United States

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with input from the North American Arabidopsis Steering Committee (NAASC): Roger Innes, Indiana University; Jennifer Nemhauser, University of Washington, Seattle; Federica Brandizzi, Michigan State University; Anna Stepanova, NC State University; Siobhan Braybrook, UCLA; Keith Slotkin, Donald Danforth Plant Science Center & Univ. of Missouri-Columbia; Cris Argueso, Colorado State University, Peter McCourt, University of Toronto, and Sean Cutler, UC Riverside

Please describe any new experimental resources and/or software tools available to Arabidopsis researchers that have been initiated or funded in your country in 2020 or early 2021

1. Brumos J, Zhao C, Gong Y, Soriano D, Patel AP, Perez-Amador MA, Stepanova AN, Alonso JM. An Improved Recombineering Toolset for Plants. Plant Cell. 2020 Jan;32(1):100-122. doi: 10.1105/tpc.19.00431. Epub 2019 Oct 30. PMID: 31666295; PMCID: PMC6961616.

The authors developed an improved recombineering-based tagging system to tag or edit plant genes using bacterial artificial chromosomes that can be introduced back into the plant genome and demonstrated the system's utility by generating translational reporter fusions for a large set of auxin-related genes.

2. Madison I, Melvin C, Buckner E, Williams C, Sozzani R, Long T. MAGIC: Live imaging of cellular division in plant seedlings using lightsheet microscopy. Methods Cell Biol. 2020; 160:405-418. doi: 10.1016/bs.mcb.2020.04.004. Epub 2020 May 30. PMID: 32896331

The authors developed an imaging technique for seedlings that involves simultaneous imaging of at least 4 samples to enable data acquisition at a high temporal resolution, while overcoming several challenges of imaging using existing microscopy techniques.

3. Buckner E, Madison I, Melvin C, Long T, Sozzani R, Williams C. BioVision Tracker: A semi-automated image analysis software for spatiotemporal gene expression tracking in *Arabidopsis thaliana*. Methods Cell Biol. 2020; 160:419-436. doi: 10.1016/bs.mcb.2020.04.017. Epub 2020 Jun 5. PMID: 32896332.

The authors developed a procedure for analyzing 3D microscopy images to track and gather quantitative spatiotemporal gene expression data in living Arabidopsis seedlings.

Please provide a paragraph describing the general impact of the COVID19 pandemic on the scientific community in your country

The COVID-19 pandemic has been highly challenging to US scientists with inequities and disparities in impact. Significant negative impacts were felt by researchers who have dependents and for whom a lack of external dependent-care has been unavailable. There has been a disproportionate impact on younger scientists for whom there are expiration dates on funding lines, and mothers

of young children who generally have borne the brunt of additional labor of childcare and home schooling. For parents and other child caregivers, the pandemic was particularly disastrous because children were home, daycare centers and summer camps were often closed, and school was remote/online. Some early data suggest that mothers were the most affected: the proportion of female authors on preprints, submissions and publications dropped, and mothers suffered a 33% larger reduction in research hours, while simultaneously taking on more household and childcare duties than fathers did (Langin, K. (2021).

The pandemic hit academic mothers especially hard, new data confirm. Science. doi: 10.1126/science.caredit.abh0110). The impact of COVID-19 on faculty of color was further exacerbated by the explosion of racial unrest that erupted during the peak of the pandemic, and continues to this day. The long-term career repercussions of the COVID-19 pandemic are difficult to predict but we expect that there will likely be significant ripple effects for years, and the effects will disproportionally affect women and people of color. Repercussions range from reduced academic productivity that may be reflected in years of disrupted research-publish-successful grant funding cycles, to attrition of women scientists and people of color from academia (and other careers) as a result of compounded societal stresses and the unbearable additional labor from the COVID-19 pandemic atop the existing challenges of research, education, service, and mentorship that are already required of most academic plant scientists.

Like many, US scientists adopted and learned to use existing software to allow remote work and teach teaching, with Zoom as a primary example. Most research labs experienced a complete shutdown with remote work for ~3 months (mid-March to mid-June 2020). Some labs were allowed to maintain their plants, yet some biological resources were lost. Many projects involving genetics were severely delayed. The shift suddenly to teaching online took tremendous effort to rework courses on the fly. Re-opening research labs, usually at partial capacity, required many weeks of paperwork and complex rotation schedules to be developed by most faculty.

Many people have had to work in shifts, so they may only get half days in the lab and limited access to necessary equipment; this has been seriously detrimental to research progress. NAASC calls for creative and robust institutional and structural efforts to mitigate the expected negative consequences of the COVID-19 pandemic, particularly on early-career scientists, mothers, and people of color. In the absence of such measures, we can predict a tragic and significant loss of highly talented and diverse members of the plant science community.

Planned events for 2021 and 2022

The 31st International Conference on Arabidopsis (ICAR, 21-25 June, 2020) was scheduled for Seattle, Washington, USA in July, 2020. NAASC (ICAR organizers) postponed the conference to 2021 due to Covid-19 pandemic, and then converted it to a virtual meeting due to uncertainties on global vaccination efforts and travel restrictions (http://icar2020.arabidopsisresearch.org).

The program (under development since fall, 2017) is the most diverse and democratically-developed in ICAR history. There are 23 invited platform speakers, including two Keynote Speakers and 21 Plenary Speakers, and 36 community-proposed and organized mini-symposia that will feature up to 252 additional speakers.

The theme of ICAR 2021-Virtual is “ARABIDOPSIS as a NEXUS for INNOVATION, APPLICATION, and IMPACT”; innovative approaches for the meeting include:Diversity and Inclusion: People and Science

• Confirmed Keynote Speakers, Drs. Detlef Weigel and Joanne Chory, are true pioneers in plant biology research. We chose them for their significant, exciting, and cross-cutting science and messages that exemplify the meeting theme to the big societal challenges we are facing.

• We developed an exciting and diverse list of plenary speakers in alignment with the conference theme by flipping the typical process: first, we developed a speaker list of those we would like to speak, regardless of topic, and once confirmed, we grouped them into sessions. This approach put the emphasis on finding exciting speakers that have a new breakthrough to present and enabled us to address our diversity, equity and inclusion objectives at a global level

• Another first for ICAR: we invited innovative mini-symposia topics from the community and received 100+ submissions for 36 slots. We reserved, in advance, at least 25% to be led by students and postdocs; we have been fundraising to provide all session organizers with budgets to recruit speakers. •We created the DiversifyPlantSci list (https://tinyurl.com/DiversifyPlantSci) to promote a global plant sciences community that reflects the diversity of all its members. The online resource is a list of plant biologists from under-represented groups, to increase diversity and inclusion by expanding beyond personal networks. This list has been used to develop invited speaker lists from some sessions

• We surveyed the global Arabidopsis community at multiple points to give input into the programs of (first) ICAR 2020, and later, ICAR 2021. A large number of speakers on our invited "short list" came from community input

• After pivoting to ICAR 2021-Virtual, we solicited community input again; based on community priorities we added live interactive discussion sessions to mini-symposia. Activities post-ICAR 2021: NAASC are coming to the end of a 5-year NSF* funding award that underpins all our community-supporting efforts. In parallel with the current major effort to organize ICAR 2021-Virtual, NAASC have been developing plans for future community activities with the intent to apply for funding support. NAASC have engaged in discussions over the past 2 years internally, as well as with external collaborators. We held a 3-day online workshop in summer 2020, (rescheduled due to Covid-19) with invited assessors and evaluators from the community to review our recent efforts and provide assessments on our progress and recommendations for future efforts.

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Selected Publications

1) Friesner, J, Colón_Carmona, A, Schnoes, AM, *et al*. Broadening the impact of plant science through innovative, integrative, and inclusive outreach. Plant Direct. 2021; 5:e00316. https://doi.org/10.1002/pld3.316a)

We highlight this NAASC-led white paper as a valuable community resource; it describes the broad context where science outreach is performed, the specific challenges faced by plant scientists, and outlines basic concepts in the design, evaluation and dissemination of outreach activities and provides case studies for their implementation; finally, it charts a course to make to make outreach more innovative, integrative and inclusive.

Advancing outreach in plant science through Inclusion, Innovation and Integration. Successful outreach programs thrive when a holistic approach is taken. Inclusive programs are crafted with awareness of the demographic, cultural and institutional contexts they exist in. Innovative programs use the state of the art organizational models in their design and devise a means of evaluating their effectiveness through assessments appropriate to their scale. Integrative programs communicate their outreach efforts across labs and institutes to disseminate and share what works. All of these activities need to be supported by an ecosystem of funding from the government, universities and private foundations that recognize excellence across these areas

2) Montgomery BL. Planting Equity: Using What We Know to Cultivate Growth as a Plant Biology Community. Plant Cell. 2020 Nov; 32(11):3372-3375. https://www.doi.org/10.1105/tpc.20.00589.a)

We highlight this important work, the first in a new series of Letters that focus on anti-Black racism globally; the author "draws analogies between how we think about plant and human communities and encourages a collective shift in academia from "gatekeeping" to "groundskeeping" practices, specifically with respect to facilitating successful outcomes for Black and other People of Color and underrepresented groups in the scientific community."

3) Shigenaga AM, Kroh GE, Argueso CT. Plant Disease & Climate Change: A Classroom Exercise Emphasizing Scientific Collaboration. The American Biology Teacher. 2021 March; 83 (3): 174–179. https://doi.org/10.1525/abt.2021.83.3.174a)

We highlight this publication on a model-learning college classroom exercise on rice susceptibility to a bacterial pathogen because it incorporates two important approaches: improving student understanding of the interactions between abiotic and biotic factors that decrease crop production, compounded by climate change, and the importance of communication between fields to produce solutions to major issues.

Major Funding Sources

- US Arabidopsis Research is primarily supported by funding through the Federal Government via the National Science Foundation (NSF): http://www.nsf.gov/
Additional support from:
- US Department of Agriculture (USDA): http://www.usda.gov/US
- Department of Energy (DOE): http://energy.gov/
- National Institutes of Health (NIH): http://www.nih.gov/
- National Aeronautics and Space Administration (NASA): http://www.nasa.gov/

Private Sources:
- Howard Hughes Medical Institute (HHMI)- alone and partnered with several other organizations, support a number of prominent US Arabidopsis researchers and educators:
(1) HHMI Faculty Scholars (current or past NAASC Scholars: Siobhan Brady, Jose Dinneny, Elizabeth Haswell, and Jennifer Nemhauser): http://www.hhmi.org/programs/biomedical-research/faculty-scholars
(2) HHMI Investigators (past NAASC Investigators: Dominique Bergmann, Philip Benfey, Joanne Chory, Jeff Dangl, Xinnian Dong, Joe Ecker, Elliot M. Meyerowitz, and Keiko Torii) http://www.hhmi.org/programs/biomedical-research/investigator-program
(3) HHMI Professors (past NAASC Professors: Richard M. Amasino and Bonnie Bartel) https://www.hhmi.org/developing-scientists/hhmi-professors