

17 researchers from Embrapa are among the most influential in the world

Study carried out by University of Stanford took into account career, scientific production in 2019, and the researchers that stood out among the top 2% in their areas of expertise

Seventeen researchers from 12 units of Embrapa, from north to south of Brazil, are among the most influential in the world according to a study carried out by University of Sandford, in the United States, and published in the Plos Biology journal. The study used citations from the Scopus database to evaluate the impact of researchers throughout their careers (from 1996 to the end of 2019) and during the entire last year.

According to the researcher of the Research and Development Secretariat (SPD) of Embrapa, Renato Passos, this study is recent, but apparently has come to stay. "It is probably the broadest and most comprehensive evaluation of individual scientific production done until now", he explains. The database used to obtain the presented results included a total of 6,880,389 scientists.

The databank generated by the study contains standardized information on citations – h index (metric widely used worldwide to quantify the productivity and impact of scientists based on their most cited articles) and co-author adapted h index (taking into account the position of the author in the cited article and a compound indicator). The scientists were classified considering 22 scientific areas and 175 subareas.

The study ranks scientists that are among the 100 thousand most influential according to a compound citation index and also those who stand out among the 2% who caused the most impact in their areas of knowledge, but who are not among the most cited 100 thousand of the database. This classification tool was used to include scientists who, although highly influential, act in areas that usually have a lower volume of citations.

According to the study, 17 researchers of Embrapa were considered highly influential: 5 among the 100 thousand most cited (considering their careers as a whole), 4 among the 100 thousand most cited in 2019 (all among the most cited in their career areas), and 8 among the top 2% cited in their areas in 2019 (see table below).

Pesquisador	2019		Carreira	
	2%	Top 100K	2%	Top 100K
Robert Michael Boddey	-	X	-	X
Henriette Monteiro Cordeiro de Azeredo	-	X	-	X
Johanna Döbereiner	X	-	-	X
Nand Kumar Fageria	-	X	-	X
Dario Grattapaglia	-	X	-	X

Pesquisador	2019		Carreira	
	2%	Top 100K	2%	Top 100K
Jayne Garcia Arnal Barbedo	-	X	X	-
Mariangela Hungria	-	X	X	-
Luiz H. C. Mattoso	-	X	X	-
Antônio R. Panizzi	-	X	X	-

Pesquisador	2019		Carreira	
	2%	Top 100K	2%	Top 100K
George Brown	X	-	X	-
José Ivo Baldani	X	-	-	-
Rosires Deliza	X	-	-	-
Rodrigo Mendes	X	-	-	-
Morsyleide de Freitas Rosa	X	-	-	-
Marcos Tavares-Dias	X	-	-	-
Renata V. Tonon	X	-	-	-
Cristiane Farinas	X	-	-	-

Different expertise that, together, add to global agricultural science

These are researchers from different areas, who, together, contribute to always maintain Embrapa present in the ranking of international scientific production.

Since the evolution of agriculture in Brazil walks hand in hand with Embrapa's history, it is possible to say that all of these researchers cooperated, in their specific areas, to the radical change that agriculture underwent from the 1970s up to the 2000s. From being an importer of foods, Brazil now occupies a top position in global agriculture, which is largely attributed to the researches carried out by each one of these scientists.

Now, here is part of the story of each of these researchers, grouped according to their classification in the study:

The five most cited for their careers and in 2019

Robert Boddey (Embrapa Agrobiologia)



Robert Boddey, an Englishman who has been living in Brazil since the end of 1970s, came to work at Embrapa after being invited by the researcher Johanna Döbereiner. Graduated in Agricultural Chemistry, with a doctorate in Agriculture and an extensive experience in the areas of soil science and microbiology, he acts in the area of nutrient cycling in agroecosystems, analyzing the impact of agriculture and livestock on the production of greenhouse gases, the intercrop of forages and legumes to increase soil carbon sequestration, and the quantification of nitrogen biological fixation in forages and legumes.

For Boddey, it is gratifying to know that researchers around the world are reading and citing the studies developed by him and his team. “Researches in areas that go against the flow usually call more attention, increasing the citations of the articles on them. And, although there are hundreds of publications on the emission of greenhouse gases in temperate regions, fewer works have been published on their emission in the tropics, which increases the frequency of the citations of our researches”, he points out. “Brazil is unique in several aspects. It is one of the only countries in the tropics with a well-developed agricultural research base, large areas planted with forages, high technology for grain production, and an efficient biofuel program”, he adds.

Henriette Azeredo (Embrapa Tropical Agroindustry)



Azeredo works on researches focused on films and coatings made from renewable and biodegradable compounds (preferentially made from food by-products, following the biorefinery concept). These materials may be used for other applications, but the researcher has aimed to increase food stability (e.g., active packaging and edible films/coatings). She has also worked with the application of bacterial cellulose on foods.

According to Azeredo, the impact of these studies is due to the increasing need (noticeable worldwide) of replacing conventional plastics (non-biodegradable, from non-renewable sources) by more environmentally friendly materials, especially for short-shelf life applications (such as food packaging, which is normally discarded after use). This type of substitution is not easy since the conventional materials are cheaper, have a high performance, and are processed by methods well established in the industry sector. This shows the need of researches to obtain materials with a similar performance, but with a lower environmental impact. In this sense, nanotechnology has been frequently used as a tool to improve the performance of these new materials.

The researcher also points out that carrying out science in Brazil is like an obstacle race. She highlights that the difficulties in raising resources and the overregulation in the research area are greater than in any other country she has worked in, distracting the researchers from their main goals to meet unproductive demands.

Johanna Döbereiner (Embrapa Agrobiology *in memoriam*)



The heart of the research of Johanna Döbereiner was always related to biological nitrogen fixation (BNF) and to the bacteria capable of carrying out this process by capturing the nitrogen present in the air and transforming it into an element that could be easily absorbed by the plants. Her studies progressed so well that they contributed to the advancement of the Pró-Álcool program and also to ranking Brazil as the second largest soybean producer in the world, only behind the United States.

BNF allows replacing nitrogen-based chemical fertilizers, bringing economic, social, and environmental advantages to the producer, consumer, and environment. It is estimated that BNF contributes globally to different ecosystems in 258 million tons of nitrogen per year and to agriculture in approximately 60 million tons.

Nand Kumar Fageria (Embrapa Rice & Beans *in memoriam*)



The researcher graduated in Agronomy at University of Udaipur (1965), with a master's degree in Agronomy – obtained at Agriculture University of Udaipur, Rajasthan (1967) –, a doctoral degree in Agronomy – at Université Catholique de Louvain (1973) –, and a post-doctoral degree – at USDA-ARS, Beltsville/Beckley.

Fageria was a researcher at Embrapa in the Agronomy area, with emphasis on soil fertility and fertilization. The main lines of his research were: highland rice, Brazilian Cerrado soils, soil acidity, and irrigated rice and bean. He authored more than 320 publications, including 14 books. He also gave lectures in the United States, Canada, Japan, China, India, Portugal, Australia, Sri Lanka, and Belgium.

Dario Grattapaglia (Embrapa Genetic Resources & Biotechnology)



Grattapaglia is responsible for sequencing the genome of eucalyptus, one of the results of his scientific production with a great impact on society, and also for other works recognized nationally and internationally. At Embrapa Genetic Resources & Biotechnology since 1994, he acts in the fields of genetics, genomics, and plant breeding, with emphasis on perennial, forest, and fruit species. In addition, the researcher works on the development and applications of genomic technologies to solve problems related to the breeding and conservation of plant and animal genetic resources. “Embrapa and our unit are proud to have a researcher like Dario”, points out the head of the unit, Cléria Inglis.

Involved in several technological processes and with knowledge in those areas, the researcher has contributed to the development of the forestry-based production sector of Brazil. Grattapaglia has led one of the most important research projects on forest areas, being the co-leader, in 2011, of the international *Eucalyptus grandis* genome project, which resulted in the complete genome of BRASUZ1 (Brazil Suzano S1) – a Brazilian *E. grandis* tree –, published in the Nature journal in 2014.

Eucalyptus is a species with a great importance for the Brazilian economy, being the basis of the forestry industry for the production of cellulose, paper, steel, and wood products. Thanks to the expertise obtained through this research, it was possible to sequence the whole eucalyptus genome (2014). This project also included two other scientists from South Africa and the United States as leaders, as well as another 50 researchers from 18 other countries.

The four most cited in 2019

Jayme Barbedo (Embrapa Agricultural Informatics)



“It was with great satisfaction that I received the news that I was included in the list of the most influential researchers of the world, because it confirms that my efforts during the last ten years have been, in fact, contributing to the advancement of agriculture and science”, shares Jayme Garcia Arnal Barbedo, researcher at Embrapa Agricultural Informatics (located in Campinas, in the state of São Paulo). “The automatic identification of plant diseases using digital images was one of the first lines of research to which I dedicated my time at Embrapa. At the time, few research groups worldwide dealt with the subject, so my works were pioneer and inspired researches in other countries”, highlights Barbedo.

This originality, together with the significant advances of his research, explains great part of the impact captured by the study carried out by Stanford University. The most recent line of research to which Barbedo has been dedicating himself, focused on detecting and counting cattle through images captured by drones, is following the same path of inspiring new solutions and technologies. All models developed for detection and counting use machine-learning techniques, and the first results were recently published in articles in the Sensors journal, volumes 19 and 20. The researches have been developed in partnership with Embrapa Southeast Livestock (located in São Paulo), Faculdade de Engenharia Elétrica e de Computação of Universidade Estadual de Campinas (FEEC/Unicamp), and Faculdades Metropolitanas Unidas (FMU), with the support of Fundação de Amparo à Pesquisa do Estado de São Paulo (Fapesp).

Mariangela Hungria (Embrapa Soybean)



The research lines with which Hungria is involved include: agronomic aspects of biological nitrogen fixation, microbial diversity, soil microbiology, plant growth-promoting bacteria,

microbial inoculants, among others. The researcher of Embrapa has published more than 700 works (studies, books, chapters of books, and technical publications).

Hungria comments that she was surprised with the result of the study of University of Stanford, but that it shows that the researches she has been developing have a global influence. “Since our studies are related to technologies for sustainable agriculture, this influence is important”, she states. “I also think it should be highlighted that, out of the ten cited researchers of Embrapa, five develop or have developed works that are relevant in the field of soil biology, a line of research in which Embrapa has a high international influence. Therefore, fomenting researches in soil biology should be considered as strategic to allow the growth of the company as a leader in this field”, she adds.

Luiz Henrique Mattoso (Embrapa Instrumentation)



Although the researcher has dedicated part of his career to management, it is research that puts a twinkle in his eye, especially when the theme is nanotechnology, a field in which he is pioneer at Embrapa, leading him to be one of the most influential in the area. His activities include contributions to the development of conductive polymers, biopolymers, bionanocomposites, sensors, biomaterials, nanofibers, nanocellulose, natural rubber, and polymeric materials from a renewable source.

The legacy of his work at Labex, from 2005 to 2007, can be currently seen in the results obtained by the Nanotechnology Network, with more than 150 researchers from 53 partner institutions (public and private), and at Laboratório Nacional de Nanotecnologia para o Agronegócio (LNNA) – for multiple users –, located in São Carlos, in the state of São Paulo, also an international pioneer.

“Teamwork makes a difference and can lead to new results and to impacting technological solutions. God gives us several talents, and our way of retributing is using science to make the lives of people better, taking care of nature and sharing knowledge for the emergence of new generations of professionals dedicated to nanotechnology and agribusiness”, ponders Mattoso.

Antônio Panizzi (Embrapa Wheat)



The researcher of Embrapa Wheat, Antônio Ricardo Panizzi, has dedicated his life to observing insects and is considered an international expert in stink bugs, developing researches in bioecology, damage to different crops, and integrated pest management. Working at Embrapa for 46 years, Panizzi is responsible for 622 publications, including articles, scientific notes, books, book chapters, proceedings papers, and technical texts.

In a pioneer study, he evaluated the action of stink bugs in a sequence of cultivated and non-cultivated host plants, anticipating the issue of biodiversity and conservation as early as the 1980s, which led him to be invited to be part of the select group of authors of Annual Review of Entomology, in 1997, the entomology journal with the highest impact factor. In 2017, he received the “Distinguished International Scientist Award”, an award given by the Entomological Society of America (ESA), in Denver, Colorado, in the United States. In April 2021, his book on the electronic monitoring of stink bug feeding behavior, a result of researches developed at Embrapa Wheat, will be published by Springer/Nature.

The researcher points out that he was surprised and grateful when he found out that his name was included in the global list of influential Brazilian researchers: “The inclusion of my name in this list is an award in my career, an achievement that should help increase the number of studies on stink bugs”, concludes Panizzi.

The eight who are among the top 2% of the world in their areas

George Brown (Embrapa Forestry)



George Brown works with several aspects of the relationship between edaphic fauna (specially worms) and soil. In addition, the researcher studies the effects of environmental contaminants on these animals and is also involved in the identification of different species. His publications on worms are well known internationally by those who work in the same field. The researcher has already published articles in *Science* and *Scientific Reports (Nature)*, showing the importance of worms as bioindicators of environmental quality and for vegetative production due to their benefic effects on soil physical, chemical, and biological properties.

Brown was surprised and could not believe that he was part of the select top 2% group of scientists. “It was a huge and pleasant surprise. I almost thought it wasn’t true, but, since it was a colleague from Universidade Federal do Paraná who sent me the message with the news, I believed it and then went to check the list that was included with the article”, he shares.

José Ivo Baldani (Embrapa Agrobiology)

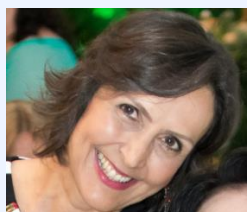


The researcher José Ivo Baldani is also among the most influential scientists of the world. An agronomy engineer with a master’s degree in Agronomy and a doctoral degree in Soil Science, Baldani has experience in the area of genetics, specifically in molecular and microorganism genetics, working with themes related to biological nitrogen fixation (BNF), diazotrophic bacteria, forages, and sugarcane. Currently, he is involved in studies aiming to reduce nitrogen fertilizer use in agriculture, without losses in crop productivity.

Baldani says it is an honor to be part of the team of influential researchers from so many different areas of scientific knowledge. “Without a doubt, this represents the collective effort of all employees of Embrapa Agrobiology and shows that, even with limited economic resources, it is possible to generate impact research, which has caught the attention of scientists who develop researches in the area of BNF”, he adds. Baldani also highlights the importance of the legacy of the researcher Johanna Döbereiner, who is still among the most influential worldwide, even 20 years after her death. “This result is fruit of the quality

of the researches carried out at Embrapa Agrobiology, in a very challenging area, which is that of BNF in forages – whose great missionary was Dr. Johanna, spreading it to different research centers around the world.”

Rosires Deliza (Embrapa Food Agroindustry)



"I was very happy to hear the news! It is always gratifying when our work is recognized by our peers. My contribution to Brazilian science began after I came back from getting my doctoral degree in England, where I researched a very innovative theme: the effect of consumer expectations on the acceptance of a product and on the product's sensorial characteristics, more specifically on the role of packaging in the way a product is perceived. At Embrapa Food Agroindustry, I call attention to the line of research focused on consumer perception of new technologies, which is essential for the success of technological innovation", states Deliza.

The researcher works in the area of sensorial analysis and consumer studies, seeking to contribute to improve population health. In this sense, she investigates two strategies: the reformulation of foods by reducing the amounts of sodium and sugar, and nutritional labeling. Regarding labeling, the results of the carried out study give Agência Nacional de Vigilância Sanitária a basis to implement resolution RDC 429 (2020), which will have a great impact on the industry sector and on consumer health. "I'd like to point out that this victory wasn't only mine...I'm extremely grateful to Dr. Hal MacFie, who supervised my dissertation; to several colleagues who took part in the researches, particularly to Amauri Rosenthal and Gastón Ares, who have been great work partners; as well as to former and current students, who motivate my walk", she concludes.

Rodrigo Mendes (Embrapa Environment)



Since he was a student at an undergraduate research program, Mendes was interested in understanding how soil microbial communities contribute to plant development. Initially, this was done by cultivating microorganisms in a laboratory and using still-limited molecular techniques to unveil the complexity of these communities. “After the development of mass sequencing techniques in the 2000s, it was as if the microscope had been reinvented, allowing unprecedented microbiological analysis”, he says.

“This allowed us to start describing the mechanisms that show how the plant defense system is composed by rhizospheric and endophytic microorganisms, considered, respectively, as the first and second microbiological lines of defense used by the plant to protect itself from infections caused by pathogens. We also investigated how plant domestication can impact the interactions with microorganisms, and our research projects focus on understanding how the microbiome of the rhizosphere opens the way for a more sustainable food production.”

Morsyleide Rosa (Embrapa Tropical Agroindustry)



Morsyleide de Freitas Rosa works with the development of products and processes focused on the sustainable and integral use of Brazilian biomass, with emphasis on bionanocomposites. The concept of integral use is part of the mission of the Biomass Technology Laboratory of Embrapa Tropical Agroindustry, where she works. The idea is to fractionate, extract, separate, and convert the raw material into different intermediate or final products, including foods, chemical products, biomaterials, and energy, maximizing economic gains and minimizing negative environmental impacts, besides improving the efficiency and sustainability of agro-industrial chains.

According to the researcher, the abundance of biomass can be seen as an advantage for Brazil to also become a reference in Bioeconomy in the future.

Regarding her recognition, Rosa understands that, in some way, this reflects the level of interest in the work carried out by her research group. “After all, the number of citations is an indicator of the relevance of a scientific research. To have this type of reach, it is fundamental to build partnerships, in order to maintain scientific and technological cooperation, both with the Academy and with the productive sector”. She also highlights that this result is a consequence of a new mosaic of investments in the country, where the Northeastern region is gaining space in the national scientific scenario.

To be among the most cited in 2019 is, above all, a result of the efforts of the research, development, and innovation (R&D&I) sought by the company and carried out in previous years. In line with this, the researcher points out the importance of investing in R&D&I, to maintain solid infrastructures and continuous financing, which will allow the country to stand out in the scientific and innovation fields. For this reason, she concludes: “Brazil is capable of more!”

Marcos Tavares Dias (Embrapa Amapá)



Marcos Tavares-Dias works with researches focused on Amazon fish health and parasitology, specifically on the sanitary problems related to fish production and disease treatment. He also carries out studies on the ecology of native fish populations, important for the fishing industry and fish production. These are broad themes, which have been narrowed to sanitary problems in fish culture in the state of Amapá and to chemical antiparasitic treatment, especially against monogeneans, a parasite that attacks cultivated fish, as well as to the use of essential and fixed (phytomedicine) oils obtained from the Amazon and developed in Brazil. Together with master's and doctoral students, he also identifies new parasite species of Amazon fish. According to Tavares-Dias, the use of phytomedicines, which are biodegradable and do not affect the environment or humankind, is important due to the increasing demand for alternative treatments to substitute

conventional ones (chemical drugs), which are more toxic to fish and have not been tested in the country nor are registered by Ministério da Agricultura, Pecuária e Abastecimento (MAPA). “This substitution isn’t easy, since, although they are not recommended for aquaculture, conventional chemical drugs are easily found in vet shops because of their wide use as crop pesticides, show good performance in the treatment against fish parasites, and are well known by the producers”, points out the researcher. He adds that this is why researches are necessary to obtain alternative products with better or similar results, but with a lower impact on the environment and organism (health) of the cultivated fish. In this sense, phytomedicines are being tested worldwide as a tool to improve therapeutic management in fish culture.

According to the researcher, national science has been discredited and receives little financing, which has significantly hampered the technological advancement previously in progress. “Because of the difficulties to obtain financing for research projects and the huge bureaucracy involved, the researchers have to use their time and are distracted from their main goals to meet the demands of the productive sector”, concludes Tavares-Dias.

Renata Tonon (Embrapa Food Agroindustry)



Tonon works in the area of food processing, with focus on the processes for the extraction and microencapsulation of bioactive compounds, aiming to aggregate value to plant raw material and agroindustry residues. The researcher has been working in this line since her doctoral degree, when she obtained a powdered acai pulp, rich in antioxidant compounds. During her post-doctoral degree, she was involved in projects to microencapsulate vegetable oils, such as those of linseed and roasted coffee, in order to protect them against oxidation. Her most repercussing articles were on these researches.

“I was very happy to hear our work was recognized. In the current scenario in the country, with all the obstacles we have to face to do our researches, this recognition is very gratifying and shows the potential we have of making quality science, essential to produce quality technology”. According to Tonon, some companies have sought Embrapa due to their interest in the development of natural ingredients with coloring, antioxidant, and/or antimicrobial properties, an increasing tendency in the food industry.

Cristiane Farinas (Embrapa Instrumentation)



Working at Embrapa Instrumentation for 13 years, the chemical engineer studies biochemical processes, with emphasis on bioprocesses, bioenergy, biorefineries, enzymes, nanocellulose, and biofertilizers. Recently, she has been working on projects with the team of the Research Network of Nanotechnology Applied to Agribusiness (AgroNano Net).

Farinas is also part of the permanent staff of the Post-graduate Program in Chemical Engineering of Universidade Federal de São Carlos (PPG-EQ/UFSCar) and of the Post-graduate Program in Biotechnology of the same university (PPG-Biotec/UFSCar), where she completed her undergraduate studies; her master's and doctoral degrees were earned at Universidade Estadual de Campinas.

“To be recognized internationally is a great joy and encouragement to continue progressing as a professor in the formation of new generations of scientists and as a researcher in an area of great potential for Brazil. When I started working at Embrapa Instrumentation and began my researches related to agroenergy, I was aware of the challenges, but, today, I'm able to envision more partnership possibilities for the advancement of knowledge and the development of technological solutions as a result of the potential of the application of chemical engineering to the agricultural sector and to the other ones we interact with”, concludes the researcher.