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PlantScienceNews

Newsletter of the Zurich-Basel Plant Science Center

No 27, Spring 2015

Upcoming Events

PSC General Assembly

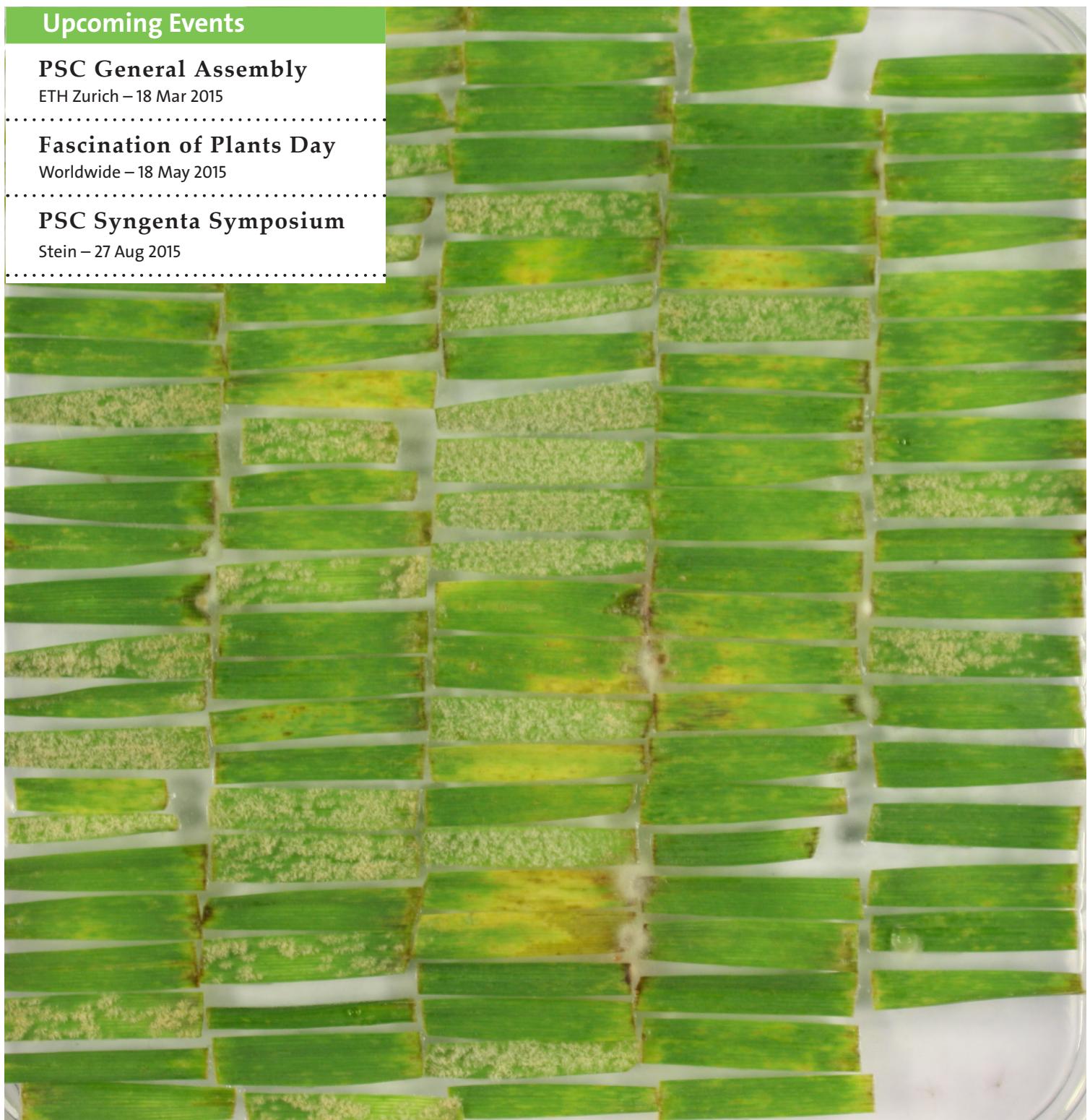
ETH Zurich – 18 Mar 2015

Fascination of Plants Day

Worldwide – 18 May 2015

PSC Syngenta Symposium

Stein – 27 Aug 2015



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Newsletter No. 27, Spring 2015

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Cover picture

Javier Sanchez Martin (University of Zurich)
Plate essay of excised wheat leaves 7 dpi with
powdery mildew of a F2 population derived from
the cross between a powdery mildew resistant
and a susceptible line fitting the 3:1 single
Mendelian ratio (3 resistant, 1 susceptible), as
expected for a single dominant gene.

Referring to unpublished data

New legal landscape for plant science research

In October last year more than twenty of Europe's most prominent plant scientists signed a joint letter warning that Europe may lose its research lead unless GM plant varieties that have been found safe are allowed, and field trials can be carried out undisturbed.



© Brüderli

Just a few months later new EU legislation was introduced, letting EU member states decide for themselves whether to allow research on GM crops in their countries. Perhaps not beneficial to industry, but researchers have the prospect of being able to use an evidence-based approach.

The public and media debate around GM crops has presented it as mainly a corporate issue but this narrative ignores its use in publicly funded research across Europe – as a more precise and reliable way to breed plants in order to address some of our most urgent farming needs and environmental threats.

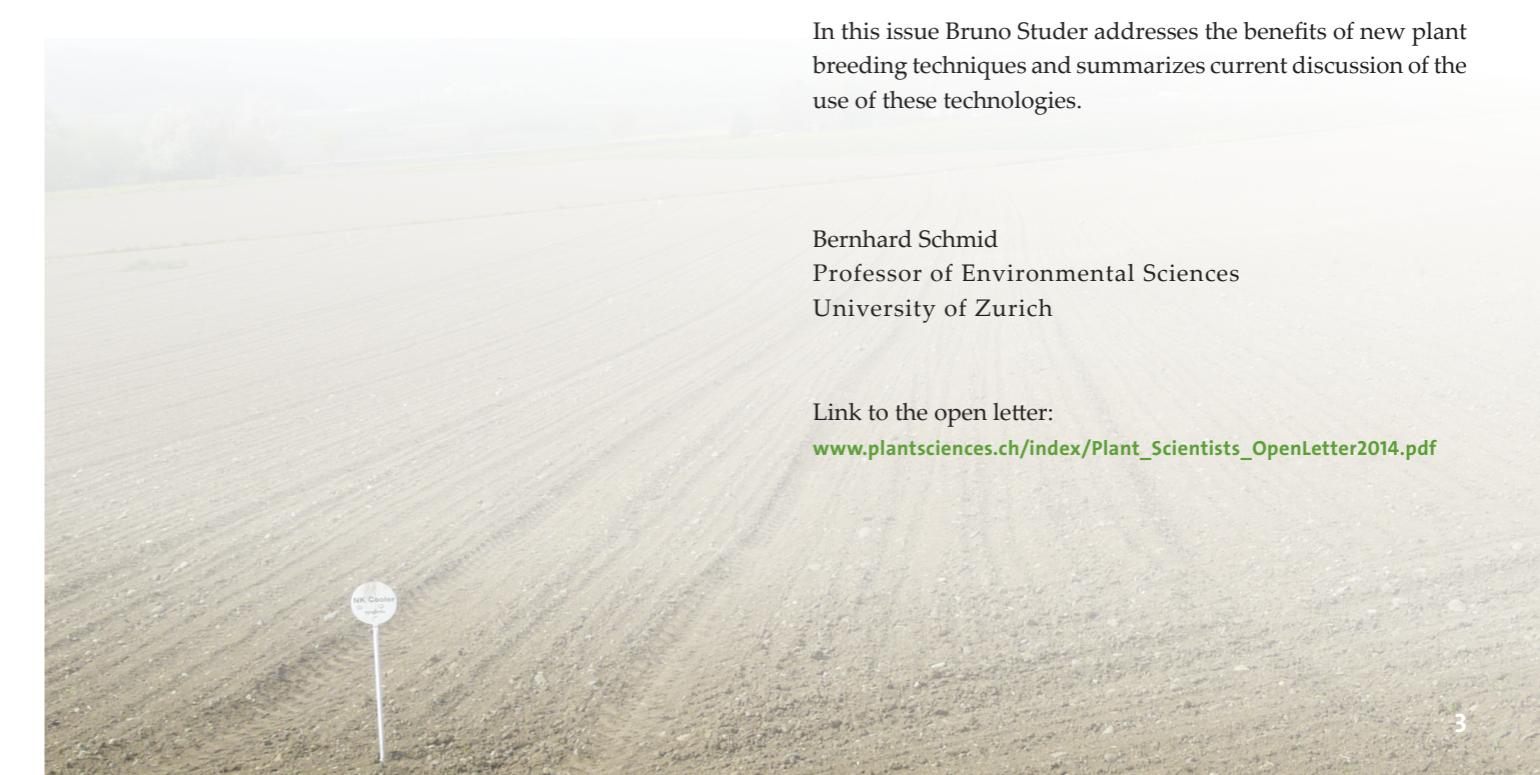
The current discussion and other upcoming debates in Europe, including which genomic techniques should be classified as GM, makes it all the more important that discussions are not based on misinformation.

In this issue Bruno Studer addresses the benefits of new plant breeding techniques and summarizes current discussion of the use of these technologies.

Bernhard Schmid
Professor of Environmental Sciences
University of Zurich

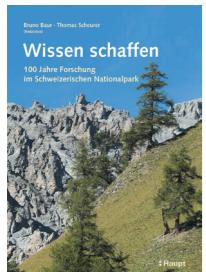
Link to the open letter:
www.plantsciences.ch/index/Plant_Scientists_OpenLetter2014.pdf

Editorial



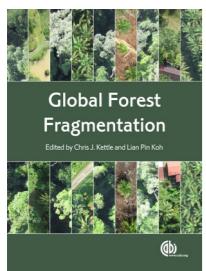
At a Glance

Books



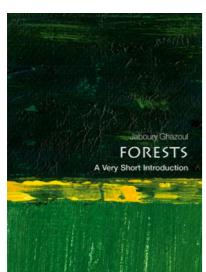
Wissen schaffen – 100 Jahre Forschung im Schweizerischen Nationalpark

B. Baur, T. Scheurer (eds)
Haupt, Bern, 2014
ISBN 978-3-258-07862-5



Global Forest Fragmentation

C. Kettle, L.P. Koh (eds)
CAB International UK, 2014
ISBN 978-1780644974



Forests: A Very Short Introduction

J. Ghazoul
Oxford University Press, U.K., 2015
ISBN 978-0-19-870617-5

PLANT fellows joining PSC groups

University of Zurich

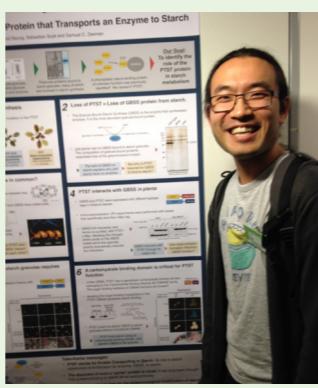
Florian Boucher to Elena Conti
Kelsey Byers and Martin von Arx
to Florian Schiestl
Eri Yamasaki to Kentaro Shimizu
Kinga Rutowicz to Célia Baroux

ETH Zurich

Engil Isadora Pujol Pereira
to Johan Six
Andrea Liliana Clavijo McCormick
to Consuelo de Moraes
Javier Palma Guerrero
to Bruce McDonald

Awards

Best poster prize went to **David Seung** (ETH Zurich, group of Samuel C. Zeeman) at the PSC Symposium on 7th of Nov 2014. The title of his presentation: A novel chloroplastic protein that transports an enzyme to starch.



© PSC

The benefits of new plant breeding techniques

Timothy Sykes & Bruno Studer

Plant breeding is an important process that allows agricultural production to adapt to changing environmental conditions, attacks from diseases and pests, and to meet the increased needs of a growing population. Constant improvements of traditional breeding methods as well as innovations in plant breeding are essential to meet these needs.

Through a set of techniques to either speed up the breeding cycle or increase the efficiency in the selection process, it has been possible to dramatically shorten the laborious and time intensive breeding process. While most of these techniques do not include direct modification of the genome, and have been successfully applied by plant breeders for decades, more recent molecular biology tools now allow any gene of interest to be precisely targeted. The novelty of this technique is that the DNA, which is introduced into a genome to specifically edit the target gene, can be removed again, so that the end product – a new crop variety – is indistinguishable from a commercially bred variety.

This raises questions, in Switzerland and beyond, as to where this new technique falls within the current legal regulatory framework. With the key consideration being: Is it the process to generate the final product or the final product itself that is to be regulated?

To answer this question, a professional evaluation based on scientific knowledge and societal requirements is essential to ensure a well-guided evaluation process and to maintain innovative plant breeding. For this, it is imperative that the research community adopts a more active and vocal stance to ensure that the public have access to all facts regarding these new breeding tech-

niques. This is particularly important for Switzerland as although the value of the maintenance of old landraces and the conservation of plant genetic resources for breeding is deeply anchored in society, the importance of modern plant breeding to obtain continuous genetic improvement of crops for food security is not well recognized. In contrast, social and economic benefits are increasingly being recognized in neighbouring countries such as Germany (Noleppa and von Witzke, 2013). Indeed, it was modern plant breeding that played the key role in the continuous advancement of crop varieties over the past decades, with achievements including yield increases, adaptation to changing climate conditions and more environmentally sustainable production systems.

So what can you do as a researcher to ensure modern plant breeding gets the recognition it deserves? Well there are many things, from writing opinion pieces for journals and newspapers to making sure that your friends and family have all the facts before making lifestyle decisions. This debate needs to be seen in the right context, especially given that current food production owes a lot to plant breeding and that these new techniques complement rather than replace traditional plant breeding methods. There are still significant gaps between what we as researchers know and what kind of information is being presented to the general public. If we want plant breeding to continue to achieve all it can

- in the increasingly important and difficult battle to provide food for the ever increasing global population - we need to ensure that innovation and implementation are not stifled before a balanced debate can take place.

Upcoming

Jahrestagung der Schweizerischen Gesellschaft für Pflanzenbauwissenschaften: Pflanzenzüchtung - Wissenschaft und Technologie für die Sorten der Zukunft

20 Mar 2015 in Zollikofen
Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften HAFL

Links

Documentation of the Séance de réflexion: Neue Verfahren in der Pflanzenzüchtung - Nutzen und Herausforderungen

Organized by the Forum for Genetic Research and the Science and Policy Platform of the Swiss Academy of Sciences in Jan 2015

www.geneticresearch.ch/d/produkte/Veranstaltungen/Tagung_2015.php

Noleppa S. & von Witzke H., 2013
Die gesellschaftliche Bedeutung der Pflanzenzüchtung in Deutschland. Einfluss auf soziale Wohlfahrt, Ernährungssicherung, Klima- und Ressourcenschutz.

HFFA Working Paper

Bericht des Bioökonomierates zur Pflanzenzüchtung:

www.biooekonomierat.de/publikationen

PSC Mentoring

Melanie Paschke

PhD students and Post docs of the PSC are welcome to join our mentoring program that supplements the PSC training programs. Many PhD students are now expected to go beyond their disciplinary thesis, for example to collaborate across disciplines and with non-academic stakeholders. Similarly, PhD candidates and Post docs are subject to new expectations that their work generates impact for society and/or policy, and that they use diverse communication channels to disseminate their results. The PSC mentoring program facilitates these transfer processes through new services.

Postdoctoral career development and training: Making effective career choices

Location: Villa of the Botanical Garden University of Zurich
Date: 7 May 2015
Lecturer: Sarah Blackford, Head of Education & Public Affairs, Lancaster University

Contact: Romy Kohlmann
romy.kohlmann@usys.ethz.ch

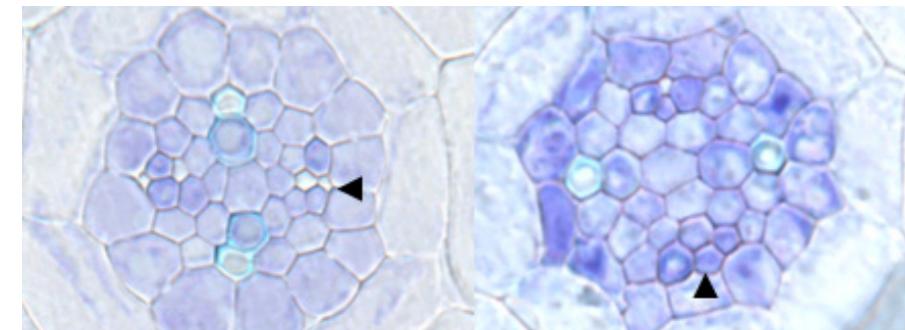
Industry mentoring: Careers for plant scientists in the seed industry

Creating opportunities to meet representatives of seed companies will be a focus of 2015. Several companies will present themselves at a Brown Bag Event organized by the PSC in Zurich. Additionally, you will be able to visit the following companies during summer 2015:

27 Aug, Syngenta AG – Join the PSC-Syngenta PhD symposium and visit the facilities at Stein near Basel

8-10 Sep, KWS Saat AG – Get to know the company during a site visit at Einbeck near Göttingen, Germany

Contact: Melanie Paschke
psc_phdprogram@ethz.ch



Root vasculature: Toluidine blue-stained histological cross sections of wild type root (left) and phosphoinositide deficient mutant (right) at the position of differentiated protoxylem. Arrowhead indicated differentiated protophloem (left) and undifferentiated cell at the position of the protophloem (right). © Antia Rodriguez-Villalon

Opportunities to join the PSC public outreach events and get one-to-one mentoring

2015 brings a bunch of opportunities to communicate your research to the public and to become an ambassador for plant sciences. The PSC will coordinate the presentation of plant sciences and offer one-to-one guidance: How to present my research results to the public and to young people? How to develop my experiment for the classroom?

18 May, International Fascination of Plants Day

This global, coordinated action aims to highlight the importance of plants and plant science for society and the planet.

4-6 Sep, Scientifica

One of the largest public events organized by the University of Zurich and ETH Zurich every second year. This year the theme is Light.

18 Sep, Lange Nacht der Wissenschaft, University of Basel

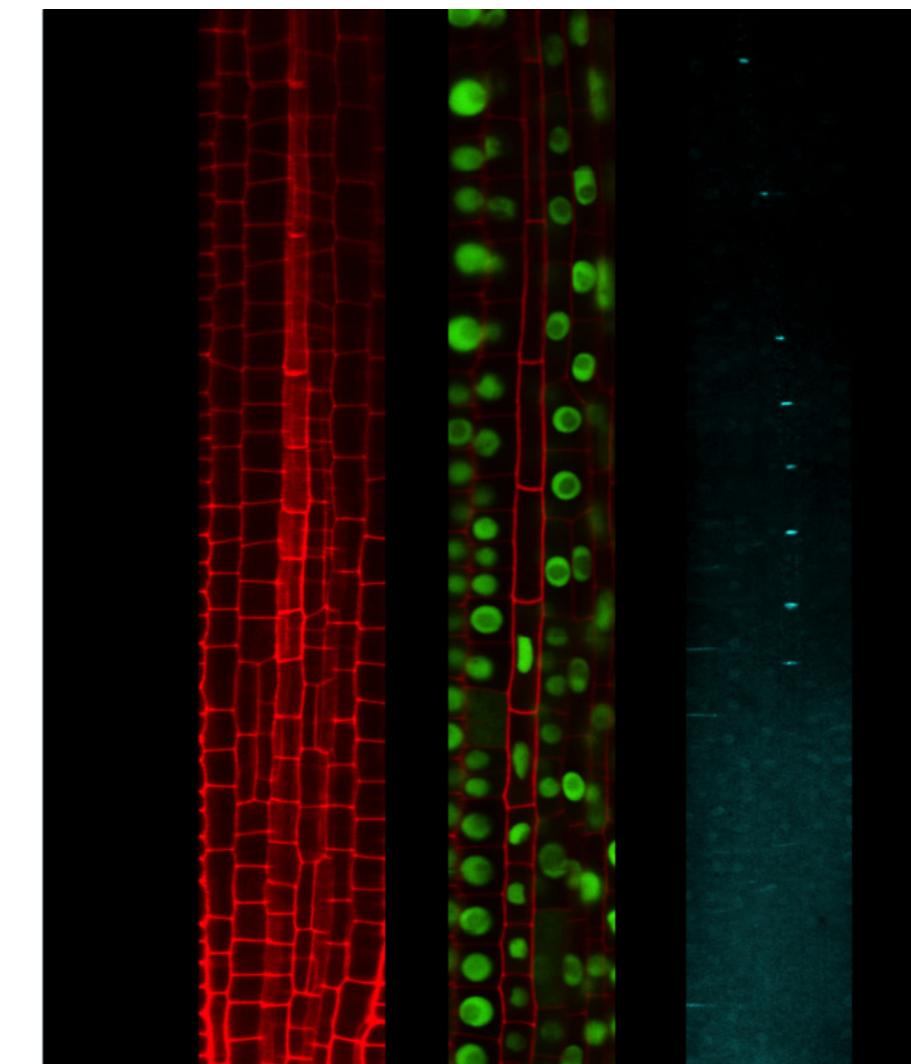
Contact: Juanita Schläpfer
juanita.schlaepfer@usys.ethz.ch

Professor Antia Rodriguez-Villalon

Antia Rodriguez-Villalon

The appearance of the vascular system was a crucial step during plant evolution as it enabled plants to conquer terrestrial ecosystems. In higher plants, xylem and phloem tissues compose the long-distance network that transports water and nutrients to sustain plant life. In order to become conductive elements, protophloem cells eliminate their nucleus and most of their organelles, enabling the transport of not only photoassimilates but also growth regulators, essentials to coordinate plant development. Despite the strong impact of protophloem differentiation on root meristematic activity, and as consequence, in the overall root

growth and architecture, very little is known about the underlying mechanisms controlling its differentiation program. In our group, we are mainly interested in the characterization of a new group of lipidic compounds, the phosphoinositides (PI), as protophloem regulators. By combining molecular genetics, cell biological and biochemical approaches, we aim to characterize the role of these lipid compounds within protophloem differentiation. In addition, our final goal is to establish a PIs-dependent signaling network that modulates the variety of molecular changes in cells morphology and physiology occurring during cell differentiation.



Root protophloem differentiation: Confocal microscopy image of 5-day-old root meristems in the protophloem differentiation region where cell wall thickening (left), nuclei degradation (middle), and callose deposition (right) can be observed. © Antia Rodriguez-Villalon



Curriculum vitae

Antia Rodriguez-Villalon received her PhD in Biochemistry in 2010 from the University of Barcelona. Her PhD was conducted at the Center of Research on Agricultural Genomics (CRAG) and dealt with the study of the mechanisms regulating secondary metabolites biosynthesis in non-photosynthetic tissues. In 2010, she was awarded with a long-term EMBO fellowship and moved to the University of Lausanne, where she analyzed the molecular mechanisms that control plant vascular differentiation and root architecture. In 2014, Antia Rodriguez-Villalon was appointed as Assistant Professor in Plant Development at ETH Zurich where she will further investigate the role of the phospholipid metabolites in vascular differentiation.

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www.swissplantscienceweb.ch/nc/research/home/portfolio/rodriguez

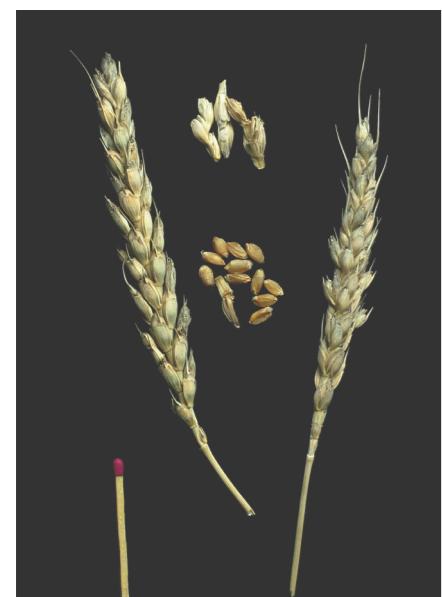
Science (2014)

doi:10.1126/science.1251788

A chromosome-based draft sequence of the hexaploid bread wheat (*Triticum aestivum*) genome

The International Wheat Genome Sequencing Consortium (IWGSC) (includes Keller B and Wicker T)

An ordered draft sequence of the 17-giga-base hexaploid bread wheat (*Triticum aestivum*) genome has been produced by sequencing isolated chromosome arms. We have annotated 124,201 gene loci distributed nearly evenly across the homeologous chromosomes and subgenomes. Comparative gene analysis of wheat subgenomes and extant diploid and tetraploid wheat relatives showed that high sequence similarity and structural conservation are retained, with limited gene loss, after polyploidization. However, across the genomes there was evidence of dynamic gene gain, loss, and duplication since the divergence of the wheat lineages. A high degree of transcriptional autonomy and no global dominance was found for the subgenomes. These insights into the genome biology of a polyploid crop provide a springboard for faster gene isolation, rapid genetic marker development, and precise breeding to meet the needs of increasing food demand worldwide.



Branched wheat (*Triticum aestivum* var. *vavilovii*) cultivated in Caucasus region
© Virtueller Sortengarten ETH Zurich

Nature (2014)

doi:10.1038/nature13809

Productivity limits and potentials of the principles of conservation agriculture

Pittelkow CM, Liang X, Linquist BA, van Groenigen KJ, Lee J, Lundy ME, van Gestel N, Six J, Venterea RT & van Kessel C

One of the primary challenges of our time is to feed a growing and more demanding world population with reduced external inputs and minimal environmental impacts, all under more variable and extreme climate conditions in the future. Conservation agriculture represents a set of three crop management principles that has received strong international support to help address this challenge, with recent conservation agriculture efforts focusing on small-holder farming systems in sub-Saharan Africa and South Asia. However, conservation agriculture is highly debated, with respect to both its effects on crop yields and its applicability in different farming contexts. Here we conduct a global meta-analysis using 5,463 paired yield observations from 610 studies to compare no-till, the original and central concept of conservation agriculture, with conventional tillage practices across 48 crops and 63 countries. Overall, our results show that no-till reduces yields, yet this response is variable and under certain conditions no-till can produce equivalent or greater yields than conventional tillage. Importantly, when no-till is combined with the other two conservation agriculture principles of residue retention and crop rotation, its negative impacts are minimized. Moreover, no-till in combination with the other two principles significantly increases rainfed crop productivity in dry climates, suggesting that it may become an important climate-change adaptation strategy for ever-drier regions of the world. However, any expansion of conservation agriculture should be done with caution in these areas, as implementation of the other two principles is often challenging in resource-poor and vulnerable small-holder farming systems, thereby increasing the likelihood of yield losses rather than gains. Although farming systems

are multifunctional, and environmental and socio-economic factors need to be considered, our analysis indicates that the potential contribution of no-till to the sustainable intensification of agriculture is more limited than often assumed.

Nature (2014)

doi:10.1038/nature13869

Selection for niche differentiation in plant communities increases biodiversity effects

Zuppinger-Dingley D, Schmid B, Petermann JS, Yadav V, De Deyn GB & Flynn DFB

In experimental plant communities, relationships between biodiversity and ecosystem functioning have been found to strengthen over time, a fact often attributed to increased resource complementarity between species in mixtures and negative plant-soil feedbacks in monocultures. Here, we show that selection for niche differentiation between species can drive this increasing biodiversity effect. Growing 12 grassland species in test monocultures and mixtures, we found character displacement between species and increased biodiversity effects when plants had been selected over 8 years in species mixtures rather than in monocultures. When grown in mixtures, relative differences in height and specific leaf area between plant species selected in mixtures (mixture types) were greater than between species selected in monocultures (monoculture types). Furthermore, net biodiversity and complementarity effects were greater in mixtures of mixture types than in mixtures of monoculture types. Our study demonstrates a novel mechanism for the increase in biodiversity effects: selection for increased niche differentiation through character displacement. Selection in diverse mixtures may therefore increase species coexistence and ecosystem functioning in natural communities and may also allow increased mixture yields in agriculture or forestry. However, loss of biodiversity and prolonged selection of crops in monoculture may compromise this potential for selection in the longer term.

Tree growth and its relation to forest ecosystem net carbon uptake

This research was part of Matthias Häni's ProDoc funded doctoral work in Plant Sciences and Policy, conducted under the supervision of Prof. Nina Buchmann at ETH Zurich.

Matthias Häni, Nina Buchmann & Roman Zweifel

This section presents key results from two of the research objectives addressed by Matthias Häni in his doctoral thesis. It was conducted under the supervision of Prof. Nina Buchmann and PD Dr. Werner Eugster, both at the Institute of Agricultural Sciences, ETH Zurich, and Dr. Roman Zweifel, Swiss Federal Institute for Forest, Snow and Landscape Research WSL. Matthias Häni is one of the first graduates of the Science and Policy PhD program. He is currently employed as a postdoctoral scientist at the WSL within the Integrated Carbon Observation System project (ICOS-CH) and the monitoring/research project TreeNet.

Relevance of forests for the global C cycle

Forests play an important role in the global C cycle, because they extend over more than one third of the Earth's land surface and they absorb large amounts of CO₂ from the atmosphere. Net CO₂ exchange and thus net ecosystem productivity (NEPC) of forests can be measured with the so-called eddy covariance technique, a relatively sophisticated yet costly method. The Grassland Sciences Group at the ETH is running several flux measurement sites since 2004 (www.gl.ethz.ch/research/projects/swiss_fluxnet) and has addressed the responses of CO₂ and water vapour exchange, but also of CH₄ and N₂O, to human and biophysical drivers.

Insights into forest ecophysiology

Besides these climatic drivers of forest productivity, Matthias also studied the timing of the day of year (DOYComp) when respiratory losses during the dormancy period were fully compensated by spring assimilation. This multisite study included data from eleven forest ecosystems in Europe. It turned out that more than 70% of the variance of year-end NEPC could be explained with DOYComp, indicating that much of the forest's C uptake is driven by the dormancy period and spring assimilation. The quality of the predictions generally increased the older and the cooler the forest was, indicating again the importance of a distinct dormancy period in European forests.

Using point-dendrometers, a simple and cheap method to record tree water relations and growth, Matthias was also able to test stem radius increments as proxies for net CO₂ exchange in six European forests. The stem increments were closely related to NEPC for these coniferous and broadleaved forests, offering great potential to use a rather simple measurement technique to parameterize a model to estimate NEPC in the future. TreeNet (<http://treenet.info>) is a monitoring and research network with currently over 25 research sites in Switzerland, yielding data of precise point-dendrometer and meteorological data. By plugging in these data into the model, NEPC of Swiss forests may be calculated and gives us indications on not only tree growth and tree water relations, but also on forest C uptake, which is a policy-relevant key applicability of this thesis.

Overall, the selected results – together with other work in this dissertation – contribute to a better understanding of ecophysiological processes in forest ecosystems, particularly in the light of anthropogenic climate change.



An automatic point-dendrometer of type Zweifel ZN11-T-IP installed at breast chest. © M. Häni

Dissertation

Häni M. 2014. Seeing the forest for the trees: Linking tree growth measurements to forest net carbon uptake.

Diss. ETH Zurich, Nr. 21968

<http://dx.doi.org/10.3929/ethz-a-010274527>

Contact

matthias.haeni@wsl.ch

Plant science at school

Carole Rapo

Dr. Konstantinos Kritsas at the Institute for Plant Biology, University of Zurich, developed a new method to isolate DNA fragments from *Brassicaceae* vegetables, which could then be interpreted in an evolutionary context. The evolutionary history of the major *Brassicaceae* crops, cauliflower and broccoli, can now clearly be understood in an experiment build up for school classes. On the 1st of December 2014, this teacher workshop "Applied research on vegetables evolution" was offered for the first time at the Life Science Zurich - Learning Center in Zurich under the supervision of Prof. Ueli Grossniklaus. The course was fully booked within two days and 16 teach-



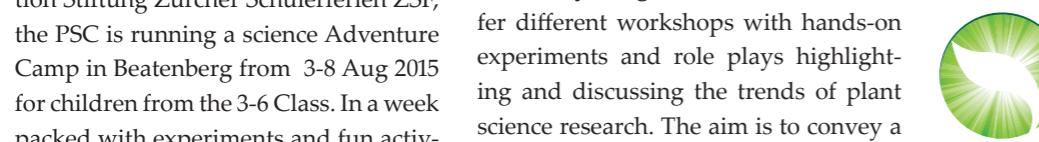
© PSC

Camp Discovery - Science Adventure for kids

Juanita Schläpfer

Together with the holiday camp foundation Stiftung Zürcher Schülerferien ZSF, the PSC is running a science Adventure Camp in Beatenberg from 3-8 Aug 2015 for children from the 3-6 Class. In a week packed with experiments and fun activities we will be looking at the survival strategies of plants in Alpine areas.

Registration

www.zsf.ch/ferienprogramm/vorschau/

Fascination of
Plants Day
May 2015

Join in!

18 May 2015 is International Fascination of Plants Day

Plants are brilliant. They produce food and they are the major source of oxygen on Earth. Plants have medicinal properties, they purify the water, they prevent erosion, and their beauty makes people feel better.

On May 18th the world will celebrate the International Fascination of Plants Day to highlight the importance of plants and plant research for society's well-being. The day offers an opportunity to engage with the public and make people more aware of the intriguing benefits of plants. This initiative has been launched by the European Plant Science Organization (EPSO).

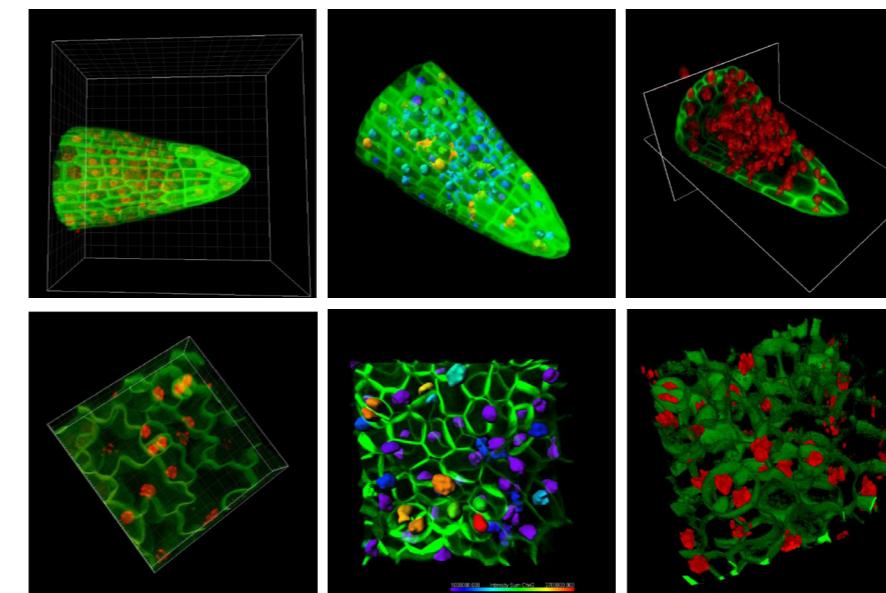
Everybody is welcome to join the initiative and to offer plant-based events for the public on or around May 18th. The Swiss Plant Science Web coordinates and promotes all events in Switzerland. To date institutions in Basel, Davos, Geneva, Wädenswil, and Zurich have announced activities for May 18th.

<http://plantday.org>

<http://swissplantscienceweb.ch/plantday-2d5>

Contact: Sylvia Martinez
Swiss Plant Science Web

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Laser scanning confocal microscopy imaging: 3D reconstruction with individual nuclei segmented for quantification of root (upper panel) and leaf (lower panel) traits. © Célia Baroux, University of Zurich

IDP BRIDGES Summer School

Tackling wicked problems

21-25 Sep 2015, Einsiedeln

Using various real-world examples, in this summer school students will learn to identify inherent properties of wicked problems and will learn skills and tools of systems thinking, problem framing and creative thinking.

PSC Colloquium

Challenges in Plant Sciences

30 Sep & 3 Nov 2015 – ETH Zurich

The colloquium is a fundamental element of the PSC's graduate programs. It links students with a broad spectrum of faculty and group leaders in the plant sciences, and introduces participants to the diversity of research fields. Group projects and presentations enrich the experience.

Frontiers in Plant Sciences New Graduate Courses

Introduction to Light Microscopy and Image Processing

27–29 Apr 2015

Dr. Gábor Csúcs, Scientific Center for Optical and Electron Microscopy – ScopeM, ETH Zurich

QTL Analysis in *Arabidopsis* – Theory and Practical Applications

15-17 Jun 2015

Prof. Ueli Grossniklaus, University of Zurich & Prof. Tom Jünger, University of Texas

Introduction to MorphoGraphX

22-24 Jun 2015

Prof. Richard Smith, Max Planck Institute for Plant Breeding Research, Köln

PhD Courses, Spring 2015

Genetic Diversity: Analysis

13–17 Jan

Chlorophyll Fluorescence - Principles and Applications

2–4 Feb

Genetic Diversity: Techniques

23 Feb & 16 Mar

Life Sciences: Next Generation Sequencing - a practical course DNA

24–27 Feb

Scientific Writing Practice II

27 Feb & 27 Mar

Visualizing your research

2 & 31 Mar

Responsible Conduct in Research for Plant Scientists

5 Mar & 8 May

Concepts in Evolutionary Biology

9–10 Mar

Career Workshop: Women in Science

15–16 Apr

Life Sciences: Next Generation Sequencing – a practical course DNA

21–24 Apr

Scientific Presentation Practice

24 Apr & 22 May

Introduction to Light Microscopy and Image Processing

27–29 Apr

Science & Policy: Communicating Science

4 & 18 May

Science & Policy: Introduction to Political Sciences

12–13 May

Introductory Course to R

1–3 Jun

Dealing with the Publication Process

12 & 15 Jun

Conservation Field Course Scotland

27 Jun–06 July

Alpine Ecology – Summer School on Alpine Plant Life

20–25 Jul

Registration

www.registration.ethz.ch/spsw/

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
Institute of Evolutionary Biology and Environmental Studies, University of Zurich
Institute of Plant Biology, University of Zurich
Institute of Systematic Botany, University of Zurich
Department of Geography, University of Zurich
Department of Environmental Sciences, University of Basel

Zurich-Basel Plant Science Center, Coordination Office

www.plantsciences.ch

