האקדמיה הלאומית הישראלית למדעים
المجمع الوطني الإسرائيلي للعلوم والآداب
THE ISRAEL ACADEMY OF SCIENCES AND HUMANITIES

NATIONAL ACADEMY OF SCIENCES

4th U.S.–Israel Blavatnik Scientific Forum

Improving Crops in the Face of Climate Change

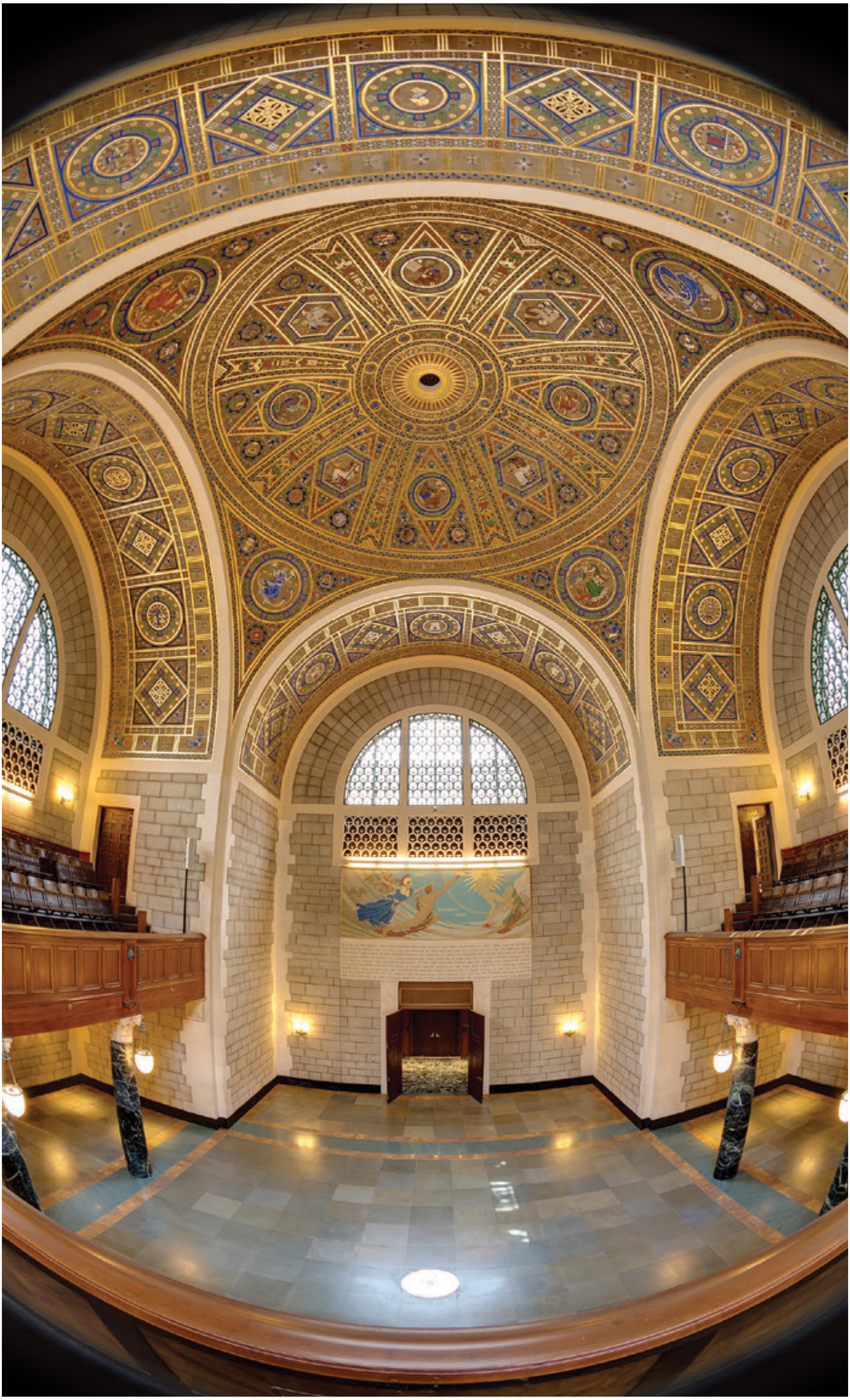
Program and Abstracts

Organizing Committee

Co-Chairs: **Edward Buckler,** Cornell University;
Avraham Levy, Weizmann Institute of Science

Members: **Jan Leach,** Colorado State University;
Zachary Lippman, Cold Spring Harbor Laboratory; **Sigal Savaldi-Goldstein,** Technion

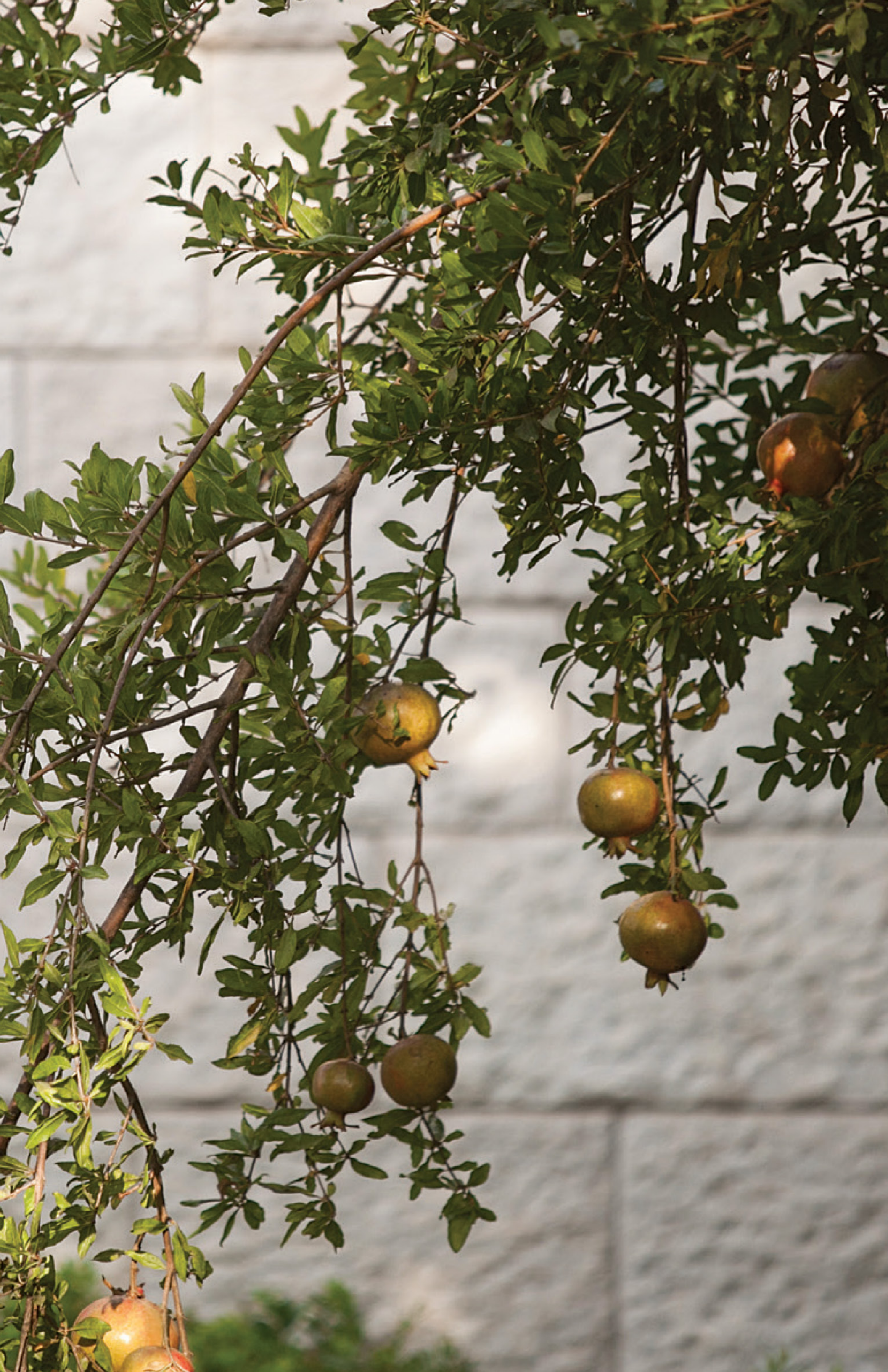
Washington, DC, November 19–20, 2024



National Academy of Sciences

The National Academy of Sciences (NAS) is a private, non-profit society of distinguished scholars. Established by an Act of Congress, signed by President Abraham Lincoln in 1863, the NAS is charged with providing independent, objective advice to the nation on matters related to science and technology. Scientists are elected by their peers to membership in the NAS for outstanding contributions to research. The NAS is committed to furthering science in America, and its members are active contributors to the international scientific community. Nearly 500 members of the NAS have won Nobel Prizes, and the *Proceedings of the National Academy of Sciences*, founded in 1914, is today one of the premier international journals publishing the results of original research. The National Academy of Engineering (NAE) and the National Academy of Medicine (NAM, formerly the Institute of Medicine) were founded under the NAS charter in 1964 and 1970, respectively. The three Academies work together as the National Academies of Sciences, Engineering, and Medicine to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine. The National Academies' service to government has become so essential that Congress and the White House have issued legislation and executive orders over the years that reaffirm its unique role.

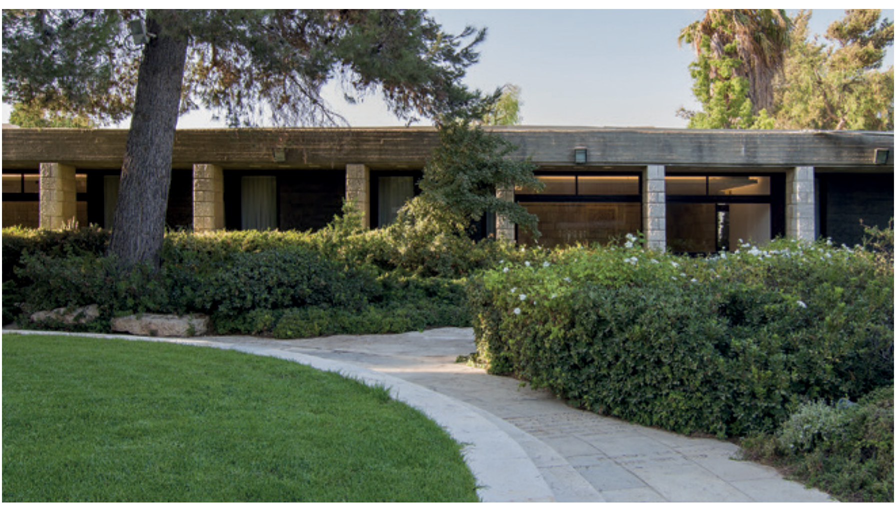
Please visit us online at **www.nasonline.org**
and follow us on X @**theNASciences**



The Israel Academy of Sciences and Humanities

The Israel Academy of Sciences and Humanities, established by law in 1961, is the preeminent scientific institution in Israel. It acts as a national focal point for Israeli scholarship in all branches of the sciences, social sciences, and humanities. The Academy comprises 149 of Israel's most distinguished scientists and scholars who operate in two divisions—the Sciences Division and the Humanities Division. It is tasked with promoting Israeli scientific excellence; advising the government on scientific matters of national interest; publishing scholarly research of lasting merit; and maintaining active contact with the broader international scientific and scholarly community.

Please visit us online at **www.academy.ac.il**
and follow us on X @**IsraelAcademy**



The Israel Academy of Sciences and Humanities © Udi Katzman
Left: © Michal Fattal

Program

Monday, November 18

6:00 pm **Welcome Reception**
Potomac Room, 3rd Floor, Fairmont Georgetown Hotel

Tuesday, November 19

7:45 am **Bus from Fairmont Georgetown Hotel to the NAS Building**

8:00 am **Breakfast** NAS East Court

8:45 am **Welcome Remarks** NAS Lecture Room

Peter L. Thoren, Executive Vice President, Access Industries, Inc.

Edward Buckler, Forum Co-Chair, Cornell University

Avraham Levy, Forum Co-Chair, Weizmann Institute of Science

9:05 am **Keynote Session**

Chair: **Edward Buckler,** Cornell University

9:15 am **Ron Milo,** Weizmann Institute of Science
The Biomass Distribution on Earth and Humanity's Impact on It

9:55 am **David Lobell,** Stanford University
Climate Adaptation in Croplands: Lessons from the Past 50 Years

10:35 am **Q&A Session with David Lobell and Ron Milo**

11:05 am **Break**

11:15 am *Session I*
New Breeding Technologies

Chair: **Zachary Lippman,** Cold Spring Harbor Laboratory

11:25 am **Carlos Messina,** University of Florida
Can Contemporary Breeding Approaches Adapt Agriculture to Satisfy Future Societal Needs and Climate Change?

11:50 am **Lunch** NAS East Court

12:50 pm **Mike Nuccio,** Inari
Enhancing the Sustainability of the Food System Through SEEDesign

1:15 pm **Michal Lieberman-Lazarovich,** Agricultural Research Organization
Site-Specific DNA Methylation Induction in Tomato

1:40 pm **Session 1 Panel and Q&A**

2:10 pm **Break**

2:20 pm *Session II*

Adapting Cropping Systems

Chair: **Avraham Levy,** Weizmann Institute of Science

2:30 pm **Omri Finkel,** The Hebrew University of Jerusalem
Establishing Causality in the Rhizosphere Using Microbiome Deconstruction

2:55 pm **Pankaj Trivedi,** Colorado State University
Rewiring Plant–Microbiome Interactions for Drought-Resilient Crop Production

3:20 pm **Break**

3:30 pm **David Zeevi,** Weizmann Institute of Science
What Microbes Can Tell Us About Their Environment

3:55 pm **Sotirios Archontoulis,** Iowa State University
Crops, Soil Water, and Nitrogen Dynamics in the U.S. Corn Belt

4:20 pm **Naftali Lazarovitch,** Ben-Gurion University of the Negev
The Effect of the Atmospheric Demand on Plant Sensitivity to Salinity

4:45 pm **Session 2 Panel and Q&A**

5:15 pm **Day 1 Adjourn**

5:30 pm **Cocktail Reception and Dinner** NAS Building

7:30 pm **Bus from NAS Building to Fairmont Georgetown Hotel**

Program

Wednesday, November 20

8:00 am **Bus from Fairmont Georgetown Hotel to the NAS Building**

8:15 am **Breakfast** NAS East Court

9:00 am *Session III*

Pathogen and Pest Control

Chair: **Jan Leach,** Colorado State University

9:10 am **Sheng Yang He,** Duke University
The Impact of Climatic Conditions on Plant–Microbe Interactions

9:35 am **Tzion Fahima,** University of Haifa
Pathogen Perception and Deception in Plant Immunity by Tandem Kinase Fusion Proteins: Origin, Function, and Potential in Resistance Breeding

10:00 am **Michelle Heck,** U.S. Department of Agriculture and Cornell University
Redefining Citrus Greening Disease Management: Innovations Driving a New Era

10:25 am **Session 3 Panel and Q&A**

11:00 am **Break**

11:30 am *Session IV*

Plant Physiology and Mechanism

Chair: **Sigal Savaldi-Goldstein,** Technion

11:40 am **Menachem Moshelion,** The Hebrew University of Jerusalem
Balancing Crop Yield Performance and Vegetative Drought Tolerance: The Role of Diurnal Stomatal Dynamics

12:05 pm **Tamar Azoulay-Shemer,** Agriculture Research Organization
Adapting Commercial Almond Cultivars to Climatic Change Through the Integration of Stem Photosynthetic Traits from Wild *Prunus arabica*

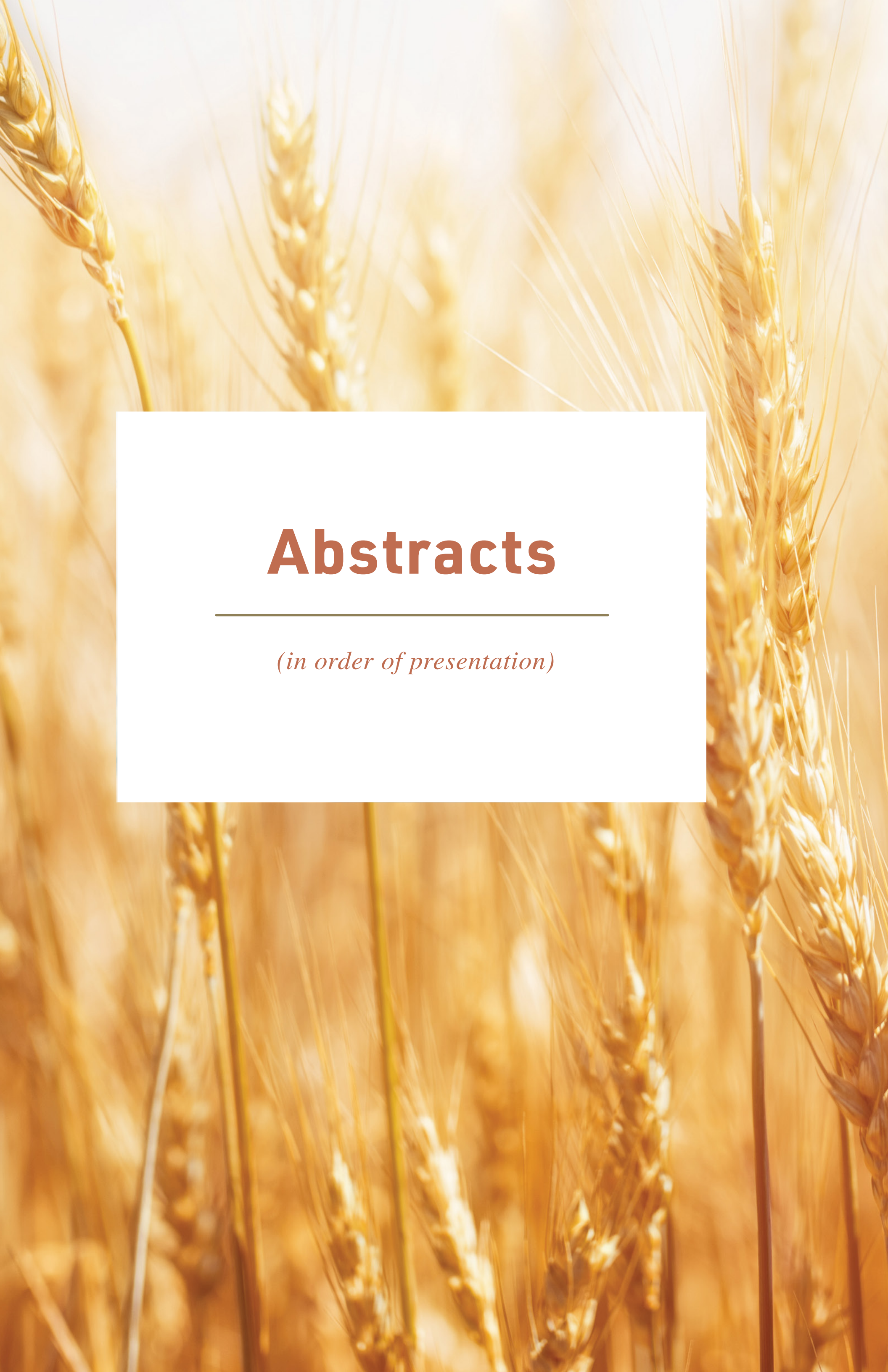
12:30 pm **Lunch** NAS East Court

1:30 pm **Lisa Ainsworth,** U.S. Department of Agriculture and University of Illinois at Urbana-Champaign
Optimizing Canopy Photosynthesis for Atmospheric Change

1:55 pm **Session 4 Panel and Q&A and Forum Wrap-Up**

2:40 pm **Conference Adjourn** Organizing Committee

3:00 pm **Tour of DC Landmarks** (optional)
The tour will depart from the NAS Building and drop attendees off at the Fairmont Hotel.



Abstracts

(in order of presentation)

Abstracts

Tuesday, November 19, 2024

Keynote Session

Chair: **Edward Buckler,** Cornell University

Humans have drastically altered the global cycles of carbon and nitrogen, reshaping ecosystems worldwide. Agriculture is both a key contributor to these changes and must also adapt to their consequences. In this session, we will first explore the scale of these transformations and then discuss strategies for adapting to and mitigating their impact.

The Biomass Distribution on Earth and Humanity's Impact on It

Ron Milo, Weizmann Institute of Science

The presentation will describe how we assembled the first census of the biomass of all kingdoms of life, with a focus on groups of special interest such as mammals. It will also discuss the far-reaching effects of humanity on this distribution, which offers a fresh perspective on our current age, the Anthropocene.

Climate Adaptation in Croplands: Lessons from the Past 50 Years

David Lobell, Stanford University

As we look forward to the challenges of improving crops in the coming decades, it can be useful to examine the recent past. Many cropping systems around the world have very different climates than 50 years ago, and farmers, breeders, and agronomists have been reacting to these changes in various ways.

The presentation will discuss what we have learned about how specific aspects of climate are changing, how cropping systems have responded, whether any adaptations have been particularly helpful, and how we might do better in the coming decades.

In many cases, we are as or more vulnerable to warming than ever, not because of a lack of breeding progress, but because of changes in other aspects of the system. Signs of slowing productivity and increasing climate extremes suggest the need both to accelerate breeding progress and to more rigorously pursue other adaptation options.

Session I

New Breeding Technologies

Chair: **Zachary Lippman,** Cold Spring Harbor Laboratory

Improving crops under the current environmental crisis will require more effective breeding tools. The session will describe the new advances that enable a precise modification of plant genomes and a more rapid and accurate prediction of plant performances during the breeding process. It will also include new methods for physiological modeling under stress, genome editing, transformation of recalcitrant crops, phenotyping, genetic selection algorithms, etc.

Can Contemporary Breeding Approaches Adapt Agriculture to Satisfy Future Societal Needs and Climate Change?

Carlos Messina, University of Florida

The presentation will demonstrate that contemporary breeding can adapt maize agriculture to climate change in the United States, but it is not sufficient to satisfy the societal demands of a modern society. Analyses of the longest field experiment in the history of crop science (1990–2021) show that rates of genetic gain were always positive and at least stable over time at 7.5 g m^{-2} y^{-1}. In the same period the May through October rainfall for the U.S. corn belt increased 113 mm and the daily temperature amplitude decreased by 1.3°C. In contrast, Gulf of Mexico hypoxia has increased since 1950. By integrating dynamical systems modeling, genetic prediction, and Bayesian optimization it is possible to increase predictive skill in breeding for yield and assess the environmental impacts of selection decisions. Using this framework, it is possible to engineer crops for improved adaptation to current and future climates while reducing greenhouse gas emissions and externalities.

Enhancing the Sustainability of the Food System Through SEEDesign

Mike Nuccio, Inari

Inari is a young agricultural biotechnology company focused on developing next-generation genetic tools for crop improvement. Its passion is new breeding technology such as CRISPR-Cas systems to alter gene activity. It couples this with computational approaches to identify genes that control plant characteristics we care about and define ways to improve those features. The presentation will illustrate who we are as a company, its vision for the future of agriculture and the science behind its work. It will also discuss what it is like to work as a scientist in a company setting.

Site-Specific DNA Methylation Induction in Tomato

Michal Lieberman-Lazarovich, Agricultural Research Organization

DNA methylation is an epigenetic modification essential for gene regulation and genome stability. Changes in DNA methylation were shown to be linked with various developmental and physiological processes, including environmental stress responses. Loss of DNA methylation at gene promoter regions was demonstrated to induce transcription, possibly due to its effect on chromatin accessibility. Thus, DNA methylation is a target for gene expression manipulations. In tomato (*Solanum lycopersicum*), the *Colorless-Non-Ripening* (*CNR*) gene expression is regulated by DNA methylation. Spontaneous DNA methylation within the CNR promoter inhibits fruit ripening and causes the colorless fruit phenotype of the *cnr* epimutant. Exploiting the easily detectable visual phenotype of *cnr*, we aimed at using the CRISPR deactivated Cas9 (dCas9) nuclease fused to a methyltransferase as a tool for DNA methylation editing in tomato. First, we characterized the *cnr* epimutant on the phenotypic, gene expression, and DNA methylation levels and validated the differentially methylated region (DMR) at the *CNR* promoter. We designed dCas9-M.SssI methyltransferase-gRNA systems to target this DMR and successfully hyper-methylated it in Ailsa Craig and MP1 tomato genotypes. Utilizing this epigenetic modification tool in tomato, a major vegetable crop, can pave the way for targeting desired genes for epigenetic editing and manipulating gene expression patterns.

Session II

Adapting Cropping Systems

Chair: **Avraham Levy,** Weizmann Institute of Science

Cropping systems must be developed to adapt to climate change, to mitigate the carbon footprint of agriculture on the environment, and to address the deterioration of soils. The session will describe advances in regenerative farming, soil microbiomes, efficient use of fertilizers, and improvement of crop performance under stress.

Establishing Causality in the Rhizosphere Using Microbiome Deconstruction

Omri Finkel, The Hebrew University of Jerusalem

The first layer of plant defense against pest and pathogens is provided by other organisms—the plant microbiota. Accumulating data suggest that the protection provided by the microbiota constitutes not just the plant's first line of defense but also possibly its most potent one, as disruptions to the microbiota render the plants susceptible to otherwise asymptomatic infections.

To understand how this layer of defense is deployed, we have been applying a realistically complex and fully tractable plant–soil–microbiome microcosm. This system provides a platform for the discovery of novel plant-beneficial traits, which only emerge within a microbial community context. In order to identify which components of the plant microbiota are critical for plant defense, we deconstructed this microcosm top-down, removing different microbial groups from the community to examine their effect on the plant. Applying this method reveals a high redundancy in the microbial protection of plants. Taxonomically disparate microbial consortia have similarly beneficial effects. Further dissection of the microbiota, however, reveals unique roles for different microbes. We discovered the protective role of the genus *Variovorax*, which removed excess microbial auxins from the rhizosphere, and more recently, the crucial role the genus *Bacillus* plays in inhibiting pathogen growth on plant leaves. These results demonstrate the power of microbiome deconstruction as an approach to dissect microbial protection of plants.

Rewiring Plant–Microbiome Interactions for Drought-Resilient Crop Production

Pankaj Trivedi, Colorado State University

The microbiome (microbiota and their genomes) inhabiting the soil, rhizosphere, roots, and other plant tissues establishes complex and dynamic interactions with the host plant. The environment highly influences these plant–microbiome interactions and these interactions can improve plant resilience to environmental stresses. Despite growing recognition of the microbiome's importance to plant growth and health, harnessing the microbial interactions and traits to improve plant resilience to climate variability remains a significant challenge. Our ongoing research provided novel evidence that drought significantly affects microbial community taxonomic composition and co-occurrence network structures in the rhizosphere. We have elucidated a novel immune-mediated pathway of microbial recruitment that increases drought tolerance. Applying microbial SynComs together with manipulating plant immune response resulted in engineering microbial-based drought resiliency in crops. Overall, our research provides a better mechanistic understanding of the plant–microbiome relationship needed to develop future tools to predict and mitigate the impacts of climate change on primary productivity and plant diversity.

What Microbes Can Tell Us About Their Environment

David Zeevi, Weizmann Institute of Science

Croplands, comprising more than 10% of the global terrestrial area, represent a major interface between humanity and the environment, particularly its microbial inhabitants. The presentation explores the complex interplay between agricultural practices and microbial communities in these expansive ecosystems. Our research investigates how human activities, such as fertilization, crop domestication, and tillage, consistently affect microbial genomes across various soil types and plant genotypes. We seek to uncover specific microbial signatures associated with various agricultural interventions, potentially informing strategies to mitigate negative impacts on soil ecosystems. The research extends beyond agriculture, offering general insights into microbial genome adaptation.

Crops, Soil Water, and Nitrogen Dynamics in the U.S. Corn Belt

Sotirios Archontoulis, Iowa State University

The U.S. Corn Belt has a complex soil water hydrological landscape with poorly drained soils (~50% of those having subsurface drainage systems to remove excess water) and well-drained soils (~10% with irrigation systems). As a result, crops are experiencing both drought and excess water stress. The degree of water stress is highly influenced by weather and, in particular, precipitation, which is also the main driver for environmental nitrogen loss. The presentation will synthesize historical changes in maize crop productivity (yields, biomass, rooting depth), water-nitrogen use, and efficiencies from a systems perspective using experimental and simulated data at scale. Then using simulation modeling and future climate change and genotype x management scenarios, the presentation will provide future projections (by 2060) and perspectives to stimulate discussion on how to adapt to climate change.

The Effect of the Atmospheric Demand on Plant Sensitivity to Salinity

Naftali Lazarovitch, Ben-Gurion University of the Negev

Salinity is a major threat to irrigated agriculture. Estimates indicate that one-third of all irrigated lands are already badly affected by salinity or are expected to become so in the near future. When plants transpire, water moves from the soil to the roots and then to the transpiring leaves along pressure gradients.

The semipermeable properties of the root surface lead to accumulation of ions outside the root and give rise to an additional osmotic potential, impeding water uptake. Thus, the interplay among transpiration rate, osmotic potential, and the ability of roots to extract water from saline soils often limits the growth and development of plants. With the help of controlled field and laboratory experiments and numerical modeling it was possible to quantify the effect of the atmospheric demand on the sensitivity of plants to salinity. Finally, some technologies to mitigate salinity stress will be presented.

Wednesday, November 20, 2024

Session III

Pathogen and Pest Control

Chair: **Jan Leach,** Colorado State University

Climate change complicates our efforts to control pathogens and pests that threaten plant health. The session describes the challenges of disease and pest control under climate change and recent advances that provide strategies to manage healthy crop production under conditions of combined biotic and abiotic stresses.

The Impact of Climatic Conditions on Plant–Microbe Interactions

Sheng Yang He, Duke University

The famous "disease triangle" concept states that plant disease outbreaks require not only a susceptible plant and a virulent pathogen but also conducive environmental conditions. For practical reasons, however, most contemporary investigations into plant–pathogen interactions at the molecular level devote relatively little effort to understanding why climatic conditions, such as humidity and temperature, have a profound effect on pathogen virulence and host susceptibility. Moreover, these studies often ignore the potentially pervasive effect a plant's endogenous microbiome may have on basic plant health and host–pathogen interactions. The presentation will give an example of the interplay among disease, environment, and microbiota during the bacterial infection of plant leaves. Our work suggests that future studies of plant–pathogen interactions should probably consider the multi-dimensional nature of "disease–environment–microbiome" interactions, which are more reflective of what occurs in crop fields and natural ecosystems.

Pathogen Perception and Deception in Plant Immunity by Tandem Kinase Fusion Proteins: Origin, Function, and Potential in Resistance Breeding

Tzion Fahima, University of Haifa

Plants have evolved a myriad of defense responses against pathogens. Yet pathogens continuously develop counter-defenses in an arms race, leading to pandemics and global food insecurity. Plants employ numerous receptors with similar architecture to perceive immunogenic signals and activate defense responses, but pathogens rapidly overcome these defenses.

My team discovered a novel protein family with tandem kinase protein (TKP) architecture that regulates plant immunity. These TKPs, functioning as potent "molecular switches," can detect pathogen infection and trigger a robust defense response, offering broad-spectrum resistance. This innovative approach opens new horizons in plant immunity research and application. We hypothesize that TKPs serve as decoys that counter-defend the suppression of receptor-like kinases by pathogen effectors.

Most functional TKPs discovered to date come from wheat wild relatives. These findings highlight the emergence of TKPs as regulators of plant immunity and emphasize the importance of crop wild relatives as a reservoir of non-canonical R-genes for resistance breeding and global food security.

Redefining Citrus Greening Disease Management: Innovations Driving a New Era

Michelle Heck, U.S. Department of Agriculture and Cornell University

The citrus industry faces an existential threat from Huanglongbing (HLB), a disease that has led to significant losses in citrus farming communities. The Grove-First framework offers a transformative approach to tackling HLB by rapidly screening treatments directly in groves using direct injection technology. By leveraging regulatory-friendly chemistries treatments, Grove-First aims to restore the viability of citrus farming, enhancing fruit yield and juice quality by providing growers with short-term deliverables for disease management. Complementing this, symbiont technology, a new plant-based technology, is being developed to potentially deliver antimicrobial peptides and other costly biotherapies to sick trees. Together, these innovations can help reverse the decline of citrus groves, preserving farmland, jobs, and local economies in rural communities. The presentation will explore the progress, methodology, and future potential of Grove-First and symbiont technology, which may address key challenges in disease management in a range of perennial tree fruit crops.

Session IV

Plant Physiology and Mechanism

Chair: **Sigal Savaldi-Goldstein,** Technion

Redesigning plants in the face of climate change will require an in-depth understanding of developmental and physiological processes in plants; in particular, regarding the response to heat and drought. The session will describe new advances toward mechanistic understanding and integration of data at various scales, from the single cell level to whole plant performance.

Balancing Crop Yield Performance and Vegetative Drought Tolerance: The Role of Diurnal Stomatal Dynamics

Menachem Moshelion, The Hebrew University of Jerusalem

Plant physiological and biochemical activities are entirely dependent on environmental conditions, which significantly influence behavior, productivity, and ultimately, crop yield. In this study, we hypothesized that the rapid response rate of stomatal apertures to environmental changes correlates with enhanced productivity, especially under fluctuating and stressful conditions. We analyzed a population of tomato introgression lines (ILs) using a gravimetric functional-phenotyping platform to evaluate their dynamic whole-plant, water-regulation responses. These responses were correlated with yield performance over several years in commercial fields. Our findings revealed notable plasticity in select ideotypic ILs. These lines exhibited opportunistic behavior with early stomatal aperture peaking under water-deficit conditions when light is sufficient and vapor pressure deficit is low. Such traits enabled dynamic daily water-use efficiency and rapid transpiration recovery upon re-irrigation after drought. Additionally, abaxial stomatal density was found to strongly correlate with the expression of stomatal-development genes SPCH and ZEP.

Adapting Commercial Almond Cultivars to Climatic Change Through the Integration of Stem Photosynthetic Traits from Wild *Prunus arabica*

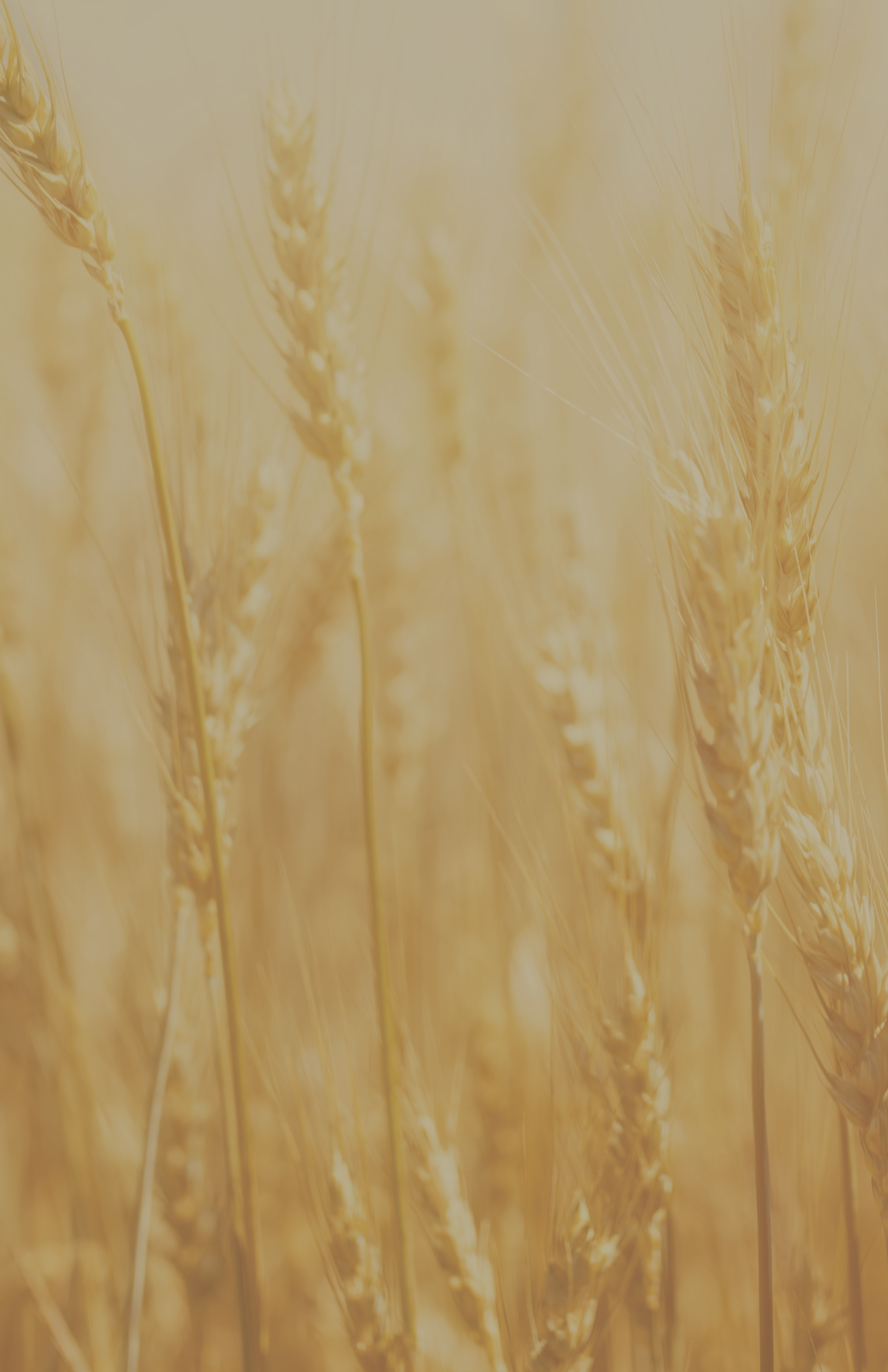
Tamar Azoulay-Shemer, Agriculture Research Organization

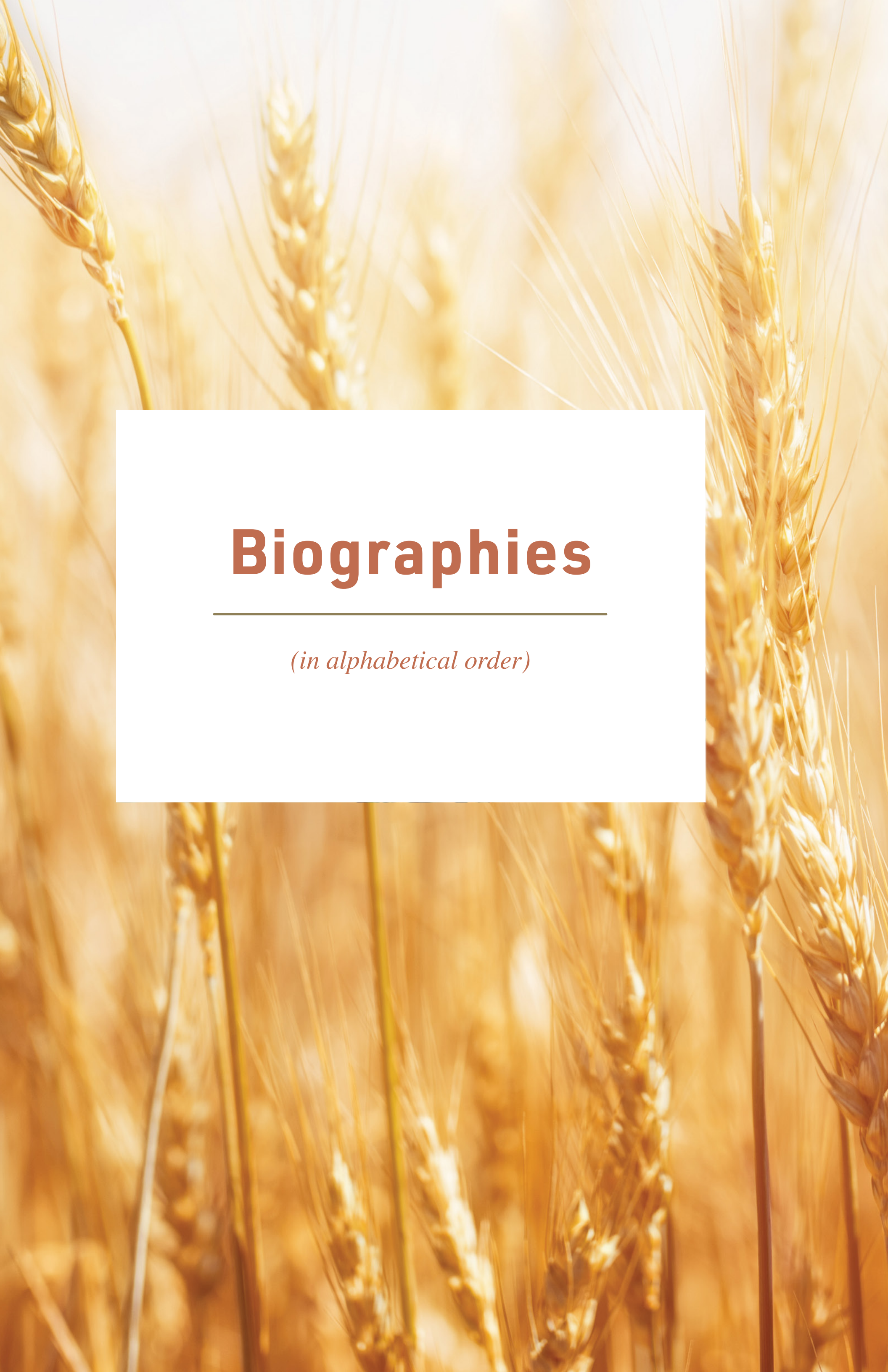
Our recent study on the wild almond species *Prunus arabica* revealed its unique ability to perform photosynthesis year-round through stem photosynthesis capability (SPC), even during the winter, after leaf fall. This trait is characterized by delayed bark formation; chlorophyll-rich, palisade-like parenchyma; functional stomata; and a specialized vascular system. Our studies focus on identifying the physiological and genetic components of the SPC, with the goal of integrating them into commercial almond cultivars. Preliminary data from hybrid populations between *P. arabica* and commercial varieties suggest that these traits contribute significantly to enhanced carbon fixation, potentially boosting almond yield. Our findings indicate that SPC traits are inheritable and could be sustained in commercial almond varieties, offering a promising avenue for developing resilient, high-yielding plants adapted to climate challenges. This research paves the way for future work to exploit these genetic insights, optimizing almond production under varying environmental conditions.

Optimizing Canopy Photosynthesis for Atmospheric Change

Lisa Ainsworth, U.S. Department of Agriculture and University of Illinois at Urbana-Champaign

Global carbon dioxide (CO_2) and ozone (O_3) cycles have greatly intensified over the past 100 years. These molecules share a diffusion pathway into leaves through stomata but have vastly different outcomes in the leaf. Increased CO_2 stimulates photosynthesis and improves water use efficiency while increased O_3 decreases photosynthesis and accelerates senescence. Optimizing photosynthesis for the continued rising in atmospheric CO_2 and O_3 pollution requires strategies to alter canopy leaf area index, photosynthetic capacity, and photosynthate allocation to seeds and grains. The presentation will describe our research efforts to identify the physiological determinants of yield changes in elevated CO_2 and O_3, along with strategies to improve canopy architecture and photosynthesis to maximize crop productivity in future environments.

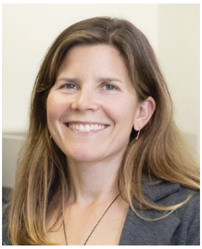




Biographies

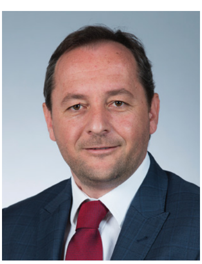
(in alphabetical order)

Biographies



Lisa Ainsworth
U.S. Department of Agriculture and
University of Illinois at Urbana-Champaign

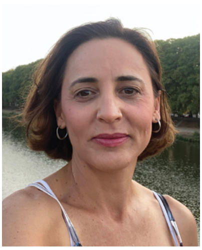
Lisa Ainsworth is the research leader of the U.S. Department of Agriculture's Agriculture Research Service's Global Change and Photosynthesis Research Unit and a professor of plant biology at the University of Illinois at Urbana-Champaign (UIUC). She received her BS in biology at the University of California, Los Angeles, and a PhD in crop sciences from UIUC. Her research addresses crop responses to global atmospheric change and potential solutions to mitigate climate change through agriculture. She studies photosynthetic responses of plants to climate change, and her research is broadly integrative, from genetic to agronomic scales. In 2019, she was awarded the U.S. National Academy of Sciences (NAS) Prize in Food and Agricultural Sciences. In 2020, she was elected a member of the NAS.



Sotirios Archontoulis
Iowa State University

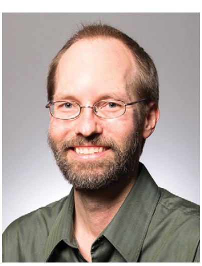
Sotirios Archontoulis is a professor of integrated cropping systems in the Department of Agronomy at Iowa State University and holds the Pioneer Hi-Bred Agronomy Professorship. His research aims to improve cropping systems' productivity, profitability, and environmental sustainability. His research combines field experimentation with simulation process-based modeling to understand genotype (x) management (x) environment interactions and predict and design future strategies across temporal and spatial scales. Archontoulis holds a PhD from Wageningen

University, the Netherlands; is a Fellow of the American Society of Agronomy; and has published more than 130 peer-reviewed publications.



Tamar Azoulay-Shemer
Agricultural Research Organization, Newe Ya'ar Research Center

Tamar Azoulay-Shemer leads the Fruit Tree Sciences Unit at the Newe Ya'ar Research Center, which is part of the Volcani Institute (ARO) in Israel. She holds a BSc and an MSc in biology from Bar- Ilan University and a PhD in horticulture from The Hebrew University of Jerusalem, where she studied chlorophyll breakdown in fruit and leaves. Her postdoctoral research at the University of California, San Diego, focused on stomatal regulation in response to environmental changes. Azoulay-Shemer's lab explores plant responses to stress, including temperature extremes, drought, and rising CO_2 levels, with an emphasis on photosynthesis and water balance. She also leads the Israeli almond breeding program, developing advanced hybrids using molecular markers to integrate important traits for environmental resilience, pest and disease resistance, and improved fruit quality.



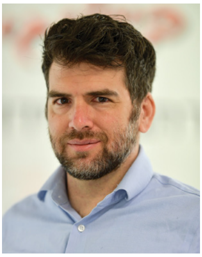
Edward S. Buckler
Cornell University

Edward S. Buckler is a U.S. Department of Agriculture's Agricultural Research Service's (USDA-ARS's) research geneticist and an adjunct professor in plant breeding and genetics at Cornell University with an educational background in molecular evolution and archaeology.

His group's research uses genomic, computational, and field approaches to dissect complex traits and accelerate breeding in maize, sorghum, cassava, and a wide range of other crops. With these technologies applied to more than 2,000 species, now the Buckler group focuses on exploring ways to re-engineer global agricultural production systems to reduce greenhouse gas emissions, ensure food security, improve nutrition, and respond to climate change. With the USDA-ARS, he leads an informatics and genomics platform to help accelerate breeding for specialty crops and animals. His contributions to quantitative genetics and genomics were recognized with election to the U.S. National Academy of Sciences (NAS) and as the recipient of the inaugural NAS Food and Agriculture Award.

Tzion Fahima
University of Haifa

Tzion Fahima is the head of the Laboratory of Plant Genomics and Disease Resistance at the University of Haifa, Israel, and the former director of the Institute of Evolution. He is interested in wheat genomics, genetics, pathology, immunology, and evolution. Fahima's lab cloned the powdery mildew and yellow rust resistance genes *Pm69*, *TdPm60*, and *Yr15*. Fahima was involved in the sequencing of wild emmer wheat and bread wheat genomes, in the positional cloning of the high grain protein QTL, *Gpc- B1*, and the cloning of several other disease resistance genes, all derived from wild emmer wheat. The highlight of his work was the discovery of the Tandem Kinase Protein Family as new regulators of plant immunity. Fahima is a member of the Scientific Board of the Israeli Gene Bank for Agriculture Crops and a member of the Coordination Committee of the International Wheat Genome Sequencing Consortium.



Omri Finkel

The Hebrew University of Jerusalem

Omri Finkel is a microbial ecologist studying plant–microbe interactions in diverse settings. He has studied microbiomes across different plant species and environments, using both culture-dependent and culture-independent methodologies.

Finkel is currently a senior lecturer at The Hebrew University of Jerusalem, where his lab studies how plants evolved to recruit beneficial microbiota, and how the microbiota can protect plants from biotic and abiotic stress.

Sheng Yang He

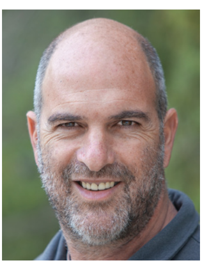
Duke University

Sheng Yang He is the Benjamin E. Powell Distinguished Professor at Duke University and an investigator at Howard Hughes Medical institute. His lab uses the plant-*Pseudomonas syringae* pathosystems to discover some of the basic principles that govern bacterial pathogenesis and disease susceptibility in plants. Results from his lab have led to original insights into important cellular processes governing plant–microbe interactions, including plant immunity, bacterial virulence, jasmonate hormone signaling, and stomatal defense. Recent research in his lab shed light on how climate conditions influence disease development and how plants control microbiota homeostasis for health. He received his bachelor's and master's degrees from Zhejiang University, China, and a PhD from Cornell University. He is a Thomson Reuters Highly Cited Researcher, a past president of the International Society of Molecular Plant-Microbe Interactions, a Fellow of the American Association for the Advancement of Science, and an elected member of the U.S. National Academy of Sciences.

Michelle Heck

U.S. Department of Agriculture and
Cornell University

Michelle Heck serves as a lead scientist and the research molecular biologist with the Emerging Pests and Pathogens Research Unit in the Robert W. Holley Center for Agriculture and Health at Cornell University, where she is also a courtesy professor of plant pathology and plant-microbe biology. Heck's lab focuses on the biology and management of insect vector-borne plant diseases. She leads the U.S. Department of Agriculture's Agricultural Research Service's Citrus Greening Grand Challenge, which is the agency's coordinated national response to combat citrus greening disease. She is also the architect of the Grove-First approach, a new framework to find safe and affordable solutions to citrus greening disease.

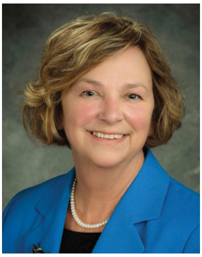


Naftali Lazarovitch

Ben-Gurion University of the Negev

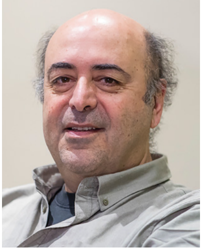
Naftali Lazarovitch's studies aim at increasing agricultural productivity while maintaining a sustainable environment through optimal fertigation scheduling. This approach is supported through numerical and analytical modeling, as well as measurement and interpretation of water flow, solute, and heat transport in the soil–plant–atmosphere system.

Lazarovitch's research is orientated toward arid and semi-arid rural regions in general and the Israeli Negev in particular. The research combines low-input agro-techniques applying furrow irrigation, with greenhouse-protected high value crops irrigated with high-frequency drip irrigation, using the most advanced technologies. The overall goal is to use environmental conditions typical to arid regions (high solar radiation, low relative humidity, extreme day and night temperatures, wide open lands, marginal water quality) to improve the welfare of people living in these regions, in both developing and developed countries.



Jan E. Leach
Colorado State University

Jan E. Leach is a plant pathologist who studies the molecular basis of plant disease susceptibility and resistance and how these responses are influenced by interactions within the phytobiome. She is a University Distinguished Professor in Agricultural Biology at Colorado State University. Leach is the immediate past president of the International Society of Plant Pathology and a Fellow and a past president of the American Phytopathological Society. Leach is a Fellow of the American Association for the Advancement of Science and a Fellow of the American Academy of Microbiology. Leach is a member of the U.S. National Academy of Sciences.

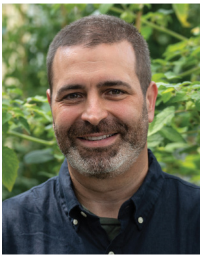


Avraham Levy
Weizmann Institute of Science

Avraham Levy received a PhD in plant genetics from the Weizmann Institute of Science in 1987. He conducted postdoctoral research at Stanford University in the United States and INRA in France. In 1992, he joined the Weizmann Institute of Science. He served as the head of the Department of Plant and Environmental Sciences and the dean. His research addresses the mechanisms responsible for the plasticity and biodiversity of plant genomes, including DNA recombination and repair. He is utilizing these mechanisms to develop precise genome engineering methods for sustainable food production systems. Levy received the 2016 Landau Prize for Plant Sciences. He was the scientific founder of two Ag-Biotech companies, an associate member of the French Academy of Agriculture, a recipient of the Enid MacRobbie Corresponding Membership Award from the American Society of Plant Biology for 2023, served as the president of the Israel Genetic Society, and currently serves as the chair of the Weizmann Green Campus Initiative Committee.

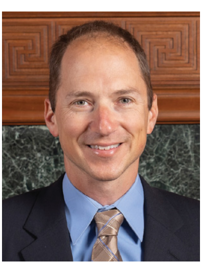
Michal Lieberman-Lazarovich
Agricultural Research Organization

Michal Lieberman-Lazarovich is a principal investigator at the Plant Sciences Institute, Volcani Center (ARO) since 2017. She completed her PhD thesis on gene targeting and chromatin remodeling in *Arabidopsis thaliana* in the lab of Professor Avraham Levy at the Weizmann Institute of Science, followed by a postdoctoral training in plant epigenetics studying the effect of DNA methylation on recombination with Jerzy Paszkowski at the University of Geneva. Her current research involves studying the developmental and molecular responses of crop plants to abiotic environmental stresses, aiming at developing stress-resilient crops in the face of climatic changes. Mainly, the lab focuses on the effect of heat stress on the productivity of tomato (*Solanum lycopersicum*) plants, monitoring physiological and developmental traits and elucidating genetic and epigenetic factors that may facilitate heat stress tolerance in tomato and other crops.



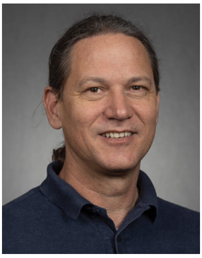
Zachary Lippman
Cold Spring Harbor Laboratory

Zachary Lippman is a professor of plant biology at the Cold Spring Harbor Laboratory and a Howard Hughes Medical Institute investigator. His group studies flower and fruit production in nature and agriculture, focusing on tomato and related crops and their wild ancestors in the nightshade family. Taking advantage of natural and engineered genetic diversity, Lippman's research has revealed how variation in the genes that control the proliferation and maturation of stem cells underlie diversity in vegetative and reproductive shoot systems. These findings have led to fundamental questions on how variation in the sequences that control both the activity and functions of genes, and also how these mutations interact, influence the development, domestication, and breeding of crops. Based on these discoveries, Lippman is bringing new tools, approaches, and principles to improve predictability in crop engineering. His contributions to plant biology and agriculture were recognized with a MacArthur Fellowship, the U.S. National Academy of Sciences (NAS) Award in Food and Agriculture, and election to the NAS.



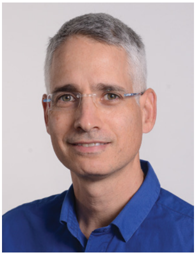
David Lobell
Stanford University

David Lobell is the Benjamin M. Page Professor at Stanford University in the Department of Earth System Science and the Gloria and Richard Kushel Director of the Center on Food Security and the Environment. He is also the William Wrigley Senior Fellow at the Stanford Woods Institute for the Environment and a senior fellow at the Freeman Spogli Institute for International Studies and the Stanford Institute for Economic Policy and Research. He earned an ScB in applied mathematics from Brown University (2000), a PhD in geological and environmental sciences from Stanford University (2005), and was a Lawrence Postdoctoral Fellow at Lawrence Livermore National Laboratory. His work has been recognized with various awards, including the Macelwane Medal from the American Geophysical Union (2010), a Macarthur Fellowship (2013), the U.S. National Academy of Sciences (NAS) Prize in Food and Agriculture Sciences (2022), and election to the NAS (2023).



Carlos Messina
University of Florida

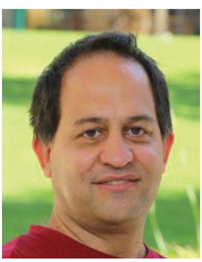
Carlos Messina is a professor in the Horticultural Sciences Department and the director of the University of Florida Institute for Food and Agricultural Sciences Crop Transformation Center. He received degrees in agronomy and crop physiology from the University of Buenos Aires in Argentina and a PhD in agricultural and biological engineering from the University of Florida. He contributed to the development of gene-to-phenotype prediction modeling theory and applications in plant breeding. He leads the development of advanced prediction methods by integrating symbolic and sub-symbolic artificial intelligence to hasten genetic gain in complex systems and circular bioeconomies.



Ron Milo
Weizmann Institute of Science

Ron Milo earned a BSc in physics and mathematics and a PhD in biological physics before being a fellow at the Harvard Medical School Department of Systems Biology. He joined the Weizmann Institute of Science in 2008.

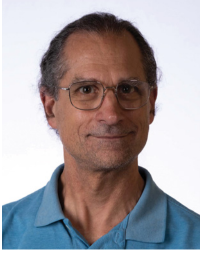
Milo harnesses the tools of systems biology to find solutions to the challenges of sustainability. His main contribution in this aspect was his demonstration of an ability to convert carbon dioxide into sugar in a synthetically engineered *E. coli*. Milo also leads a global accounting of biomass on Earth, giving a fresh perspective on the impact of humanity and the future of biodiversity. Milo is the author of the book *Cell Biology by the Numbers*, read online and in print by more than 1 million people per year and translated to multiple languages.



Menachem Moshelion
The Hebrew University of Jerusalem

Menachem Moshelion is at the Institute of Plant Sciences and Genetics in Agriculture, Robert H. Smith Faculty. His research interests lie in improving agronomic plant vigor, developing stress tolerance, and enhancing yield production. He delves into quantitative analysis of environmental signaling in crops, examining its impact on productivity and survivability. Another key area of his expertise is in the regulatory role of plant aquaporins (water channels) in controlling plant water balance.

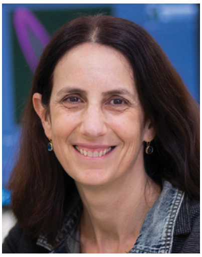
Moshelion is also passionate about technological advancements in agriculture. He has been working on developing a high-throughput automated screening system for online plant diagnosis, aiding in the selection of optimal plants for specific conditions. This integration of technology and plant science is pivotal in addressing current and future challenges in agriculture and food security. His academic and research endeavors aim to blend traditional agronomy with modern technology to unlock new potentials in crop production and environmental sustainability.



Mike Nuccio

Inari

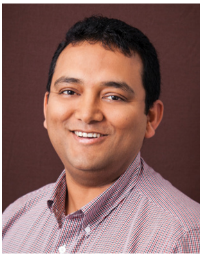
Mike Nuccio completed a PhD at Texas A&M University in plant molecular genetics and his postdoc in plant metabolic engineering at the University of Florida. He joined Syngenta to work in trait gene discovery and trait development for GM applications, primarily in maize. He focused on the response to water deficit and yield formation. In 2017, Nuccio joined Inari Agriculture to help build the company's research and development capabilities. His technical activities are in trait development and plant delivery applications using genome modification tools.



Sigal Savaldi-Goldstein

Technion

Sigal Savaldi-Goldstein is a professor at the Faculty of Biology at Technion - Israel Institute of Technology. She received her PhD from the Weizmann Institute of Science in Israel and carried out postdoctoral research training as a BARD fellow at the Salk Institute in the United States. She and her team discovered that the growth of both above- and below-ground organs depends on the cell-specific function of brassinosteroid signaling. They also uncovered a reciprocal control of mineral nutrients and BR signaling as a means to achieve growth plasticity. Her lab is currently engaged in researching the orchestration of hormonal signaling, cell identity, inter-tissue coordination, and mechanical constraints in control of plant development, using the root as a primary model system.



Pankaj Trivedi
Colorado State University

Pankaj Trivedi's research explores multitrophic interactions among and between microbiomes and the plant environment that influence the health and productivity of managed and natural systems. By employing integrative microbiome research, he aims to develop new bioinformatic tools and host–microbiome models that will enable plant breeders and ecologists to predict beneficial interactions to improve crop yields and plant resilience to changing environments. Trivedi received his PhD training in microbiology from Kumaun University, India. He received postdoctoral training in molecular–plant microbiome interactions and computational biology from the University of Florida and Western Sydney University. His research program is supported by funding from the National Science Foundation, the U.S. Department of Agriculture, the Defense Advanced Research Projects Agency, and the industry. He currently supports a team of six graduate students, two postdoctoral researchers, two staff scientists, and numerous undergraduate researchers. He is the founding member of The Global Initiative of Sustainable Agriculture and Environment and an active member of science advisory panels associated with industry and national and international agencies. Trivedi has given more than 30 invited talks in the past 5 years and contributed to research resulting in more than 150 publications, with more than 13,000 citations.

David Zeevi

Weizmann Institute of Science

David Zeevi is a principal investigator at the Department of Plant and Environmental Sciences at the Weizmann Institute of Science. Zeevi did his PhD with Eran Segal at the Weizmann Institute of Science and his postdoc as an independent fellow at The Rockefeller University's Center for Studies in Physics and Biology. He has co-authored several publications in the microbiome field, linking the microbiome to the effects of artificial sweeteners (Suez et al., *Nature* 2014) and host circadian rhythm (Thaiss et al., *Cell* 2015), inferring bacterial growth dynamics (Korem et al., *Science* 2015), predicting the glycemic responses of individuals to complex meals (Zeevi et al., *Cell* 2015; Korem et al., *Cell Metabolism* 2017), characterizing microbial genomic variability across individuals (Zeevi et al., *Nature* 2019), and understanding resource conservation in marine microbes (Shenhav and Zeevi, *Science* 2020). Zeevi's lab studies how microbes are affected by human interferences.

www.nasonline.org

National Academy of Sciences
2101 Constitution Avenue, NW, Washington, DC 20418