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PlantScienceNews

Newsletter of the Zurich-Basel Plant Science Center

No 32, Fall 2017

Upcoming Events

Launch of *fem*inno – PSC Career Development Program

Oct 2017

PlantHUB – 1st Annual Meeting

27-29 Nov 2017, ETH Zurich

PSC Symposium
Dynamics of Plant Development and Evolution

30 Nov & 1 Dec 2017, ETH Zurich

Content

Newsletter No. 32, Autum 2017

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Arabidopsis kamchatica specimen growing in the wild near Girdwood, Alaska. © Amy Paape

Editorial

All about checkpoints

Sometimes in order to proceed in life you have to stop and re-evaluate. Have you thought about checkpoints in your professional development? What is the basis of your decision-making? Awareness, inspiration or courage? Who influences you?

The PSC is launching a new *Career Development Program for Female Scientists* – called *fem*inno, tools to take you to the next level of your career. The program offers training, coaching and networking aiming to identify resources and make use of them. A concept that is also know as the 4 C's of career success: CONTROL – know yourself, CONFIDENCE – tools, CURIOSITY – know opportunities, CONCERN – plan ahead.

On another note, this year's *PSC Symposium: Dynamics in Plant Development and Evolution* will explore checkpoints in plant development. The topics will range from the cellular to the ecosystem level – giving insights into cellular communication, pathogen evolution, hormone signaling, plant-insect interaction, light perception, epigenetics, population dynamics and evolution of plant shape. Uncovering fundamental mechanisms of plant development and evolution is required for understanding how plants adapt to an ever-changing environment on a multi-scale level. The PSC Symposium will also provide a venue for students and postdoctoral scientists to interact with the invited speakers. A dedicated lunch session will allow time for informal discussion of their careers and professional checkpoints.

Thanks to the organization committee for putting such an exciting program together. Particular thanks to Joop Vermeer, University of Zurich and Antia Rodriguez Villalon, ETH Zurich for additional fundraising.

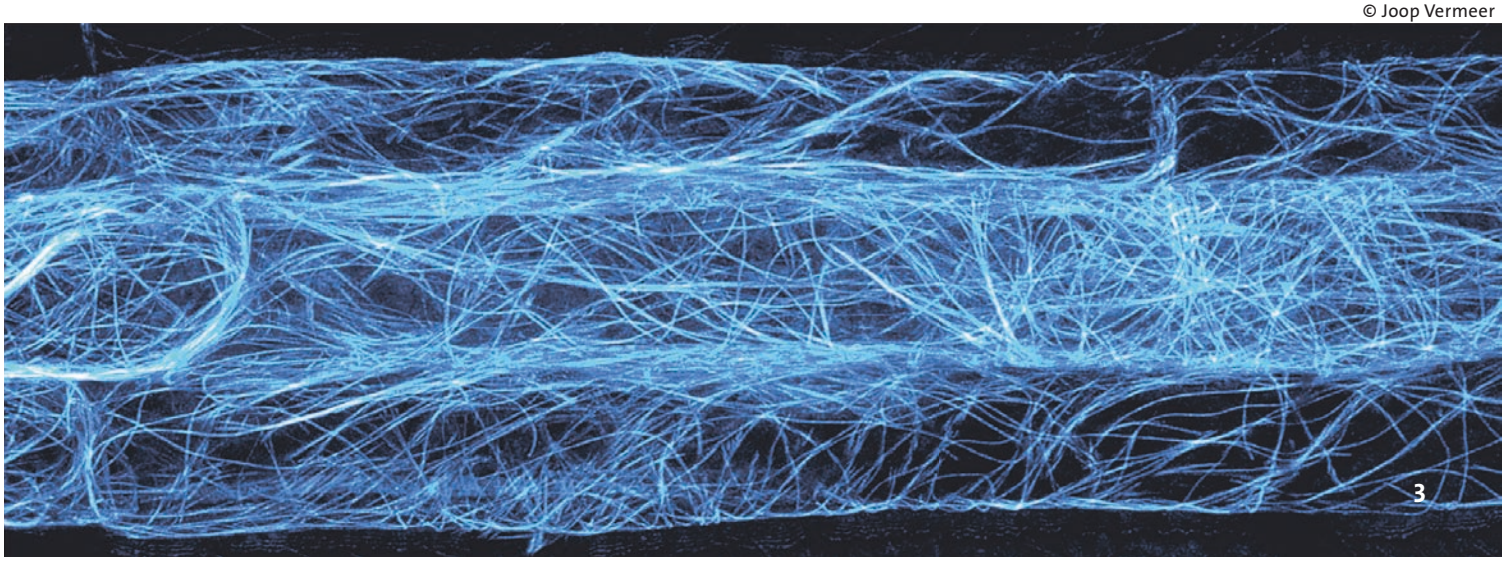
Looking forward seeing you there!

Manuela Dahinden & Melanie Paschke
PSC Managing directors

If you only connect the dots with the numbers on them, you will never build a new picture.

Anil Sethi: From Science to Startup

© Joop Vermeer



Putting plants in school: On the potential of epigenetic memory in crop breeding

Next generation of cold-stressed soybeans growing in the Botanical Garden, University of Basel. © Michael Thieme

Michael Thieme

Conventional and organic plant breeding is based on the presence of naturally occurring, or induced random changes in the DNA sequence of an organism, so called mutations. These mutations result in both genetic and phenotypic diversity, and can be used to select advantageous genotypes or traits during the breeding process. Figuratively, breeding for desired traits can be compared with a laborious search for new and meaningful sentences in a book where single letters or words were randomly erased or exchanged.

Innovative approaches: stimulating the short term memory

As plants are not equipped with legs or wings to escape life-threatening situations, they had to evolve a great diversity of mechanisms to keep up with evolution. One of the most fascinating skills of plants is their distinct ability to remember situations they experienced during their life cycle. Surprisingly, this knowledge of the plant's past not only influences the individual plant itself, but can under certain circumstances also be passed on to the plant's progeny to prepare it for similar situations.

This concept was already been proposed in the 19th century by Jean-Baptiste de Lamarck. The phenomenon that information other than the genetic sequence of an organism is passed on to the next generation is nowadays described as «epigenetic memory».

Metaphorically speaking, this additional, epigenetic information tells the plant where exactly in its large «genetic encyclopedia», on which page or in which sentence, it can read to overcome a threatening situation. Several studies provide proof of evidence for such a transgenerational memory in plants. For example, plants that were in contact with pathogens revealed an increased pathogen-resistance in the next generation, compared to plants that were sheltered from harm.

The formation of this epigenetic memory is based on two biochemical mechanisms: DNA methylation and histone modification. In order to shape the specific epigenetic landscape of an organism, methyl groups are added to or removed from specific nucleotides of the genetic code. This modifies their meaning and, for example, suppresses the activity of nearby genes. One can compare this mechanism with highlighting certain words in a book with a text marker. During histone modification, important structural modifications are made, which makes certain regions of the genetic code more or less easy to read. Again, compared with a book, this mechanism is analogous to changing the font size of certain paragraphs.

However, similar to humans, plants apparently tend to forget without permanent training. Hence, even if the plant's memory can be passed on to two or three generations, this is hardly enough to face future challenges in agriculture.

The total recall: plants use «cheat sheets»

Besides using text markers to highlight certain words or sentences, plants have an even more powerful natural genetic resource that can be harnessed for breeding purposes. Referring to the analogy as the genome being a huge encyclopedia, this genetic resource, so called retrotransposons (retroTEs), can be pictured as «cheat sheets». Just like during a school exam, if placed at the correct position in the notebook, these highly informative pages can positively influence the performance of a plant. Fascinatingly, it seems that these mobile genetic elements are particularly effective in regulating flanking genetic regions under stress conditions. They function as natural genetic switches and direct linkers

of the environment to the genome. They are considered as hot-spots of epigenetic memory.

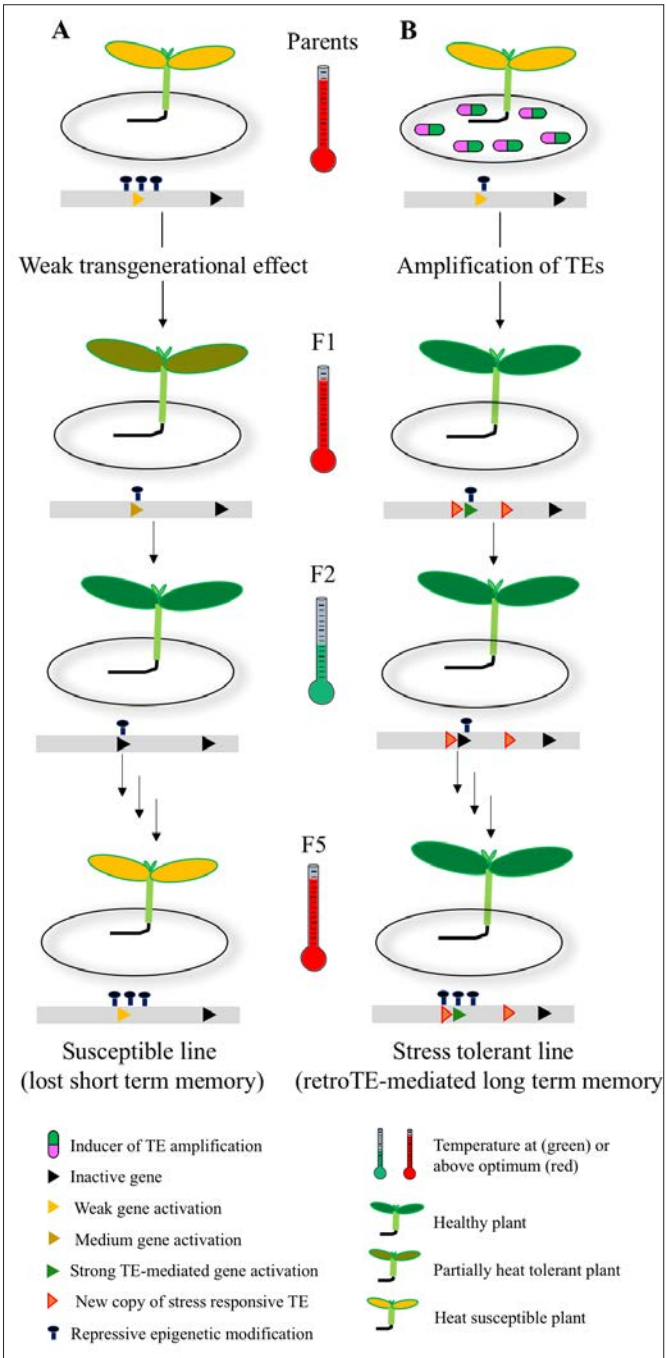
The best part about these «cheat sheets» however is that they can be copied and firmly integrated somewhere else in the encyclopedia. The huge amount of such retroTEs in plants strongly suggests that they serve as a genetic backup resource that can be used in various different situations.

Reinforcing the memory: encouraging plants to copy their «cheat sheets»

So far, the major challenge in making use of retroTEs for crop breeding was that plants would normally avoid the risk of producing too many copies of their «cheat sheets». Hence, to avoid their uncontrolled proliferation under optimal growth conditions these elements are normally strictly repressed by the plant. During my PhD project I discovered a key mechanism at the origin of retroTEs repression that can easily be targeted with a simple transient application of drugs. I was able to show that plants grown on two specific compounds produce huge amounts of a specific «cheat sheet», called *ONSEN* (jap. «hot spring») in response to heat stress. Most importantly, I demonstrated that such treatments efficiently result in new stably inserted copies of these heat responsive elements in the progeny of treated and heat stressed plants (Thieme *et al.* 2017).

Its potential in crop breeding

As this transient controllable process of «enticing to cheat» involves only the stimulation of natural processes and does not include controversial genetic engineering, it has the potential to revolutionize breeding for the organic sector. Based on what is already known about the contribution of retroTEs to plant diversity and evolution, I now believe that the term «hidden treasure» (Mirouze and Vitte, 2014) would actually be more appropriate than only describing them as a collection of ordinary «cheat sheets». By multiplying these retroTEs in the genome, they can, amongst other advantageous effects, cause valuable «gain of function» mutations and contribute to the evolution of new gene regulatory networks. In case of future challenges related to global warming, imagine having a crop with a «cheat sheet» saying «how to adapt to heat» next to a gene important for heat-resistance.



Enticing to cheat: Induced amplification of retrotransposons for an increased stress tolerance in plants. © Michael Thieme

A) Stress induces the transgenerational alteration of epigenetic silencing of stress-resistance genes resulting in slightly increased stress tolerance of plants in the F1 generation. Without recurring stress, epigenetic stress memory is lost over successive generations resulting in susceptible lines. B) Transient inhibition of retroTE-defense in combination with a stress factor leads to controlled amplification of stress-responsive retroTEs in the plant genome. Repeated stress leads to strong retroTE-mediated and stress-depended activation of stress-resistance genes and increased tolerance already in the F1 generation. Induced retroTE-amplification results in tolerant lines

References

Mirouze, M. and Vitte, C. (2014) Transposable elements, a treasure trove to decipher epigenetic variation: insights from *Arabidopsis* and crop epigenomes. J Exp Bot 65: 2801-2812.

Thieme, M., Lanciano, S., Balzergue, S., Daccord, N., Mirouze, M. and Bucher, E. (2017) Inhibition of RNA polymerase II allows controlled mobilisation of retrotransposons for plant breeding. Genome Biol 18: 134.

This research project was supported by a PSC PhD fellowship as part of the Innovative Doctoral Program IDP BRIDGES, a Marie Curie Action of the European Union.

At a Glance

Awards

Christian Schöb, formerly group leader at University of Zurich, received a SNSF professorship for Agricultural Ecology that he took up at the ETH Zurich Institute of Agricultural Sciences.

Achim Walter, professor of Crop Science at the Institute of Agricultural Sciences, ETH Zurich, has been appointed honorary member by the agro food network SVIAL.

Silvia Dorn, ETH Zurich, was awarded an Honorary Doctorate of Science by Newcastle University, UK.

Stephanie Cheesman, ETH Zurich, won the Hans Vontobel-Preis 2017 for her outstanding doctoral thesis in agricultural science entitled: Finding the truth in wishful thinking: an on-farm study on maize-based conservation agriculture systems in Southern Africa (Emmanuel Frossard group).

Maria Vorkauf, University of Basel, received a poster award in the category Geosphere/Biosphere at the Swiss Global Change Day for her poster: The influence of snow cover duration on alpine plant phenology (Erika Hiltbrunner group).

Open call

Applications for PhD and postdoc fellowships can be submitted until 1st of November 2017. The funds are intended to promote innovative research in plant sciences. In addition to the scientific quality of the project and the qualification of the applicants, research co-operation within PSC will be an important criterion in the project selection.

This call is reserved for PSC professors and group leaders.

For application templates please contact:

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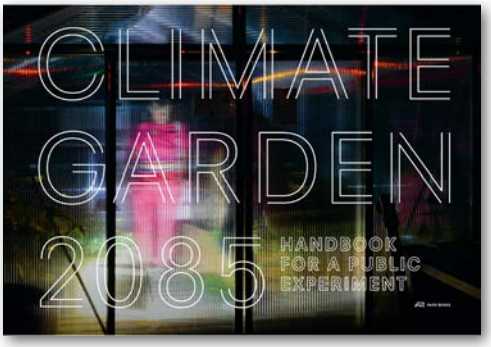
mdahinden@ethz.ch
or visit
www.plantsciences.ch/research/fellowships/syngenta.html

PSC Publications



Climate Garden 2085 –
Handbook for a public experiment
Juanita Schläpfer-Miller, Manuela Dahinden (Eds.)
Park Books
ISBN: 978-3-03860-059-6 German
ISBN: 978-3-03860-060-2 English

Proceedings of the PSC Summer Schools 2014 and 2016

Agriculture in transformation – Concepts for agriculture production sytems that are socially fair, environmentally safe and economically viable

Melanie Paschke (ed.),
IDEA Verlag GmbH
ISBN: 978-3-88793-257-2

Neue Technologien in der Pflanzenforschung – eine Alternative zu Pflanzenschutzmitteln?

Manuela Dahinden, Jörg Romeis, Liselotte Selter, Gerd Folkers (Hrgs.)

Druckzentrum ETH Zürich, 2017
ISBN: 978-3-906327-61-7

Merging parental gene expression in allopolyploids provides a generalist strategy

This research was supported by a PLANT FELLOW postdoc fellowship in the group of professor Kentaro Shimizu at the University of Zurich.

Tim Paape

Allopolyploid hybrids are formed when two or more species hybridize without genome reduction. In allopolyploids, duplicated genes, or 'homeologs', act as functional duplicates. Inheritance of gene expression levels of homeologs in the hybrids that are similar to either parental species is considered «parental legacy».

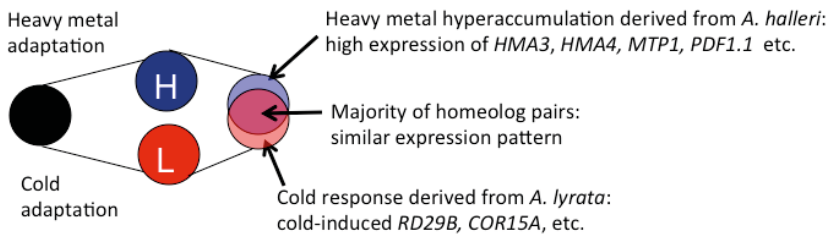
The allopolyploid species *Arabidopsis kamchatica* is a natural hybrid of diploid *A. halleri* and *A. lyrata* without chromosome reduction. The *A. lyrata* parent inhabits mostly high latitude, colder climates, while the *A. halleri* subsp. *gemmifera* parent inhabits warmer, lower latitudes in East Asia. The latitudinal distribution of *A. kamchatica* is perhaps the broadest of any *Arabidopsis* species which spans from Taiwan, low and highland Japan, Russia, Alaska USA, and the Pacific Northwest of USA. The merging of parental gene expression likely provides plasticity in the hybrid species allowing it to inhabit both parental distributions.

A unique trait in the diploid parent *A. halleri* is the ability to hyperaccumulate large amounts of heavy metals such as zinc and cadmium in the shoots, while the *A. lyrata* parent is not a hyperaccumulator. Heavy metal hyperaccumulation is genetically tractable due to previous differential expression and functional studies. To test whether *A. kamchatica* retained hyperaccumulation following hybridization between parents with divergent hyperaccumulation abilities, we grew plants hydroponically under zinc stress. We discovered that hyperaccumulation of zinc by *A. kamchatica* was reduced to about half of *A. halleri*, but was 10-100 fold greater than *A. lyrata*.

Genome assemblies of both diploid parents were used to assign next-generation sequencing reads to their parental origins to quantify homeolog specific expression and polymorphism in *A. kamchatica*. The genes HEAVY METAL ATPASE4 (HMA4) and METAL TRANSPORTER PROTEIN1 (MTP1), involved in zinc transport and detoxification respectively, were expressed greater than 10-fold higher in the halleri-derived copies compared with the lyrata-derived copies but about half of the *A. halleri* parent. Polymorphism data showed a significant reduction in genetic diversity over a large genomic region surrounding the HMA4 locus derived from the *A. halleri* parent compared with the syntenic *A. lyrata*-derived region, indicating different evolutionary trajectories for a large effect locus in a polyploid species.

By testing many globally collected accessions for hyperaccumulation and gene expression, we found that hyperaccumulation is a constitutive trait in both *A. halleri* and *A. kamchatica* regardless of their native soil type suggesting it serves a function beyond adapting to toxic soils, such as defense against herbivores. Our findings support a transcriptomic model in which environment-related transcriptional patterns of both parents are conserved but attenuated, and can provide a generalist strategy for allopolyploid species to respond to broader environmental conditions.

We are currently analysing whole genome polymorphism data in *A. kamchatica* to detect signatures of selection, population structure and linkage disequilibrium. Further studies will be conducted to better understand the ecological genetics of quantitative variation in hyperaccumulation, functional genetics of reduced hyperaccumulation, and insect resistance.



A model showing that the transcriptional patterns underlying divergent traits of both diploid parents can be combined in the allopolyploid. Candidate genes for heavy hyperaccumulation show strong *A. halleri*-derived patterns of constitutive expression and response to Zn treatments (this study), while cold treatments show *A. lyrata*-derived expression responses detected by Akama et al., 2014. © T. Paape

Reference

Conserved but attenuated parental gene expression in allopolyploids: constitutive Zinc hyperaccumulation in the allotetraploid *Arabidopsis kamchatica*.
Timothy Paape, Masaomi Hatakeyama, Rie Shimizu-Inatsugi, Teo Cereghetti Yoshihiko Onda, Tanaka Kenta, Jun Sese and Kentaro K. Shimizu
Molecular Biology and Evolution: 33 (11), 2016 pp. 2781–2800

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Professor Jordi Bascompte

We combine mathematical models, simulations, and data set analyses to address fundamental and applied questions in ecology. Our current major research interest focuses on the structure and dynamics of ecological networks. This complements main approaches to biodiversity research that neglect species interactions or assume these are homogeneously distributed. As an example, our application of network theory to the study of mutualisms among free-living species has provided a quantitative framework to address mutualistic interactions at the community level. Our work has shown that these networks of mutual dependencies between plants and animals present general architectural patterns that maximize the number of coexisting species and increase the range of perturbations that can be withstood before one or more species goes extinct.

Curriculum vitae

Jordi Bascompte is Professor of Ecology at the University of Zurich and Director of its Specialized Master on Environmental Sciences. He has been ranked by Thompson Reuters as one of the most highly cited ecologists in the decade 2002-2012. Among his distinctions are the European Young Investigator Award (2004), the Ecological Society of America's George Mercer Award (2007), the Spanish National Research Award (2011), and the British Ecological Society's Marsh Book of the Year Award (2016). Recipient of an ERC's Advanced Grant, Jordi has served in the Board of Reviewing Editors of Science and has been the Ideas and Perspectives Editor at Ecology Letters. His research has been featured in some of the top journals including Nature, Science, and PNAS. Among his books are Self-Organization in Complex Ecosystems (with R.V. Solé) and Mutualistic Networks (with P. Jordano), both published by Princeton University Press. Jordi obtained a PhD in Biology from the University of Barcelona (1994), supervised by Ricard V. Solé. This was followed by a postdoctoral position in Stephen Frank's laboratory at the University of California, Irvine (1996 and 1997). Later on, he was awarded an independent postdoctoral fellowship by the USA National Science Foundation at the National Center for Ecological Analysis and Synthesis (NCEAS) (1998 and 1999). In 2000, he became Associate Professor (Professor from 2008) at the Estación Biológica de Doñana, a center of the Spanish Research Council in Sevilla, where he worked before moving to Zurich in 2015.

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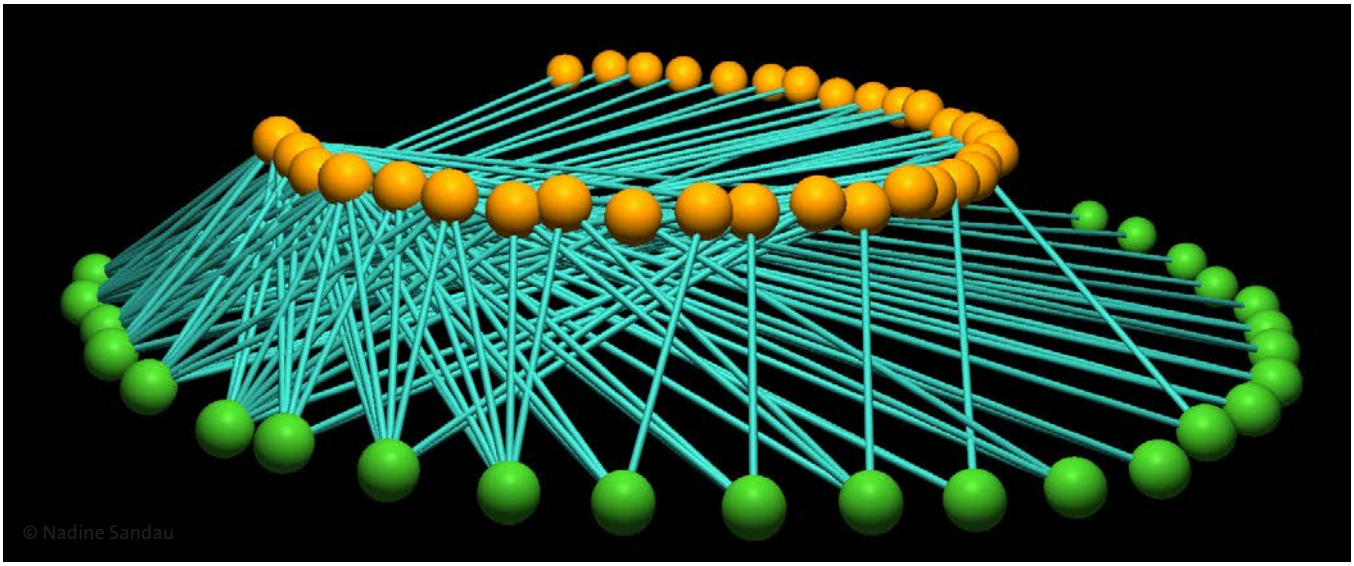
Interaction scheme © J. Bascompte



Nature (2017)
doi: 10.1038/nature22898

Beyond pairwise mechanisms of species coexistence in complex communities

Levine JM, **Bascompte J**, Adler PB, Allesina S

The tremendous diversity of species in ecological communities has motivated a century of research into the mechanisms that maintain biodiversity. However, much of this work examines the coexistence of just pairs of competitors. This approach ignores those mechanisms of coexistence that emerge only in diverse competitive networks. Despite the potential for these mechanisms to create conditions under which the loss of one competitor triggers the loss of others, we lack the knowledge needed to judge their importance for coexistence in nature. Progress requires borrowing insight from the study of multitrophic interaction networks, and coupling empirical data to models of competition.

Nature Biotechnology (2017)
doi: 10.1038/nbt.3877

Rapid cloning of genes in hexaploid wheat using cultivar-specific long-range chromosome assembly

Kaur Thind A, **Wicker T**, Šimková H, Fossati D, Moullet O, Brabant C, Vrána J, Doležel J, **Krattinger SG**

Cereal crops such as wheat and maize have large repeat-rich genomes that make cloning of individual genes challenging. Moreover, gene order and gene sequences often differ substantially between cultivars of the same crop species. A major bottleneck for gene cloning in cereals is the generation of high-quality sequence information from a cultivar of interest. In order to accelerate gene cloning from any cropping line, we report 'targeted chromosome-based cloning via long-range assembly' (TACCA). TACCA combines lossless genome-complexity reduction via chromosome flow sorting with Chicago long-range linkage5 to assemble complex genomes. We applied TACCA to produce a high-quality (N50 of 9.76 Mb) *de novo* chromosome assembly of the wheat line CH Campala *Lr22a* in only 4 months. Using this assembly we cloned the broad-spectrum *Lr22*a leaf-rust resistance gene, using molecular marker information and ethyl methanesulfonate (EMS) mutants, and found that *Lr22a* encodes an intracellular immune receptor homologous to the *Arabidopsis thaliana* RPM1 protein.

Science (2017)
doi: 10.1126/science.aaf6532

RETINOBLASTOMA RELATED1 mediates germline entry in Arabidopsis

Zhao XA, Bramsiepe J, Van Durme M, Komaki S, Prusicki MA, Maruyama D, Forner J, Medzihradszky A, Wijnker E, Harashima H, Lu Y, **Schmidt A, Guthorl D, Logrono RS,** Guan YS, Pochon G, **Grossniklaus U,** Laux T, Higashiyama T, Lohmann JU, Nowack MK, Schnittger A

Unlike animals, plants do not set aside a germline. Instead, germ cells are developed on demand from somatic lineages. Zhao *et al.* examined the regulatory pathways that manage the transition from somatic to germ cell development in the small plant *Arabidopsis*. The transcription factor WUSCHEL (WUS) was needed early on for development of ovules. Soon after, a trio of inhibitors that work through a cyclin-dependent kinase allowed a transcriptional repressor to down-regulate WUS. This opened the door to meiosis, while restricting the number of reproductive units per seed to one.

Science (2017)
doi: 10.1126/science.aal4122

Effects of network modularity on the spread of perturbation impact in experimental metapopulations

Gilarranz LJ, Rayfield B, Linan-Cembrano G, **Bascompte J**, Gonzalez A

Networks with a modular structure are expected to have a lower risk of global failure. However, this theoretical result has remained untested until now. We used an experimental microarthropod metapopulation to test the effect of modularity on the response to perturbation. We perturbed one local population and measured the spread of the impact of this perturbation, both within and between modules. Our results show the buffering capacity of modular networks. To assess the generality of our findings, we then analyzed a dynamical model of our system. We show that in the absence of perturbations, modularity is negatively correlated with metapopulation size. However, even when a small local perturbation occurs, this negative effect is offset by a buffering effect that protects the majority of the nodes from the perturbation.

Nature Communications (2017)
doi: 10.1038/ncomms14691

Real-time divergent evolution in plants driven by pollinators

Gervasi DDL, Schiestl FP

Pollinator-driven diversification is thought to be a major source of floral variation in plants. Our knowledge of this process is, however, limited to indirect assessments of evolutionary changes. Here, we employ experimental evolution with fast cycling *Brassica rapa* plants to demonstrate adaptive evolution driven by different pollinators. Our study shows pollinatordriven divergent selection as well as divergent evolution in plant traits. Plants pollinated by bumblebees evolved taller size and more fragrant flowers with increased ultraviolet reflection. Bumblebees preferred bumblebee-pollinated plants over hoverfly-pollinated plants at the end of the experiment, showing that plants had adapted to the bumblebees' preferences. Plants with hoverfly pollination became shorter, had reduced emission of some floral volatiles, but increased fitness through augmented autonomous self-pollination. Our study demonstrates that changes in pollinator communities can have rapid consequences on the evolution of plant traits and mating system.

Understanding risks and resilience in plant systems

Luisa Last & Melanie Paschke

Participants and lecturers involved in exciting conversations, critical reflection, lively group work and enthusiastic discussions until late at night: it is **Summer School** time at the PSC!

From 29 May to 2 June 2017 PhD students had the opportunity to approach systemic risk and the role of resilience by following lectures, attending hands-on workshops and by working on case studies. The research presented, and the five case studies, addressed areas such as climate change, ecosystem research, epidemiology, agriculture and economics, all of them with strong links to plant sciences.

With humankind exceeding the planetary boundaries and the safe operating space, systemic risks have become frequent, our climate system is approaching a new state, biodiversity loss is jeopardizing ecosystem services, pests are globally spreading and threatening our food security. These are complex systems characterized by interconnections between species, agents, individuals and multiple stable states, whereas regime shifts can be triggered towards non-linear behavior.

The definition of systemic risks and of risk assessment was done by **Pia-Johanna Schweizer** (Institute of Advanced Sustainability Studies, IASS). She pointed out that what we see as a risk is very much influenced by social norms. **Melanie Paschke** (PSC) elaborated on the precautionary principle and its eligibility for example in case of catastrophic problems. **Andrea Downing** (Stockholm Resilience Center) illustrated complex adaptive systems at the socio-ecological interface and their behavior, such as the lake Victoria system with its complex interlinkages between fish populations and human activities. **Mary Lou Zeeman** (Bowdoin College) superbly explained the mathematical models when a system is triggered towards the system's tipping points eventually moving in another state. She also showed the math behind concepts as hysteresis and path dependence. **Adam Clark** (U Minnesota) gave deep insight into modeling of empirical variables to predict future behavior of systems and how to distinguish chaotic from noisy systems. **Christopher Gilligan** (U Cambridge) provided insights to emerging pathogens in crop plants and provided a hands-on exercise on epidemiological models.

The students also discussed examples where system anomalies might point towards tipping points for example: **Christophe Randin** (U Lausanne) presented his work on shifting plant phaenological patterns in tree species. **Matthew Barbour** (U Zurich) focused on the role of diversity in achieving food-web resilience. **Robert Finger** (ETH Zurich) introduced the role of risk management in agricultural production from an economic point of view.

More information

www.plantsciences.uzh.ch/en/teaching/summerschool.html

Frontiers in Plant Sciences

Introduction to Microscopy and Image Processing
24–26 Oct 2017
Dr. Simona Rodighiero

Insights into transmission microscopy (phase contrast, DIC), fluorescence microscopy (including confocal imaging), basics of image processing.

Application of Chlorophyll Fluorescence
13 & 14 Nov 2017
Dr. Jörg Leipner

Insight into practical applications of non-invasive photosynthesis and analysis techniques.

RNA Sequencing – A Practical Course for Plant Scientists
31 Oct–3 Nov 2017
Dr. Lucy Poveda, Dr. Weihong Qi

Aimed at scientists interested in NGS technologies, particularly applied to RNA sequencing, available techniques and their applications.

PhD Courses HS 2017

Science & Policy: Stakeholder Management
25–28 Sep

Transdisciplinary Seminar on Research for Sustainable Development
4 Oct–13 Dec

Scientific Visualisations using R
9–10 Oct

PSC Colloquium: Challenges in Plant Sciences
17 Oct & 15 Nov

Science & Policy: Evidence-based Policy Making
30 Oct & 7 Dec

Sustainable Plant Systems
31 Oct & 4 Dec

Genetic Diversity Techniques
1 & 22 Nov

Writing a Post-Doctoral Grant
7–9 Nov

Registration
https://spsw.registration.ethz.ch

Make innovation happen

*fem*inno

New PSC career development program for female scientists

Melanie Paschke

The PSC has been awarded funding for a new career development program targeting female scientists inlcuding PhDs, postdocs and group leaders. The project is funded by the Federal Office for Gender Equality for 2017–2019.

It is part of the PSC's long-time experience with career programs as well as with bridging research innovation and application. This new innovation ecosystem will support early-stage female scientists in their decision-making for a university or an industry-related research and career. A diverse training program will enable them to develop competencies for entrepreneurship and for leadership as well as to facilitate innovation projects and find the necessary funding and collaborations for their implementation.

The goal is that by 2020, 75 % of the 40 participants will reach a leading position in research & development or that they will be engaged in their own (academic or non-academic) innovation projects.

Instruments in *fem*inno

- Career retreat and specific training courses on leadership and negotiation skills
- Workshop on innovation management exploring the potential of ones own research, developing a business road-map, and raising the necessary funding
- Company visits and exploratory workshops
- Reflections on own role in a gender-sensitive innovation environment
- Exchange with role models and mentors

PSC is collaborating with: Life Science Zurich, Offices for Gender Equality (University of Zurich and University of Basel), Career Services (University of Zurich), Companies such as KWS Saat AG, Phytax, Weleda, Ricola, PhytoSuisse, LimmaTech Biologics AG, Novartis Roche, Syngenta, LemnaTec, Mettler Toledo, Nebion, etc. and start-up such as Datascientists, Andiolize, Combagroup.

Program enrolment for female scientists from the plant sciences and the life sciences will start in October 2017 and in June 2018 (two rounds of application, 20 participants each).

Guide for applicants

www.plantsciences.uzh.ch/en/mentoring.html

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One-to-One Mentoring

PSC offers one-to-one mentoring to improve the impact of research through involvement in public dialogue and outreach activities. In 2017/2018 it includes public round tables, school class workshops and science holiday camps.

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Upcoming Course

Women in Science
18 & 19 Jan 2018, ETH Zurich
Dr. Hilde Janssens

Program

Day 1: Background information and facts about women in science, stereotypes & biases, personality, and basic communication tools.

Day 2: Self-confidence, motivation, difficult conversations, work-life balance, goal setting and time management.

Max. 20 participants, open to all, free of charge

Registration
https://spsw.registration.ethz.ch

Public engagement with science

Reflection on the PSC Future Forums held in late spring 2017.

Research inherently influences the future and most researchers want their work to contribute to a desirable future. What kind of future this might be and how to get there is mainly a normative question about values and social responsibility. Acknowledging the societal dimensions of research calls for joint participation of various societal actors in setting the research agenda. This requires an effort by the researchers that goes beyond improving public understanding of science. By now stakeholder engagement is best-known from technological risk assessments of large projects and has repeatedly shown to improve acceptance legitimacy and also fairer implementation. Similarly, research projects can better align the scientific outcomes with societal needs if a public dialogue is conducted already from early stage on.

Sascha Ismail & Melanie Paschke

In spring 2017, the PSC organized a one-day symposium on the topic: Public engagement with science – relevance and methods. Six speakers introduced researchers to the background and best-practice examples of public engagement, covering topics such as participatory risk assessments, ethics, sociology and psychology. The participants practiced technological risk assessment and discussed societal dimensions of their own research projects as well as chances and barriers for engaging with the public.

In early summer, the PSC organized two public workshops, called *Future Forums*. The first workshop on a desirable urban food supply in 2030 was open to a general audience. The second workshop targeted representatives of civil society organisations who are explicitly aiming to support sustainable agriculture.

Conducting these workshops showed that public engagement with science is not trivial and that especially practical issues have to be considered. Researchers and the public have to invest time in such a dialogue. It also has to be kept in mind that not all types of research are equally suitable for a public dialogue. In general, applied research topics that have a sense of urgency are more suitable than basic research. The efforts required to identify and reach interested people should not be underestimated and is normally not a core expertise of scientists. Although targeting representatives from citizens groups is the easiest, this might bias the outcome of engaging with the public. As a consequence it is almost impossible to claim that a research project has been developed together with «society» when some of the societal actors cannot be reached. Further, it has to be acknowledged that when people invest their spare time they want something in return. When targeting civil society organisations this seems less of a problem. We believe that this is because such a dialogue can meet their own aims of supporting a sustainable development. Another reason might be that these people are professionally involved in the topic and therefore a dialogue with scientists provides an opportunity to them to stay up to date with latest developments.

Outcomes

We found that a more resource efficient agriculture is widely accepted. Research on low-input agriculture was repeatedly mentioned to be of general interest. We also identified that plant breeding for improved local adaptation, drought resistance, nutrient value, protein content, yield, less or no pesticide, storage potential and shelf life are generally viewed as valuable contributions for future food supply challenges. With respect to digitalization and new technologies in agriculture, there was a mixture of excitement towards the potential benefits and a skepticism due to the uncertainty related to the environmental and societal implications. In addition, there were reservations rooted in the expectation that these developments will be driven primarily by economic forces and only secondarily by research or societal needs. Here, particularly, public engagement with science would allow identifying and addressing such fears, as well as fostering trust in research.

Based on the above outlined experiences, the PSC will explore in the near future which formats it could offer to support research projects that want to engage with the public. An idea that came up during the workshops, and might be worth pursuing was to establish a platform for discussing and adapting research ideas with the interested public. At such a platform, scientists could present their research ideas for a public evaluation with the help of science facilitators. Such a formalized platform would provide a low threshold opportunity to engage with the public and could provide input from the public in a highly effective way.

The Future Forums were supported with funds from 2016 SUK-Programm «Doktoratsprogramme»: PSC PhD Program in Plant Sciences.

Citizen Science
Where seeds fall

Juanita Schläpfer

If a piece of uncovered soil is left to itself, plants begin to sprout even in the busiest of city streets. The city air carries seeds that land somewhere, germinate, and become a new plant.

The PSC citizen science project «Where seeds fall» will examine the survival chances of urban plant populations and their genetic diversity. The goal is to document which plants are growing spontaneously in the city of Zurich and how they are influenced by the surrounding biodiversity. The more flowers in the vicinity, the more flowers reach your own garden. We are distributing plant trays to participants which they fill with soil and set out on their balcony or garden. Around forty people are already participating and have sent in photos of the first seeds landing and germinating.

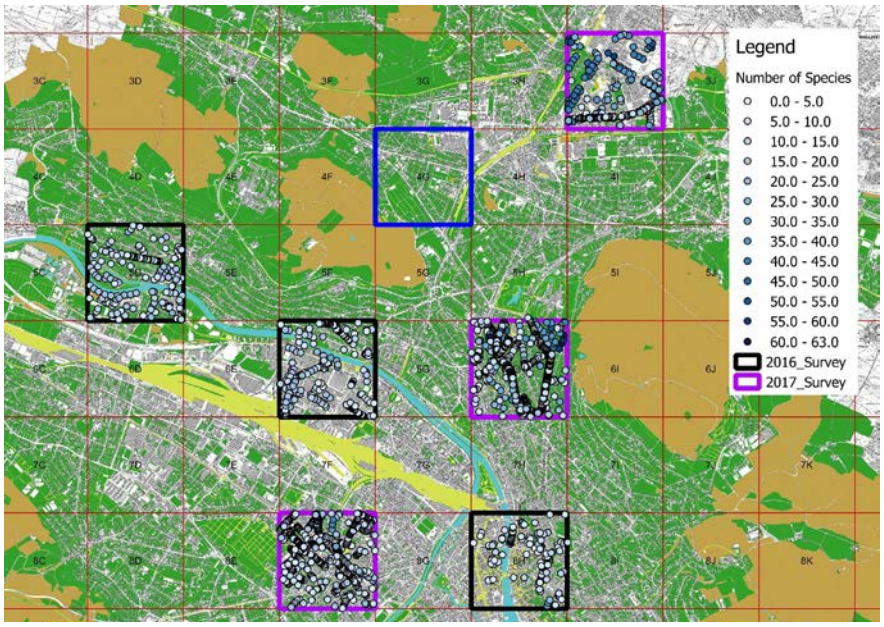
We presented the project at the UZH Graduate Campus Annual Ceremony on 13 July, Scientifica 1–3 Sep 2017 and will recruit further volunteers at the **Treffpunkt Science City event on 19th of Nov**.

If you live in the city of Zurich and wish to participate, send an email to:
psc-expeditionen@ethz.ch

Organizers
Christoph Kueffer, Professor for Urban Ecology, Landscape Architecture, HSR Rapperswil & Institute of Integrative Biology, Environmental Systems Science, ETH Zurich

Kevin Vega, PSC-Mercator fellow, ETH Zurich & HSR Rapperswil

Juanita Schläpfer, PSC



Zurich map with research quadrants showing species diversity. One question is whether there is gene flow between plant populations, and by using modelling techniques, how a network might be strengthened. © Kevin Vega

Climate Garden 2085
exhibit moves to the Swissnex Hub in San Fransisco

The Climate Garden 2085 exhibition curated by the PSC in conjunction with the Botanical Garden of the University of Zurich will be installed in the Swissnex gallery in San Francisco from Oct–Nov 2017. The local focus there will be on crop plants and garden edibles cultivated in Bay Area gardens, and on the coastal redwoods which are already losing range due to reduced coastal fog.

The Swissnex audience is comprised of a mixed San Francisco crowd, but primarily tech company employees and Bay Area educators. We will make sure to showcase PSC research!

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www.swissnexsanfrancisco.org

Upcoming

Cyberkids – PSC holiday camp
9–14 Oct 2017
With Juanita Schläpfer, PSC

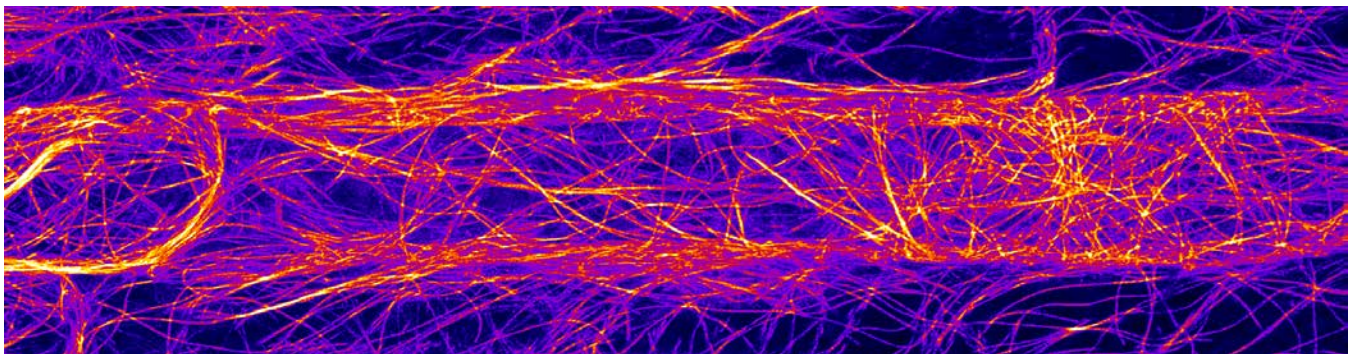
for 8–12 year olds
Ferienhaus der Stiftung Zürcher Schulferien in Maligiaso, Tessin
www.plantsciences.uzh.ch/de/outreach/ferienlager.html

Plant Science at School Teacher Workshop
Pflanzenökophysiologie – Den Pflanzen den Puls fühlen
2 Nov 2017
With Achim Walter and Carole Rapo, PSC

www.plantsciences.uzh.ch/en/outreach/atschool.html

Treffpunkt Science City Family Program
Es regnet Blumensamen in Zürich
19 Nov 2017
With Juanita Schläpfer, PSC

www.treffpunkt.ethz.ch



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PSC Symposium
Dynamics in Plant Development and Evolution

30 Nov & 1 Dec 2017

ETH Zurich, Auditorium Maximum, HG F30, Rämistr 101, Zurich

Program

Thursday, 30 November

8.45 h Welcome

Session: Selection & adaptation

9.00 h **Kirsten Bomblies**, John Innes Center, UK: *The evolution of meiosis in Arabidopsis arenosa*
9.30 h **Cris Kuhlemeier**, U Bern, CH: *The molecular basis of pollinator-mediated speciation in Petunia*
10.00 h **Juliette de Meaux**, U Cologne, DE: *Does defense coevolve with flowering time in A. thaliana?*

10.30 h Coffee break with poster session

Session: Response to signals

11.00 h **Fredy Barneche**, IBENS Paris, F: *Light signaling controls nuclear architecture reorganization during seedling development*
11.30 h **Daniel Croll**, U Neuchâtel, CH: *How pathogens rapidly surmount plant resistance in agricultural ecosystems*
12.00 h **Ueli Grossniklaus**, U Zurich, CH: *Receptor-like kinase-mediated signalling during plant reproduction*
12.30 h **Claudia Köhler**, SLU Uppsala, SE: *Epigenetic regulation of transposable elements drives plant speciation*

13.00 h Lunch break with poster session

Session: Communication

14.30 h **Marja Timmermans**, U Tübingen, DE: *Small RNAs as mobile, morphogen-like signals in development*
15.00 h **Thomas Greb**, COS Heidelberg, DE: *Cell fate decisions during radial plant growth – making a case for phloem specification*
15.30 h **Ross Sozzani**, North Carolina State U, USA: *Modeling gene regulatory networks that control the Arabidopsis root stem cells*
16.00 h **Monika Hilker**, FU Berlin, DE: *Insect egg deposition warns plants of impending herbivory*

16.30 h Poster awards by the PSC president
16.45 h Apéro and poster session

Friday, 1 December

Session: Morphogenesis

8.30 h **Olivier Hamant**, ENS Lyon, F: *Mechanical signals in plant morphogenesis*
9.00 h **Karin Schumacher**, COS Heidelberg, DE: *Vacuoles – pumping up the plant volume*
9.30 h **Elizabeth Haswell**, Washington U in St. Louis, USA: *Stretching the imagination – mechanosensitive channels in plants*
10.00 h **Elena Kramer**, Harvard U, USA: *Exploring the genetic basis of floral novelty in Aquilegia*

10.30 h Coffee break

Session: Polarity & (a)symmetries

11.00 h **Dolf Weijers**, U Wageningen, NL: *The Arabidopsis embryo as a model for understanding the genetic basis for multicellular development*
11.30 h **Ralf Reski**, U Freiburg, DE : *Cuticule, sporophyte, stomata: three plant innovations that changed our planet*
12.00 h **Dominique Bergmann**, U Stanford, USA: *Making a (cellular) difference*
12.30 h **Erik Nielsen**, U Michigan, USA: *Functional Analysis of the roles of CSLD proteins during plant cell wall deposition in Arabidopsis*

13.00 h Young scientists and speakers lunch discussion (reservation necessary). For all other participants: end of conference

Scientific Program Committee

Célia Baroux, U Zurich; **Antia Rodriguez Villalon**, ETH Zurich; **Florian Schiestl**, U Zurich; **Joop Vermeer**, U Zurich; **Alex Widmer**, ETH Zurich; **Yvonne Willi**, U Basel; **Samuel Wüest**, U Zurich, **Manuela Dahinden** and **Sylvia Martinez**, PSC

Registration and poster abstract submission
www.celldynamics2017.ethz.ch

Poster abstract submission deadline is 29 October 2017. Registration is mandatory (help us to avoid food waste).

Admission
PSC members (includes staff and students): free of charge. Other participants: CHF 50.

The symposium is supported by Swiss National Science Foundation, the Company of Biologists, Leica, SystemsX.ch, and the Swiss Industry Science Fund.

PlantHUB 1st Annual Meeting

27–29 Nov 2017, Zurich

PlantHUB trains 10 PhD students in skills and competencies necessary to apply responsible research and innovation (RRI) in the area of plant breeding and production. The first training block is devoted to the concept of innovation management. By exploring the whole value chain of innovation, students will learn how to develop ideas and build business cases. On Monday 27 Nov all consortium members meet for a retreat.

More information: www.plantsciences.uzh.ch/en/research/fellowships/PlantHUB.html

PlantHUB is a European Industrial Doctoral Programme (EID) funded by the H2020 PROGRAMME Marie Curie Actions – People, Initial Training Networks (H2020-MSCA-ITN-2016).

The Zurich-Basel Plant Science Center is a competence center linking and supporting the plant science research community of the University of Zurich, ETH Zurich and the University of Basel. The center promotes fundamental and applied research in the plant sciences. We seek creative approaches to research mentoring and coursework for students and postdocs, and we provide platforms for interactions with peers, policymakers, industry, stakeholders and the public.

PSC Member Institutions

Institute of Agricultural Sciences, ETH Zurich
Institute of Integrative Biology, ETH Zurich
Institute of Microbiology, ETH Zurich
Institute of Terrestrial Ecosystems, ETH Zurich
Department of Evolutionary Biology and Environmental Studies, University of Zurich
Department of Plant and Microbial Biology, University of Zurich
Department of Systematic Botany, University of Zurich
Department of Environmental Sciences, University of Basel

Zurich-Basel Plant Science Center, Coordination Office

www.plantsciences.ch