



PLANT CELL ATLAS

ANNUAL REPORT
2024-2025



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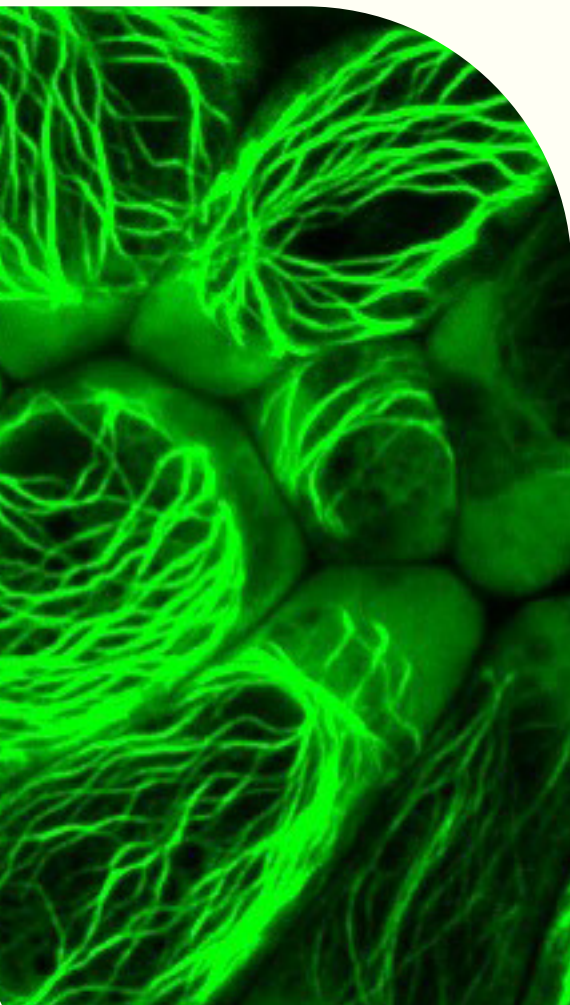
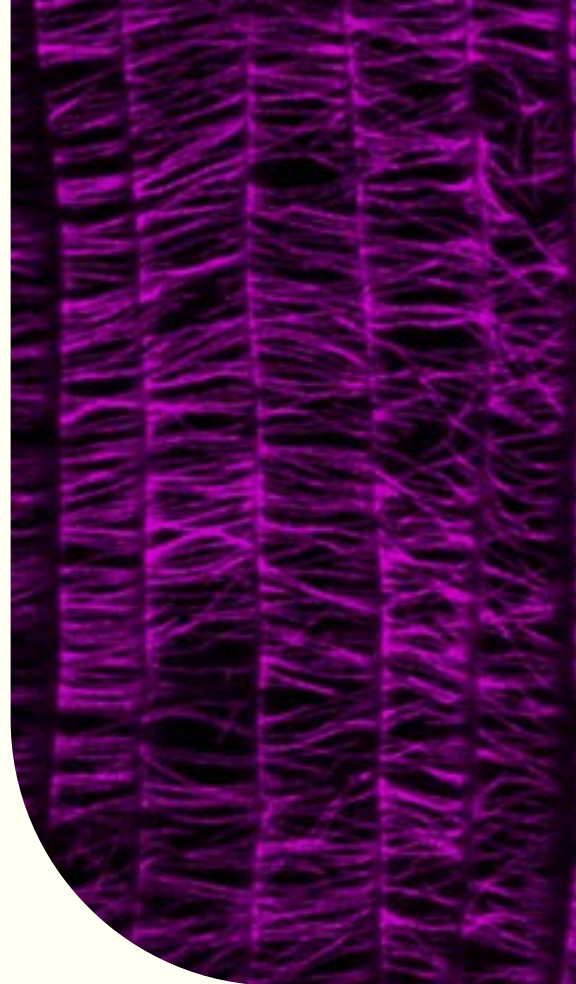
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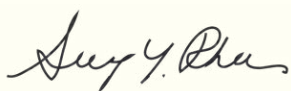
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EXECUTIVE SUMMARY

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 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) Research Coordination Network (RCN) was launched by scientists from the Carnegie Institution for Science and NYU with a goal of building a community of 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 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.



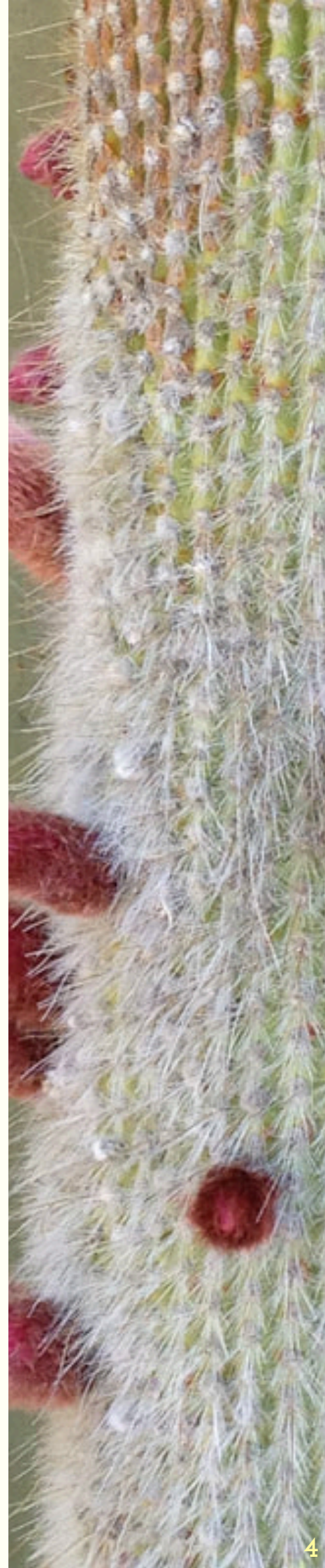
SEUNG YON (SUE) RHEE

*Principle Investigator - PCA Research
Coordination Network*



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 AND OUTREACH

The Spatial Metabolomics Workshop Part II

The Spatial Metabolomics Workshop brought together world leaders in spatial and mass spectrometry imaging-based metabolomics from plant sciences and beyond to help realize the development of a comprehensive PCA metabolome.

This workshop helped with the PCA's overall goal by bringing together a community which comprehensively described plant cell types by integrating high-resolution subcellular and cellular location information of nucleic acids, proteins, and metabolites.

In line with achieving this goal, metabolomics itself provides a functional readout of the cellular and molecular programs controlled through expression of genes and proteins, as metabolites are directly linked to cellular function, response to environmental stresses, and progression to disease.

Significant advances in mass spectrometry imaging and spatially resolved mass spectrometry technologies now make high-spatial resolution metabolomics notably more accessible for plant science. Moreover, new multiomics methods, including spatially resolved approaches, enable the ability to directly connect transcriptional and proteomic signatures with metabolic activity.



The Spatial Metabolomics workshop featured six expert speakers from around the world in two sessions (morning and afternoon). 338 people registered for this event with just under 300 people attending between the two sessions. Attendees tuned in from 29 countries and over 50% were early career researchers (ECRs).

This workshop was organized by The Metabolomics Committee Lead Chris Anderton (Pacific Northwest National Laboratory) and Metabolomics Committee Member Aleksandra Skirycz (Michigan State University).

Image credits: (Left) Morgan Magilligan, Leiboiff Lab, and Johanna Murray. (Top) Morgan Magilligan, Marco Vicari, and Johanna Murray.

COMMUNITY IMPACT AND OUTREACH

MSU Science Festival and Glencairn Science Night

PCA members meet the community where they're at by attending outreach events that can help educate on the importance of plant cell research.

During fiscal year 4, PCA hosted booths at two events located in East Lansing, MI: The Michigan State University Science Festival STEAM Expo Weekend and the Glencairn Elementary School Science Night.



Entitled, "Exploring Plant Cells" the booths at both events brought together scientists dedicated to unlocking the mysteries of plant cells and sparking curiosity in future generations.

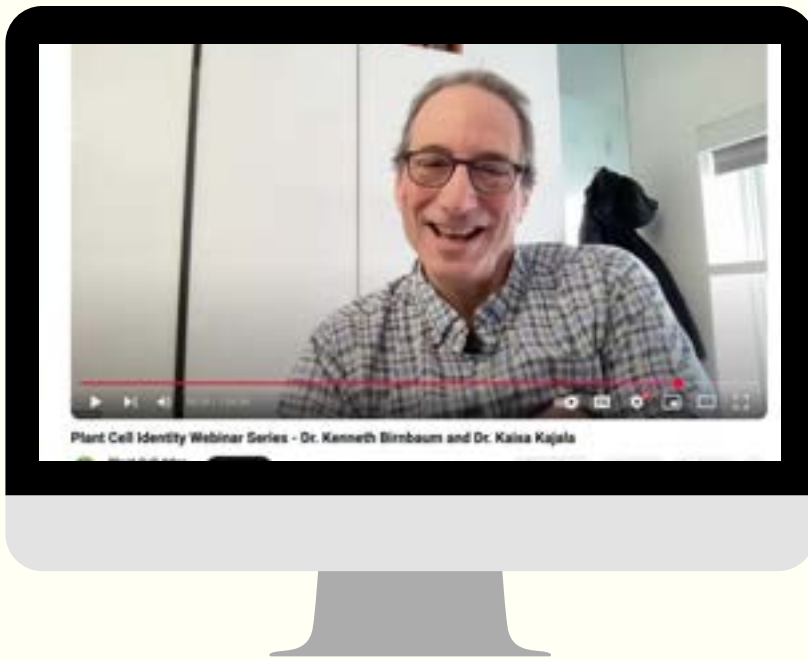
At the PCA booths, participants could dive into the microscopic world of plants using real microscopes, compare plant and animal cells with hands-on models, and explore a fun cell-type activity about the differences between plants and animals. Attendees also learned about Dr. Marie Clark Taylor, her life and her impact on plant science education.

Approximately 600 people visited the table and participated in the activities over the two days at the MSU Science Festival and around 100 students participated in this event at the Glencairn Science Night.



COMMUNITY IMPACT AND OUTREACH

Plant Cell Identity Webinar Series



The Plant Cell Identity Webinar Series is an on-going series which discusses how to define plant cell types and states quantitatively and qualitatively using single-cell and spatial omics approaches.

Each session features one or two different speakers that are experts in the field from around the world. From working out how cells develop their identity to uncovering how cell states change through development and from stress, these webinars cover how plant cell types and states are defined quantitatively and qualitatively using single-cell and spatial omics approaches.

Appealing to a global audience, which has so far resulted in over 100 participants at each session, this series has had over 1,000 people registered for the workshop in total.

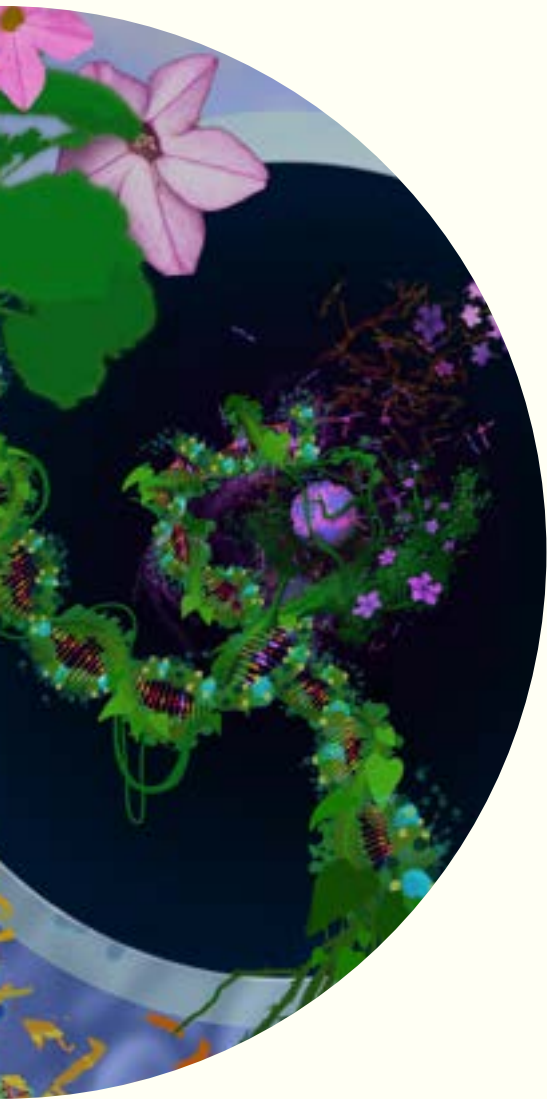
This series was organized by the Plant Cell Identity Committee Leads and ECRs Natanella Illouz-Eliasz (Salk Institute) and Trevor Nolan (Caltech).



COMMUNITY IMPACT AND 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 artwork that features historic plant scientists and information on Plant Biotechnology. The Plant Scientists exhibit features the lives and accomplishments of 4 historical 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 three Colleges and Universities - Bowie State University, Howard University, and Morgan State University. These exhibits were on display this past fiscal year at Oregon State University and Michigan State University.

PCA ART EXHIBIT

In FY4, the PCA Art and Science Exhibit was on display at three venues around the US.

All art banners (four Historical Plant Scientists (HPS); 4 Plant Biotechnology - Plant Biotech, and one banner on African Ethnobotany) were displayed by the Plant Resilience Institute at the Michigan State University (MSU) STEM Teaching and Learning Facility for the entire month of February, 2025.



Additionally, all of these art banners were on display at the Michigan State University's Science Festival STEAM Expo for the weekend of April 5-6, 2025.

Lastly, all of the banners were also on display at Oregon State University's Department of Botany and Plant Pathology on the first and second floors of Cordley Hall.

Engagement with the artwork and the exhibit's stickers from each event is tracked with QR codes (Plant Biotech = 216 total scans, HPS = 174 total scans, HPS Stickers = 97 total scans).



PCA: AT A GLANCE



PCA PUBLICATIONS

In the 2024 calendar year, PCA RCN members published 531 scientific articles in high-profile journals. Here are some articles published by PCA members that we would like to highlight:

Anderton, C. R., & Uhrig, R. G. (2024). The promising role of proteomes and metabolomes in defining the single-cell landscapes of plants. *New Phytologist*, 245(3), 945-948. <https://doi.org/10.1111/nph.20303>

Borowsky, A. T., & Bailey-Serres, J. (2024). Rewiring gene circuitry for plant improvement. *Nature Genetics*, 56(8), 1574-1582. <https://doi.org/10.1038/s41588-024-01806-7>

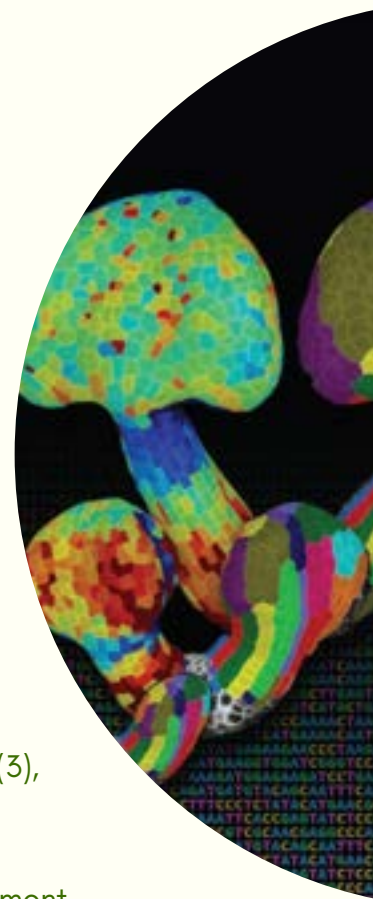
Ferreira Neres, D., Taylor, J. S., Bryant, J. A., Bargmann, B. O. R., & Wright, R. C. (2024). Identification of potential auxin response candidate genes for soybean rapid canopy coverage through comparative evolution and expression analysis. *Frontiers in Plant Science*, 15. <https://doi.org/10.3389/fpls.2024.1463438>

Ferreira Neres, D., & Wright, R. C. (2024). Pleiotropy, a feature or a bug? Toward coordinating plant growth, development, and environmental responses through engineering plant hormone signaling. *Current Opinion in Biotechnology*, 88, 103151. <https://doi.org/10.1016/j.copbio.2024.103151>

Greenblum, S. (2024). Microbial adaptability in changing environments. *Nature Reviews Microbiology*, 1-1. <https://doi.org/10.1038/s41579-024-01046-w>

Grones, C., Eekhout, T., Shi, D., Neumann, M., Berg, L. S., Ke, Y., Shahan, R., Cox, K. L., Fabio Gomez-Cano, Nelissen, H., Lohmann, J. U., Giacomello, S., Martin, O. C., Cole, B., Wang, J.-W., Kaufmann, K., Raissig, M. T., Gergo Palfalvi, Greb, T., & Libault, M. (2024). Best practices for the execution, analysis, and data storage of plant single-cell/nucleus transcriptomics. *the Plant Cell*, 36(4), 812-828. <https://doi.org/10.1093/plcell/koae003>

Hawkins, C., Xue, B., Yasmin, F., Wyatt, G., Zerbe, P., & Rhee, S. (2024). Plant Metabolic Network 16: expansion of underrepresented plant groups and experimentally supported enzyme data. *Nucleic Acids Research*, 53(D1), D1606-D1613. <https://doi.org/10.1093/nar/gkae991>



PCA PUBLICATIONS CONT.

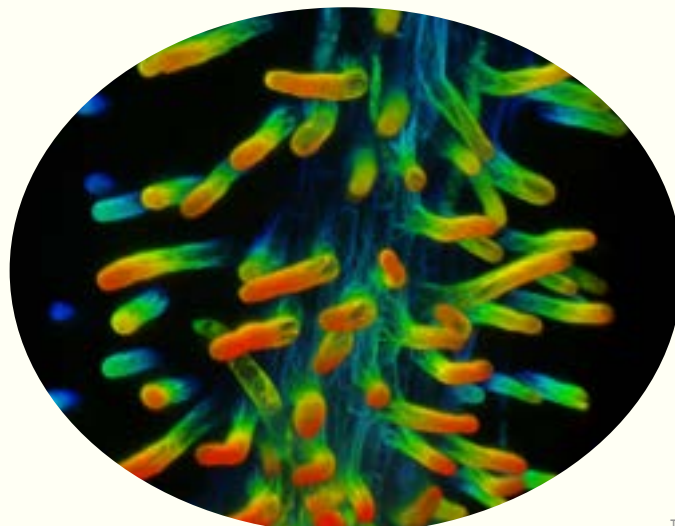
Kovacik, M., Nowicka, A., Zwyrtková, J., Beáta Strejčková, Isaiá Vardanega, Esteban, E., Pasha, A., Kateřina Kaduchová, Maryna Krautsova, Červenková, M., Šafář, J., Provart, N. J., Simon, R., & Ales Pecinka. (2024). The transcriptome landscape of developing barley seeds. *The Plant Cell*, 36(7), 2512-2530. <https://doi.org/10.1093/plcell/koae095>

Morffy, N., Van den Broeck, L., Miller, C., Emenecker, R. J., Bryant, J. A., Lee, T. M., Sageman-Furnas, K., Wilkinson, E. G., Pathak, S., Kotha, S. R., Lam, A., Mahatma, S., Pande, V., Wao, A., Wright, R. C., Holehouse, A. S., Staller, M. V., Sozzani, R., & Strader, L. C. (2024). Identification of plant transcriptional activation domains. *Nature*, 632(8023), 166-173. <https://doi.org/10.1038/s41586-024-07707-3>

Rhee, S. Y., Anstett, D. N., Cahoon, E. B., Covarrubias-Robles, A. A., Danquah, E., Dudareva, N., Hiroshi Ezura, Gilbert, K. J., Gutiérrez, R. A., Heck, M., Lowry, D. B., Mittler, R., Muday, G., Mukankusi, C., Nelson, A. D. L., Restrepo, S., Hatem Rouached, Seki, M., Walker, B., & Way, D. (2024). Resilient plants, sustainable future. *Trends in Plant Science*. <https://doi.org/10.1016/j.tplants.2024.11.001>

Sergio Alan Cervantes-Pérez, Zogli, P., Amini, S., Thibivilliers, S., Tennant, S., Md Sabbir Hossain, Xu, H., Meyer, I., Akash Nooka, Ma, P., Yao, Q., Naldrett, M. J., Farmer, A., Martin, O., Bhattacharya, S., Kläver, J., & Libault, M. (2024). Single-cell transcriptome atlases of soybean root and mature nodule reveal new regulatory programs controlling the nodulation process. *Plant Communications*, 5(8), 100984-100984. <https://doi.org/10.1016/j.xplc.2024.100984>

Twyford, A. D., Beasley, J., Barnes, I., Allen, H., Azzopardi, F., Bell, D., Blaxter, M. L., Broad, G., Campos-Dominguez, L., Choonea, D., Crowley, L., Piotr Cuber, Cunliffe, M., Dombrowski, A., Douglas, B., Forrest, L. L., Gaya, E., Greeves, C., Griffin, C., & Harley, J. (2024). A DNA barcoding framework for taxonomic verification in the Darwin Tree of Life Project. *Wellcome Open Research*, 9, 339-339. <https://doi.org/10.12688/wellcomeopenres.21143.1>



COMMUNITY TESTIMONIALS

"Over the past year, PCA supported my meeting participation, invited me to speak at the symposium, and provided invaluable mentorship during my faculty job search."

- Mingyuan Zhu, Postdoctoral Associate, Duke University



"Overall, the Plant Cell Workshop Webinar Series was an informative and engaging experience. The series covered a broad range of topics, making complex biological concepts accessible and interesting for both beginners and those with more advanced knowledge."

- 2025 PCA Plant Cell Identity Webinar Series Attendee



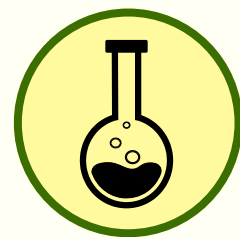
"PCA CN participation has played a key role in helping me gain confidence in leadership roles."

- Purva Karia, Postdoctoral Fellow, Carnegie Institution for Science

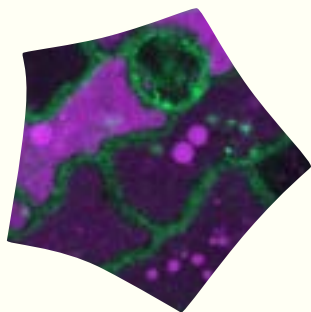


DATA

Workshops & Symposia

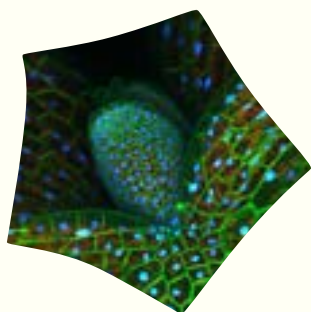


**In 2024-2025 the PCA held 2 scientific workshops and one 2-day symposium.
(ECR = Early Career Researcher)**



The Third Annual PCA Symposium
908 people

The symposium's attendees represented 59 different countries. 80% of the speakers were ECRs and they represented eight different countries.



Plant Cell Identity Webinar Series
1,000 people and counting

The Plant Cell Identity (PCI) Webinar Series features 13 speakers, 6 of which (46%) are ECRs. Each session is led by a moderator and 66% of the moderators are ECRs. This series was also organized by two ECRs.



Spatial Metabolomics Workshop
290 people

338 people registered for this event with just under 300 people attending between the two sessions. Attendees tuned in from 29 different countries and over 50% were ECRs.

PCA LEADERSHIP

Steering Committee



Dr. Seung Yon Rhee
Michigan State
University



Dr. Ken Birnbaum
New York
University



Dr. Siobhan Brady
University of
California, Davis



Dr. Julia Bailey-Serres
University of California,
Riverside



Dr. Marc Libault
University of
Missouri



Dr. Marisa Otegui
University of Wisconsin,
Madison



Dr. Nicholas Provart
University of
Toronto

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Committee Chairs



Dr. Christopher
Anderton
Pacific Northwest
National Lab



Dr. Jennifer
Brophy
Stanford
University



Dr. Benjamin
Cole
Lawrence Berkeley
National Lab



Dr. Kevin
Cox Jr.
Donald Danforth
Center



Dr. Kirk
Czymmek
Donald Danforth
Center



Dr. Luigi Di
Costanzo
University of
Naples Federico II



Dr. Margaret
Frank
Cornell University



Dr. Shao-Shan
Carol Huang
New York
University



Dr. Natanella
Illouz-Eliaz
Salk Institute



Dr. David Jackson
Cold Spring
Harbor
Laboratory



Dr. Purva Karia
Carnegie
Institution for
Science



Dr. Heather
McFarlane
University of
Toronto



Dr. Hilde
Nelissen
VIB-UGent Center
for Plant Systems
Biology



Dr. Luke
Nikolov
Indiana
University



Dr. Trevor
Nolan
California Institute
of Technology



Dr. Nicola Patron
University of
Cambridge, UK



Dr. Rachel
Shahan
University of
California, Los
Angeles



Dr. Felix Shaw
Earlham
Institute



Dr. R. Glen
Uhrig
University of
Alberta

PCA LEADERSHIP

Core Network Participants



1. Dr. Amir Ahkami - Pacific Northwest National Lab, USA
2. Dr. Sahand Amini - University of Missouri-Columbia, USA
3. Dr. Christopher Anderton - Pacific Northwest National Laboratory, USA
4. Dr. Julia Bailey-Serres - University of California, Riverside, USA
5. Dr. Yoselin Benitez-Alfonso - University of Leeds, UK
6. Dr. Kenneth Birnbaum - New York University, USA
7. Dr. Nanna Bjarnholt - University of Copenhagen, Denmark
8. Dr. Alex Borowsky - Stanford University, USA
9. Dr. Siobhan Brady - University of California, Davis, USA
10. Dr. Janeen Braynen - Cold Spring Harbor Laboratory, USA
11. Dr. Jennifer Brophy - Stanford University, USA
12. Dr. Tessa Burch-Smith - Danforth Center, USA
13. Dr. Jeremy Coate - Reed College, USA
14. Dr. Benjamin Cole - Lawrence Berkeley National Laboratory, USA
15. Dr. Maite Colinas - Max Planck Institute for Chemical Ecology, Germany
16. Dr. Kevin Cox Jr - Donald Danforth Center, USA
17. Dr. Kirk Czymmek - Donald Danforth Center, USA
18. Dr. Luigi Di Costanzo - University of Naples Federico II, Italy
19. Dr. Gozde Demirer - California Institute of Technology, USA
20. Dr. Jazz Dickinson - University of California, San Diego, USA
21. Dr. Jeffrey Doyle - Cornell University, USA
22. Dr. Georgia Drakakaki - University of California, Davis, USA
23. Dr. Quentin Dudley - University of Wisconsin-Madison, USA
24. Dr. Chris Dundas - University of Georgia, USA
25. Dr. Michelle Facette - University of Massachusetts, Amherst, USA
26. Dr. Noah Fahlgren - Donald Danforth Center, USA
27. Dr. Andrew Farmer - National Center for Genome Resources, USA
28. Dr. Alisdair Fernie - Max Planck Institute of Molecular Plant Pathology, Germany
29. Dr. Alejandro Fonseca Cárdenas - Swedish University of Agricultural Sciences, Sweden
30. Dr. Margaret Frank - Cornell University, USA

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Core Network Participants



31. [Dr. Stefania Giacomello](#) - SciLifeLab, Sweden
32. [Fabio Gomez-Cano](#) - University of Michigan, USA
33. [Dr. Sharon Greenblum](#) - Lawrence Berkeley National Laboratory, DOE Joint Genome Institute, USA
34. [Dr. Shao-shan Carol Huang](#) - New York University, USA
35. [Dr. Natanella Illouz-Eliaz](#) - Salk Institute for Biological Studies, USA
36. [Dr. David Jackson](#) - Cold Spring Harbor Laboratory, USA
37. [Dr. Kaisa Kajala](#) - Utrecht University, The Netherlands
38. [Dr. Purva Karia](#) - Carnegie Institution for Science, USA
39. [Dr. Sunil Kenchanmane](#) - University of California, Riverside, USA
40. [Dr. Daniel Kierzkowski](#) - University of Montreal, Canada
41. [Dr. Charlotte Kirchhelle](#) - ENS Lyon, France
42. [Dr. Sunita Kumari](#) - Cold Spring Harbor Laboratory, USA
43. [Dr. Dae Kwan Ko](#) - Michigan State University, USA
44. [Dr. Samuel Leiboff](#) - Oregon State University, USA
45. [Dr. Mao Li](#) - Donald Danforth Center, USA
46. [Dr. Song Li](#) - Virginia Polytechnic Institute, USA
47. [Dr. Marc Libault](#) - University of Missouri, USA
48. [Dr. Tie Liu](#) - University of Florida, USA
49. [Dr. Shelley Lumba](#) - University of Toronto, Canada
50. [Dr. Sibongile Mafu](#) - University of Massachusetts, Amherst, USA
51. [Dr. Heather McFarlane](#) - University of Toronto, Canada
52. [Dr. Devang Mehta](#) - KU Leuven, Belgium
53. [Dr. Gaurav Moghe](#) - Cornell University, USA
54. [Dr. Jenny Mortimer](#) - University of Adelaide, Australia
55. [Dr. Hilde Nelissen](#) - VIB-UGent Center for Plant Systems Biology
56. [Dr. Lachezar Nikolov](#) - Indiana University, USA
57. [Dr. Tatsuya Nobori](#) - Salk Institute for Biological Studies, USA
58. [Dr. Trevor Nolan](#) - California Institute of Technology, USA
59. [Dr. Toshihiro Obata](#) - University of Nebraska Lincoln, USA
60. [Dr. Ronan O'Malley](#) - University of Chicago, USA
61. [Dr. Marisa Otegui](#) - University of Wisconsin, Madison, USA

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Core Network Participants



62. Dr. Gergo Palfalvi - Max Planck Institute, Germany
63. Dr. Michael Passalacqua - Cold Spring Harbor Laboratory, USA
64. Dr. Nicola Patron - University of Cambridge, UK
65. Dr. Marta Peirats-Llobet - La Trobe University, Australia
66. Dr. Noé Perron - University of Florida, USA
67. Dr. Nicholas Provart - University of Toronto, Canada
68. Dr. Elsa Quezada-Rodríguez - Universidad Nacional Autónoma de México, Mexico
69. Dr. Ivan Radin - University of Minnesota, USA
70. Dr. Seung Yon Rhee - Michigan State University, USA
71. Dr. Bob Schmitz - University of Georgia
72. Dr. Rachel Shahan - University of California, Los Angeles, USA
73. Dr. Felix Shaw - Earlham Institute, UK
74. Dr. Rüdiger Simon - Heinrich Heine University, Germany
75. Dr. Pallavi Singh - University of Essex, UK
76. Dr. Aleksandra Skirycz - Michigan State University, USA
77. Dr. R. Glen Uhrig - University of Alberta, Canada
78. Dr. Batthula Vijaya Lakshmi Vadde - Salk Institute, USA
79. Dr. Justin Walley - Iowa State University, USA
80. Dr. Jianping Wang - University of Florida, USA
81. Dr. Zhiyong Wang - Carnegie Institution for Science, USA
82. Dr. Olivia Wilkins - University of Manitoba, Canada
83. Dr. R Clay Wright - Virginia Polytechnic Institute, USA
84. Dr. Shouling Xu - Carnegie Institution for Science, USA
85. Dr. Qiuming Yao - University of Nebraska-Lincoln, USA
86. Dr. Mingyuan Zhu - Duke University, USA

PCA AFFILIATED ORGANIZATIONS



University of
Massachusetts
Amherst BE REVOLUTIONARY



Utrecht University



THE UNIVERSITY
of ADELAIDE



LA TROBE
UNIVERSITY



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COLLEGE



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UNIVERSITY OF
MICHIGAN



UC San Diego



Caltech



UNIVERSITY OF
TORONTO



SciLifeLab



Duke
UNIVERSITY



UNIVERSITY OF MINNESOTA



Oregon State
University

IOWA STATE
UNIVERSITY



UNIVERSITY OF
CAMBRIDGE



MICHIGAN STATE
UNIVERSITY



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Institute



hhu

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Düsseldorf



ENS DE LYON



University
of Essex

UC DAVIS



NCGR

National Center for Genome Resources

UNIVERSITY OF LEEDS



Cold Spring Harbor Laboratory

Funding provided by the National Science Foundation grant numbers [MCB-1916797](#), [MCB-2052590](#) & [MCB-2420360](#)

Where to Find Us



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



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plantcellatlas@gmail.com



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[Plant Cell Atlas](https://www.linkedin.com/company/plant-cell-atlas)



SCAN ME