



PLANT CELL ATLAS

**ANNUAL REPORT
2021-2022**



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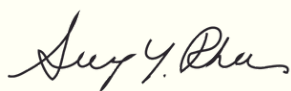
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EXECUTIVE SUMMARY

Plants play a fundamental role in our society, providing us with air, food, fuel, materials, and medicines. Plant science has the potential to solve many current and future challenges including climate change, pollution, and food scarcity. Recent innovations and applications of advanced single-cell sequencing, high-resolution imaging, mass spectrometry, data science, artificial intelligence, and gene editing technologies to plants are generating an unprecedented wealth of data on plant molecular mechanisms and processes. To fully realize the potential of these data, a comprehensive and standardized approach is needed.

In June of 2021, the Plant Cell Atlas (PCA) was officially launched to build a community of diverse scientists from around the world to develop a platform to synthesize and visualize these data to accelerate plant science research. Furthermore, in recognition of the importance of diverse scientists to advancing plant research, we are committed to engaging and training scientists from historically underrepresented groups to grow a more equitable plant science community. We have made spectacular progress in all aspects of the PCA, including community building, training early career scientists, and connecting with historically underserved communities, which are highlighted in the remaining pages of this report.



SEUNG YON (SUE) RHEE

PCA Research Coordination Network

Principle Investigator



SELENA L. RICE

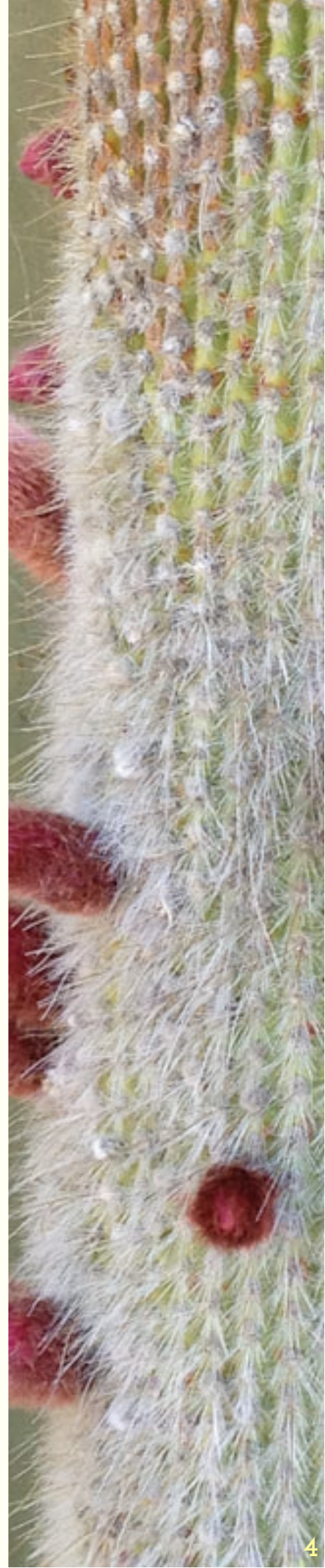
PCA Scientific

Coordinator



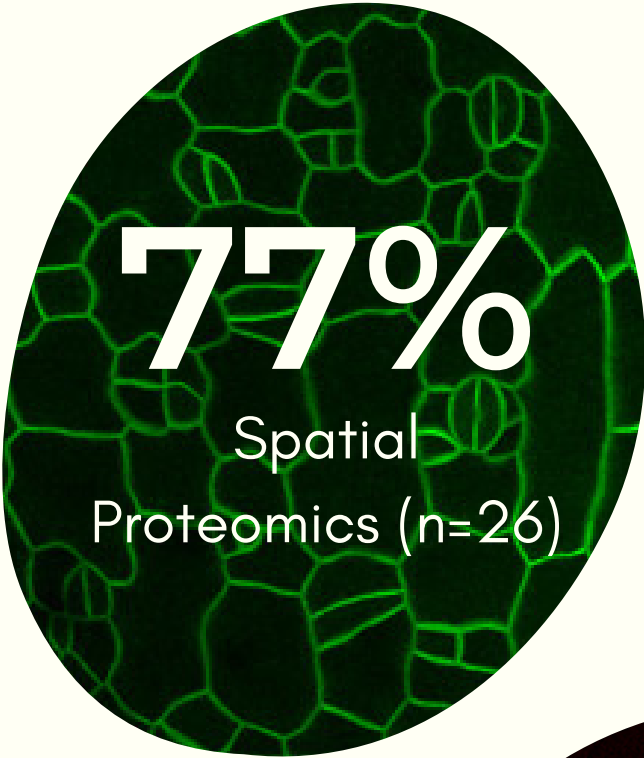
RCN GOALS

The primary goal of the Plant Cell Atlas (PCA) Research Coordination Network (RCN) is to build a community that sets standards for generating and integrating large scale plant cell data sets to enable the production of a Plant Cell Atlas.



COMMUNITY IMPACT

Across three workshops in 2021-2022, 77-100% of respondents found the workshop relevant or helpful for their research.



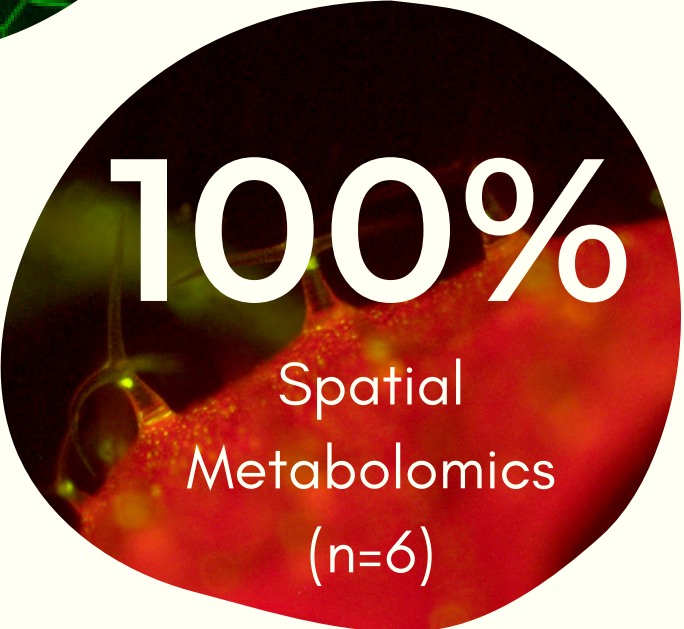
77%

Spatial
Proteomics (n=26)



90%

2021 PCA
Symposium (n=61)

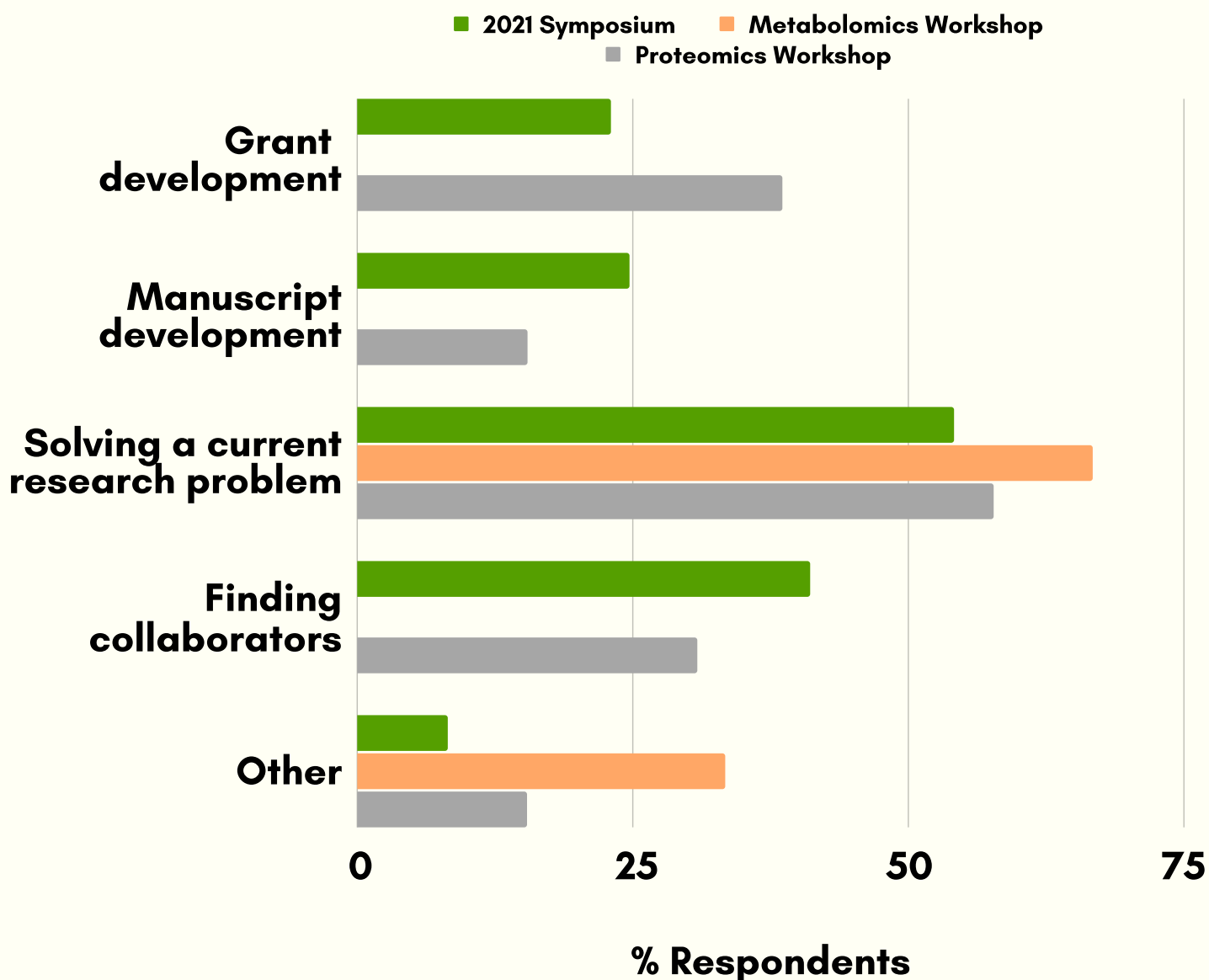


100%

Spatial
Metabolomics
(n=6)

COMMUNITY IMPACT

Percentage of PCA workshop participants who found the workshop helpful to a particular aspect of their research.



PCA: AT A GLANCE

**Community
numbers as of
May 31, 2022**



**Twitter
1201
followers**



**YouTube
107
subscribers**



**PCA
Website
70,376
impressions**

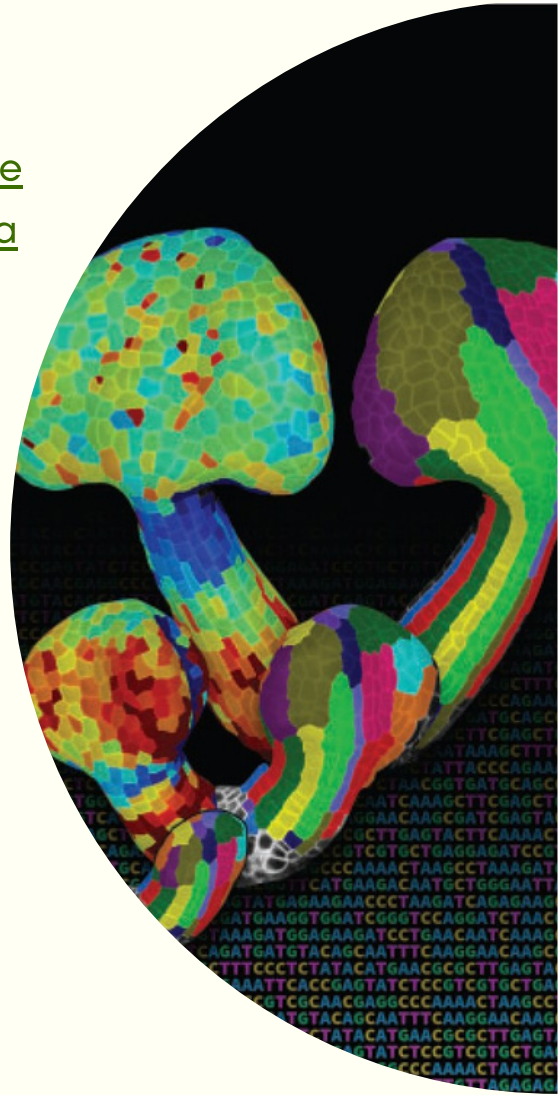


**Email
List
898
subscribers**

PCA PUBLICATIONS

Plant Cell Atlas Consortium, *et al.* (2021) Science Forum: Vision, challenges and opportunities for a Plant Cell Atlas. *eLife*.

Eckelbarger M, *et al.* (2021) Recognizing Pioneering Black Plant Scientists in Our Schools and Society. *Trends in Plant Science*. 26(10).



Birnbaum KD, *et al.* (2022) The Plant Cell Atlas: focusing new technologies on the kingdom that nourishes the planet. *Plant Physiology*. 188(2).

Rhee SY & Rice SL. (2022) Growing a community: Building the Plant Cell Atlas. *Futurum Careers*. 14, 28-31.



PCA FOCUS ISSUE

In February 2022 *Plant Physiology* released a Focus Issue on the Plant Cell Atlas. Listed below are all of the articles found in the PCA Focus Issue.

- [Birnbaum KD, et al. 2022. The Plant Cell Atlas: focusing new technologies on the kingdom that nourishes the planet. Plant Phys. 188 \(2\).](#)
- [Cesarino I. 2022. Better NOT together: single-cell transcriptomic landscape of leaf tissues. Plant Phys. 188 \(2\).](#)
- [Ovečka, M, et al. 2022. Imaging plant cells and organs with light-sheet and super-resolution microscopy. Plant Phys. 188 \(2\).](#)
- [Cox, KL Jr, et al. 2022. Organizing your space: The potential for integrating spatial transcriptomics and 3D imaging data in plants. Plant Phys. 188 \(2\).](#)
- [Weiner E, et al. 2022. Electron microscopy for imaging organelles in plants and algae. Plant Phys. 188 \(2\).](#)
- [Clark NM, et al. 2022. To the proteome and beyond: advances in single-cell omics profiling for plant systems. Plant Phys. 188 \(2\).](#)
- [Brophy JAN. 2022. Toward synthetic plant development. Plant Phys. 188 \(2\).](#)
- [Cuperus JT. 2022. Single-cell genomics in plants: current state, future directions, and hurdles to overcome. Plant Phys. 188 \(2\).](#)
- [Mair A & Bergmann DC. 2022. Advances in enzyme-mediated proximity labeling and its potential for plant research. Plant Phys. 188 \(2\).](#)
- [Silveira SR, et al. 2022. Live-imaging provides an atlas of cellular growth dynamics in the stamen. Plant Phys. 188 \(2\).](#)
- [Laureyns R, et al. 2022. An in situ sequencing approach maps PLASTOCHRON1 at the boundary between indeterminate and determinate cells. Plant Phys. 188 \(2\).](#)
- [Jawaid MZ, et al. 2022. A biophysical model for plant cell plate maturation based on the contribution of a spreading force. Plant Phys. 188 \(2\).](#)
- [Morel O, et al. 2022. REPRISAL: mapping lignification dynamics using chemistry, data segmentation, and ratiometric analysis. Plant Phys. 188 \(2\).](#)
- [Duncan K, et al. 2022. X-ray microscopy enables multiscale high-resolution 3D imaging of plant cells, tissues, and organs. Plant Phys. 188 \(2\).](#)
- [Hernández-Herrera P, et al. 2022. Live Plant Cell Tracking: Fiji plugin to analyze cell proliferation dynamics and understand morphogenesis. Plant Phys. 188 \(2\).](#)
- [Apelt F, et al. 2022. Shoot and root single cell sequencing reveals tissue- and daytime-specific transcriptome profiles. Plant Phys. 188 \(2\).](#)
- [Abramson BW, et al. 2022. The genome and preliminary single-nuclei transcriptome of *Lemna minuta* reveals mechanisms of invasiveness. Plant Phys. 188 \(2\).](#)
- [Tenorio Berrío R, et al. 2022. Single-cell transcriptomics sheds light on the identity and metabolism of developing leaf cells. Plant Phys. 188 \(2\).](#)

COMMUNITY TESTIMONIALS

"PCA serves as a fantastic platform for people to network with each other and facilitate new collaborations." - Assistant Professor, Leiden University, The Netherlands

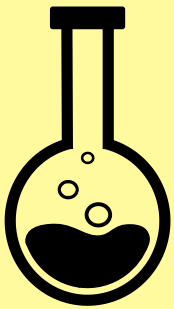


"This meeting was one of my 2021 highlights. I really enjoyed the talks - almost all were excellent. I also enjoyed the "working" sessions where we discussed the future of our field. I want to have more of these discussions, they were collegial and reminded me of how bright and thoughtful many of our peers are." - 2021 PCA Symposium attendee

"PCA has brought many people together from different countries to a single platform where ideas and research work could be shared." - Graduate student, Punjab Agricultural University, India



PCA ACTIVITIES



Research



Training



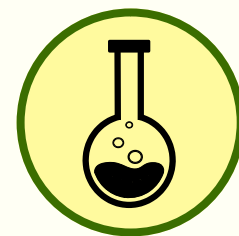
Outreach



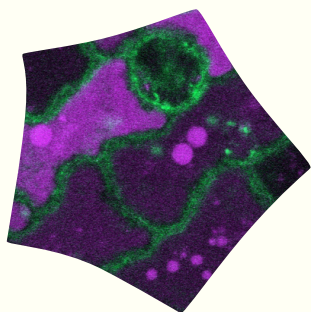
Leadership

RESEARCH

Workshops & Symposia



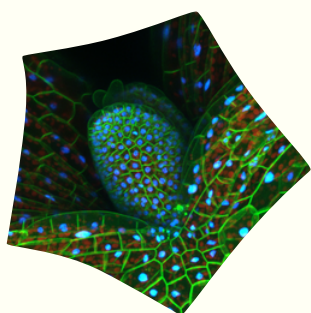
**In 2021-2022 the PCA held 4 scientific workshops and one 2-day symposium.
(ECR = Early Career Researcher)**



Single-cell Sequencing Workshop

327 people (71% ECRs)

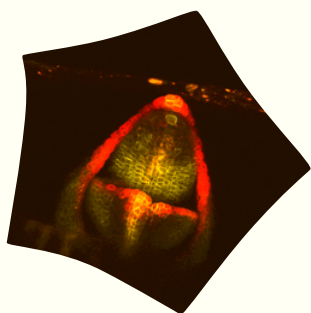
Leading scientists showcased the use of single-cell sequencing methods in plants and cutting-edge techniques in mice and humans.



Spatial Proteomics Workshop

343 people (76% ECRs)

World leaders in spatial quantitative proteomics in plant sciences and beyond presented their research and discussed how these techniques could be used to develop a plant proteome.



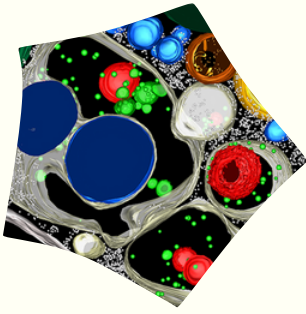
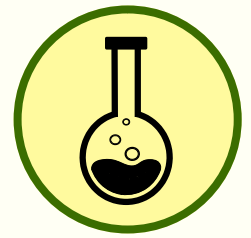
Spatial Metabolomics Workshop

122 people (68% ECRs)

Experts in spatial metabolomics and mass spectrometry-based imaging discussed how these new techniques can be applied to plants.

RESEARCH

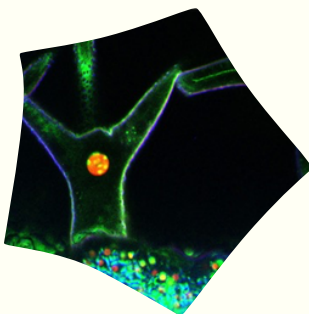
Workshops & Symposia



Multiplex Microscopy Symposium

135 people (69% ECRs)

Pioneers of cutting-edge, multiplex imaging and analysis approaches discussed their work and how these methods may be applied to plant systems.



2021 PCA Symposium

499 people (70% ECR)

A 2-day symposium was held with speakers focused on the most exciting scientific and technological breakthroughs in plant single cell science. It featured 6 oral sessions and 4 poster sessions. Community discussion sessions were also held to discuss how PCA relevant data could be analyzed, annotated, and accessed.

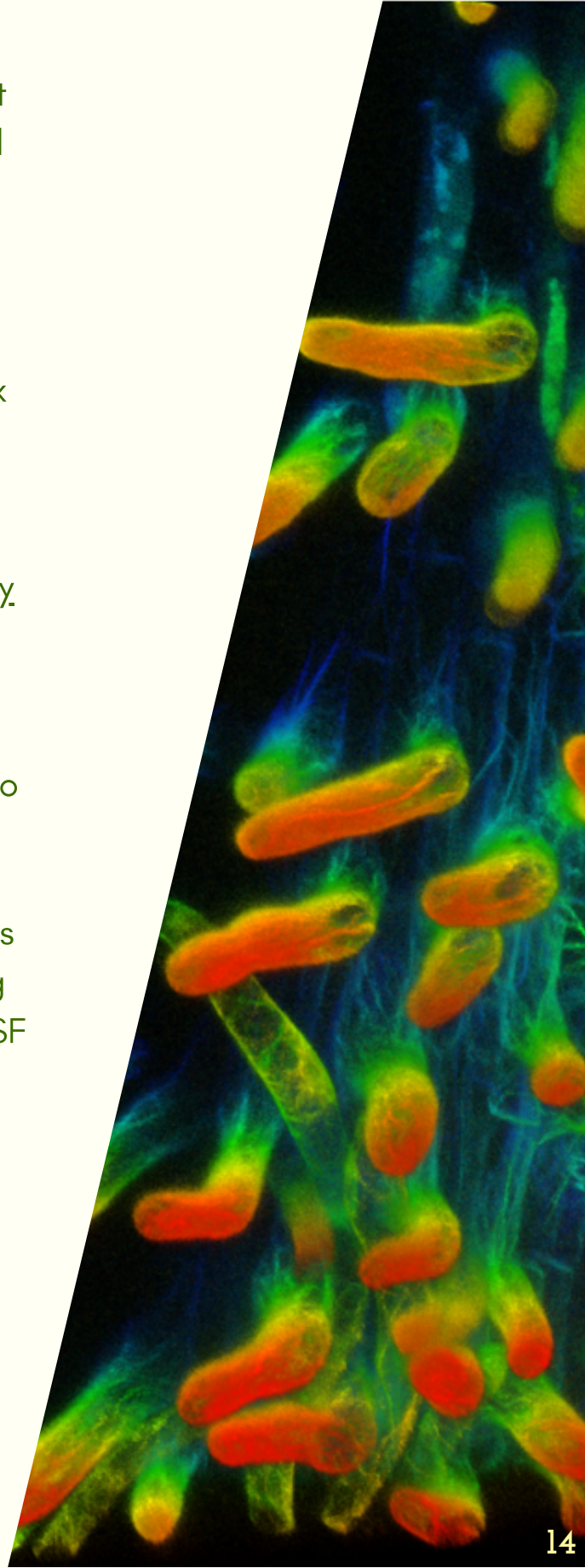
TRAINING

Workshops



In 2021, the PCA held 2 career development events. The first was a career panel focused on "Academic Careers of the Future". The panel featured 3 academic scientists at different career stages. The 54 registrants heard about the personal and professional paths of each scientist and were able to ask for advice about their own careers.

The second career development event was the establishment of a Writing Accountability Group in the fall of 2021. This initiative was designed for scientists working on writing projects (grants, manuscripts, etc.) to talk asynchronously on Slack and meet virtually to ask questions and get feedback on their writing projects. The group held a kick-off seminar in September 2021 where attendees heard tips and received guidance on writing grant proposals and manuscripts from an NSF Program Officer and a Science Editor from the journal Developmental Cell.



TRAINING

PCA Travel Award



In March 2022, the PCA established its first annual Travel Award for scientists from underrepresented groups to attend the ASPB Plant Biology 2022 conference in Portland, Oregon in July 2022. Two outstanding scientists were selected and are receiving full funding for registration, travel, and accommodations for the conference. We are also providing administrative assistance to help with the logistics of registration and travel and are providing points of contact at the conference and continued career mentorship after the conference.



Maketalena Aleamotu'a

I am Maketalena Aleamotu'a from the Kingdom of Tonga, a small Polynesian nation in the South Pacific. I undertook my undergraduate degree and MSc at the University of Canterbury in New Zealand, with my Master's research focused on identifying single-stranded DNA viruses from Tongan bat guano. Having always had an interest in how plants work at the molecular level, I changed fields to plant biology for my PhD. My recently submitted thesis (University of Newcastle, Australia) investigated the cellular and molecular biology of phi thickening development in Brassica roots, and identified novel genetic loci linked to jasmonic acid-induced phi thickening development.



Iman Yangaza

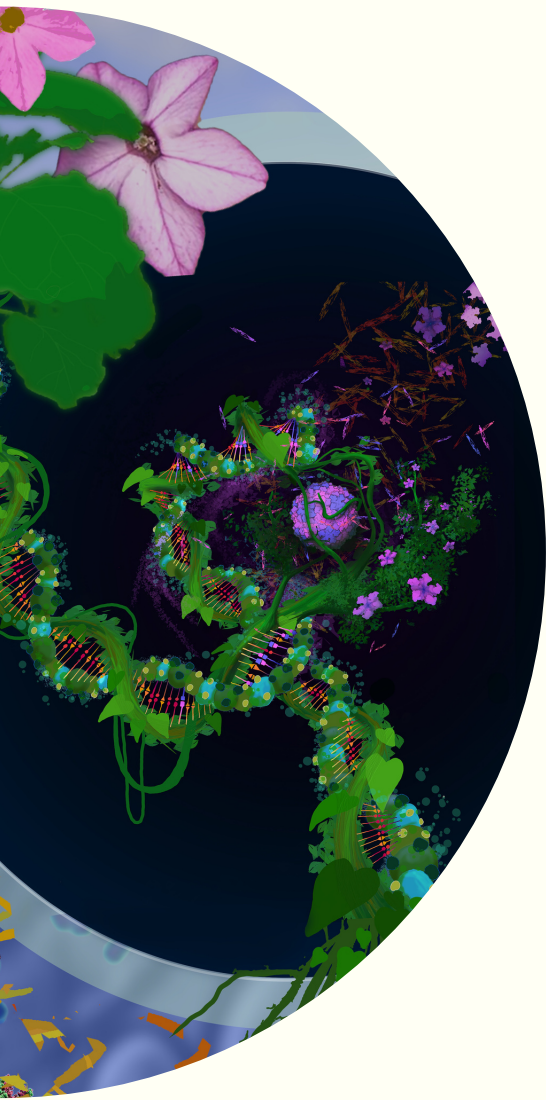
Iman is an Assistant Lecturer in the Department of Botany, University of Dar es Salaam. He holds MSc in Climate Change and Sustainable Development and a BSc in Molecular Biology and Biotechnology from the University of Dar es Salaam. Iman is currently a Ph.D. student in the Department of Botany at the University of Dar es Salaam. His research is on assessing Avocado's (*Persea americana*) genetic diversity and productivity in Tanzania. He has attended training, including plant tissue culture in India (2017) and plant molecular biology in Kenya (2021). His interest is in plant biology, climate change, and scientific data mining.

OUTREACH

Art & Science Exhibit



To engage students and inform them about the history and potential of plant science, we established the PCA Art and Science exhibit. This exhibit features 2 sets of artwork, one on Black Plant Scientists and one on Plant Biotechnology. The Black Plant Scientists exhibit features the lives and accomplishments of 4 historical Black Plant Scientists – Dr. Marie Clark Taylor, Edmond Albius (shown right), George Washington Carver, and Dr. Percy Lavon Julian.



The Plant Biotechnology exhibit features two real world applications of plant science – phytoremediation and vaccine development (shown left). These exhibits were developed with input from faculty at 3 Historically Black Colleges and Universities – Bowie State University, Howard University, and Morgan State University. The Black Plant Scientists exhibit was shown at these schools in Fall 2021 and the Plant Biotechnology exhibit is currently up for the Spring 2022 semester.

PCA LEADERSHIP



Overview

The PCA Core Network Participant (CNP) group is a cohort of scientists from diverse fields and backgrounds who guide and develop PCA activities. In 2021-2022, the original PCA CNP group expanded from 48 to 62 members, improving the representation of the CNP. The PCA believes that diversity is key to accelerating scientific discoveries, and we are actively committed to improving diversity in plant science.

Women
41% increase

Early Career
Researchers
25% increase

Underrepresented
Groups
80% increase

PCA LEADERSHIP

Steering Committee



Dr. Seung Yon Rhee
Carnegie Institution
for Science



Dr. Julia Bailey-Serres
University of California,
Riverside



Dr. Ken Birnbaum
New York
University



Dr. David Ehrhardt
Carnegie Institution
for Science



Dr. Marisa Otegui
University of Wisconsin,
Madison



Dr. Nicholas Provart
University of
Toronto

PCA LEADERSHIP

Committee Chairs



Dr. Christopher
Anderton
Pacific Northwest
National Lab



Dr. Ken
Birnbaum
New York
University



Dr. Jennifer
Brophy
Stanford
University



Dr. Benjamin
Cole
Lawrence Berkeley
National Lab



Dr. Kirk
Czymmek
Donald Danforth
Center



Dr. Michelle
Facette
University of
Massachusetts,
Amherst



Dr. Noah
Fahlgren
Donald Danforth
Center



Dr. Margaret
Frank
Cornell
University



Dr. Elizabeth
Haswell
Washington University
in St. Louis



Dr. Shao-Shan
Carol Huang
New York
University



Dr. Samuel
Leiboff
Oregon State
University



Dr. Marc
Libault
University of
Nebraska, Lincoln



Dr. Selena
Rice
Carnegie Institution
for Science



Dr. R. Glen
Uhrig
University
of Alberta

PCA LEADERSHIP

Core Network Participants



1. Dr. Amir Ahkami – Pacific Northwest National Lab, USA
2. Dr. Christopher Anderton – Pacific Northwest National Laboratory, USA
3. Dr. Julia Bailey-Serres, University of California, Riverside, USA
4. Dr. George Bassel – University of Warwick, UK
5. Dr. Yoselin Benitez-Alfonso – University of Leeds, UK
6. Dr. Kenneth Birnbaum – New York University, USA
7. Alex Borowsky – University of California, Riverside, USA
8. Dr. Jennifer Brophy – Stanford University, USA
9. Dr. Benjamin Cole – Lawrence Berkeley National Laboratory, USA
10. Dr. Kevin Cox Jr – Donald Danforth Center, USA
11. Dr. Cesar L. Cuevas-Velazquez – Universidad Nacional Autónoma de México, México
12. Dr. Kirk Czymmek – Donald Danforth Center, USA
13. Dr. Luigi Di Costanzo – University of Naples Federico II, Italy
14. Dr. José R. Dinneny – Stanford University, USA
15. Dr. Georgia Drakakaki – University of California, Davis, USA
16. Dr. David Ehrhardt – Carnegie Institution for Science, USA
17. Dr. Moisés Expósito-Alonso – Carnegie Institution for Science, USA
18. Dr. Michelle Facette – University of Massachusetts, Amherst, USA
19. Dr. Noah Fahlgren – Donald Danforth Center, USA
20. Andrew Farmer – National Center for Genome Resources, USA
21. Dr. Margaret Frank – Cornell University, USA
22. Dr. Suryatapa Ghosh Jha – Claremont Colleges, USA
23. Dr. Stefania Giacomello – SciLifeLab, Sweden
24. Fabio Gomez-Cano – Michigan State University, USA
25. Dr. Elizabeth Haswell – Washington University in St. Louis, USA
26. Dr. Cornelia Hooper – University of Western Australia, Australia
27. Dr. Kun Huang – Dana-Farber Cancer Institute, USA
28. Dr. Shao-shan Carol Huang – New York University, USA
29. Dr. Aman Husbans – University of Pennsylvania, USA
30. Dr. Terry Jackson – Jaxsun Enterprises, USA
31. Dr. Kaisa Kajala – Utrecht University, The Netherlands

PCA LEADERSHIP

Core Network Participants



32. Dr. Purva Karia – Carnegie Institution for Science, USA
33. Dr. Charlotte Kirchhelle – ENS Lyon, France
34. Dr. Dae Kwan Ko – Michigan State University, USA
35. Dr. Samuel Leiboff – Oregon State University, USA
36. Dr. Mao Li – Donald Danforth Center, USA
37. Dr. Marc Libault – University of Nebraska, Lincoln, USA
38. Dr. Tie Liu – University of Florida, USA
39. Dr. Terri Long – North Carolina State University, USA
40. Dr. Shelley Lumba – University of Toronto, Canada
41. Dr. Thelma Madzima – University of Washington Bothell, USA
42. Dr. Sibongile Mafu – University of Massachusetts, Amherst, USA
43. Dr. Heather McFarlane – University of Toronto, Canada
44. Dr. Devang Mehta – University of Alberta, Canada
45. Dr. Jenny Mortimer – University of Adelaide, Australia
46. Dr. Lachezar Nikolov – University of California, Los Angeles, USA
47. Dr. Toshihiro Obata – University of Nebraska Lincoln, USA
48. Dr. Marisa Otegui – University of Wisconsin, Madison, USA
49. Dr. Gergo Palfalvi – National Institute for Basic Biology, Japan
50. Dr. Nicola Patron – Earlham Institute, UK
51. Dr. Nicholas Provart – University of Toronto, Canada
52. Dr. Seung Yon Rhee – Carnegie Institution for Science, USA
53. Dr. Selena Rice – Carnegie Institution for Science, USA
54. Dr. Maite Saura-Sanchez – VIB-University of Gent, Belgium
55. Dr. Rachel Shahan – Duke University, USA
56. Dr. R. Glen Uhrig – University of Alberta, Canada
57. Dr. Batthula Vijaya Lakshmi Vadde – Cornell University, USA
58. Dr. Justin Walley – Iowa State University, USA
59. Dr. Zhiyong Wang – Carnegie Institution for Science, USA
60. Dr. Clay Wright – Virginia Polytechnic Institute, USA
61. Dr. Shouling Xu – Carnegie Institution for Science, USA
62. Dr. Kangmei Zhao – Carnegie Institution for Science, USA

PCA CORE NETWORK PARTICIPANTS



PCA AFFILIATED ORGANIZATIONS



University of
Massachusetts
Amherst BE REVOLUTIONARY™



Utrecht University



THE UNIVERSITY
of ADELAIDE



Penn
UNIVERSITY of PENNSYLVANIA

NC STATE
UNIVERSITY



Washington
University in St. Louis



VIRGINIA TECH.



WARWICK
THE UNIVERSITY OF WARWICK



VIB-UGENT
CENTER FOR PLANT
SYSTEMS BIOLOGY



DONALD DANFORTH
PLANT SCIENCE CENTER
DISCOVERY | COMMUNITY | IMPACT



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON



UNIVERSITY OF
ALBERTA



THE UNIVERSITY OF
WESTERN
AUSTRALIA

SciLifeLab



UNIVERSITY OF
TORONTO



RIVERSIDE



BOTHELL



Pacific Northwest
NATIONAL LABORATORY



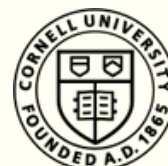
CARNEGIE
SCIENCE



Oregon State
University



JOINT GENOME INSTITUTE
DEPARTMENT OF ENERGY



CORNELL UNIVERSITY
FOUNDED A.D. 1865

Duke
UNIVERSITY



NYU

MICHIGAN STATE
UNIVERSITY



Dana-Farber
Cancer Institute



Earlham
Institute



ENS DE LYON



CLAREMONT
McKENNA
COLLEGE

UC DAVIS



NCGR

National Center for Genome Resources

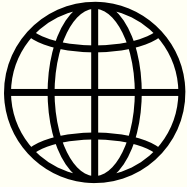
IOWA STATE
UNIVERSITY



UNIVERSITY OF LEEDS

Funding provided by the Carnegie Institution for Science and National Science Foundation
grant numbers [MCB-1916797](#) & [MCB-2052590](#).

Where to Find Us



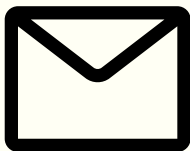
<https://www.plantcellatlas.org/>



<https://www.youtube.com/c/PlantCellAtlas>



[@CellAtlas](https://twitter.com/CellAtlas)



plantcellatlas@gmail.com

