

Citricultor

Fundecitrus

SCIENCE AND SUSTAINABILITY
IN CITRICULTURE



JOSÉ LUIS CUTRALE

The businessman will
be remembered for his
passion for citriculture,
brilliant contribution to
the business sector and
support to science
PAGE 4



ORANGE JUICE DOES NOT RAISE BLOOD GLUCOSE

WITH THE MYTH DEBUNKED, ORANGES SHOULD BE INCLUDED IN THE DAILY DIET IN VIRTUE OF ITS SEVERAL BENEFITS, SUCH AS THE STRENGTHENING OF THE IMMUNE SYSTEM AND THE ANTIOXIDANT AND ANTI-INFLAMMATORY PROPERTIES OF THE FRUIT

Citricultor

CITRICULTOR magazine is a free publication edited by the Fundo de Defesa da Citricultura - Fundecitrus. Fundecitrus, a world reference in science for citriculture, is a non-profit private institution established in 1977 and maintained by citrus growers and processors in the state of São Paulo, Brazil, to foster the sustainable development of the Brazilian citrus belt.

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TRIBUTE

José Luis Cutrale and his legacy to the global citrus industry



CROP

Scarce rains reduce by 0.9% the initial estimate for the 2022-2023 crop season



ECONOMY

NFC exports have been growing in the last 17 years and it has also been stirring the domestic market

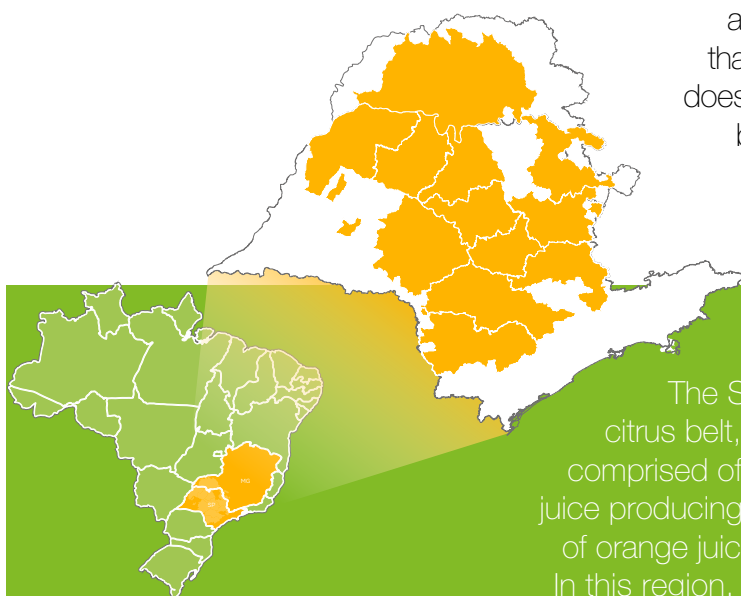


IRRIGATION

There is a growing need to widen the use of water resources in agriculture

HEALTH

Research debunks the myth and concludes that orange juice does not influence blood glucose



BRAZILIAN CITRUS BELT

The São Paulo and West-Southwest Minas Gerais citrus belt, located in the Southeast region of Brazil and comprised of approximately 350 cities, is the main orange juice producing region in the planet: three out of five glasses of orange juice consumed in the world are produced here. In this region, citriculture creates 200 thousand direct and indirect jobs and collects 189 million dollars in taxes.

More than
2,000
visits

Audiences in
10 countries

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on the main
platforms



THE TREE OF JOSÉS

JOSÉ LUIS CUTRALE'S STORY IS THE FRUIT OF THE TRAJECTORIES OF HIS FATHER AND GRANDFATHER, WHICH CONTINUE NOW WITH HIS CHILDREN AND GRANDCHILDREN; CITRICULTURE WAS ENDOWED WITH HIS LEGACY OF PASSION AND UNRELENTING SUPPORT TO SCIENCE

It was pouring rain in the dawning hours of that day. And it was under the drizzle that ensued that José Luis Cutrale and his two sons, Junior and Henrique, made it into the Fundecitrus premises in the morning of December 7, 2017.

They greeted the president of the Advisory Council, Lourival Carmo Monaco, the general manager, Juliano Ayres, and the managers who were there; they were quickly briefed on the main projects underway, congratulated everyone on the 40th anniversary of the institution, thanked the organizers for the invitation to the event that would start shortly afterwards and explained they had to decline the invite because in addition to being very private people, they had to fulfill their commitment with the employees of Sucocítrico Cutrale Ltda by attending its year-end Convention. It was not just any Convention: Cutrale was celebrating its 50 years of operation, and even on such a remarkable day, they insisted on stopping by at Fundecitrus to congratulate us on our 40th anniversary.



José Luis Cutrale and the president of Fundecitrus, Lourival Carmo Monaco, at the institution's headquarters, in December 2017, next to the plaque honoring José Cutrale Júnior and Carl Fischer, founders of Fundecitrus, installed in 1997

In preparation for the photo of José Luis and Monaco (on the side), the Fundecitrus tribute plaque to José Cutrale Júnior and Carl Fisher (in memoriam) could be seen between them, hanging beneath the bountiful sibipiruna tree 20 years before, in 1997. But before sealing this moment with the photo, they first watched the movie "A 40-year story", which would be shown later at the event.

"How can one tell a 40-year story?", asks the unmistakable voice, perfect for the occasion, of the collector and advocate of rustic culture, Rolando Boldrin. Following the flow of the text, with a sovereign narrative, setting the pace of the images, using the virtually untranslatable vocabulary, intonation, and accent to which we relate so much, the movie talked about history and science, discoveries and achievements, challenges and successes, flowers and winds, constituting a tribute offered by Fundecitrus to citrus growers in São Paulo and Minas Gerais states. José Luis Cutrale was moved. "This is my story," he said.

The drizzle trickled down and evaporated in that very morning, a late-autumn sun rose in the sky, and although it was not noon yet, the warmth could be felt. The memories of that movie remained. It faithfully represents the spirit of the Cutrale family: their interest in roots and tradition – José Luis' smile in the photo really depicts his feeling of being next to his father in this eternized glimpse of time – and also their low profile, their passion for citriculture and their commitment to the company's workers.



Italian immigrant Giuseppe Cutrale (fourth from right to left) and founder of Sucocítrico Cutrale Ltda, José Cutrale Júnior (third from right to left), at the São Paulo Municipal Market in the late 1940s

IL RISORGIMENTO, IMMIGRATION, LIFE MADE IN 'MÉRICA, MÉRICA, MÉRICA'

For whatever reason, be it the magnitude of the business and its aura of perpetuity, or the very peculiar conveyance of knowledge and command from generation to generation, always in prosperity, or the mythical aspect of a remarkably strong brand in its segment, albeit brandless, or the label found on shelves around the world before the eyes of consumers, so tangible; no matter what the reason is, the passing of José Luis Cutrale, on August 17, 2022, in London, incites the need to tell the story of his company, as if the keyboard typed the words by itself.

José Luis had not celebrated his first birthday yet when his father, José Cutrale Júnior, took over his grandfather's business in 1947. José Cutrale was the youngest child of another José, whose actual name was Giuseppe

Cutrale, an Italian immigrant from Sicily, where he already worked with his family in orange groves.

Sicily is the largest island in the Mediterranean. It was occupied by the most diverse civilizations, in the most diverse eras: by the Sicani, Elymians and Sicules five thousand years ago, by the Phoenicians, around three thousand years ago, back in Prehistory; by the Greeks and Carthaginians, in Ancient times; by the Vandals, Ostrogoths, Byzantines, Arabs, Normans, Swabians, Angevins, Aragonese, and persecuted Jews during the Middle Ages; by the Spaniards and Piedmontese, by the Habsburg and Bourbon dynasties, in the Modern Age; and as late as in the Contemporary Age, the unification of Italy took place, namely, "Il Risorgimento", in 1861. Sicily is part of the history of navigation and commerce.

This dull paragraph is intended to suggest that perhaps the family's negotiation skills are

directly connected to historical events in Sicily. Based on this assumption, knowing how to till the land and mastering negotiation skills were a necessity, instruments of survival.

Somehow, the typical pronunciations and expressions of a language or dialect were eventually blended into life in America, in the already cosmopolitan São Paulo of the 1930s, more precisely in the Cantareira Market, the Municipal Market of São Paulo, whose name became the Mercado, inaugurated in 1933.

"The market was the best place to learn how to trade. Trading was done with Arabic, Italian, Portuguese, Japanese, Turkish, and Spanish merchants, people who had migrated to be successful, each of them with their stories," as citrus grower and merchant, Raphael Juliano,

who died in 2021, told Fundecitrus in 2017.

In the early 1940s, at the age of seven, Raphael Juliano started working with his grandfather at a fruit stand in the Mercado in order to help with the household expenses. He then met the patriarch Giuseppe Cutrale, who purchased oranges in Rio de Janeiro and resold them in São Paulo; he also met José Cutrale, a contemporary producer who also promoted the expansion of citriculture across the state of São Paulo in the 60s, 70s and even in the 80s; and he also met and worked with José Luis, from the third generation of immigrants.

During this interview in 2017, Raphael Juliano, the "father" of the Lima Sorocaba variety, expressed his admiration for José Cutrale Júnior, Carl Fisher, and Edmond Van Parys. With a smile

on his face, he recalled that he had to be an early bird to be able to compete with José Cutrale when it came to selecting the best fruits.

FROM FRUIT TO JUICE

This determination – not in itself, but combined with a very sharp intuition, entrepreneurship and a sense of opportunity – is found in the origin, development, and even in the current leadership of the Cutrale Group. This obstinacy is present throughout the history of the company, from the acquisitions of Fazenda Santa Alice, in Bebedouro city (SP state), in the 1950s, the first agricultural unit of the conglomerate, and of the Suconasa plant, in Araraquara city (SP state), in 1967, when the citrus company Citrícula Brasileira Ltda became Sucocítrico Cutrale Ltda, to the acquisition of Chiquita Brands International in 2014, with operations in 70 countries.

Initially, José Cutrale decided to grow part of the oranges he sold. In 1956, he set up a processing unit or packing house in Bebedouro city, and the then Citrícula Brasileira Ltda became the first Brazilian company to export fresh fruit, raising the standard of production quality. Next, he realized he had an opportunity in his hands, filled his heart with courage – the two words have the same genesis, the same root in Portuguese – and acquired Suconasa, which had gone bankrupt after the death of Pedro Santiago, founder of the Toddy company.

José Cutrale renegotiated contracts with suppliers, resumed operations with most of them, and set the plant to operate at full force. The rest is history. In a way, this is also the story of Brazilian citriculture.



Sitting on the sofa at the Cutrale stand, at the Citrus, Commercial and Industrial Trade Show in Bebedouro (Feccib), in 1972: Rosana Falcioni Cutrale, José Luis Cutrale, Amélia Bernardini Cutrale, and José Cutrale Júnior



José Luis Cutrale Junior, Graziela Cutrale, José Luis Cutrale, José Henrique Cutrale, and José Cutrale Júnior at the Araraquara plant in 2003

LEADING THE COMPANY IN THE AGE OF GREENING

José Cutrale died in December 2004, the year in which greening was detected in Brazil. However, the family's struggle with the phytosanitary challenges of citrus farming started much earlier, dating back to the notification of the first citrus canker outbreak in the state of São Paulo, in the Presidente Prudente region, in 1957.

Another grower of the same period and José Cutrale's competitor was Antonio Ambrosio Amaro's father, an agronomist who joined the Instituto de Economia Agrícola (Agricultural Economy Institute) (IEA) in 1962. Amaro was one of the bridging stakeholders, connecting the public agencies with the private sector in the fight against citrus canker. In 1977, this integration resulted in the creation of Fundecitrus, the first non-governmental organization for plant health in Brazil. José Cutrale was one of its founders.

"It became very clear [from the moment the resources were insufficient to curb the disease] that both parties needed to contribute, both the industry and the citrus growers," Amaro reported in an interview to Fundecitrus in 2017.

The cooperation efforts between the government of the state of São Paulo and Fundecitrus to fight citrus canker carried on until 2012, when the Department of Agriculture and Supply (SAA) changed the control strategy.

At that moment, exactly ten years ago, Fundecitrus had to reinvent itself within its initial purpose, which is to be an ins-

titution for the advocacy of citrus farming. And so it did. José Luis Cutrale was not negligent, as he never was in the relevant, most decisive moments. He was one of the leaders of the citrus growers' group that defended not only the continuity of the institution, but also the expansion of the Research and Development department.

We may enumerate at least four of these important decisive moments, in which the main citrus growers, namely, Cutrale led by José Luis, Citrosuco, and LDC Sucos supported the institution and helped to guide its steps. The first of them, which is directly related to the necessary reinvention of the institution in 2012, took place in 1994, when Fundecitrus created the Department of Research and Development and ceased to be just a research funding entity, acting beyond this role by carrying out studies with its own structure and coordinating projects in partnership with other teaching and science institutions in Brazil and around the world.

The second step took place at the turn of the millennium. The incidence of citrus variegated chlorosis (CVC) reached its peak, affecting almost

half of the trees in the citrus belt of São Paulo and Minas Gerais states; citrus sudden death (CSD) was identified in the Triângulo Mineiro region (West of Minas Gerais state); and citrus canker, for the first time, spread to 1% of the plots of the farming areas. Anyone who knew citriculture in that period would say that the activity would last, at most, a few more years. Citrus growers and industries contributed with extra resources, approximately 4,000 workers went to the citrus belt fields to eliminate infected areas with citrus canker, and Fundecitrus' research efforts generated the required knowledge for the sector to overcome CVC and CSD.



The third step, which is also related to the 2012 reinvention of Fundecitrus, took place in 2009, with the creation of the Biotechnology Laboratory. Cutrale, Citrosuco, and LDC Sucos' vision – based on the understanding that, depending on the future incidence and severity of the disease, conventional management of greening could be insufficient to keep the disease at non-threatening levels – and also the complementary three-year funding were essential for Fundecitrus to embark on and advance in biotechnology.

And the fourth great achievement was the development of the Crop Estimate Survey and the Fundecitrus Tree Inventory in 2014. There is no governance

without transparency. The sector lacked a study that was both reliable and impartial, which could provide information both to citrus growers and the various markets.

WHAT NOW, JOSÉS?

José Luis Cutrale, an entrepreneur who will always be remembered in the business world as the man who strengthened the company founded by his father. The man who has expanded production in the fields and at the production plants, and who widened national and international markets. The leader who built the company's bridge to the digital era and to the demands of sustainable development. And the businessman who diversified Cutrale's operations, investing with the same level of determination in the grain, logistics, banana, salad, seasoning, and soft drink sectors. Since 2002, among other examples of philanthropy, the juice served with the meals in public schools of Araraquara city – both under municipal and state management – is provided by Cutrale.

In the world

of citriculture, according to the core definition of this word, meaning the farming activity per se, José Luis Cutrale was leading his company precisely in the most challenging phytosanitary period of the sector, the time when greening was detected. This is when yet another José, the French scientist Joseph Marie Bové, the most accomplished phytopathologist of his generation, after whom the Research and Development Department of Fundecitrus was named, joins the battlefield.

José Luis and Joseph Marie talked several times. Joseph Marie's communication skills and José Luis' ability to understand were decisive for implementing the tripod of greening management, which later unfolded into the "ten commandments" of control, including investments in biotechnology, the most promising scientific area to provide lasting solutions against the disease. As such, these were crucial steps to maintain the competitiveness of the Brazilian citrus industry.

José Luis Cutrale leaves his wife, three children, six grandchildren, and an answer to the question: would the Brazilian citrus farming be so large, would it be a global leader, and even Fundecitrus, would it be a world reference in science and sustainability for citrus farming, without people like Jose Luis Cutrale? The answer is so obvious that, once again, the keyboard writes by itself: no. 🍊



José Luis Cutrale and his sons, now Co-Chairmen of the Board (Chairmen of the Board of Directors of the Cutrale Group), José Luis Cutrale Junior, and José Henrique Cutrale in New York (USA), in 2004

High consumption of NFC drives several sectors

IN 17 YEARS, EXPORTS OF READY-TO-DRINK JUICE HAVE PEAKED AT 1.5 MILLION TONNES; THE DOMESTIC MARKET ALSO EXPERIENCES AN INCREASE AND COMPANIES INVEST TO GROW

The main Brazilian exporters of ready-to-drink orange juice (NFC) have been working to win more space, overcoming natural and phytosanitary challenges as well as the competition from other producing countries. Mexico is one of these countries, since Mexican juice is exported to the United States without tariffs, unlike the Brazilian juice. On the other hand, the Chinese market is promising, although its expansion is still under development.

In the last 18 crop seasons, Brazilian exports of NFC jumped 296% in volume, according to data from the Department of Foreign Trade (Secex), an agency connected to the federal government. The numbers reveal that the product had a greater growth in demand than that of concentrated juice, although the later

has historically accounted for the highest volume of shipments of orange byproducts to international markets.

In the same period, the concentrated juice had a drop of 46% in exports. The peak of NFC exports took place in the 2017-2018 crop season, when 1.5 million tons left the country. This season is followed by the 2018-2019 and 2019-2020 crops, with 1.4 and 1.3 million tons, respectively (*see chart on the next page*).

SERVING THE MARKET

This increase in the international demand for NFC required changes in Brazilian companies, which were also impacted by shifts in the pattern of domestic consumption. In the case of Agroternas – which operates in the agribusiness sector, focusing

on citrus planting and processing – seeking investment and promoting capacity building was the solution.

The group chose to obtain its return on investment from ready-to-drink juice just two years ago. “We stopped the NFC production in the mid-2000s to turn our attention to concentrate juice and to the supply of oranges to the large juice companies. In recent years, we have had to reinvest in this segment with equipment, logistics, tanks and team training so that our NFC could be as close as possible to the freshness and taste of the fruit in the groves,” explains the

"WE UNDERSTAND THERE IS STILL A LOT OF ROOM TO FURTHER EXPAND THE ORANGE JUICE NATIONAL MARKET," DECLARES GUTIERREZ FROM SUCOS SPRES

Director of Agroindustrial Production, Ezequiel Castillo.

Agroterenas anticipates that around 10% of the orange crop will be used for the production of NFC this year. From this volume, only 1% is consumed nationally. Castillo points out that this is the start of this type of production and that ready-made juice should gain more space. "We operate in a large portion of the orange chain and we have been witnessing a shift in the market for at least ten years. We have seen a drop in the demand for fresh fruit in supermarkets and an increase in the demand for juice, especially for NFC. As such, we could no longer hold the investments," he added.

AT HOME

Exports have increased, but it was no different in the Brazilian households. Although it

accounts for a small percentage of the entire processed volume of fruits (from 3% to 5%), the increased consumption in the domestic market has encouraged entrepreneurs in the sector to invest in processing, filling, and distribution.

Javier Gutierrez, Director of Sucos Spres in Ribeirão Preto (SP state), claims that the brand's production for the domestic market has doubled in recent years. "Today, we have the capacity to produce 1 million liters of orange juice per month. We have navigated very well through this transformation because we are the oldest fresh juice company operating in the Brazilian market. The scenario for our market is a growing number of people looking for a high-quality product to replace soda for instance," he explains.

In the last five years, Spres has invested in filling automa-

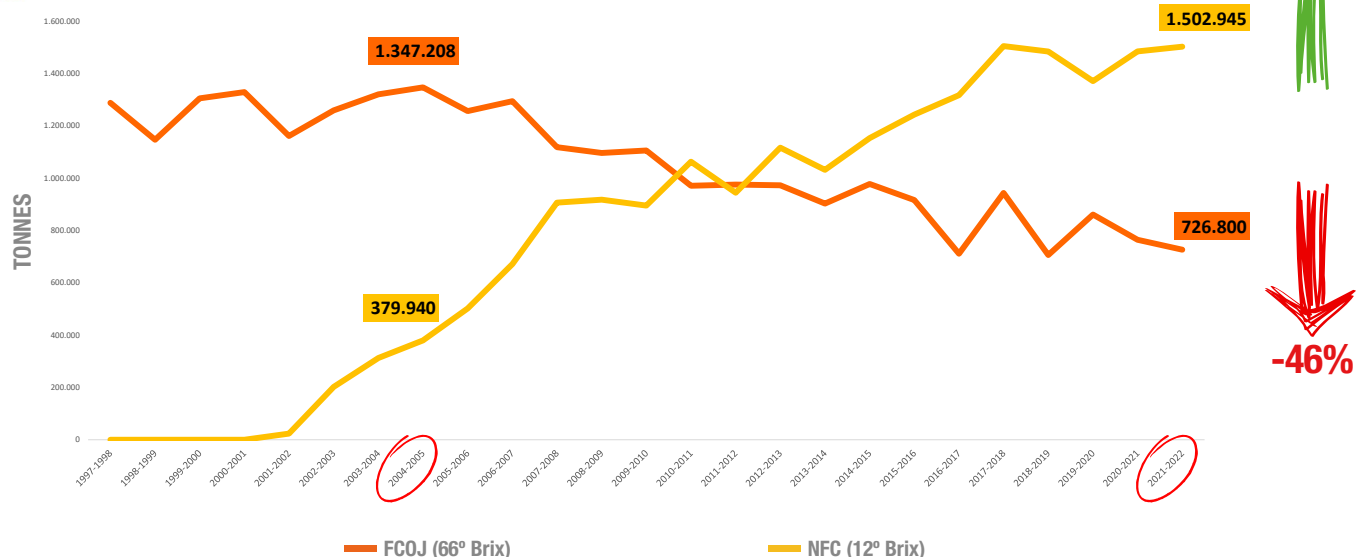
2021-2022 CROP: INCREASE IN ORANGE JUICE SHIPMENTS

Total shipments of Brazilian orange juice (FCOJ Equivalent to 66° Brix) exported through the Port of Santos amounted to a volume of 1.07 million tons in the 12 months of the 2021-2022 crop season. The figures were reported by Secex, compiled by CitrusBR, and they represent an increase of 5.33% compared to the 2020-2021 season, when 1,019,554 tons were shipped.

Among the markets, Europe continues to be the main destination for Brazilian exports of orange juice, with a share of 63.61%, followed by the USA, with 20.75%; China, with 8.3%; Japan, with 3.50%; and other markets, with 3.84%.



EVOLUTION OF NFC AND CONCENTRATED ORANGE JUICE EXPORTS



tion and cold storage capacity in order to expand its areas of operation. "We understand that there is still a lot of room to grow the national market of orange juice," says Gutierrez.

CHAIN EFFECT

With the need to expand to meet the needs of the thriving fresh juice market, technology companies also had to adapt, seeking to serve the processing sector. "We are working on alternatives to improve indus-

trial processing, be it on optimized options for extraction and filtration, with the aim of improving throughput and product quality, or on the later stages of product conservation and ingredient recovery," explains Daniela Kharfan, Manager of Research and Development at JBT.

Our view is that the food processing technology industry has been increasingly seeking to invest in different alternatives of production systems in order to obtain products

with different cell contents and to introduce ingredient recovery systems, such as citrus oils. More recently, JBT has invested in the development of edible films from orange cells contained in industrial waste. "We are talking, above all, about sustainability. It is a product that has proven to be an alternative to the conventional use of plastic, enabling the use of the whole orange, even after the full extraction of the juice and other byproducts," she concludes. 🍊

MAIN DESTINATIONS OF THE BRAZILIAN ORANGE JUICE EXPORTS



EUROPE

63,61%



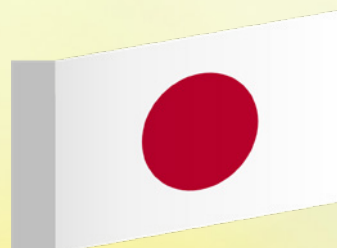
UNITED STATES

20,75%



CHINA

8,3%



JAPAN

3,5%

Source: CitrusBR

Digital Fundecitrus: high quality and distance education

THE PLATFORM OFFERS A COMPILATION OF FREE CLASSES ON THE MAIN TOPICS OF CITRICULTURE WITH A SPECIALIZED TEACHING STAFF

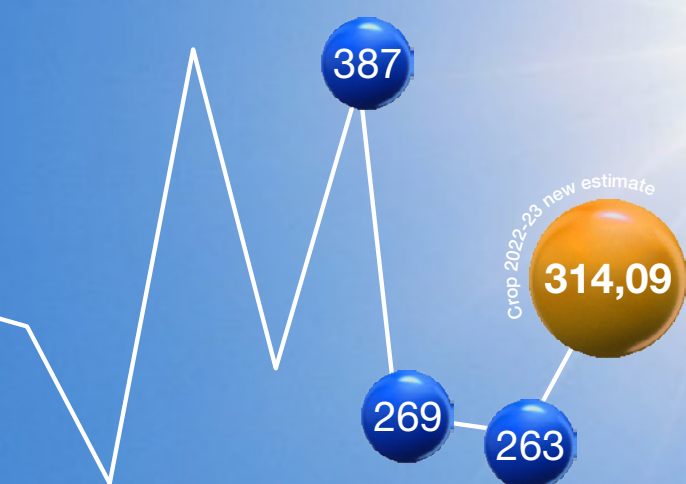


VISIT THE
PLATFORM
AND
REGISTER

Launched in August, Digital Fundecitrus is a platform for free online courses that conveys knowledge on the main topics of citrus farming. With over 1,200 registered participants, classes are available to all industry professionals.

The first course which was made available on the platform is about greening. Divided into three modules, with 26 classes in total, the course can be accessed anywhere and at any time – just fill out the registration form on the platform's website. There are more than seven hours of lessons only in this module. "The new platform enables the users to update themselves, by attending classes with great experts, at no cost. The tool is yet another source of knowledge to train professionals in the field and it contributes to the work developed by producers, helping them to preserve their increasingly healthier groves," explains the General Manager of Fundecitrus, Juliano Ayres. 🍊





Low rainfall reduces the 2022-2023 crop estimate

EVEN WITH LOW RAINFALL, THE HARVEST MAY ENABLE CITRUS GROWERS TO ENJOY SOME BUFFER PRODUCTION, INTERRUPTING THE TWO CONSECUTIVE CYCLES OF LOW PRODUCTION

The 2022-2023 orange crop forecast in the São Paulo and West-Southwest Minas Gerais citrus belt was re-estimated at 314.09 million boxes of 40.8 kg. This number represents a decrease of 2.86 million boxes in relation to the initial forecast disclosed by Fundecitrus last May, accounting for a drop of 0.9%. The growth rate compared to the previous crop (closed at 262.97 million cases) is 19%.

According to the coordinator of the Fundecitrus Crop Estimate Survey (PES), Vinícius Trombin, the reason for the reduced estimate is the low volume of rainfall recorded in recent months. "Although the scenario is more favorable than last year's situation because of the higher and better distributed rainfall, the volume is well below the historical average," he explains.

LITTLE RAIN

Data from Somar/Climatempo indicate that the average accumulated rainfall in the citrus belt, from May to August 2022, was 84 millimeters, 48% lower than the climatological normal (1981-2010). A climate which was drier and warmer than the normal pattern was observed in all regions during this period. In Bebedouro and Limeira, the rainfall index was 59% below the historical average; Porto Ferreira registered -57%; São José do Rio Preto, -52%; Duartin, -50%; Avare, -48%; Matão, -45%; Brotas and Itapetininga, -44%; Altinópolis, -40%; Votuporanga, -33%; and the Triângulo Mineiro region, -12%.

With little rain, fruit growth is impaired. This could already be seen in the harvest of oranges of early varieties.

Considering all the varieties of the new estimates, the projected average number of 258 fruits to compose a 40.8 kg box whose average orange weighs 158 grams, increases to 261 fruits per box, with each fruit weighing 156 grams, which is equivalent to the average weight observed in the last five crops. "Even with this slight reduction, the oranges weigh more than those of the past harvest at this very stage of development," he highlights.

EXPECTATIONS

As the rains were better distributed, the orange trees, in general, went through the winter period maintaining their dark green foliage, unlike last year, when the landscape in the countryside became arid as the result of leaves with altered color and no brightness – groves with intense defoliation and with-

red fruits were often observed. "September, historically, marks the beginning of the season of high-volume rains, therefore, weather conditions are expected to be more favorable from now until the end of the crop season. The PES team is strictly monitoring the fruit growth and drop rate throughout the citrus belt. The results of this work will be included in the next crop review, which will take place on December 12," concluded Trombin.

YIELD

In terms of the yield per sector, the Southwest region, which includes the areas of Avaré and Itapetininga, should have the highest rate, reaching 1,089 boxes per hectare and recovering from the 21.4% drop witnessed in the past crop. Next, the South region should register 937 boxes according

A DROP OF 2.86 MILLION BOXES IN RELATION TO THE INITIAL FORECAST RELEASED IN MAY

to the new estimate; the North region, 854; the Central region, 844, and the Northwest region, 827 (see map below). In the opinion of Fundecitrus' General Manager, Juliano Ayres, the anticipated increase in yield as compared to the previous crop results from the growers' continuous work. "The new crop promises to be strong for producers, even in the face of challenges that are inherent to citrus farming. The sector has the privilege of relying on the experience of these people who, historically, have led our citrus industry towards sustained success," he points out. 🍊

NEW ESTIMATE FORECASTS



158

grams,
on average,
per fruit



912

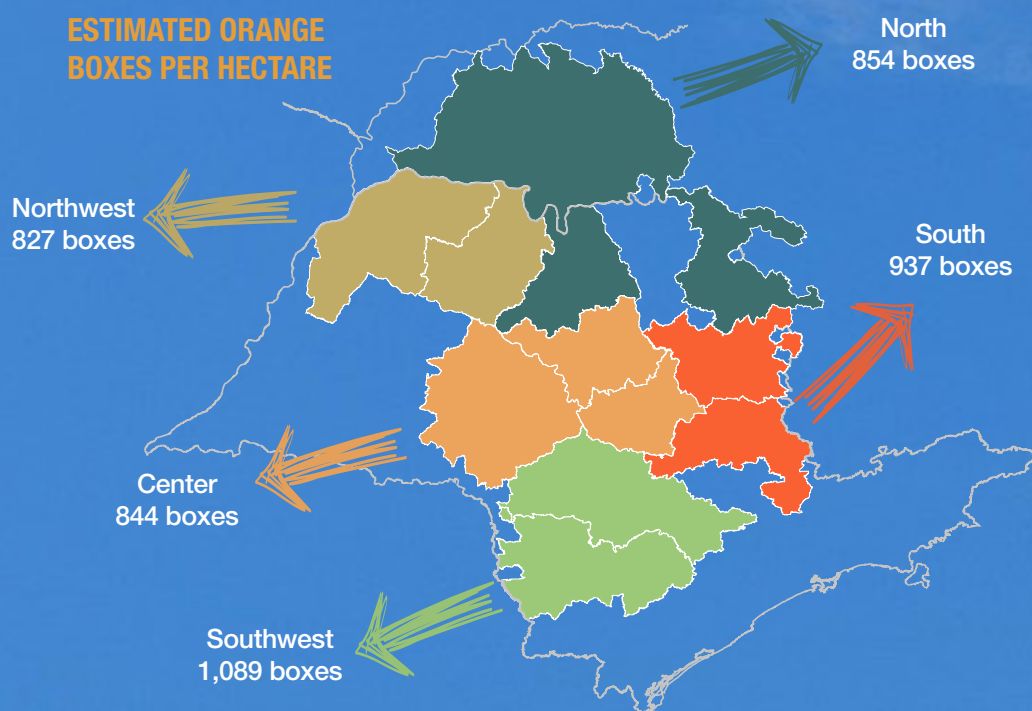
boxes per
hectare



1,85

box per
tree

ESTIMATED ORANGE BOXES PER HECTARE



Loss of 49 million boxes

SURVEY ON FRUIT DROP CAUSED BY PESTS AND DISEASES IN THE CITRUS BELT IS AN ALERT FOR GREATER FOCUS ON MANAGEMENT MEASURES

Fruit drop is a problem that has a direct economic impact on citrus growers. Data collected for the re-estimated forecast of the 2022-2023 crop show that the projected average drop rate went from 20% to 19.80%. If this percentage is confirmed, it will only be below the rates observed in the last two crops, which were 21.6% in 2020-2021 and 21.8% in 2021-2022, the highest rate

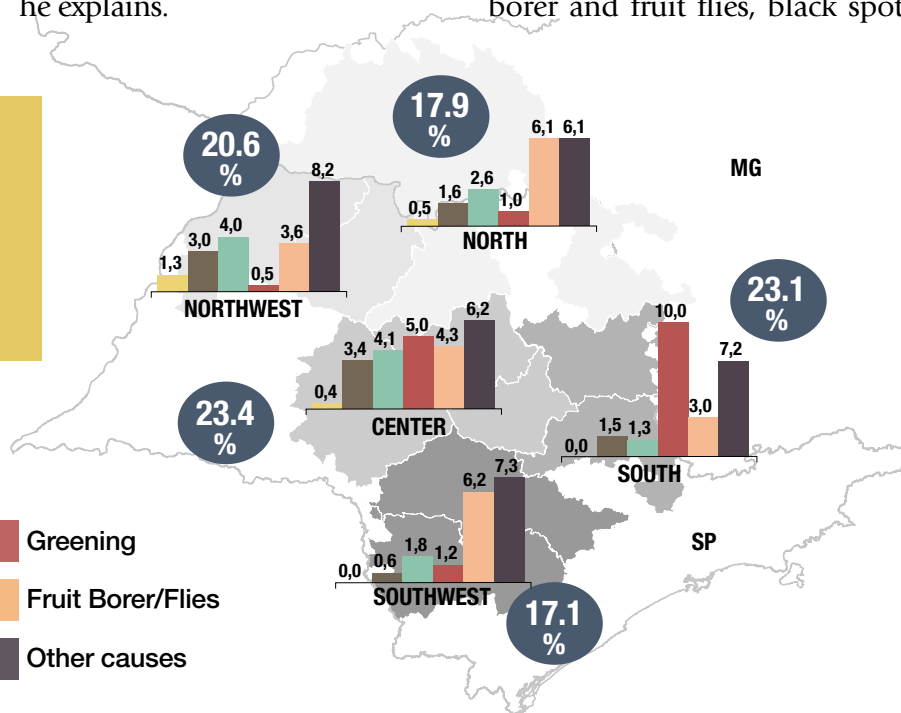
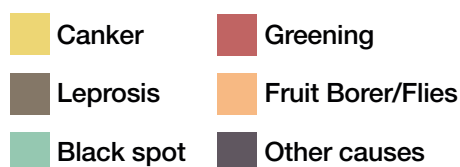
ever surveyed, which accounts for 49.2 million boxes.

According to the PES coordinator, Vinícius Trombin, the rate is lower than that of the last surveys due to the homogeneity of bloom, in addition to the greater volume and better distribution of rainfall. "The last two years were extremely dry compared to the historical data, which contributed to higher levels of drop rate," he explains.

FACTORS

The intensification of phytosanitary problems throughout the belt is the main factor which directly influenced the anticipated decline. The increased incidence of orange trees with greening symptoms, for instance, rose from 22.37% in 2021 to 24.42% in 2022. Other pests and diseases impact fruit drop, such as fruit borer and fruit flies, black spot,

AVERAGE PERCENTAGE OF PREMATURE DROP OF ORANGE FRUITS DUE TO MAIN DISEASES AND PESTS IN THE CITRUS BELT IN THE 2019-2020, 2020-2021 AND 2021-2022 CROPS



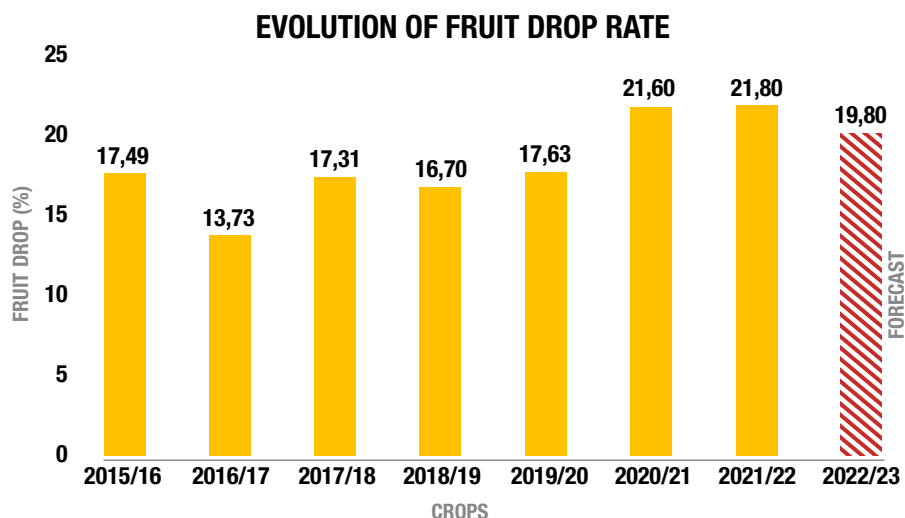
leprosis, and citrus canker. The highest rate of decline projected is that of the South area, in the regions of Porto Ferreira and Limeira, at an average of 24.80%.

The lowest rate is found in the Southwest area, in the regions of Avaré and Itapetininga, reaching 16.90%. "This lower rate of fruit drop in the Southwest is mainly due to the lower incidence of some of the main diseases or fewer conditions favoring their development, as well as the better distribution of rainfall associated with milder temperatures," explains Fundecitrus researcher Franklin Behlau.

HISTORY

In the last three crops, the Central and Southern regions of the citrus belt had the highest average fruit drop due to pests and diseases. The analysis is the result of a study prepared by Behlau and researcher and postdoctoral fellow Rafaele Moreira. The Central region was the most affected, with 23.4%, and the South, with 23.1%. According to the study, greening was the most devastating disease in these two regions (*see more in the chart*).

In the Central region, greening-related fruit drops reached



5%, followed by fruit borer/flies (4.3%), black spot (4.1%), leprosis (3.4%) and canker (0.4%). In the South, the impact of greening is even worse. In the last three crops, the disease caused the fall 10.1% of the fruits; fruit borer/flies (3%), leprosis (1.5%) and black spot (1.3%) come next.

"The result of this survey only reinforces what we already know about the severity of greening in the citrus industry, including the fact that these two regions stand out historically as the most affected areas by the disease," declares Behlau. In the Central region, for example, which has a transitional climate between the borders of its area, all the

main pests and diseases have an important impact on fruit drop before harvesting.

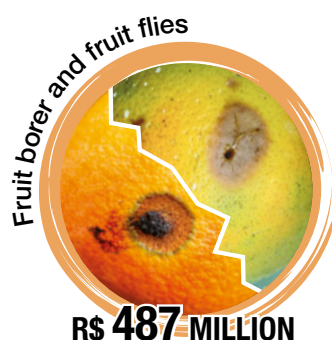
ECONOMIC IMPACTS

The researchers' survey also contemplated the economic impacts caused by the fruit drop in the 2021-2022 crop season. The losses amount to R\$ 1.27 billion, with 49.2 million boxes lost due to the main pests and diseases.

"The last crop registered the highest drop rate in history. If we add up the losses arising from the main pests and diseases, almost 70% of fruits are lost before harvest. In other words, the scenario is still very challenging for the entire sector," he highlights. 🍊

ECONOMIC IMPACTS FOR CITRICULTURE

Estimated loss with fruit drop due to pests and diseases in the 2021-2022 Crop





More orange trees and less area

THE BELT HAS 199.31 MILLION ORANGE TREES OF THE MAIN VARIETIES DISTRIBUTED OVER 387.07 THOUSAND HECTARES

The 2022 Tree Inventory, produced by Fundecitrus, shows that in the last four years there was a 2.52% growth in the number of orange trees in the citrus belt of São Paulo and West-Southwest Minas Gerais in relation to the last mapping carried out in 2018. There are 199.31 million trees.

In this eighth edition of the inventory, 160,000 km² were analyzed through high-definition satellite images. These images were made available to the research professionals and superimposed on the plot locations identified in the previous mapping, thereby facilitating the visualization of the sites that should be visited for data collection. "In total, more than 916,000 km were covered by the PES teams to update the data of all

the plots of the citrus farming area," says the research coordinator, Vinícius Trombin.

After collecting satellite images and data on the properties, the information was processed and organized with confidentiality until its disclosure to the sector.

AREA REDUCTION

In the new portrait of the citrus belt, the citrus planted area is further decreased, this time by 0.8%. However, the numbers show that the shrinking was

not as intensive as the reduction observed in the previous mapping. Between 2015 and 2018, the planted area diminished 16,956 ha, and now, between 2018 and 2022, it shrank 3,714 ha, going from 465,635 ha to 461,921 ha.

Only the orange groves, including all varieties, currently account for 397,529 hectares, a comparative reduction of 4%. On the other hand, acid limes and lemons gained space, with an increase of 32.58%. Tangerines grew by 3%.

The inventory also reveals that the decrease in the orange grove area is related to the insufficient number of new plantings to offset the grove area lost due to eradication or sheer abandonment. The regions of Porto Ferreira and Limeira show the largest area lost, with 13.04%. The regions of Votuporanga and São José do Rio

GROVES WITH ACID LIMES AND LEMONS GAIN SPACE, RISING FROM 8% TO 11% IN THE BELT. TANGERINES REMAIN STABLE, ACCOUNTING FOR ROUGHLY 3%



LIME AND LEMON GROVES EXPAND...

The area of acid lime and lemon groves, which had increased by around 11,000 ha between 2015 and 2018, expanded further, reaching an area of almost 52,000 ha. About 65% of this total area is concentrated in just two regions, Bebedouro (38%) and Matão (27%).

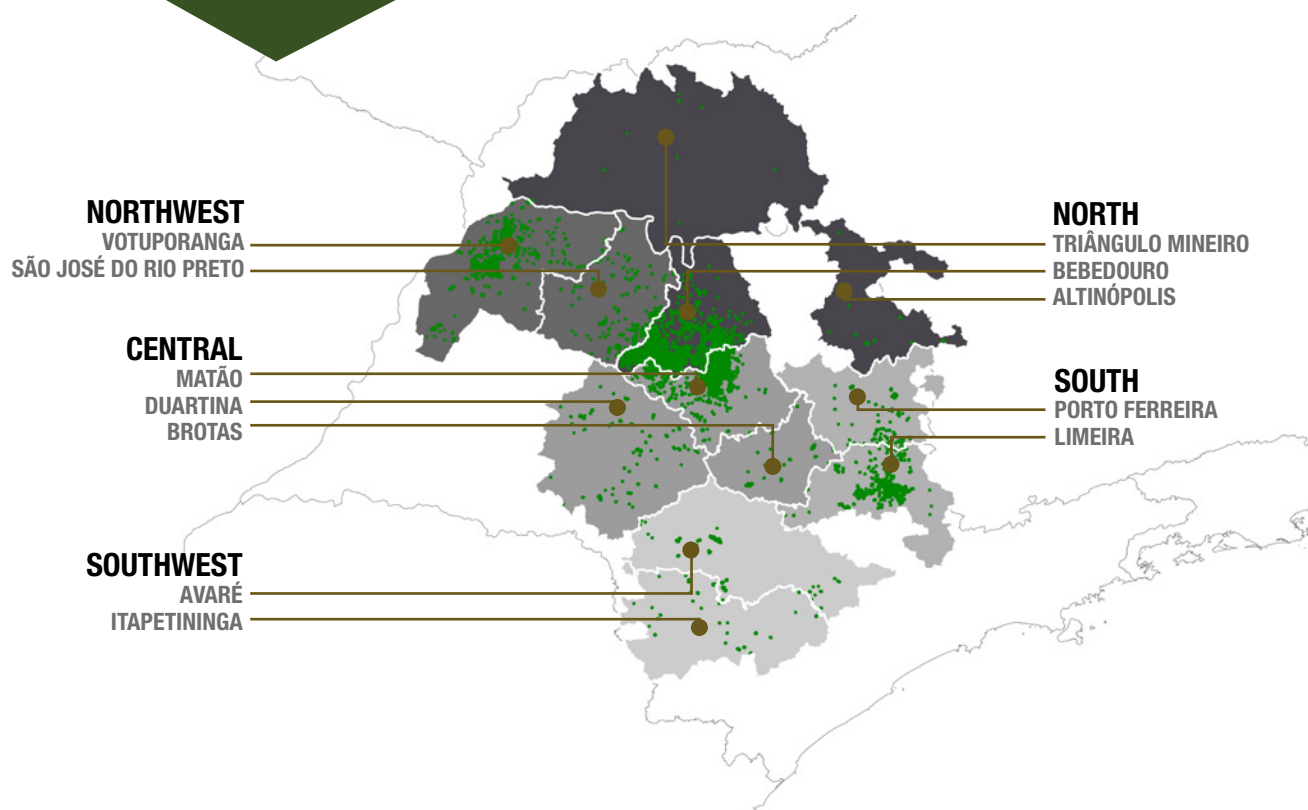
The distribution by variety shows that approximately 89% of this area is planted with Tahiti acid lime, 11% with Sicilian lemon, and 1% with other varieties.

Preto come next, with a loss of 10.39% of planted areas. Trombin explains that the reductions in area are mainly connected to the decreased yield caused by greening and climate change, which are more severe in the Northwest and South regions.

"In the case of the Southern region of the belt, the area decreased due to the high incidence of plants with greening. This triggers a drop in yield rates, which leads to the eradication of groves and, consequently, to the reduction of the planted

area. In the Northwest, one of the current causes is the lack of rainfall, which has been a historical problem in the region. In the last two years, water scarcity hit the municipalities of this region more intensively, resulting in lower yields," he concludes. 🍋

LOCATION OF PLOTS WITH VARIETIES OF ACID LIMES AND LEMONS



Citrus groves are grown outside the belt

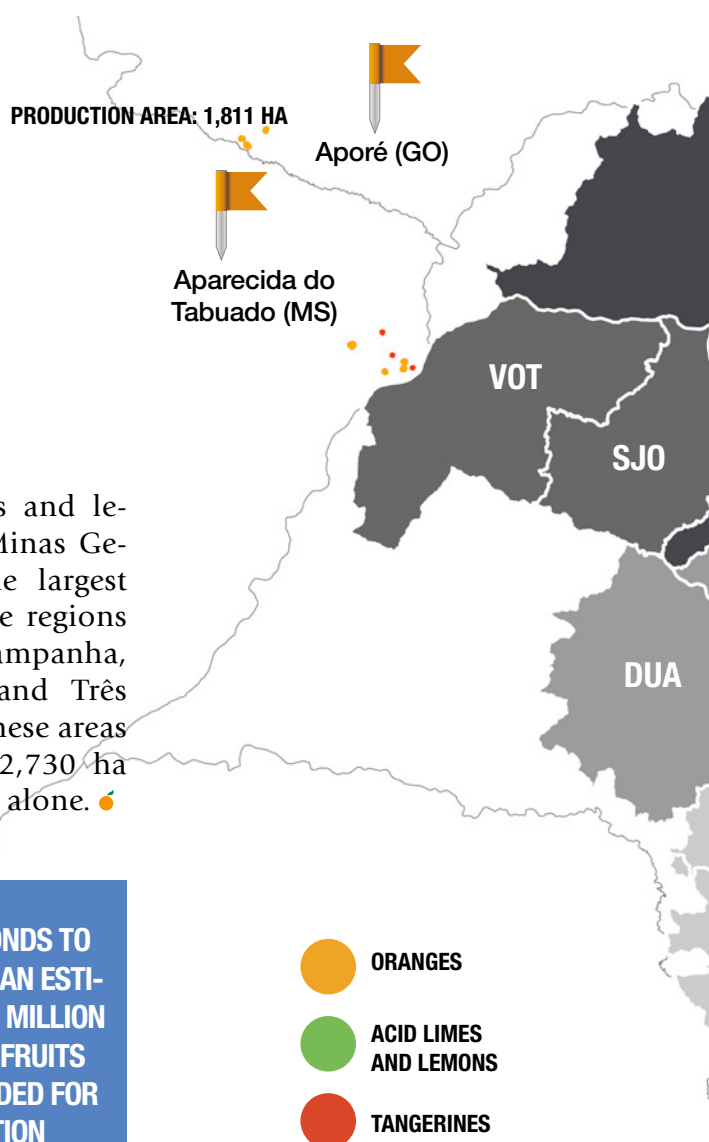
CITRICULTURE ADVANCED, SPRAWLING INTO 11 NEIGHBORING MUNICIPALITIES TO THE CITRUS FARMING AREA IN THE STATES OF MINAS GERAIS, GOIÁS, AND MATO GROSSO DO SUL

The new Fundecitrus Tree Inventory included, for the first time, commercial groves in municipalities outside the citrus belt, which are close to neighboring areas, in order to monitor the evolution of citrus plantings on these borders. The plantings are distributed in 11 municipalities and cover an area of 6,339 ha, with an estimated number of 3.508 million holes.

Most of the fruits produced in these regions are intended for fresh consumption: 47% of the area is farmed with tangerines, 43% with oranges, and

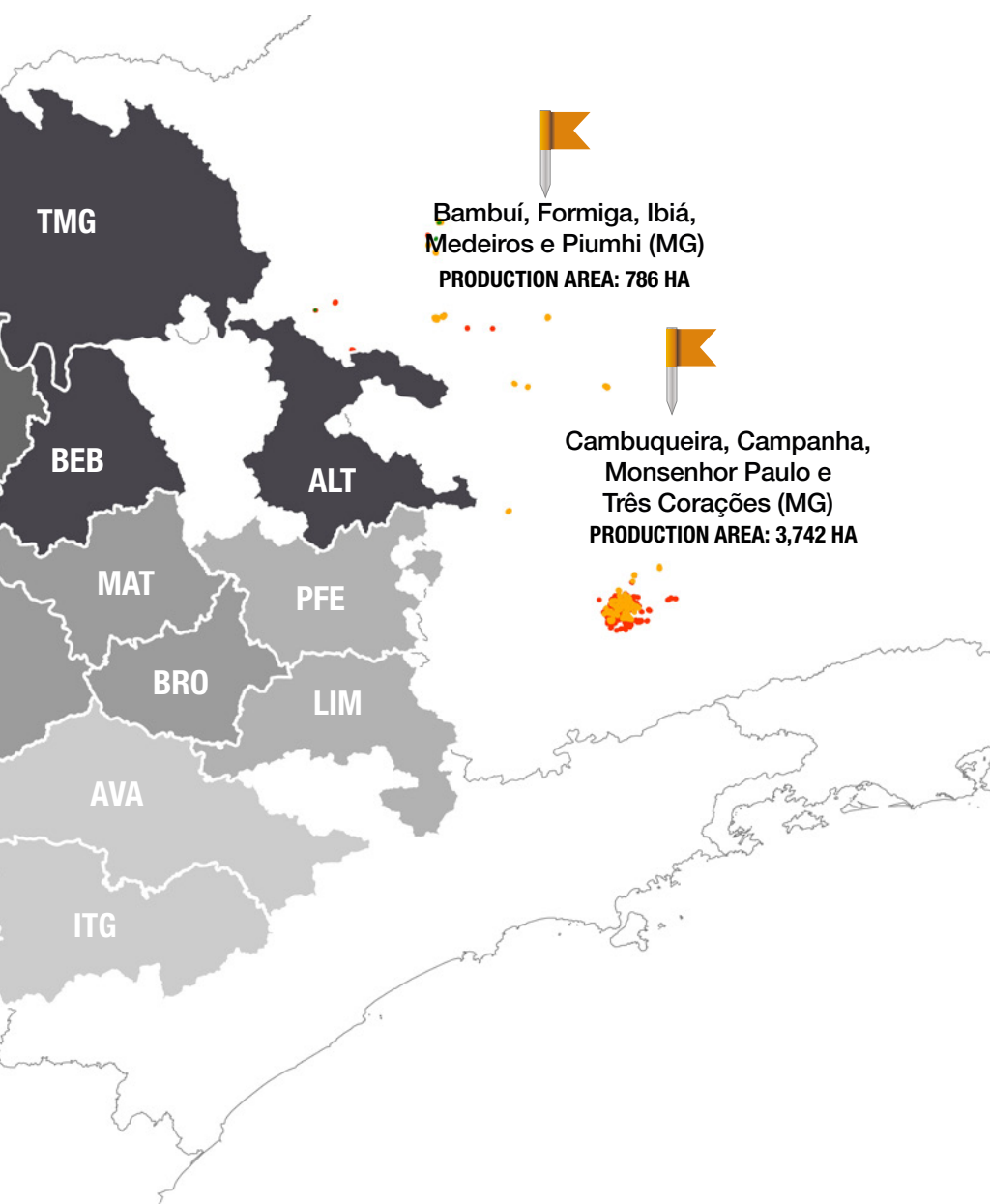
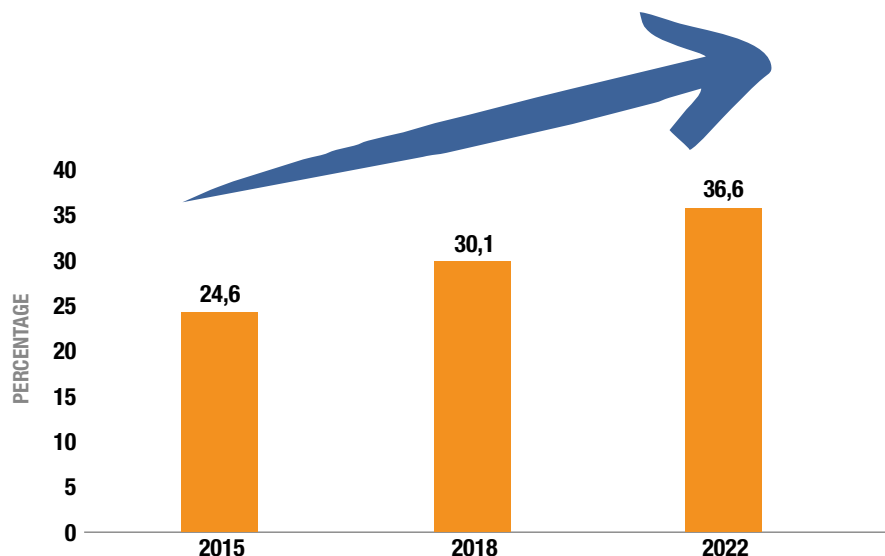
10% with acid limes and lemons. The state of Minas Gerais accounts for the largest area, especially in the regions of Cambuquira, Campanha, Monsenhor Paulo, and Três Corações. Together, these areas have approximately 2,730 ha of the Ponkan variety alone. 🍊

NEW AREA CORRESPONDS TO ABOUT 6,300 HA, WITH AN ESTIMATED NUMBER OF 3.5 MILLION HOLES. MOST OF THE FRUITS PRODUCED ARE INTENDED FOR FRESH CONSUMPTION



EVOLUTION OF IRRIGATION IN THE CITRUS BELT

94% of the irrigated area uses the drip system



IRRIGATION IS MORE WIDELY ADOPTED IN THE GROVES

As a way to fight against droughts and further expand production, groves with irrigation systems have been growing in number in the citrus belt. In 2015, the share of irrigated areas was 24.6%, then it rose to 30.1% in 2018, and now it has reached 36.3%.

“If only adult groves are considered, the share of the irrigated area goes up to 38.9%,” explains the survey coordinator, Vinícius Trombin. In absolute values, the Votuporanga region had the highest expansion in the use of irrigation, with an increase of 5,556 ha compared to 2018.

The regions in which irrigated areas account for more than half of the total area are: Triângulo Mineiro (87%), Bebedouro (74%), Votuporanga (71%), Matão (60%), and São José do Rio Preto (54%). “Regarding the system used, approximately 94% was found to be drip. It is a technology with the best efficiency and water savings, since irrigation is delivered at the plant roots,” he concludes.

Irrigated groves: a path with no return to the future of food production

WITH INCREASINGLY SCARCE RAIN PERIODS AND SHARP DEMOGRAPHIC GROWTH, THERE IS A GROWING NEED TO DRIVE THE SUSTAINABLE AND EFFICIENT USE OF WATER RESOURCES IN AGRICULTURE



Guilherme Fonseca, citrus grower in the Andes district (Bebedouro/SP)

The high productivity level of sectors of the economy is fundamental for the sound promotion of business and, consequently, for the sustainable supply of consumer markets. In agriculture, it is no different. The search for efficiency undoubtedly entails the need for investment, especially when there are challenges imposed by nature.

For instance, the absence of rain or its concentrated distribution, events which are increasingly prevalent, adversely impacts production. The alternative solution adopted by some citrus growers is to invest in the irrigation of groves. Data collected by Fundecitrus in its Tree Inventory of the citrus belt reveal that the practice of irrigation has grown by almost 33% in the last six years (*see more on page 21*), and this adoption trend should be even stronger in the future, especially in places that suffer from scarce rains.

According to the researcher in the field of water resources and irrigation at Embrapa Cerrados, Lineu Rodrigues, the global food security is at stake. The United Nations (UN) estimates that the growth of the world population should bring more than 2.5 billion people to live in urbanized areas by 2050. "There is a need for an actual 70% increase in food production to cope with the supply of this scenario 30 years from now," he warns.

MORE IRRIGATION IS NEEDED

The solution to turn this game around is to at least triple the irrigated area in Brazilian agri-

culture, so that the production is not affected by droughts, and the crops do not fall short of expectations. According to the researcher, Brazil is one of the few countries with the capacity to expand its irrigated area in a sustainable fashion, going from 1.5 million irrigated hectares to 55 million.

"Irrigation technology has a high potential to contribute to food and environmental security, as well as to reduce hunger and poverty," he says.

WITH THE IMPLEMENTATION OF AN EFFICIENT IRRIGATION SYSTEM, CITRUS PRODUCTION COULD GROW, ON AVERAGE, 33%

Irrigation, argues the researcher, is the practice that most requires water resources. However, the volume used accounts for less than 0.6% of the volume available in rivers. "Expansion is feasible if good management practices of water resources are utilized. Water is an irreplaceable resource in agricultural farming," he explains.

HIGH YIELD

The yield rate in the citrus belt continues to accelerate, as a result of significant improvements that have taken place in recent years in citrus farming, including better quality seedlings from protected nurseries, planting density, better combination of canopy and rootstock, migration to more



Lineu Rodrigues,
researcher at
Embrapa Cerrados

PERSONAL ARCHIVE

cialized in irrigation for citrus farming, the implementation of an efficient irrigation system may boost citrus production, on average, by 33%. "Irrigation has been advancing in citrus farming and, more recently, it has moved down to the southern region of the state. This technical trend is expanding into areas where the incidence of rain has been dwindling," he explains.

Silva warns about the need to irrigate in the North and Center regions of the state of São Paulo. "If that doesn't happen, we are talking about truly jeopardizing production. In other words, citrus growers face the risk of not affording to pay for their investments in the groves because the trees will bear fewer fruits or because the plants will die from water stress," Silva emphasizes.

CHALLENGES

Specific public policies for the sector and broad access to technology for small producers are the main bottlenecks for the sustainable growth of irrigation in the country. "Having a more efficient legislative framework does not mean acting against

favorable regions, improved disease management, nutrition, and irrigation. In the last five years, according to Fundecitrus data, the average number of orange boxes harvested per hectare is 843. A figure well above the one recorded in the 1980s, for example. In 35 years, citrus production per hectare leaped by circa 178%, from 331 boxes in the 1988-1989 crop to 920 boxes, which is the new estimate for the 2022-2023 crop (*see more in*

the chart on page 25).

"A large share of this high yield was also spurred by the advances in irrigation in our sector. We are talking about an expansion rate of irrigated areas that jumped from 3% to 36% in 30 years. This scenario demonstrates that there is no turning back on the irrigation path," asserts Fundecitrus General Manager, Juliano Ayres.

According to Guilherme Oliveira Silva, agronomist and consultant at Forbb, a company spe-

CONTROLLED "RAIN" IS REASSURING FOR CITRUS GROWERS

When rains are intensive and constant, damage to agriculture is inevitable. However, long drought periods may also cause losses. "Irrigation is the process that will balance this disarray, with a high level of efficiency and cutting-edge technology," guarantees the Agronomic Manager Cristiano Jannuzzi, from Netafim, a company specialized in irrigation. The primary benefit of the system is gene-

rating a controlled "rain" that is customized to the needs of each grove.

In a well-designed irrigation project, it is possible to estimate the correct time to irrigate, using a probe monitoring system directly in the soil. "Regardless of the size of the business, producers cannot leave their production at the mercy of insecurity, not knowing whether there will be the required rainfall for a good harvest or

not", affirmed Lineu Rodrigues, a researcher at Embrapa Cerrados.

"The irrigation system will ensure that the appropriate amount of water is delivered to the crop in order to maintain its productivity," concludes Jannuzzi. He guarantees that the technology available in the country does not fall short of the solutions of the big players in the market, such as Israel and the USA.

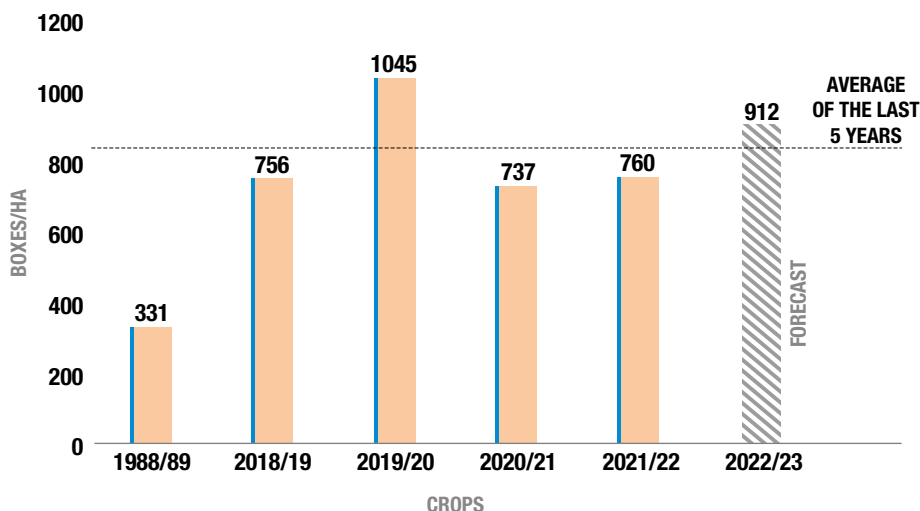
the environment. Legislation must always be revisited, especially when the laws are very old. There is no harm in doing that, especially when the protection of the environment and the production of food for people are the main objectives,” explains Rodrigues.

In the researcher’s opinion, the path encompasses strengthening and integrating sectoral policies and their respective plans, especially those that have a deeper connection with irrigated agriculture, such as water resources, energy, environment, and infrastructure policies. “There are several challenges to be tackled in order to produce food with sustainability, but undoubtedly some of the main and most difficult solutions are those that do not depend solely on producers,”



EVOLUTION OF ORANGE PRODUCTION PER HECTARE

In the last 35 years, since the end of the 1980s, the yield rate of citrus farming in São Paulo state has increased 2.5 times



he explains. One of the solutions is the management of water resources, which is a key element in the process of regulating water

use and water security, as well as the effective and true integration of institutional actions and sectoral public policies. 🍊

THE SOLUTION TO KEEP UP PRODUCTION IN THE GROVES

Little rain, many uncertainties and several losses. This was the scenario faced routinely at Fazenda Serra, in the Andes district, in Bebedouro (SP state). In order to further face these challenges, almost a year ago the citrus grower Guilherme Fonseca chose to open wells and build a dam to start working with fertigation in part of his property dedicated to orange farming. Today, about 13.5% of the property is equipped with a drip system. “In this initial moment, the objective is correcting the average yield oscillation caused by the absence of rain. After accomplishing that, we will set out to expand our productive potential,” he explains. Last year, Fonseca’s harvest amounted to 850 boxes per hectare. This

year, he expects to reach 1,000.

In recent years, the citrus grower has seen orange trees die from water stress as well as the emergence of diseases that he had not seen on his property.

“Sudden death is one of them. We lost a lot of trees,” he complains. “Without irrigation, citrus growers will not survive through these climate changes. The main issues are the survival of our groves and the health of the business,” he says.

Sustainability is a must at Fazenda Serra, which is certified by the Rainforest Alliance. By implementing fertigation, management is enhanced. “The water that is supplied to groves promotes hydration and, at the same time, nourishes the orange trees with the controlled input of fertilizers. This also prevents waste on several management fronts,” he concludes.

Orange juice does not affect blood glucose

FIND OUT MORE
ABOUT THE STUDY:



RESEARCHERS HAVE CONCLUDED THAT THE BIOACTIVE COMPOUNDS AVAILABLE IN ORANGES PREVENT THE ELEVATION OF BLOOD SUGAR

One of the most recent studies carried out by the Food Research Center (FoRc) of the Faculty of Pharmaceutical Sciences of the University of São Paulo (USP), with the support of Fundecitrus, analyzed the impacts of orange consumption on glycemic levels, which is the blood glucose level. Research indicates that the fruit bioactive compounds help to modulate this index, and they may even promote health improvements. Moreover, other benefits are under investigation.

THE STUDY

Healthy volunteers were divided into three groups: the first drank water after meals; the second, orange juice; and the third, water with a sugar content equivalent to that available in orange juice.

After one hour, the amount of glucose (sugar) in each participant's blood was analyzed. The three groups showed changes, but the volunteers who consumed sugar in water had the highest blood glucose rate (± 135 mg/dl), unlike the volunteers who drank orange juice or water. These volunteers had similar, much lower blood glucose rates (100 to 108 mg/dl). This means that there was no significant increase in the values of blood glucose and insulin (a hormone produced by the pancreas that metabolizes blood glucose).



According to the senior professor of the University of São Paulo and principal researcher at FoRc, Franco Lajolo, even with a significant concentration of sugars (glucose, fructose, and sucrose), which are naturally present in the fruit, oranges do not cause a significant change in the blood glucose of individuals who consume them during meals.

"In several clinical trials that we have conducted, we have confirmed that the intake of orange juice during meals does not result in a glucose peak, the blood glucose remains low," he points out.

According to Lajolo, the explanation may lie in the action of the fruit's components.

"It is possible that some bioactive compounds interact with the gut microbiota, helping to control the elevation of the glycemic rate. For this very reason, and also because of additional benefits, we encourage

everyone to include oranges in their diet," advises Lajolo.

ACTION IN THE BODY

In order to better understand how orange juice helps to curb the increase in blood glucose, researchers collected blood samples from the participants and investigated the circulating microRNAs, which regulate the expression of genes associated with the various metabolic pathways. Orange juice caused an increase in the expression of one of these genes, the miRNA-375, which is related to the production of insulin, in addition to being considered an indicator of the pancreatic cell function, which makes it an ally for diabetes. The findings are highly significant, and results are being confirmed.

The FoRc researcher, Neuza Hassimotto, points out that, ac-

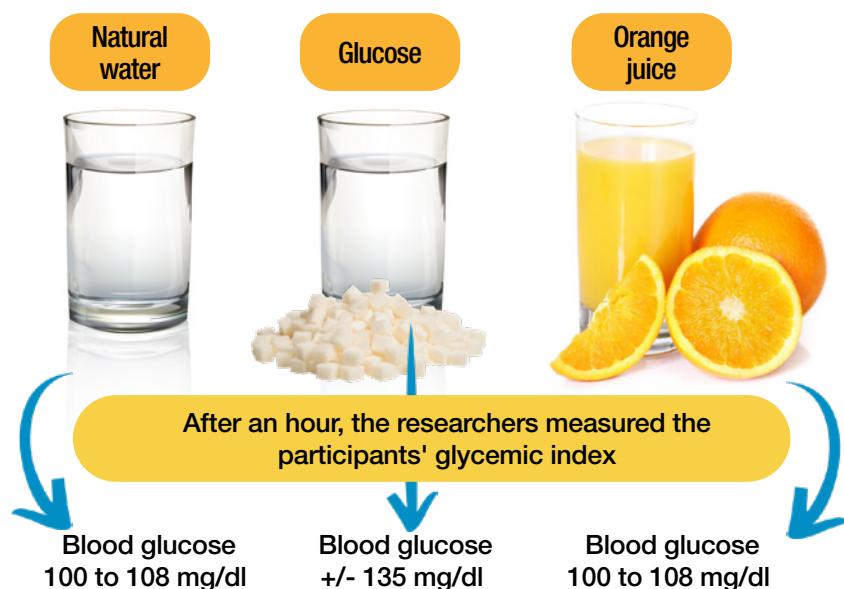
cording to studies, when orange juice is ingested with some food, especially during meals, it offers a quick release of energy to the body, without drastically increasing blood glucose.

"The research results were beneficial both for healthy people, who drank the juice for a week or a fortnight, as well as for obese people, who have insulin resistance. Moreover, the juice also promotes positive effects in some molecular processes," she explains.

Fiber and flavonoids contained in orange juice have been shown to reduce glucose uptake. "Flavonoids have antioxidant and anti-inflammatory action, which has been proven to promote a beneficial effect on insulin production and blood glucose modulation, which may explain the positive results of the study," comments the researcher. 🍊

IMPACT OF ORANGE JUICE INTAKE ON GLYCEMIC LEVELS

Study showed that the increase in the blood sugar level when drinking orange juice after meals is similar to that of drinking water



OTHER BENEFITS OF ORANGE JUICE

- Source of **vitamin C** which strengthens the immune system
- Source of **flavonoids** and **carotenoids**, which have antioxidant and anti-inflammatory properties
- Availability of **fibers** that improve bowel function
- Source of **potassium** which is important for the functioning of all cells
- Source of **magnesium** which supports the supply of energy
- Prevention of **chronic diseases** such as obesity, cardiovascular disease, and diabetes