NEWSLETTER

2009/15

Zurich – Basel
Plant Science Center

UNI BASEL · Universität Zürich · ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

Editorial

Photo Arturo Bolanos Carpio

To mark the Zurich–Basel Plant Science Center's 10th anniversary, its members went on a retreat, with the aim of looking ahead and defining future milestones as part of the PSC's strategic plan. The group addressed many issues related to research, education and science policy. In this editorial, I would like to focus on those that are of greatest interest for the next generation of plant scientists.

We can look back on a very fruitful 6-year period of sponsoring by Syngenta Switzerland. As part of this collaboration, twelve interdisciplinary research projects were initiated. Six of the young scientists involved have already obtained their PhD degrees, while the remaining six are expected to complete their research projects in the coming years. Encouraged by these positive experiences, the PSC is seeking to prolong its successful collaboration with Syngenta and possibly to extend the program to new industrial partners.

Close collaboration is common practice among scientists at both the national and international level. In the coming years, the PSC will work to establish international cooperations with institutions in China, Japan and the UK. This will create possibilities for young scientists and PSC members to extend their scientific networks, learn new methods by visiting other labs, and forge new collaborations.

Over the last two years, the PSC Graduate Program, which was initiated in 2002, has been integrated into the Life Science Zürich Graduate School. Backed by its well-established PhD student recruiting mechanism, the PSC provides excellent starting conditions for students eager to embark on an exciting career in plant science research.

Ueli Grossniklaus, University of Zurich, PSC chairman

Awards

Prof. Thomas Boller has been elected a member of the European Molecular Biology Organization (EMBO) for his proven excellence in research. EMBO Membership is a life-long honour, with new members nominated and elected annually by existing members.

Prof. Nina Buchmann was elected member of the National Research Council in of the Swiss National Science Foundation (SNSF). She was also appointed member of the Swiss Agricultural Research Council.

Dr. Maohua Chen won the SGP Poster Award at the Scientific Fall Meeting 2008 of the Swiss Society of Phytomedicine (Silvia Dorn group).

Prof. Silvia Dorn was elected to The Council, which is the Entomology Section of the International Union of Biological Sciences (IUBS), in appreciation of her fundamental scientific contributions to entomology.

The ETH Zurich Latsis Prize 2008 was awarded to **Dr. Teresa Fitzpatrick,** Swiss National Science Foundation (SNSF) Förderprofessorin at the University of Zurich, for her excellent work on the biosynthesis of vitamin B6 in plants that led to the discovery of a novel metabolic pathway. Much of this work was performed when she was a Senior Research Fellow (Oberassistentin) in Nikolaus Amrhein's group at the ETH Zurich.

Deborah Vogt-Renz M.Sc. won the first prize for the best talk at the Biology'08 conference in Lausanne. She also received a poster award at the 2008 annual meeting of the British Ecological Society (Peter Stoll group).

Upcoming events

Dialog Grün

4. Fachtagung zur Grünen Gentechnologie, September 4, 2009, Zurich, ETH-Zentrum, Semperaula

PSC Symposium 2009

Plant Microbe Interactions
November 13, 2009, University of Basel, Main Auditorium Kollegienhaus

RESEARCH

Syngenta projects

This section presents results from a project devoted to the study of resource partitioning in plants and funded by Syngenta. The research was part of Stefanie von Felten's doctoral thesis conducted under the joint supervision of Prof. Nina Buchmann and Dr. Pascal Niklaus, Institute of Plant Sciences, ETH Zurich and Prof. Andrew Hector, Institute of Environmental Sciences, University of Zurich.

Neutral vs. niche-structured communities: testing for resource partitioning by plants

How diversity of plant species can coexist on a small scale still represents a puzzle in plant sciences, given that all plants require the same small set of resources (i.e., light, space, carbon, water, nutrients). One possible mechanism to explain coexistence, as well as the positive relationship between plant species richness and productivity that is generally found in biodiversity experiments, is the complementary use of resources by niche separation among species. However, rigorous experimental tests for resource partitioning are still scarce. Moreover, the niche paradigm has recently been challenged by so-called neutral models.

In this project, we tested for complementary nitrogen (N) use by grassland plants. We used ^{15}N labeling techniques to test whether different plant species partition N by soil depth, and whether this changes with species richness (monocultures and mixtures of 2 and 4 species). Since little is known about how microbial processes interfere with such resource partitioning, we also measured N uptake by soil microbes.

We were able to show that niche overlap (the similarity of species' N uptake from shallow vs. deep soil) decreased with species richness. However, although present, differences between species' N uptake patterns were not as large as expected, especially in mixtures. Moreover, we found low niche overlap most often in mixtures dominated by species with higher-than-average yields in monoculture, rather than mixtures with high complementarity effects (sensu Loreau & Hector 2001), which was unexpected.

Total ^{15}N uptake was higher in mixtures vs. monocultures, but there was no linear effect of species richness. Similarly, we only found a trend for increased plant N in mixtures, because higher plant biomass was counterbalanced by lower N concentration. In line with these results, partitioning of both N and ^{15}N between plants and soil microbes was also not affected by plant species richness. It seems that higher biomass production of diverse plant communities does not necessarily require higher N uptake, but can be mediated by higher biomass to N ratios. Overall, our results provide little evidence for N partitioning as a major mechanism to explain coexistence of plant species and overyielding of mixtures. More likely, plant coexistence might be mediated by a combination of mechanisms instead of a single most important one.

Stefanie von Felten, Institute of Plant Sciences, ETH Zurich and Institut of Environmental Sciences, University of Zurich

Although these results have not yet been published, other parts of Stefanie von Felten's PhD thesis were published in:

von Felten S. & Schmid B. (2008) Complementarity among species in horizontal vs. vertical rooting space. Journal of Plant Ecology 1:33–41.

von Felten S., Hector A., Buchmann N. Niklaus P.A., Schmid B. & Scherer-Lorenzen M. Belowground nitrogen partitioning in experimental grassland plant communities of varying species richness. Ecology. (in press)

Photos Roger Meier

Above: Washing roots of a two species mixture *(Taraxacum officinale* and *Ranunculus acris)*.
Below: Destructive harvest work (shoots and roots).

EDUCATION / EVENTS

PhD Program in Plant Sciences, Spring 2009

- The Successful Start of a Professional Career, March 5–6, 2009
- Scientific Writing II, February 20 & March 20, 2009
- Scientific Presentation Practice, April 17 & May 04, 2009
- Writing a Post-doctoral Grant (new), March 26–27, 2009
- Project Management for Research, April 8–9 & April 30, 2009
- Innate Immunity, April 21–24, 2009
- Chromosomal Counting Technique for the Research of Polyploid Species (new), May 8, 11 & 14, 2009
- Online Publishing, Communicating and Creating a Web Presence: How to Make your Research Visible, May 18-19, 2009
- Plant Disease Diagnostics, June 10–12, 2009
- QTL Analysis in *Arabidopsis:* Theory and Practical Applications, April 2–3, 2009
- Conservation Field Course in Scotland, July 12–20, 2009
- Angiosperm Systematics (new), every Tuesday 10–12.
- Current Topics in Grassland Sciences 1, every Tuesday 10–12.

PhD Program in Plant Sciences, Spring 2009

Responsible Conduct in Research for Plant Scientists

March 24 and May 15, 2009

When studying at university, and especially when producing a Master's thesis, students become part of the scientific community. As members of this community, they have to learn the codes of professional and responsible conduct in research. In this new PSC Master's course, Master's students will be able to learn more about the specific rules, regulations and guidelines regarding responsible conduct in their research fields. They will also increase their awareness of potential conflicts of interest and receive practical suggestions on how to react in cases of uncertainty regarding matters such as authorship and giving credits, data handling and interpretation, communication and responsibility to the public, and the role of graduate students in the research community. Students will discuss case studies with a conflict potential. They will work together in teams, discuss the codes of conduct and values established within the scientific community, and apply them to case studies.

Details & Registration by February 28, 2009:
http://www.plantscience.ethz.ch/education/Masters/Responsible_Conduct.

Events

For more events within PSC vist our homepage

http://www.plantscience.ethz.ch/
http://www.plantscience.uzh.ch/
http://www.plantscience.unibas.ch/

Access to genetic resources and the sharing of benefits resulting from their use

May 28, 2009, 14.15–15.00h, ETH Zurich

Sylvia Martínez, PSC, University of Basel

Whenever scientists intend to use organisms or parts thereof from abroad for research purposes, they need to adhere to a specific code of conduct as stipulated by the Convention on Biological Diversity (CBD). This talk includes information about the international Access and Benefit Sharing system regarding non-commercial academic research. It explains the necessary steps to take when requesting access to genetic resources for research purposes. It also sets out possibilities for benefit sharing within the academic context.

SCIENCE HIGHLIGHTS

Nature 455:213–215 (2008)

Old-growth forests as global carbon sinks

Luyssaert S, E-D Schulze, A Börner, A Knohl, D Hessenmöller, BE Law, P Ciais and J Grace

Old-growth forests remove carbon dioxide from the atmosphere at rates that vary with climate and nitrogen deposition. The sequestered carbon dioxide is stored in live woody tissues and slowly decomposing organic matter in litter and soil. Old-growth forests therefore serve as a global carbon dioxide sink, but they are not protected by international treaties, because it is generally thought that ageing forests cease to accumulate carbon. Here, we report a search of literature and databases for forest carbon-flux estimates. We find that in forests between 15 and 800 years of age, net ecosystem productivity (the net carbon balance of the forest including soils) is usually positive. Our results demonstrate that, contrary to the longstanding view that they are carbon neutral, old-growth forests can continue to accumulate carbon. On the basis of our analysis, unmanaged primary forests in the boreal and temperate regions of the Northern Hemisphere alone sequester about 1.3 ± 0.5 Gt of carbon per year. Old-growth forests accumulate carbon for centuries and contain large quantities of it. We expect, however, that much of this carbon, even soil carbon, will move back to the atmosphere if these forests are disturbed. DOI:10.1038/nature07276

Nature Cell Biology 10:1217–1223 (2008)

The ABC transporter AtABCB14 is a malate importer and modulates stomatal response to CO_2

Lee M, Y Choi, B Burla, Y-Y Kim, B Jeon, M Maeshima, J-Y Yoo, E Martinoia and Y Lee

Carbon dioxide uptake and water vapour release in plants occur through stomata. These cells respond to light intensity, CO_2 and water availability, and plant hormones. Many aspects of CO_2-dependent stomatal movements are still not understood. Here, we show that the ABC transporter AtABCB14 modulates stomatal closure on transition to elevated CO2. Stomatal closure induced by high CO_2 levels was accelerated in plants lacking AtABCB14. Apoplastic malate has been suggested to be one of the factors mediating the stomatal response to CO_2 and, indeed, exogenously applied malate induced a similar AtABCB14-dependent response as high CO_2 levels. In isolated epidermal strips, malate-dependent stomatal closure was faster in plants lacking the AtABCB14 and slower in AtABCB14-overexpressing plants than in wild-type plants, indicating that AtABCB14 catalyses the transport of malate from the apoplast into guard cells. Indeed, when AtABCB14 was heterologously expressed in *Escherichia coli* and HeLa cells, increases in malate transport activity were observed. We therefore suggest that AtABCB14 modulates stomatal movement by transporting malate from the apoplast into guard cells, thereby increasing their osmotic pressure. DOI:10.1038/ncb1782

The Plant Cell 20:1–19 (2008)

Starch Granule Biosynthesis in *Arabidopsis* Is Abolished by Removal of All Debranching Enzymes but Restored by the Subsequent Removal of an Endoamylase

Streb S, T Delatte, M Umhang, S Eicke, M Schorderet, D Reinhardt, and SC Zeeman

The major component of starch is the branched polymer of glucose, amylopectin. The combination of chain length distribution, branching frequency and branching pattern allows amylopectin to crystallize and form insoluble starch granules. Previous work suggested that debranching enzymes (DBEs) are essential for amylopectin biosynthesis. We analyzed all DBE mutant combinations of *Arabidopsis*. When any DBE activity remains, starch granules are still synthesized but quadruple mutants lacking all four DBE proteins (Isoamylase1 [ISA1], ISA2, and ISA3, and Limit-Dextrinase) are devoid of starch granules and instead accumulate highly branched glucans, the structure of which is very different to amylopectin. While these data supported the idea that DBEs are essential, we found that soluble glucans are simultaneously degraded by α- and β-amylases during periods of net accumulation. Remarkably, the additional loss of the chloroplastic α-amylase AMY3 (in the quintuple mutant) restores starch granule biosynthesis. Thus, while DBEs function in amylopectin biosynthesis, debranching is not mandatory. DOI:10.1105/tpc.108.063487

PSC MEMBERS

Professor Alexander Knohl: new PSC member

Terrestrial ecosystems are important components of the global climate system either as sinks or as sources of water and trace gases such as carbon dioxide or methane. Furthermore, they provide essential services to society by producing food and wood and by improving water quality. In the Terrestrial Ecosystem Physiology group at the Institute of Plant Sciences, ETH Zurich, we seek to understand ecophysiological processes and biogeochemical cycles of terrestrial ecosystems. We investigate how they respond to a changing environment and to land-use management.

As a key tool, we use recently developed laser spectrometry for continuous measurements of stable isotopes in carbon dioxide and water vapor. These instruments overcome previous limitations by conventional isotope-ratio mass spectrometry, as they now allow continuous high frequency measurements of stable isotopes under field conditions. Stable isotopes serve as tracers of the carbon and water cycle in forest and grassland ecosystems and allow us to resolve component fluxes and transfer rates of carbon and water among various ecosystem compartments. In particular, we seek to understand the response of terrestrial ecosystems to drought across spatial scales ranging from leaf to ecosystems and regions. We conduct controlled drought experiments in climate chambers, studying the ecophysiological drought response of individual beech and spruce trees and of plant-soil interactions. We also use chamber-based methods and the eddy covariance technique to measure fluxes of stable isotopes in carbon dioxide and water vapor at the ecosystem scale at forest and grassland field sites. Using European and global databases of ecosystem carbon and water fluxes and ecosystem modeling, we investigate ecophysiological processes and vegetation-atmosphere feedbacks across different land-use types and regions. The scope of our research links plant sciences and earth sciences by combining ecophysiology, stable isotope ecology, micrometeorology, and soil sciences.

Curriculum vitae

Alexander Knohl received his PhD in Terrestrial Ecology in 2003 at the Max Planck Institute for Biogeochemistry and the Friedrich-Schiller University in Jena/Germany. From 2004 to 2006 he was a Marie Curie Postdoctoral fellow in Biometeorology at the University of California in Berkeley, USA and from 2006 to 2007 at the Max Planck Institute for Biogeochemistry in Jena/Germany. Since May 2007, he has been a Marie Curie Team leader and since October 2008 assistant professor for Terrestrial Ecosystem Physiology at the Institute of Plant Sciences at ETH Zurich.

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Photo Alexander Knohl

Photo S. Etzold

Top: Continuous measurements of stable isotopes in CO_2 at the Lägeren site using laser spectroscopy.
Below: Forest at the Lägeren site.

FOCUS

PSC provides the UK Royal Society with evidence regarding food security

md. In October 2008, PSC representatives replied to the UK Royal Society's call for evidence on "Biological approaches to enhance food-crop production". In the light of growing concerns about the long-term sufficiency and sustainability of the world's food supplies, the Royal Society invited organizations and individuals to contribute to the study by collecting evidence.
The PSC supports the view that food-crop improvement could be achieved in a sustainable way over the coming decades by combining the advantages of all available approaches, including agricultural biotechnology, cropland management and certain organic farming practices. It advocates a multidisciplinary approach integrating expertise from ecology, evolutionary biology, developmental biology, agronomy and molecular biology to facilitate further scientific breakthroughs. The full report is available at the PSC website:
http://www.plantscience.ethz.ch/press/index_EN.

Call: «For Women in Science» promotion program

In cooperation with the Swiss Academies of Arts and Sciences and the Swiss UNESCO commission, L'Oréal Switzerland has launched a support program. It encourages women to continue their career in research and supports excellence in science. A research grant (up to CHF 160,000) will be awarded every two years. The deadline for applications is March 2nd, 2009.
Information:
http://www.loreal.akademien-schweiz.ch

Call: Prix Schläfli 2009 for evolutionary biology

Each year, the Swiss Academy of Sciences (SCNAT), invites talented young scientists to apply for a career grant in the form of the Prix Schläfli price, which is awarded for outstanding research work. In 2009, the call is for work in the field of evolutionary biology. Those who are eligible to apply are young Swiss researchers, and the work submitted should be doctoral or postdoctoral work completed after 2007. Manuscripts must be submitted by March 31st, 2009.
Information in German and French:
http://www.scnat.ch/d/Preise/Prix_Schlaefli/

Impressum

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