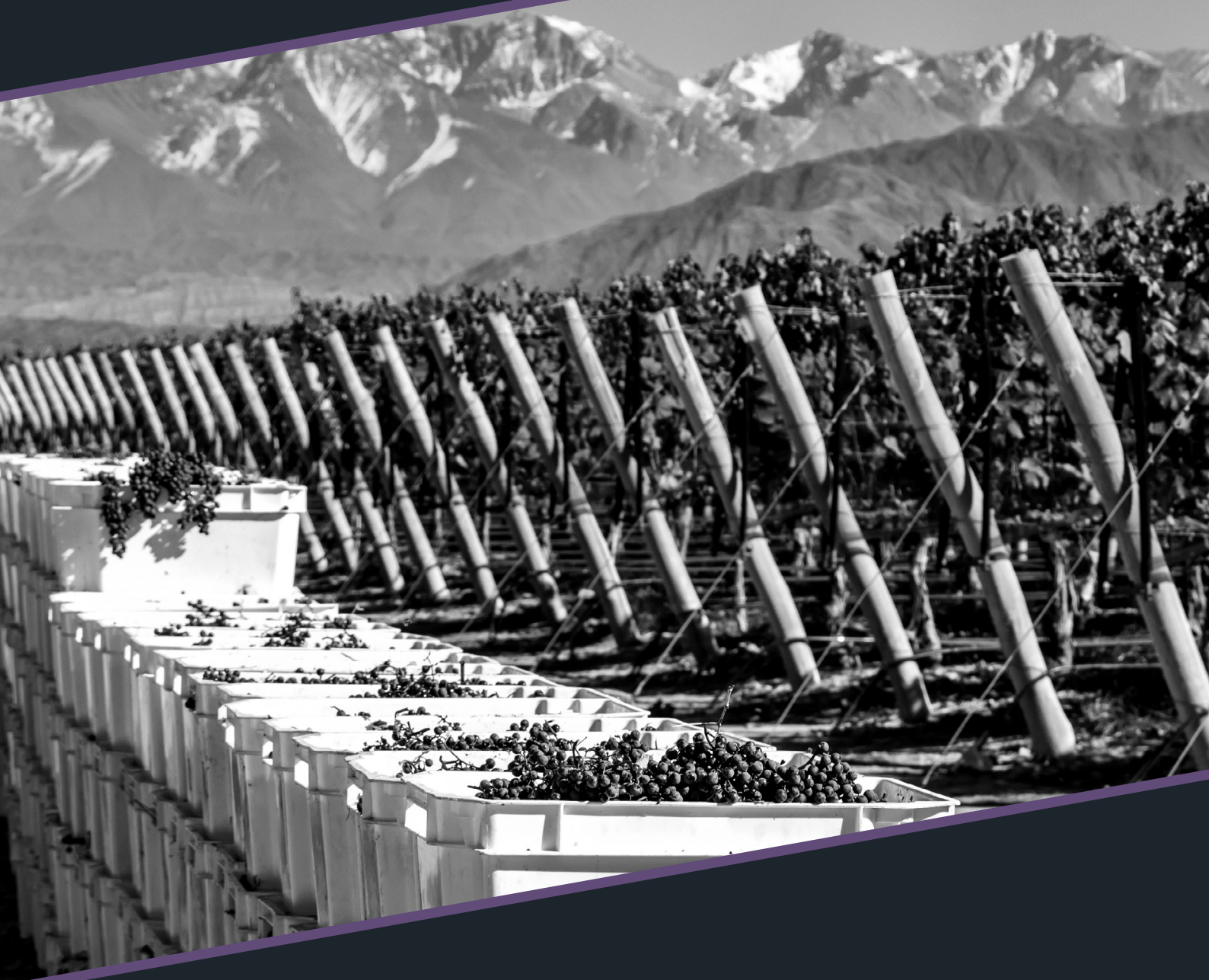




Australian Government

IP Australia

Patent Analytics Hub



# A Growing South: Patent analytics on plant biotechnology in Latin America

June 2021



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## SUMMARY

This report analyses plant biotechnology patents originating in Latin America as an indication of the commercial interests and expertise in the region. It examines overall patent family numbers, market destinations and crossovers between biotechnology and other technologies.

Patent data spanning 2000 to 2018 shows that overall innovation in plant biotechnology has been growing in Latin America since 2000.



Since 2000 there have been **402 plant biotechnology** patent families **originating in Latin America**



Patent family **filings** in plant biotechnology originating in Latin America have **increased steadily since 2000**



Of the 402 patent families, **166** (41 per cent) are directed to **genetically modified plants**



**Brazil** produced the **most patent families** directed to plant biotechnology **in Latin America**



The **United States** is the **largest destination** market in the world **for plant biotechnology** patent families **originating in Latin America**



**Australia** ranks **on a par with China and Argentina** as a **destination market**

# INTRODUCTION

IP Australia is dedicated to building prosperity for Australia and ensuring that Australians benefit from great ideas. Using patent analytics to provide evidence of innovation, we leverage our unique access to IP data, knowledge and expertise to deliver value to the broader economy.

This report has been written for the International and Astronomy Branch, Science and Commercialisation Division, in the Australian Government Department of Industry, Science, Energy and Resources. Its purpose is to examine innovation in plant biotechnology originating in Latin America. Understanding trends in patents that originate in a region can show levels of commercial innovation and know-how and capability in that region.

## What is plant biotechnology?

Humans have been altering plants through domestication, cross-breeding and selective breeding for over 10 000 years. This has created new species and subspecies of plants, many of which have fuelled the rise of civilisations. Plant biotechnology is a modern version of this ancient practice that uses scientific methods to alter agricultural plants and organisms. Using techniques such as genetic modification, laboratory culture and phenotype modification, plant biotechnology allows more precision and complexity in the development of new plant species and subspecies.

In this report, plant biotechnology is defined as technologies for “new plants or processes for obtaining them; plant reproduction by tissue culture techniques.”<sup>1</sup> This is the definition of Cooperative Patent Classification (CPC) A01H. All patents applications are classified according to the CPC by patent offices, providing a reliable means to identify technology-specific patents in large international data sets that overcomes difficulties associated with language differences.

Plant biotechnology has become an increasingly important part of global supply chains and

ecosystems. The dual impact of climate change and population growth means we are feeding more people with less arable land and more extreme weather patterns than ever before. Plant biotechnology offers both financial and humanitarian solutions to some of the challenges we face. From disease resistant bananas to high yield wheat, plant biotechnology has the potential to lead to safer, more efficient use of land and increase profitability. The commercial seed market for genetically modified (GM) crops (one subcategory of plant biotechnology) was worth over US\$20bn in 2018 alone.<sup>2</sup>

## Why patent data?

Patents can be used as indicators of innovative activity. By extracting and analysing data associated with patent documents, we can measure aspects of inventive activity such as scope, intensity, collaboration and impact. These metrics can be developed across technology sectors and by measures including individuals (inventors), institutions (applicants) and regions.

Patents are granted for devices, substances, methods or processes that are new, inventive and useful, giving exclusive commercial rights in exchange for full public disclosure of the invention. This means patents are a source of data on innovation trends in science and technology. More information about the patent system is given in Appendix A: Definitions.

The patent families analysed in this report have been identified as having at least one applicant originating from Latin America. Applicants are entities (often corporations or universities) that file the patented applications, and are therefore commercially involved in the patented technology. The address of applicants indicates locations of commercial innovation in that technology.

<sup>1</sup> [https://worldwide.espacenet.com/classification?locale=en\\_ep#/CPC=A01H](https://worldwide.espacenet.com/classification?locale=en_ep#/CPC=A01H)

<sup>2</sup> <https://www.fortunebusinessinsights.com/industry-reports/genetically-modified-seeds-market-100389>



# PLANT BIOTECHNOLOGY

## Overview

As the basis for this report, the PATSTAT global database (2019 Autumn edition) was searched for inventions relating to plant biotechnology filed by applicants originating from Latin American countries. The search found 402 unique INPADOC patent families (see Appendix A: Definitions) relating to plant biotechnology filed worldwide by Latin American applicants since 2000. The search strategy used a combination of keywords, International Patent Classification (IPC) symbols and CPC symbols (Appendix B: Search Strategy).

## Timeline

Analysing patent family filings across time can indicate growth or decline in innovation or interest in a technology. Figure 1 shows the number of patent

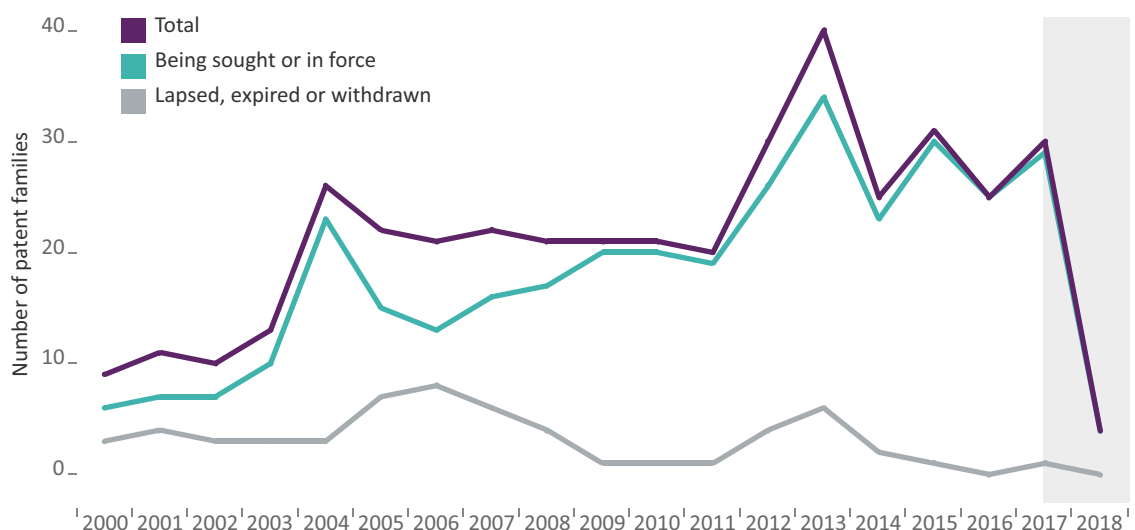
families filed each year, both in total and by their legal status. The number of patents in an active state (i.e. that are either in force or for which protection is being sought, and are not lapsed, expired or withdrawn) provides an indication of whether applicants are continuing to protect their inventions.

Since 2000 patent filings related to plant biotechnology by Latin American applicants has steadily increased indicating a growing interest and capability in plant biotechnology innovation for this region. Patent filings peaked in 2013 (40 patent families) which saw 13 patent filings by Mexican applicants, 12 by applicants from Brazil and seven by applicants from Argentina. The highest number for filings for any country in a year is 18 filings from Costa Rica in 2004, the majority of which are for new plants in the *Impatiens* genera.

**Figure 1: Patent families relating to plant biotechnology in Latin America, by current legal status and earliest priority year, 2000-18**

(Note: the data is not complete after 2016 due to the delay in patent publication. The decline from 2017-2018 may be caused by this delay and is not indicative of a trend).

Source: PATSTAT 2019 Spring Edition



## Filing destinations

The commercial markets or manufacturing destinations for inventions in any technology can be indicated by the jurisdictions in which patent applications are filed. Applicants must file patent applications in each patent jurisdiction where they wish to have patent protection. Figure 2 lists the top 20 filing jurisdictions for patent families relating to plant biotechnology with a Latin American applicant. Also included in this figure is a map highlighting all jurisdictions where patents have been filed.

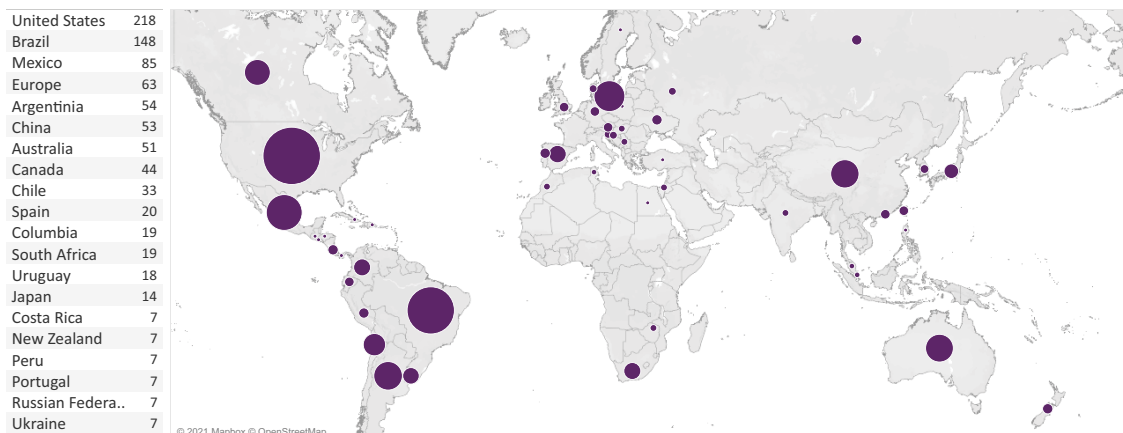
Patent Cooperation Treaty (PCT) filings (141 patent families) were excluded from Figure 2 because they do not represent an enforceable right in any jurisdiction. European patents are enforceable in

designated contracting states to the European Patent Convention at the date of filing of the application and are included in this analysis.

The single largest destination market for plant biotechnology patents with a Latin American applicant is the United States (218 patent families). Australia, with 51 filings, is the third most popular destination market outside of the Americas. This indicates the value of the Australian market to Latin American plant biotechnology patent applicants. Patent protection in China, with 53 filings, is valued at similar levels by Latin American plant biotechnology patent applicants as Australia as a target destination.

Figure 2: Latin American patent family filings relating to plant biotechnology by filing jurisdiction, 2000-18

Source: PATSTAT 2019 Spring Edition



## Applicant origin

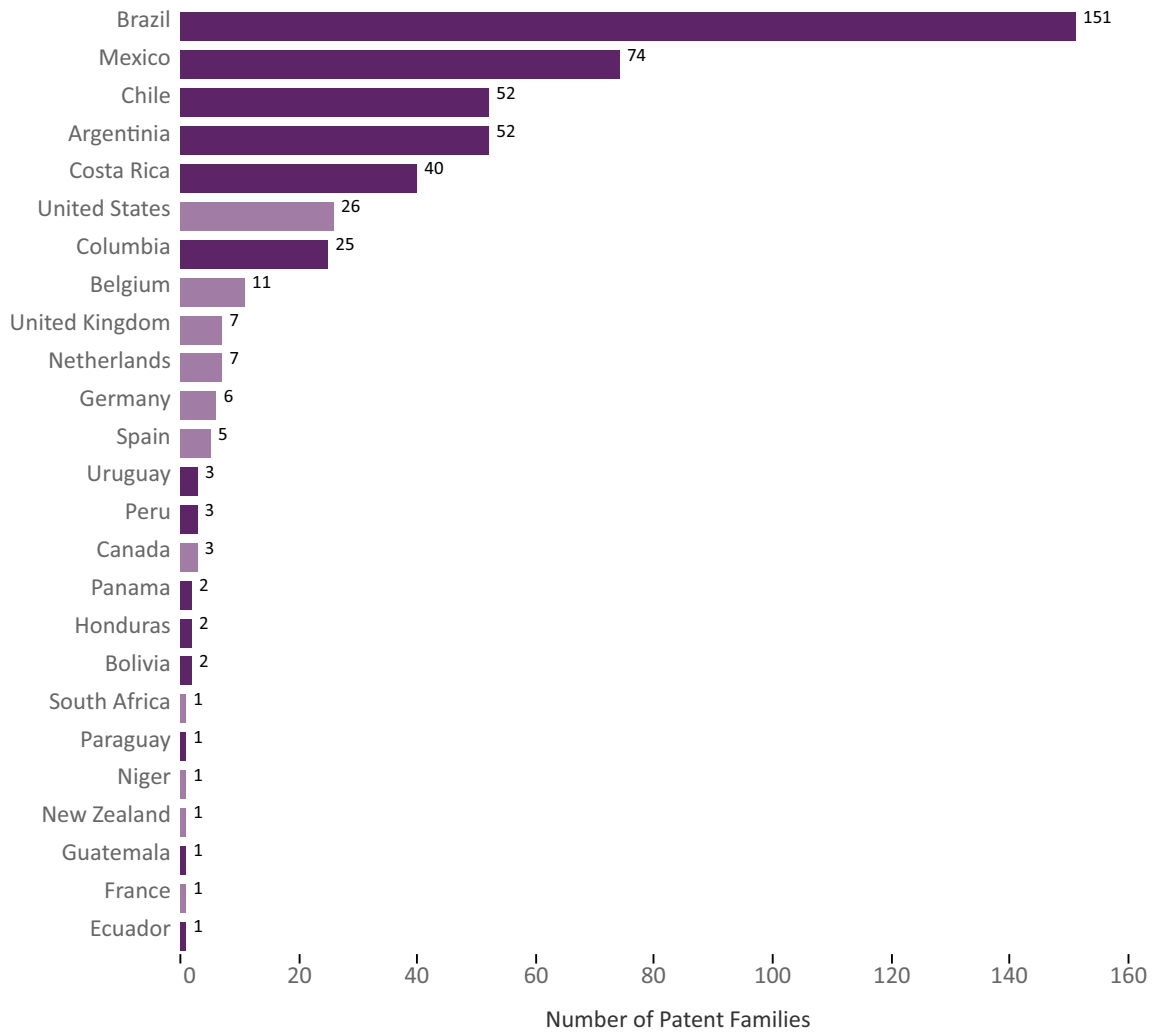
Analysis of patent family applicant address indicates origins of investment or interest in a specific area of innovation. Figure 3 shows applicant origin locations with the highest number of patent family filings relating to plant biotechnology.

The top five countries filing patents in plant biotechnology are Brazil, Mexico, Chile, Argentina and Costa Rica. Brazil is the dominant applicant origin for this technology field, with a total of 151 patent family filings or 38 per cent of total patent filings originating there.

Countries outside of Latin America are included when applicants from these countries co-file patents with Latin American applicants. These co-filings can be an indicator of international collaboration. The United States is the most common non-Latin American country of applicant origin, followed by Belgium, the United Kingdom, Netherlands, Germany and Spain. More detailed information on applicants from these countries can be found in the Collaborations section of this report.

Figure 3: Patent family filings relating to plant biotechnology, by applicant origin, 2000-18<sup>3</sup>

Source: PATSTAT 2019 Spring Edition



**Top applicants**

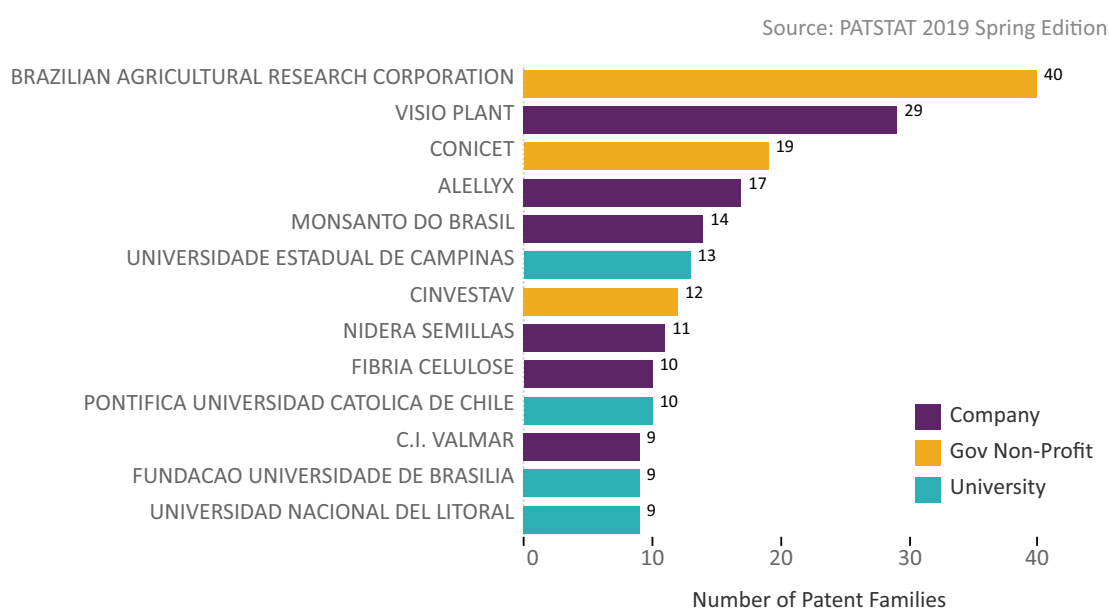
Entities file patent applications to protect their ideas and products. The number of patent families filed by an applicant in a specific technology can indicate their interest and market presence or a desire to build and maintain a market share.

The top 13 Latin American applicants for inventions relating to plant biotechnology are shown in Figure 4. Six of the top 13 applicants were from Brazil and include the Brazilian Agricultural Research Corporation, Alellyx, Monsanto Do Brasil, Universidade Estadual De Campinas, Fibria Celulose and Funacao Universidade De Brasilia.

Three of the top 13 applicants were from Argentina and include CONICET, Nidera Semillas, Universidad Nacional Del Litoral. Other top applicants include Visio Plant from Costa Rica, CINVESTAV from Mexico, Pontifica Universidad Catolica De Chile from Chile, CI Valmar from Columbia.

<sup>3</sup> If a single patent filing has applicants from different locations, the patent will be counted once for every applicant origin listed on the patent

Figure 4: Patent family filings relating to plant biotechnology by applicants from Latin American countries, 2000-18



### Brazilian Agricultural Research Corporation

The Brazilian Agricultural Research Corporation (Embrapa) is the top ranked applicant identified in this field, with 40 patent families filed since 2000. Founded in 1973, Embrapa is a state-owned research corporation affiliated with the Brazilian Ministry of Agriculture, Livestock and Food Supply. With an established international cooperation network, they currently have partnerships in every continent and are the top co-filing Latin American applicant in plant biotechnology.<sup>4</sup> Their peak filing period was nine patent families filed in 2012.

### Visio Plant

There is limited information on the applicant Visio Plant. Each of 29 patent families filed by Visio Plant contain a single plant patent filed in the United States. The inventor named on these patents was Ludwig Kientzler and both addresses correspond to InnovaPlant de Costa Rica SA, a subsidiary of the plant breeding company Kientzler GmbH & Co. KG which has its headquarters in Gensingen, Germany.

### CONICET

The National Scientific and Technical Research Council (Consejo Nacional de Investigaciones Científicas y Técnicas, CONICET) is an Argentine government agency that directs and coordinates most of the scientific and technical research done in public universities and institutes. Established in 1958, its activity covers four primary areas of knowledge: Agrarian, Engineering and Material Sciences; Biological and Health Sciences; Exact and Natural Sciences; and Social Sciences and the Humanities.<sup>5</sup>

### Alellyx

Alellyx Applied Genomics Ltda is an applied genomics company founded in 2002 and based in Campinas, Brazil. Its research is focused on developing biotechnology traits for eucalyptus, citrus and sugarcane. The company's location and expertise in Brazil are especially important for sugarcane, as Brazil is the world's largest producer of sugarcane, the largest exporter of finished sugar, and the world's second-largest producer of ethanol after the United States.<sup>6</sup> Alellyx Applied Genomics Ltda was acquired by Monsanto in 2008.<sup>7</sup> In 2018, Monsanto was acquired by BayerAG.<sup>8</sup>

<sup>4</sup> Embrapa, International operations <https://www.embrapa.br/en/international-operations>

<sup>5</sup> Conicet, Description <https://www.conicet.gov.ar/about-the-conicet/?lan=en>

<sup>6</sup> CB Insights, Alellyx <https://www.cbinsights.com/company/alellyx>

<sup>7</sup> LinkedIn, Alellyx Applied Genomics Ltda <https://www.linkedin.com/company/alellyx>

<sup>8</sup> Bayer History <https://www.bayer.com/en/history/2010-2018>



## Monsanto Do Brasil

Monsanto Do Brasil was a subsidiary of the multinational company Monsanto, as acquired by BayerAG in 2018.<sup>9</sup> Patent families filed by Monsanto Do Brasil have been listed in the PATSTAT database as originating from Brazil and therefore have been included here. All patent families identified in this dataset were filed by Monsanto Do Brasil between 2003 to 2008, with most being directed to transgenic technologies.

## Universidade Estadual De Campinas

Universidade Estadual De Campinas (University of Campinas/UNICAMP) is a public research university in the state of Sao Paulo, Brazil. It is consistently ranked among the top universities in Latin America. The university has 1800 faculties, with a large research output - close to 10% of all indexed scientific papers in Brazil have a UNICAMP co-author. In addition, UNICAMP is the Brazilian organisation with the largest technological output, with over 50 patent applications filed each year since 2002<sup>9</sup>. Its strong research focus is reflected by the number of graduate students, accounting for 48 per cent of its student body.<sup>10</sup>

## CINVESTAV

The Centre for Research and Advanced Studies of the National Polytechnic Institute (CINVESTAV) is a Mexican decentralised public body with its own legal entity and assets.<sup>11</sup> It receives an annual subsidy from the federal government to fund its operations. Consisting of 28 research departments, the Department of Biotechnology and Biochemistry is located in the Irapuato Campus.<sup>12</sup>

## Nidera Semillas

Nidera Semillas is an important seed supply company with a presence in Brazil, Argentina, Uruguay and Paraguay. The company holds its own research and processing facilities that focus on high yielding corn, soy, sunflower and wheat varieties. In 2018, Nidera Semillas was acquired by Syngenta, a multinational company now owned by the China National Chemical Corporation.<sup>13</sup>

## Fibria Celulose

Fibria Celulose is a Brazilian-based pulp and paper company, created by a merger between Aracruz Celulose and Votorantim Celulose e Papel.<sup>14</sup> It produces, sells and exports eucalyptus short fibre pulp for manufacturing toilet, uncoated and coated paper products.<sup>15</sup> Additionally, the company is engaged in eucalyptus cultivation.<sup>16</sup>

## Pontifica Universidad Catolica de Chile

Established in 1888, Pontifica Universidad Catolica de Chile is one of six private Catholic institutions in Chile. Ranked among the 250 best universities in the world and second at a regional level, it is an important national centre for research on social sciences, natural sciences, health, economics, agriculture, philosophy, theology, arts and literature.<sup>17</sup>

<sup>9</sup> Top Universities, Universidade Estadual de Campinas (Unicamp) <https://www.topuniversities.com/universities/universidade-estadual-de-campinas-unicamp#289590>

<sup>10</sup> The University of Campinas <http://www.internationaloffice.unicamp.br/hotsite/>

<sup>11</sup> Cinvestav, Know us <https://www.cinvestav.mx/Con%C3%B3cenos>

<sup>12</sup> Cinvestav, Unidad Irapuato <http://www.ira.cinvestav.mx/Investigaci%C3%B3n/Biotecnolog%C3%ADayBioqu%C3%ADmica/tabid/92/language/es-MX/Default.aspx>

<sup>13</sup> <https://www.syngenta.com/en/company/media/syngenta-news/year/2018/syngenta-completes-acquisition-nidera-seeds-cofco>

<sup>14</sup> Water Action Hub, Fibria Celulose <https://wateractionhub.org/organizations/804/d/fibria-celulose-sa/>

<sup>15</sup> Bloomberg, Fibria Celulose <https://www.bloomberg.com/profile/company/VCP:US>

<sup>16</sup> Cruchbase, Fibria Celulose <https://www.crunchbase.com/organization/fibria-celulose-s-a>

<sup>17</sup> Universitas 21, Pontificia Universidad Catolica de Chile <https://universitas21.com/u21-members/our-members/pontificia-universidad-catolica-de-chile>

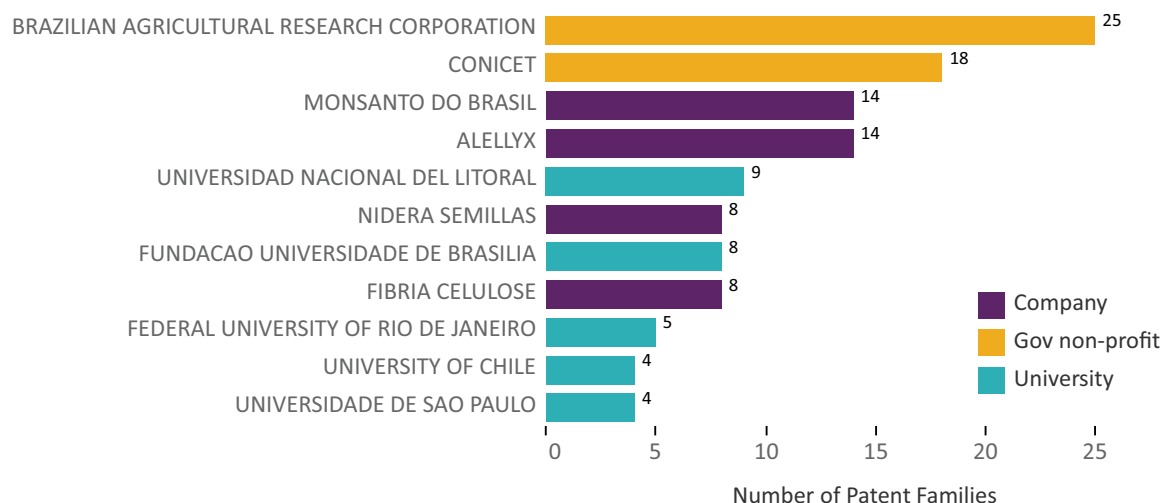


## Collaborations

Co-filing applicants on a patent can be used as a proxy indicator for collaboration. The top co-filing applicants from Latin America in technology relating to plant biotechnology are shown in Figure 5.

Figure 5: Top co-filing Latin American applicants in plant biotechnology, 2000-18

Source: PATSTAT 2019 Spring Edition



The Brazilian Agricultural Research Corporation was the overall leading patent filer for this technology, and was also the top collaborating applicant. Within Latin America, they most commonly collaborate with Fundacao Universidade De Brasilia (eight patent families), Federal University Of Rio De Janeiro (two patent families) and the Instituto Agronomico De Campinas (two patent families). Internationally, the Brazilian Agricultural Research Corporation has collaborated with Katholieke Universiteit Leuven (four patent families), United States Department of Agriculture (two patent families) and Texas A & M University System (one patent family).

CONICET are the third highest patent filer in this technology and have collaborated with several Latin American entities including Universidad Nacional Del Litoral (nine patent families), Bioceres (three patent families) and the University of Buenos Aires, the Universidad Nacional De Rosario, the Instituto Nacional De Tecnologia Agropecuaria and Estacion Experimental Agroindustrial Obispo Colombres each with two patent families. International collaborators include Plant Bioscience (six patent families), INIS Biotech (two patent families) and Advanta International (one patent family).

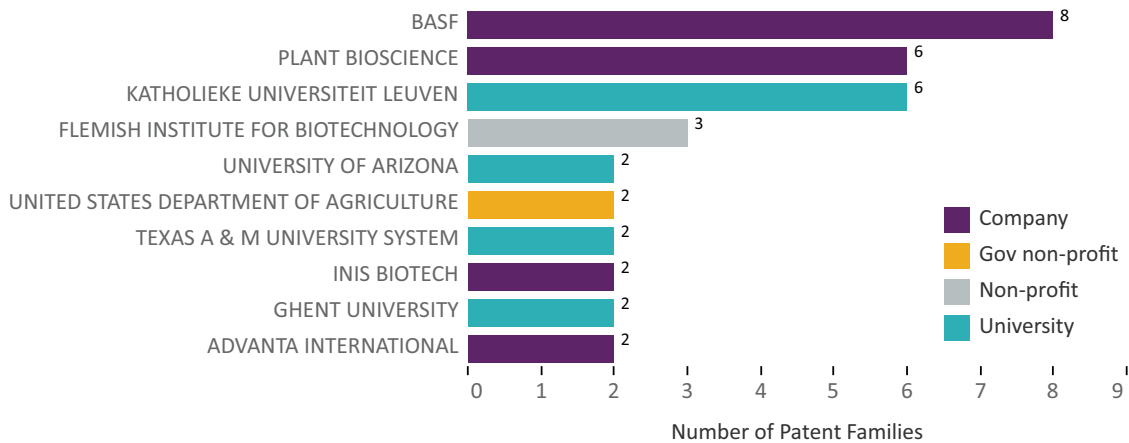
Alellyx, the third highest patent filer in this technology, collaborated with Monsanto Do Brasil on 14 patent families. Eight of these families also included Fibría Celulose as an additional co-filing applicant.

The top international applicants that co-filed with applicants from Latin America are shown in Figure 6. BASF (Badische Anilin & Soda Fabrik) was the leading international collaborator with six patent families co-filed with Nidera Semillas and one patent family co-filed with the Brazilian Agricultural Research Corporation and one with Instituto Nacional De Tecnologia Agropecuaria.

Of the applicants from North America, the University of Arizona collaborated with the Universidad Nacional Autonoma De Mexico on two patent families, the United States Department of Agriculture collaborated with the Brazilian Agricultural Research Corporation, and the Texas A&M University System collaborated with the Brazilian Agricultural Research Corporation (one patent family) and the Instituto Tecnológico Y De Estudios Superiores Monterrey (one patent family).

Figure 6: Top co-filing international applicants with Latin American patent applicants in plant biotechnology, 2000-18

Source: PATSTAT 2019 Spring Edition



### Australian collaborators

In this study, we have not identified any patents co-filed with applicants originating from Australia and from Latin America since 2000. Prior to 2000, there was one patent family co-filed by applicants from Australia (Molecular Plant Breeding Nominees, Southern Cross University, South Australian Research and Development Institute, Department Of Natural Resources And Environment Victoria, University Of Adelaide) and Mexico (International Maize and Wheat Improvement Centre). This patent (AU7246800) was directed to molecular markers in ryegrasses and fescues.

### Technology overview

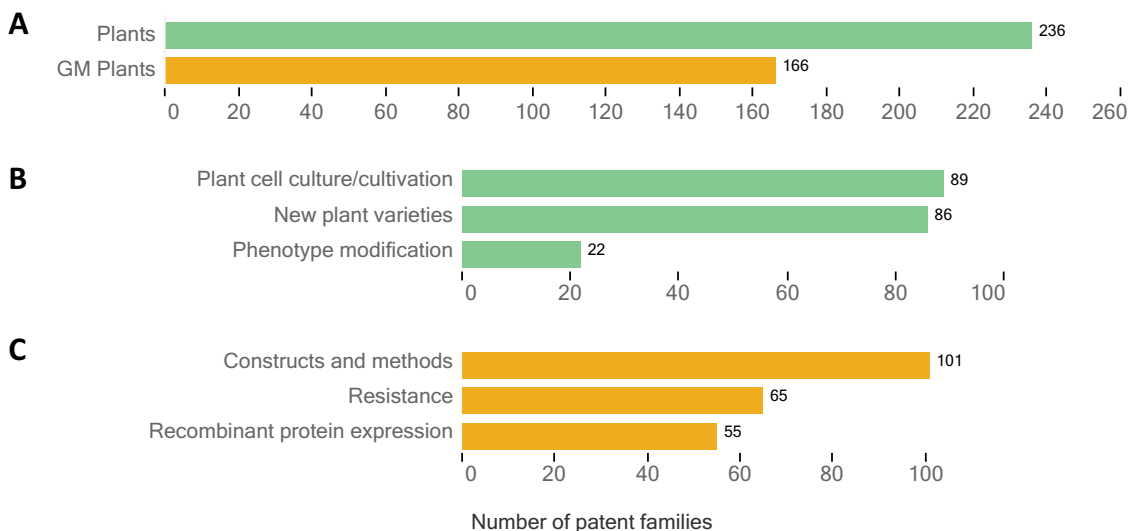
Analysing the technical content of patents can provide more granular insights into specific technology areas. All patent families identified in this analysis as originating in Latin America and related to plant biotechnology were classified into two broad technology categories; plants, containing 236

patent families and GM plants, contain 166 patent families (Figure 7A). The top applicants for patents directed to plant technologies are Viso Plant (29 patent families), C. I. Valmar (nine patent families) and the Brazilian Agricultural Research Corporation and Athena Mudás both with six patent families. The top applicants for patents directed to GM plants are the Brazilian Agricultural Research Corporation (34 patent families), Alellyx (17 patent families), CONICET (15 patent families) and Monsanto Do Brasil (14 patent families).

Within each broad category, a number of subcategories were identified. Because patents can be classified as containing more than one technology, our analysis was performed using a non hierarchical system allowing overlap in technology classifications for each patent. As a result, each patent can belong to multiple subcategory classifications. The top subcategories for Plants and GM plants are shown in Figure 7B and Figure 7C respectively. These are discussed in more detail below.

Figure 7: Patent family filings relating to plant biotechnology by technology category, 2001-18

Source: PATSTAT Autumn 2019



## Plants

**Plant cell culture/cultivation** – this subcategory contains patents that are mainly directed to micropropagation or cultivation processes for a range of diverse plant varieties. Universities make up eight of the top 10 applicants in this subcategory. Examples of patent applications in this category include:

WO2017089957 - Method for propagation of woody plants from leaf cuttings

US2019100726 - Method to obtain vegetable fibres from the isolation and cultivation of meristematic cells

WO2018057031 - Production of biomass in ultra high density plantations.

**New plant varieties** – this subcategory includes patents directed to new varieties flowering garden plants such as New Guinea Impatiens plants (25 patent families filed by Visio Plant) and Alstromeria plants (8 patent families filed by C. I. Valmar). Patents were also directed to other plant varieties of agricultural significance including grape vines, blackberries, avocados, nectarines, lemons and apples. Examples of patent applications in this category include:

USPP23222 - New Guinea Impatiens plant named Vinflavimp

USPP22009 - Alstroemeria plant named 'Jasoa'.

**Phenotypic modification** - this subcategory includes patents that are mainly directed to processes for inducing and selecting phenotypic changes in plant varieties without using genetic engineering. Examples of patent applications in this category include:

WO2013050950 - Method for monitoring, diagnosis and/or prognosis of hypoxia related disorders using nfat5

MX2017000405 - Method to induce genetic variability in vanilla spp.

## GM plants

**Constructs and methods** – this subcategory includes patents that are directed to various nucleic acid sequences, vectors and methods used for the production of transgenic plants. The top applicants for this category include the Brazilian Agricultural Research Corporation (17 patent families), Allelyx (15 patent families) and Monsanto Do Brasil (12 patent families). Examples of patent applications in this category include:

US2016281101 - Compositions and methods containing a specific leaf promoter to modify the expression of genes of interest in plants

US2010005539 - Compositions and methods for modifying gene expression using the promoter of ubiquitin conjugating protein coding gene of soybean plants.

**Resistance** – this subcategory includes patents that are directed to transgenic plants and methods of producing transgenic plants that display increased resistance to chemicals (such as herbicides or pesticides), resistance to pests and increased tolerance to environmental stress. The top applicants for this category include the Brazilian Agricultural Research Corporation (17 patent families), BASF (7 patent families) and Universidad Nacional Del Litoral, Nidera Semillas and CONICET each with six patent families. Examples of patent applications in this category include:

US2018103600 - Polynucleotides and methods for transferring resistance to asian soybean rust

US2016002660 - HAHB11 provides improved plant yield and tolerance to abiotic stress

US2015181873 - Herbicide-resistant sunflower plants, polynucleotides encoding herbicide-resistant aceto hydroxy acid synthase large subunit proteins, and methods of use.

**Recombinant protein expression** – this subcategory includes patents that are directed to transgenic plants that express foreign genes. Examples of patent applications in this category include:

US2017362601 - Chimeric proteins which enhance the activity of DNA binding domains (dbd) and transcription factors in plants

US2017283818 - Compositions and methods for producing starch with novel functionality





## CONCLUSION

This report has examined plant biotechnology patents originating in Latin America. We identified 402 patent families filed globally since 2000. Steady filing activity over time for plant biotechnology patents indicates this is an area of ongoing active innovation. Overall, patent filing activity for plant biotechnology originating in Latin America has been consistent since 2004 indicating this technology is an active area for innovation for this region.

Most patent filings (236 patent families) were directed to new plant varieties and micropropagation or cultivation processes for non-transgenic plants. A total of 166 patent families were directed to GM plants or various nucleic acid sequences, vectors and methods used for their production.

The most prolific patent filing Latin American country was Brazil with 151 patent families. The Brazilian Agricultural Research Corporation was the top filing applicant with 40 patent families filed since 2000.

The largest destination market for plant biotechnology patents filed by Latin American applicants is the United States (218 patent families). Australia, with 51 filings, is the third most popular destination market outside of the Americas.

This technology sector benefits from international collaboration and is of global interest. While this study did not identify co-filing collaborations between entities from Latin America and Australia, academic research and further collaboration may build Australia's position in this sector.



## APPENDIX A: DEFINITIONS

### Patents, applications and publications

A patent is a right that is granted for any device, substance, method or process that is new, inventive and useful. Australian patent rights are legally enforceable and give the owner, or patentee, exclusive rights to commercially exploit the invention in Australia for a period of up to 20 years. In this report, an application refers to a single patent filing. A patent application is usually published within 18 months of its earliest filing date (also known as the priority date). We consider that the priority date is most relevant for our analysis as it is the closest date to that when the invention occurred.

There are two major routes for filing a patent application: the international route and direct filing. The international route involves filing a PCT application, which establishes a filing date in all 152 contracting states.<sup>18</sup> Subsequent prosecution at national patent offices, referred to as national-phase entry, is made at the discretion of the applicant. A patent can only be enforced once it has been granted and a PCT application must enter the national-phase to proceed towards grant. Alternatively, applications can be filed directly in the jurisdictions of interest.

A patent application is in force when it has not lapsed (due to expiry or non-payment of renewal fees), been revoked or withdrawn. Data was taken from the most recent legal status action in the PATSTAT database. A family has been designated as being in force if it contains at least one in force application.

### Patent families

Applications with the same priority document, but filed in different jurisdictions, are known as patent families. Patent families enable us to analyse inventive activity regardless of the number of jurisdictions in which protection is sought. Patent families are used in analytics to represent a single invention. We determine patent families based on INPADOC database definition, with a unique family ID for patents that share a common priority document.<sup>19</sup> The number of patent families is typically used as a metric. There are some exceptions when reporting individual applications, as each application represents a legal right in an individual jurisdiction. When analysing applicants, related commercial entities are grouped by a single, harmonised name. When individual publication numbers are quoted, we have chosen a representative publication from the patent family, typically US or WO English language documents.

### Classification

Patents are classified by technology into the hierarchical IPC or CPC systems. The CPC began in 2013 and provides significantly more depth to the hierarchy of the IPC.<sup>20</sup> For more information on the coverage of the CPC, see the CPC Annual Report 2017-18.<sup>21</sup>

<sup>18</sup> WIPO, [www.wipo.int/pct/en/pct\\_contracting\\_states.html](http://www.wipo.int/pct/en/pct_contracting_states.html)

<sup>19</sup> Martinez, 'Insight into Different Type of Patent Families', OECD Science, Technology and Industry Working Papers, No. 2010/2, OECD Publishing, Paris; see section 3.2, 'Extended families'.

<sup>20</sup> European Patent Office and United States Patent and Trademark Office, [www.cooperativepatentclassification.org/](http://www.cooperativepatentclassification.org/)

<sup>21</sup> EPO and USPTO, <http://www.cooperativepatentclassification.org/publications/AnnualReports/CPCAnnualReport20172018.pdf>

## Country of origin

Many records in the PATSTAT database (around 50 per cent) do not have any associated country code information for applicants/inventors. In previous patent analytics studies, null data has generally been excluded from the country of origin analysis.

In this patent analytics report, we have used other data available in PATSTAT to provide additional insights for patent families that do not have applicant origin data available. This method of country code assignment leverages all data from the entire PATSTAT database, and not only country codes information from a subset of the data extracted for a specific technology area.

The country of origin of a patent family is assigned using a three-step process.

1. Where country code is available for applicant data, this is used as the country of origin.
2. If the country code is 'null' and the applicant name is associated with a standardised or cleaned version of their name (e.g. the PATSTAT standardised PSN name), there may be several versions of an associated applicant name with several entries for country code. A count of the total number of applications applied for with each country code is used to determine the most representative country and that is applied. This is an independently developed technique analogous to the technique detailed by the European Commission.<sup>22</sup>
3. If the country code for the standardised name is 'null' or where no applicant details are recorded for the patent application, then the first application authority is used. This is the country the earliest priority document was filed into for the patent family and it is used as a country of origin. This authority is the first by date where the authority is a country and not an international body. For international applications, the receiving office is used where possible.

It is important to note that as patent families are used, most families that are filed internationally have reliable country code data, either through World Intellectual Property Organisation, European Patent Office, United States Patent and Trademark Office, or other large patent offices. Applicants that often file internationally will have standardised name-associated country information for the same reason, even for local applications. The first application authority is therefore generally only used as a proxy for origin in the case of patent families that are filed to one jurisdiction only, increasing the probability that the country is correctly assigned.

<sup>22</sup> Pasimèni, F. (2019) SQL query to increase data accuracy and completeness in PATSTAT, World Patent Information, vol 57, p 1-7 <https://www.sciencedirect.com/science/article/pii/S0172219018300875?via%3Dihub>

## APPENDIX B: SEARCH STRATEGY

Searching patent information to identify relevant records for analysis requires a stepped approach to identify broad categories of relevance, and then specific records within them that meet the technology brief.

The following outlines the detail of the search and analysis process conducted.

### Data extraction and analysis

We used five phases of data extraction and analysis.

- Phase 1: Development of a search strategy (below).
- Phase 2: Data mining using the PATSTAT 2019 Autumn edition database. The unique INPADOC family members relating to A01H IPC/CPC classification filed by Latin American applicants were identified and used as the basis of the analysis.
- Phase 3: Semiautomated data-cleaning, to remove data duplications, unrelated families and to consolidate applicant names.
- Phase 4: Data categorisation according to the technological focus of the patent families. The technological focus was determined using the CPC and IPC symbols.
- Phase 5: Data analysis using Tableau 2020.2 for calculations and visual presentation of patent metrics.

### Search strategy

The search was limited to patent applications that had an earliest priority date between 2000-18, CPC/IPC symbols and specific country names as listed here.

#### 1. IPC/CPC Symbols:

A01H/low (note that /low indicates that all symbols lower in the hierarchy were included).

#### 2. Country names:

Brazil, Mexico, Columbia, Argentina, Peru, Venezuela, Bolivarian Republic of, Chile, Guatemala, Ecuador, Bolivia, Plurinational State of, Honduras, Paraguay, El Salvador, Nicaragua, Costa Rica, Panama, Puerto Rico, Uruguay, Suriname and Guyana



## APPENDIX C: TECHNOLOGY ANALYSIS

Patent families relating to plant biotechnology were first categorised into two groups: plants and GM Plants using IPC/CPC symbols. This classification was done in Tableau Desktop.

Multiple classification symbols may be present for a single patent family. Our analysis was performed using a non-hierarchical system allowing overlap in technology classifications for each patent.

As a result, each patent can belong to multiple subcategories. The table below provides the IPC/CPC subclasses and/or the keywords used to capture patents for each technology subcategory.

### Technology categorisation

Functional category	Subcategories	IPC/CPC classification	Notes
Plants	Plant cell culture/cultivation	A01H/4 or C12N/5	Micropropagation or cultivation processes
	New plant varieties	A01H/5/low	New plant varieties
	Phenotype modification	A01H/3/low	Processes for inducing and selecting phenotypic changes in plant varieties without using genetic engineering
GM Plants	Constructs and methods	C12N15/low	Tools and methods to produce transgenic plants
	Resistance	C12N15/low and (A01N/low or A01P/low)	Plants with increased resistance to chemicals, pests or environmental stress
	Recombinant protein expression	C12N15/low and C07K/low	Transgenic plants that express foreign genes

