



Agricultural **Trends and Challenges**

Report 2021 —







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Opening Letter







Trends and challenges in Agriculture 2021

As spring approaches, we are reminded once again that a fresh start for agriculture is around the corner. This past year has highlighted the importance of the food supply chain, which begins in the soil. 2020 has challenged every player in agriculture on their abilities to adopt innovative solutions.

The impact of the pandemic outbreak has put much pressure on the food supply chain and brought its fragility to the forefront of our attention as a society. We need to ensure more sustainable ways to increase food production and preserve natural assets, especially those as crucial as soil fertility and life.

Long before the outbreak, agriculture started to face some of the immediate challenges to improve the amount and quality of the crops while minimizing the environmental impact. Changes in agriculture are motivated by adapting to consumer needs, more restrictive regulations on inputs and the need to increase the positive impact on the environment to mitigate climate change.

The use of technology in the agriculture sector has proven, that simple yet efficient tools can combine natural resources within the soil with scientific data to create effective solutions. Looking forward with lessons learned from 2020, we expect this growing season to bring about many innovative opportunities for tackling challenges in agriculture.



Alberto Acedo
Co-Founder and CSO of Biome Makers



Adrian Ferrero
Co-Founder and CEO of Biome Makers

An aerial photograph of a vast agricultural field, likely a cornfield, with rows of crops in various stages of growth, showing yellow and green hues. A dirt road or path runs through the field, and a small, light-colored building is visible near the center. The background shows a dense forest of tall trees.

Methodology



Collecting feedback around the world

In January-February of 2021, we conducted a survey among nearly **100 farmers and agronomists** located in the **USA, Central and South America as well as Europe**, on the challenges they commonly face and what they expect from the coming growing season. In order to understand the drivers behind agriculture's challenges and trends, we have asked survey participants about their **current management practices, familiarity with sustainable farming techniques**, knowledge and trust in smart solutions, and the level of impact from Covid-19 and climate change. We further assess the role of such environmental crises in the adoption of agricultural trends. We then delve into the primary factors involved in the farmer ag-input selection process, and gauge product satisfaction rates.

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+100

Farmers & Agronomists



+15

Countries

We assess the impact of Covid-19 on the food supply chain and its role in the adoption of agricultural trends. We also measure the traction of innovations and smart solutions as well as input selection processes among agricultural professionals in recent years.

In this study we incorporated the opinions of experts in agriculture on the key survey findings: **David Olson** - co-owner of Sustainable Growing Solutions, **Nate Wall** - Winemaker at Troon Vineyards, **Karbel Montes** - Plant Nutrition expert from Dole, **Brian O'Toole** - Chairman of Terravesco and as well as our experts in agriculture and agronomy at **Biome Makers**.



The economy and the impact of Covid-19

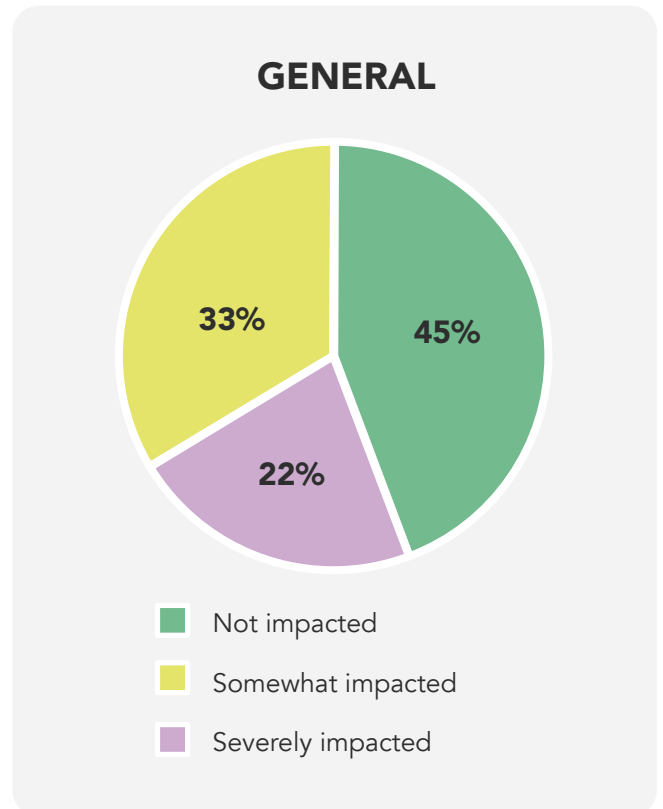


The impact of Covid-19

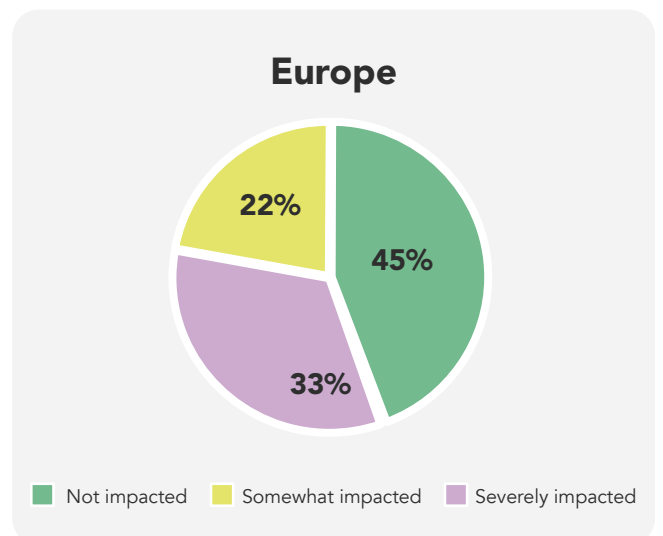
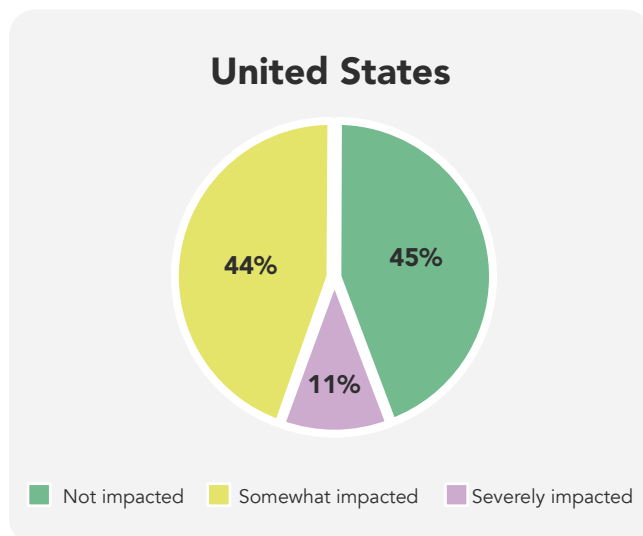
The global economy has been impacted greatly by the pandemic. Many essential businesses such as farm owners both large and small in scale, were challenged to implement safety procedures in a short time and adapt their routines to keep their businesses afloat, while supplying produce to the public.

In order to understand the impact on farmers across the world, we compared the severity of the impact experienced by farmers from the United States and European countries to identify any contrasts in how farmers from various countries were impacted by the pandemic.

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Our results show that while the same percentage of farmers from USA and European countries were not impacted by the pandemic, the severity of those who were impacted was higher in Europe than in the United States.





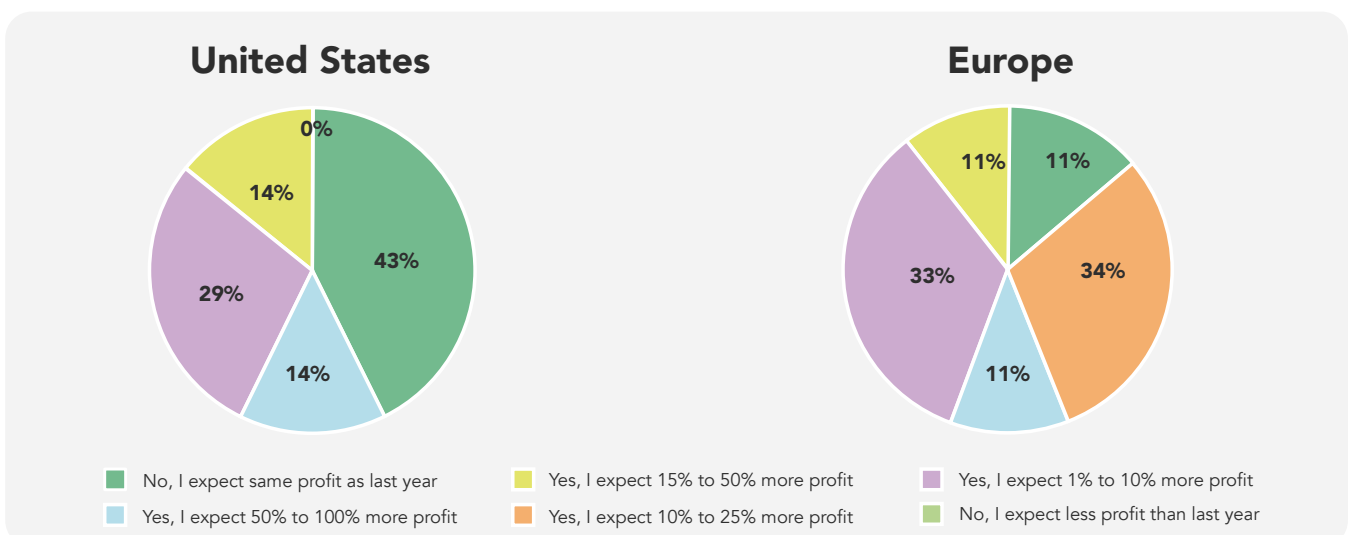
“88% of respondents in Europe expect an increase in their profits and believe that this growing season holds a promising yield whereas 57% of US farmers expect more profit as compared to last year”

Profit projections

Although we know that the macroeconomic shocks caused by COVID-19 are expected to put downward pressures on agricultural commodity prices, **88% of respondents in Europe expect an increase in their profits** and believe that this growing season holds a promising yield; **compared to the**

US, where 57% expect more profit as compared to last year.

Conclude that **2021 holds the promise of a better harvest and economical dynamics for agribusinesses**, especially in Europe according to the data.



An aerial photograph of a lush green agricultural landscape. The image shows a grid of rectangular fields, a winding road, and a strip of trees. The text 'Trends & Challenges' is overlaid in white, bold font. There are also several semi-transparent geometric shapes (a large triangle and several rectangles) overlaid on the image.

Trends & Challenges



Key trends in agriculture

The insightful responses to our survey highlighted key areas in agriculture that farmers are trending towards, in addition to areas that they are struggling with.

These key concepts revealed in the survey include:

01



SUSTAINABILITY

Sustainable practices will gain significant traction among farmers looking to protect their farmland fertility and the environment. Cover Crop are the number one practice to be adopted in 2021.

02



AGRICULTURAL INPUT EFFICIENCY

Manufacturers will need to make improvements on product effectiveness, as 84% farmers have not yet found a product that they are completely satisfied with.

03



CARBON SEQUESTRATION

Farmers are concerned about the increased frequency of extreme weather that leads to early booms and early sprouting.

04



AGTECH FOR PROFATIBILITY

57% of growers are eager to adopt new technologies to increase profits, although they find it difficult.

05



NEXT GENERATION OF FARMING

The next generation of farmers face grave challenges, but are more open to smart solutions.





SUSTAINABILITY



Sustainability practices as a trend in 2021

Sustainability is at the core of maintaining successful and long-lasting farmlands capable of producing food for our growing population. It is gaining traction among farmers, who are recognizing the long-term benefits of sustainable farming and preserving the value of their lands.

75% of participating farmers selected "sustainable practices" as their management priority. Moreover, **74% of agronomists indicated that turning to sustainable practices is a top trend** among the farmers they work with. On the other hand, **49%**

of farmers indicated that cover cropping is a sustainability practice that they are willing to adopt. Another **38% are open to conservation agriculture methods, and 45% are willing to adopt regenerative agricultural practices.**

Although it is not possible to fully identify the cause and effect behind this increased interest in sustainability, we observed sustainable practices as a trend among farmers motivated by profitability as well as farmers currently challenged by ag-inputs as one of the top two operational costs.

"Sustainability is gaining traction among farmers, who are recognizing the long-term benefits of sustainable farming and preserving the value of their lands."

Soil, a living system

Soil, also commonly referred to as earth or dirt, is a mixture of organic matter, minerals, gases, liquids, and organisms that harmoniously work together to support life. Within a tablespoon of soil, there are more microorganisms than there are people on earth.

Scientific definitions distinguish soil from dirt by restricting the latter term specifically to displaced soil. In simpler words, dirt is soil that is in the wrong place. When cut off from its ecosystem, subsequently losing its functionality, soil turns to dirt, and becomes no longer a productive member of the society. In order for soil to be productive, **it has to stay alive and it has to remain healthy.**

Soil health, as FAO describes it, is the capacity of soil to function as a living system. Healthy soils maintain a diverse community of soil organisms that help to control plant diseases, insect and weed pests, and form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with positive outcomes on water and nutrient holding capacity, and ultimately improve crop production.





Soil not only functions as a medium for plant growth, supply, purification, and storage of water, or as a habitat for organisms, but it also plays a vital role as a modifier of Earth's atmosphere. Healthy soil means cleaner air and water, fertile and rich crops and forests, productive pastures, and diverse wildlife. In other words, **"better soil, better food, better life"**. For soil to be considered healthy, it needs a rich and diverse living community: macrofauna such as nematodes, arthropods, and mollusks, and microorganisms such as bacteria, archaea, fungi, and protozoa. The second group, formed by tiny creatures living underneath the ground, is defined as **the soil microbiome**. These microorganisms carry out a range of processes important for soil health and fertility in both natural ecosystems and agricultural systems. They transform organic matter into plant nutrients, along with converting the soil minerals into disease-suppressing compounds.




Soil biodiversity, also referred to as the "factory of life" by the EU Commission, plays an important role within the global ecosystem. Through microorganisms, soil can mitigate climate change, store greenhouse gases, purify water and prevent erosion. The interconnected nature of ecosystems is an undeniable fact that lays beneath our feet.

Soil,
A Living System



[Soil, a living system \(Article\)](#)

You can read an extended version of this article.



“There is a growing understanding and appreciation of the linkage between the soil and microbial health of the vineyard, and the production of complex, nuanced wines most expressive of the terroir where they are grown. I foresee this trend continuing to build momentum in 2021 as wine growers look to adopt more regenerative agricultural practices, healing their soils and minimizing their carbon footprint while simultaneously improving the quality of their product. It’s a win-win-win.”

Nate Wall

Troon Vineyards

A circular white logo with a thin black border is centered over a photograph of a vineyard. The vineyard rows are in the foreground, leading towards a building and a parking lot in the middle ground. The background consists of rolling green hills under a clear blue sky. The logo contains the text 'TROON VINEYARD' in a bold, sans-serif font, with 'APLEGATE VALLEY' and 'OREGON' in a smaller font below it, separated by horizontal lines.

TROON VINEYARD

APLEGATE VALLEY
— OREGON —



INPUT EFFICIENCY



Looking for products with proven effects

Input efficiency is crucial to ensuring input investment returns on farmlands. 38% of farmers participating in our survey indicated that investing in farm productivity is one of their top challenges. Among the many products on the market, it can be difficult to choose an effective and cost-efficient product with minimal impact on the soil's natural nutrient mobilization capabilities.

A whopping 84% of farmers indicated that they have not yet found a product that they are completely satisfied with as of this year. Another 39% of farmers indicated that inputs are one of their top two operation expenses. **The future of ag-input manufacturing requires market differentiation and demonstrated effectiveness as well as safety.**

“84% of farmers indicated that they have not yet found a product that they are completely satisfied with as of this year.”



GHEOM[®], track the effect of your ag inputs

GHEOM[®] A MICROBIOME-BASED PROTOCOL FOR FIELD TRIALS

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Biological solutions are an excellent tool for agriculture to increase the yield and quality of crops while reducing environmental issues. The value of Gheom[®] is to prove out biological product efficacy analyzing the most meaningful bioindicator in nature - the soil microbiome.

Measurable independent protocol to evaluate and produce claims associated with crop inputs. A marketchanging tool to deliver food security and sustainability.

A vital service for ag input manufacturers who seek better claims and transparency of how and where their biological products work.





Already in use by top manufacturers across the world

Locus Agricultural Solutions



"You can't optimize what you can't measure, and we feel that the Gheom® platform is a significant step towards unraveling the elegant aspects of microbial soil ecology and its impact on crop productivity".

Disagro



"This data-driven assistant is a game-changer to upgrade agronomic advice on fertilization and crop protection programs, including biologicals, in an integrated management approach"

-Juan Jose Chavez, the Product Manager for Advanced Analytical Services in DISAGRO

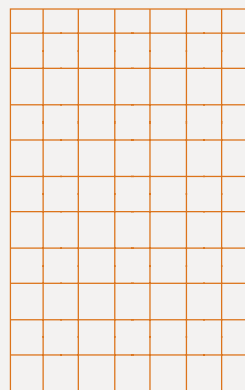
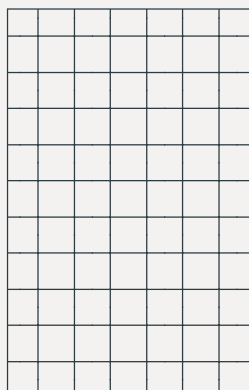


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Sampling Methodology

BEFORE INPUT (M0)

AFTER INPUT (Mn)



Control Zone

To be treated zone

Control Zone

To be treated zone

Applicable to:



Any Crop



Any Soil



Several samples per time



Several sampling times

“There are some exciting developments in the use of our biological products for increased plant nutrient efficiency. Using SAP analysis we were able to demonstrate a 29% increase in plant Phosphorus nutrient status and a 20% increase in Nitrogen nutrient status. The increase in Nitrogen status was particularly good as the grower used 50% less Nitrogen input. These test results demonstrate the power of biology in increasing nutrient input efficiency and plant nutrient status. The performance of the biology in improving the fertilizer efficiency and plant nutrient status has led the grower to completely overhaul their fertilizer program to integrate biology as a key component in unlocking the soil nutrients and optimizing plant fertility.”

David Olson

*Co-owner at Sustainable
Growing Solutions*





CLIMATE SMART AGRICULTURE
Carbon Sequestration



Climate change impact in agriculture

Climate change has a substantial impact on food production. 68% of survey participants indicated that they have been impacted by climate change in one way or another. Provided examples of common challenges they face include: issues with increased frequency of extreme weather events such as droughts, fires, and irregularities in seasonal weather. These weather irregularities have led to early blooms and early sprouting, making crops vulnerable to returning frost damage.

Consequently, many participants indicated that they have suffered crop loss, reduced crop quality due to unusual temperatures at harvest time, and irrigation challenges due to unpredictable rainfall. To put the severity of the issue into perspective, climate change tied with soil erosion as the top challenge for 70% of participants.



“Climate change tied with soil erosion as the top challenge for 70% of participants.”

One of the opportunities we have in our society to mitigate the risk posed by climate change on our food supply is farmlands themselves! By adopting sustainable practices, formerly carbon releasing farmlands have a huge potential to become carbon sinks in a matter of just a couple of years. Carbon farming is projected to gain even more traction in 2021 with the attention of tech giants who are focused on innovating solutions for reducing greenhouse gases. In order to achieve this goal, we must turn to practices that allow the soil to retain its bioactivity, thus providing an opportunity for microorganisms to sequester carbon.


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While farmers struggle with already-dwindling profits and facing many uncertainties, it is the responsibility of the industry and policy makers to empower them to adopt sustainable practices. Programs such as Carbon Farming Initiative and carbon credits are projected to become more versatile in agriculture.

As of now, however, only 30% of farmers have indicated knowledge of the existing Carbon Farming Initiative (CFI). In conclusion, these statistics reveal that there is a need to improve accessibility to these programs, just as much as creating additional programs.





Regenerative Agriculture, as defined by the Rodale Institute, “focuses on rebuilding organic matter and living biodiversity in soil which produces increasingly nutrient-dense food year after year—while rapidly sequestering excess atmospheric carbon underground to reverse climate change.

The fundamental cultural practice of regenerative agriculture include: no/low tillage, crop rotation, cover cropping, composting and the use of biologicals/biofertilizers to accelerate soil health and fertility. All of these practices contribute to carbon sequestration and the reduction of greenhouse gas emissions, and as such, are essential to “Climate-Smart” Agriculture.

The policy priorities for the newly elected Biden Administration have climate change at the very top of the list. The Administration is pursuing a bold, comprehensive climate agenda that includes a wide variety of policy initiatives to reverse global climate change.

These policy initiatives will affect virtually every corner of our economy and society.”

Brian O’Toole

Chairman of Terravesco



TERRA  VESCO®
FEED THE SOIL.®



AGTECH FOR PROFITABILITY



Empower farmers

How can we empower farmers to maximize yields, crop quality and farm productivity, all the while maintaining and/or improving soil health?

The answer lies in technology. 70% have indicated that they do not currently use any agtech services. Additionally, 57% selected “adopting and learning new technologies” as one of their important future challenges for their agribusiness in 2021.


Although it may be challenging for farmers to adopt from the numerous new technologies introduced to the market, expos and tradeshow have been effective ways to introduce farmers to potentially beneficial technologies. 60% indicated that expos and tradeshow featuring new technologies have made an impact on their management practices.



Though investment in productivity has been shown to be a challenge among our survey participants, investing in technology has the potential to reduce costs in the long run. According to these results, we can conclude that farmers need support with upfront costs to introduce new technologies into their farming practices, enabling long-term increase in farming profitability.

Despite these challenges, 95% have indicated that they would recommend agtech services such as soil health analyses to their colleagues. As a general concept, technology plays an important role in ensuring profitability and soil health. Without the adoption of various forms of technology, it will be very difficult to achieve sustainability and profitability simultaneously.

Luckily, funded initiatives such as Fields4ever are gaining traction, offering farmers and researchers interested in long-term profitability access to technologies free of charge.

A photograph of a lush green field, likely a crop field, under a bright blue sky with scattered white clouds. The field is filled with tall, green plants, possibly corn or soybeans, with some white flowers visible. The background shows a line of trees and a clear horizon.

“When speaking of Ag Technologies, there are a number of new innovations that can offer enormous savings for growers. For example, soil microbiome analyses are adding a new important layer of insights to conventional soil tests. Another one that comes to mind is Plant Tape. This unique technology provides transplant seedling efficiencies without the labor costs and also avoids the excess added management of using conventional plug seedling trays. These innovations are just a few of the many ag technologies that are revolutionizing the agriculture world and like many other technologies, this type of trend is becoming more and more widely accepted on farms.”

Luis Benvenuti, Field Agronomist

University of Arizona Ag Technology Lecturer





NEXT GENERATION OF FARMING



Enabling new generations of farmers

A common concern about the future of agriculture is encouraging young people to stay in rural areas and become future farmers. **35% of farmers indicated the issue as an important future challenge for their agribusiness.** In order to attract young people to agriculture, it is crucial to ensure that the lands they inherit are capable of quality food production in a profitable manner. We must also ensure that the next generations have better access to assistance for sustainable food production, with new technological advancements in agricultural sciences. According to Young Farmers in the EU economics and characteristics, In 2011-2013, farmers younger than 35 years old had the highest net investment value per farm on average. In contrast, the oldest farmers had negative net investments, which means that they were not replacing their capital stock in line with depreciation – a sign of phasing-out of production activities.

“35% of farmers indicated that encouraging young people to stay in rural areas and become future farmers is a major challenge.”

According to EU Agricultural and Farm Economics Briefs, the majority of current farming managers learn their profession through practical experiences only. However, young farmers tend to follow a full agricultural training cycle, allowing them to be more exposed to learning new techniques and technologies, increasingly bringing them into practice on their farms.

We have an opportunity to see the adoption of new techniques that help reduce the impacts of climate change, and enabling regeneration of farmlands using data-based technologies.



The challenge is to produce food! Like our ancestors, we and future generations of farmers will be challenged to increase or maintain the productivity of their crops. In 2021, The resilience to which we have been subjected as a result of the COVID-19 pandemic, which has put unprecedented pressure on food supply chains, is emphasized in 2021.

There are unprecedented pressures on food chains around the world. However, the agricultural sector faces many additional uncertainties. Diseases such as Panama Disease (Foc R4T), which threaten to wipe out Musaceae crops in tropical and subtropical areas, the spread subtropical areas, the spread of pests to new regions such as locusts in Central America, restrictions on the use of agrochemicals, molecules in decline, low prices due to new food trends, climatic phenomena extreme and increasingly unpredictable climatic phenomena, and government policies with little support for agriculture. There is no doubt that the challenge is enormous. However, our expectation is for growth over the previous year, given that we are better prepared, with technology and information, to face the challenges of the future. With technologies and information to face the inclemencies and thus, little by little, return to the production that guarantees food for all.”

Karbel Montes

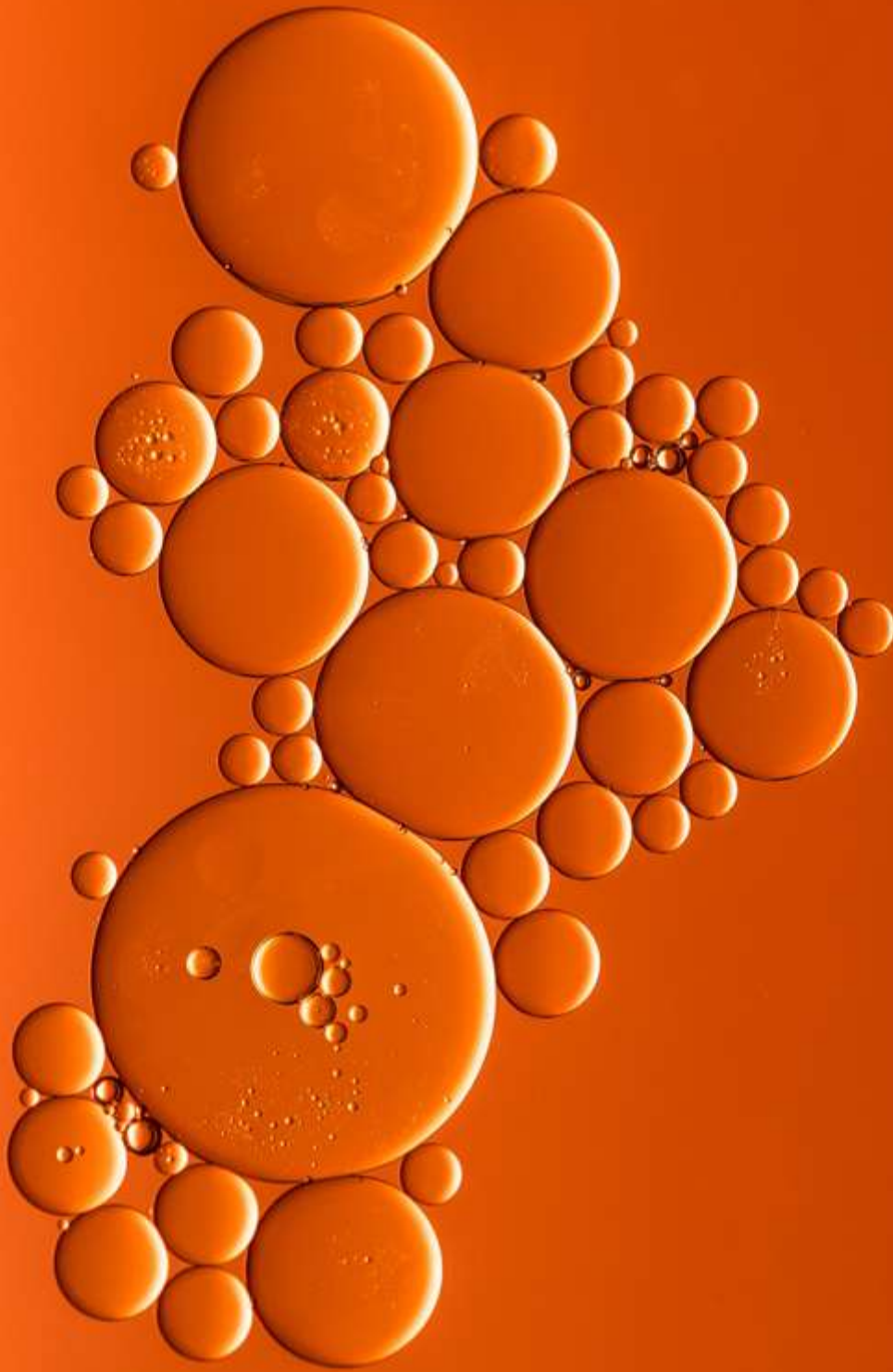
Dole



Soil Microbes







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The importance of soil microbes

A common factor among the trends and challenges we are seeing in agriculture is **soil health**. In terms of climate, preserving microorganisms involved in carbon sequestration and prevention of soil erosion is a top priority. Without soil biodiversity and the many other ecosystem services they provide, sustainable farming becomes increasingly difficult to achieve.

Input efficiency will suffer in the absence of the microbes that convert input nutrients into bioavailable forms for plants. As a result, AgTech will become far more versatile and relied upon to reverse the impact of farming practices that damage the soil microbiome, and future generations

will struggle with a lack of fertile soil to provide food for the growing population.

It is most effective to act now, to prevent degradation and soil loss, as opposed to leaving it up to the future generations to find solutions in much harder conditions and higher food demand.

To promote soil health, we must look into what the soil has to offer, what it needs, and feed it accordingly. This can be made possible by regular soil analyses, which also empower farmers to select and use ag inputs most efficiently while combating climate change and promoting sustainability for generations to come.



We thanks the collaboration of

Terra Vesco, Dole, Troon Vineyards and Sustainable Growing Solutions





**And all the farmers, growers and agronomists
that participated in our survey.**

Thank you!







About Biome Makers

Biome Makers is a global agtech company providing microbiome insights to empower smart agriculture. The company has developed a patented technology integrating DNA Sequencing and ecological computing technologies using one of the more complex biomarkers, the soil microbiome.



This technology is translated into **innovative tools for agriculture that help farmers to assess the quality of their soil, the impact of different agricultural practices and the effect of Ag inputs, in order to improve crops and recover soil health.** This technology can be applied to any crop and any soil. Biome Makers is on a mission to connect soil microbial networks to farms, through BeCrop, a global soil tech platform.

Founded in California's Silicon Valley in 2015, Biome Makers currently serves +600 clients across +34 countries worldwide. Among them are research institutions, Ag manufacturers, farmers, laboratories, agronomists and Ag retailers. The headquarters are currently located in West Sacramento, CA including a laboratory facility. Biome Makers currently has a second laboratory located in Valladolid, Spain.

Biome Makers is an active member of the Global Soil Laboratory Network (GLOSOLAN) for the Food and Agriculture Organization of the United Nations (FAO), and member of the California Life Sciences Association (CLSA). It is also backed by recognized institutions and investors such as Illumina Accelerator, Viking Global Investors, Seaya Ventures, JME Ventures and Local Globe, with a total investment of \$8 million.

Contact us

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biomemakers.com/contact-us



BIOME MAKERS



Biome Makers is a silicon valley startup that has become a world leader in developing a unique set of tools that connect soil biology to decision-making processes in agriculture, based on the functional analysis of soil microorganisms (bacteria and fungi).

