

17th International Symposium on Iron Nutrition and Interactions in Plants

Program Book



Gatersleben / Quedlinburg, Germany

July 6 – 10, 2014



Acknowledgements:

The organizers are grateful for the support of our sponsors:



WELCOME

On behalf of the organizing committee it is my pleasure to welcome you to the 17th International Symposium on Iron Nutrition and Interactions in Plants (ISINIP) to be held on the campus of the Leibniz-Institute of Plant Genetics & Crop Plant Research in Gatersleben (IPK Gatersleben) and in the historical city of Quedlinburg, Germany.

Since the first symposium held in 1981 in Provo, Utah, USA, the ISINIP has become a premier international convention for a wide range of researchers interested in various topics related to iron nutrition in plants. These span from the ecophysiological aspects of iron acquisition and the interactions of iron with other elements or with microorganisms, over the molecular regulation of iron homeostasis, through to the agronomic measures that are to be taken in order to alleviate the symptoms of iron deficiency in crops. Over the past 16 meetings the ISINIP has always been committed to be an excellent forum for scientific discussions and the exchange of ideas among researchers, from leading scientists in the field to young postgraduate students. It is our real privilege to host the 17th symposium in Gatersleben/Quedlinburg, in what is the second time to bring this important event to Germany.

The 17th ISINIP will consist of 9 sessions, for which we have received 113 abstracts from 15 countries. This number reflects a broad interest in this rather specialized research area, and the excellent quality of the contributions emphasizes the leading position that iron research takes in the field of plant nutrition. I believe that this symposium will be another great opportunity for promoting new ideas and become an important starting point for new research collaborations in the future.

The members of the local organizing committee wish this to be a valuable meeting and hope you enjoy the scientific program as well as the social events. In this regard, I express my sincere gratitude to all members of the local organizing committee for their enthusiastic effort and the sponsors for their invaluable support.

With best regards

Prof. Dr. Nicolaus von Wirén
Chair, Local Organizing Committee

Local Organizing Committee

Nicolaus von Wirén, IPK Gatersleben
Petra Bauer, University of Düsseldorf
Tom Buckhout, Humboldt University Berlin
Elmarie Fischer, IPK Gatersleben
Sabine Odparlik, IPK Gatersleben
Nicole Schmid, IPK Gatersleben
Anja Hartmann, IPK Gatersleben
Ricardo Giehl, IPK Gatersleben
Alexandra Leskova, IPK Gatersleben
Seckin Eroglu, IPK Gatersleben

GENERAL INFORMATION

Date and venue

Welcome and conference

06 July 2014: Palais Salfeldt, Kornmarkt 5, 06484 Quedlinburg

Conference

07-10 July 2014: IPK Lecture Hall, Corrensstr. 3, 06466 Gatersleben

(Time table for bus transfer is given in the program)

Banquet

09 July 2014: at 20:00 Hotel Schlossmühle, Kaiser-Otto Str. 28, 06484 Quedlinburg

Registration desk

The registration desk will be at your service every day. It is in charge of the registration, hotel bookings, social arrangements and excursions.

Conference Badge

Your personal badge is your entrance ticket to the sessions. Please remember to **always** wear your badge during all conference activities and social events. Only with your badge you will receive your lunch and have access to your lunch-box.

Registration fee includes:

Full participation in the conference

Conference bags

Coffee breaks

All lunches / lunch box

Banquet

Excursion

An accompanying person's fee includes:

Welcome reception

Excursion

Banquet

Language

The official language is English. Simultaneous translations will not be available.

Instructions for oral presentations

Please check the program for the position and length of your presentation. Make sure that your talk is uploaded as early as possible or at least before your session starts. Speakers are requested to hand over their PowerPoint files by USB sticks.

We wish to discourage you from using your own laptop computers as branching and unbranching requires often too much time. If you have special formats requiring to connect your laptop directly, please test this beforehand. Be prepared to provide your file also on a transformable format.

Instructions for the poster presentations

Posters will be displayed continuously from Monday till Thursday. Please place your poster at the assigned position in front of the lecture hall or in the hall upstairs. Poster presenters are requested to stand in front of their posters during their poster session (Monday – odd numbered posters; Wednesday – even-numbered posters).

Internet connection

Internet will be available free of charge for the registered participants either using the desktop computers located on the upper level of the lecture hall or by WLAN using your own device. If you are a member of an institution, which is a member of the 'eduroam' community, you should use the wireless network 'eduroam' in the same way you would connect to at your home institution. Otherwise WLAN access information will be provided at the registration desk.

Meals

Lunch, coffee/tea during breaks will be available to registered participants. Please remember to wear your badge as proof that you are a registered participant.

Social events

Harz excursion: Please wear robust walking shoes and be prepared to walk for 3-4 h. Please remember to bring your own sun protection (hat, sun cream etc.).

Halberstadt / Werningerode excursion: Comfortable shoes are advisable. Please take your dinner in Werningerode (at your own expense) because most restaurants in Quedlinburg will be closed by the time of your arrival.

Liability

The organizers regret that they cannot accept liability for any personal accidents, loss of belongings or damage to private property of participants and accompanying persons that may occur during the symposium.

Smoking

Smoking is not permitted inside the conference building or at the venues for the social events. Smokers are kindly requested to smoke outdoors.

Parking

Parking is available at the open air parking area of the symposium venue at the IPK free of charge.

17th International Symposium on Iron Nutrition and Interactions in Plants

IPK Gatersleben/Quedlinburg, Germany

Schedule of the symposium program

Sunday, 6 July 2014 (Location: Palais Salfeldt)

- 15:30 – 20:00 Registration open
- 17:30 – 17:45 Welcome address
Nicolaus von Wirén
Andreas Graner, Director of IPK Gatersleben
- 17:45 – 18:30 Keynote Address: Robert C. Hider, King's College London, "Chemical properties of endogenous plant iron chelators: phytosiderophores, nicotianamine, citrate, glutamate and substituted catechols"
- 18:30 – 19:15 Keynote Address: Sabeeha Merchant, University of California Los Angeles, "Molecular genetic dissection of chloroplast iron homeostasis"
- 19:15 – 21.30 Welcome reception

Monday, 7 July 2014 (Location: IPK Gatersleben)

- 08:30 Bus transfer from Quedlinburg to IPK Gatersleben
- 09:00 – 09:30 Poster mounting, Registration open
- 09:30 – 10:50 Session 1 "Iron dynamics in soils"**
Chair: Roberto Pinton
- 09:30 – 10:00 Thomas Riedel, University of Oldenburg, Germany, "Coupled iron and organic matter cycling in water-logged soils"
- 10:00 – 10:20 Walter Schenkeveld, University of Vienna, "A window of Fe uptake in strategy II acquisition: a conceptual model for the rhizosphere geochemistry of phytosiderophores"
- 10:20 – 13:00 Session 2 "Iron acquisition and transport"**
Chair: Roberto Pinton
- 10:20 – 10:50 Javier Abadia, Spanish Council for Scientific Research Zaragoza, "Advances in iron nutrition based on mass spectrometry approaches"
- 10:50 – 11:20 Coffee Break
- 11:20 – 11:40 Nicole Schmid, Leibniz Institute of Plant Genetics and Crop Plant Research, Gatersleben, "Feruloyl-CoA 6'-Hydroxylase1-dependent coumarins mediate iron acquisition from alkaline substrates in Arabidopsis"

- 11:40 – 12:00 Jorge Rodriguez-Celma, Academia Sinica, Taiwan, “IRON BINDING COMPOUND1, a new 2-oxoglutarate Fe(II)-dependent oxygenase, is critically involved in the production of iron binding coumarins in Arabidopsis”
- 12:00 – 12:20 Günther Weber, Leibniz-Institute for Analytical Sciences Dortmund, “Redox-mediated iron release from ferric phytosiderophores: why is ascorbate more effective than other reductants?”
- 12:20 – 12:40 Rumen Ivanov, Heinrich Heine University Düsseldorf, “Regulation of Arabidopsis iron acquisition by the intracellular protein trafficking machinery”
- 12:40 – 13:00 Shuang Li, Capital Normal University China, “Monoubiquitin-dependent endocytosis and autophagy pathways regulate iron-induced MxIRT1 degradation for iron homeostasis”
- 13:00 – 14:30 Lunch
- 14:30 – 17:40** **Session 3 “Cellular iron homeostasis”**
Chair: Sabeeha Merchant
- 14:30 – 15:00 Jean-Francois Briat, French National Centre for Scientific Research Montpellier, “Twenty years of ferritin research: What’s up now?”
- 15:00 – 15:30 Janneke Balk, John Innes Centre UK, “The biosynthesis of Fe(S) cofactors and cellular compartmentalization”
- 15:30 – 15:50 Akihiro Saito, Tokyo University of Agriculture, “Fe deficiency induces phosphorylation and translocation of the light-harvesting antenna Lhcb1 in thylakoid membranes of barley”
- 15:50 – 16:10 Katrin Phillippar, Ludwig Maximilian University of Munich, “The PIC1-NiCo-YGGTc metal translocon in chloroplast envelopes”
- 16:10 – 16:40 Coffee Break
- 16:40 – 17:00 Tomoko Nozoye, The University of Tokyo, “Rice nicotianamine synthase localizes to particular vesicles for proper function”
- 17:00 – 17:20 Tom Buckhout, Humboldt University Berlin, “Vacuolar-Iron-Transporter1-like Proteins mediate iron transport in Arabidopsis”
- 17:20 – 17:40 Erin Connolly, University of South Carolina, “Ferric-reductases and transporters that control mitochondrial Fe homeostasis in Arabidopsis”
- 17:40 – 18:30** **Session 4 “Iron chelates and remedy of iron-deficiency-induced chlorosis”**
Chair: Adamo Domenico Rombolà
- 17:40 – 18:10 José-Maria García-Mina, TimacAGRO International Spain, “Development of new iron-based products for crop iron deficiency remediation”
- 18:10 – 18:30 Juan J. Lucena, Autonomous University of Madrid, Spain, SPAD versus chlorophyll-a fluorescence induction measurements to study the efficacy of ⁵⁷Fe chelates and complexes applied to soybean plants in soil culture

18:30 – 20:30 **Poster Session** with beer and wine (odd numbered Posters)

20:30 Bus transfer from IPK Gatersleben to Quedlinburg

Tuesday, 8 July 2014 (Location: IPK Gatersleben)

08:30 Bus transfer from Quedlinburg to IPK Gatersleben

09.00 – 10:40 **Session 5 “Regulation of iron deficiency responses”**
Chair: Tom Buckhout

09.00 – 09:30 Mary Lou Guerinot, Dartmouth College New Hampshire, “ Integrating iron uptake and distribution in plants”

09.30 – 10:00 Wolfgang Schmidt, Academia Sinica Taiwan, “Post-transcriptional regulation of iron deficiency responses”

10:00 – 10:20 Hong-Qing Ling, Chinese Academy of Sciences, “Progress in the understanding the molecular regulation mechanism of iron uptake in Strategy I plants”

10:20 – 10:40 Kyoko Higuchi, Tokyo University of Agriculture, “Regulation of metabolic adaptations to Fe deficiency in barley”

10:40 – 11:10 Coffee Break

11:10 – 11:40 Petra Bauer, University of Düsseldorf, “Network of functions involved in iron deficiency response regulation”

11:40 – 12:00 Takanori Kobayashi, Ishikawa Prefectural University, “Regulation of iron deficiency response and possible iron sensing by iron-binding RING ubiquitin ligases OsHRZ1 and OsHRZ2”

12:00 – 12:20 ? Francisco Romera, University of Córdoba, “ Interaction of shoot derived signals with ethylene in the regulation of Fe acquisition genes by Strategy I plants”

12:30 Pick-up of lunchboxes and Departure by bus at the main gate

Excursion A: Walk in the Harz mountains

Excursion B: Visit to the dome in Halberstadt and to Wernigerode

Wednesday, 9 July 2014 (Location: IPK Gatersleben)

08:30 Bus transfer from Quedlinburg to IPK Gatersleben

09:00 – 10:30 **Session 6 “Strategies to improve iron nutrition in plants”**
Chair: Francisco Romera

- 09:00 – 09:30 Michelle Graham, United States Department of Agriculture, “Combining virus induced gene silencing and RNA-seq to understand soybean responses to iron deficiency chlorosis”
- 09:30 – 09:50 Inez Slamet-Loedin, International Rice Research Institute, “Field grown novel transgenic Indica rice with polished grain iron level potentially provides sufficient dietary iron in rice-based diets”
- 09:50 – 10:10 Jelena Pavlovic, University of Belgrade, “Interactions between iron and silicon in cucumber”
- 10:10 – 10:30 Lili Wei, French National Centre for Scientific Research Montpellier, “Role of nicotianamine in the distribution of irCuireon in the chloroplast and the nucleus”
- 10:30 – 11:00 Coffee Break
- 11:00 – 13:00 **Session 7 “Iron interactions with other elements”**
Chair: Erin Connolly
- 11:00 – 11:30 Kuo-Chen Yeh, Academia Sinica Taiwan, “Fe homeostasis and heavy metal tolerance: sensing and control of uptake”
- 11:30 - 12:00 Maria Bernal, Ruhr University Bochum, “How does copper or zinc nutritional status affect iron homeostasis?”
- 12:00 – 12:20 Steffen Abel, Leibniz-Institute of Plant Biochemistry, Halle, “Iron – phosphate interactions control cell-specific callose deposition to adjust root meristem activity to external Pi status”
- 12:20 – 12:40 Cathy Curie, French National Centre for Scientific Research Montpellier, “Manganese homeostasis and its interplay with iron in Arabidopsis”
- 12:40 – 13:00 Mark G. M. Aarts, Wageningen University, “Transcriptional analysis of Zn and Fe homeostasis in the Zn/Cd accumulating bioindicator species *Gomphrena claussenii*”
- 13:00 – 14:50 Lunch
(Meeting of the Steering Committee)
- 14:50 – 16:10 **Poster Session** (even numbered Posters)
- 16:10 – 16:40 Coffee Break
- 16:40 – 18:20** **Session 8 “Translocation and seed loading of iron”**
Chair: Mary-Lou Guerinot
- 16:40 – 17:10 Stéphane Mari, French National Centre for Scientific Research Montpellier, “The dynamics of iron pools between organelles and within organs”
- 17:10 – 17:40 Sébastien Thomine, French National Centre for Scientific Research, France, “Molecular mechanisms of metal storage in *Arabidopsis thaliana* seeds”

- 17:40 – 18:00 Alex Johnson, The University of Melbourne, "Localization of iron in wheat grain using synchrotron X-ray fluorescence microscopy and strategies for endosperm enrichment"
- 18:00 – 18:20 Louis Grillet, Academia Sinica Taiwan, "IRON MAN, a novel protein family activates iron uptake in shoots and roots of monocots and dicots"
- 18:30 Bus transfer from IPK Gatersleben to Quedlinburg
- 20:00 Banquet at Hotel Schlossmühle in Quedlinburg**

Thursday, 10 July 2014 (Location: IPK Gatersleben)

- 08:30 Bus transfer from Quedlinburg to IPK Gatersleben
- 09:00 – 09:30 Naoko Nishizawa, The University of Tokyo, "Sensing iron and regulation of iron homeostasis in plants"
- 09:30 – 10:40 Session 9 "Iron in plant-microbe interactions"**
Chair: Jean-Francois Briat
- 09.30 – 10:00 Holger Deising, Martin Luther University of Halle-Wittenberg, "Infection structure-specific regulation of Fe uptake is required for evading plant defense responses and full virulence of the maize anthracnose fungus *Colletotrichum graminicola*"
- 10.00 – 10.20 Haruhiko Inoue, Max Planck Institute for Plant Breeding Research Cologne, "Plant growth promoting functions under iron-deficiency mediated by the *Arabidopsis thaliana* bacterial root microbiota"
- 10:20 – 10:40 Coffee Break
- 10:40 – 11:10 Alia Dellagi, Institut Jean Pierre Bourgin, AgroParisTech- INRA France, "Role of iron in plant immunity"
- 11:10 – 11.30 Irene Murgia and Gianpiero Vigani (summarizing the Frontiers special issue)
- 11:30 – 11.40 Closing
- 11:40 Poster dismantling and Lunch
- 11:45 Bus transfer from IPK Gatersleben to Leipzig airport (with lunchbox)
- 13:00 Bus transfer from IPK Gatersleben to Quedlinburg

S6T3

Interactions between iron and silicon in cucumber

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Silicon (Si) and iron (Fe) are respectively the second and the fourth most abundant minerals in the earth's crust. While the essentiality of Fe has been discovered in the middle of the 19th century, Si is still not fully accepted as an essential element for higher plants; however, Si is proved to alleviate multiple environmental stresses in plants. So far, Fe deficiency have mainly been studied and characterized in nutrient solution experiments devoid of Si, hence information on the interactions between these two minerals in plants is still limited. Here we investigated how Si ameliorates Fe deficiency in cucumber (model of Strategy 1 and Si-accumulating species), focusing on the mechanisms involved in Fe acquisition from the rhizosphere and utilization of root apoplastic Fe, as well as on Fe distribution towards young leaves in Fe-deficient cucumber plants.

Application of Si increased the root apoplastic Fe pool, together with the enhanced expression of genes involved in reduction-based Fe uptake (FRO2, IRT1 and HA1). Moreover, in Fe deficient cucumber roots; Si influenced the genes involved in the carboxylate, shikimate and phenylpropanoid metabolism, thus resulted in enhanced accumulation of Fe chelating compounds (organic acids and phenolics) for improved Fe mobilization from the rhizosphere and reutilization of root apoplastic Fe (Pavlovic et al., 2013). Application of Si also facilitated mobility and xylem traslocation of Fe towards shoot, along with the accumulation of Fe-mobilizing compounds such as citrate in xylem sap, root and shoot tissues or catechins in roots (Pavlovic et al., 2013; Bityutskii et al., 2014). Very recently, we demonstrated that Si enhanced remobilization of labelled ⁵⁷Fe from old leaves and its retranslocation to the younger leaves is accompanied by Si-induced expression of genes encoding both NA biosynthesis (SAM and NAS) and YSL transporters responsible for symplastic Fe unloading in leaves and phloem transport of Fe-NA complex.

In conclusion, the alleviating effect of Si seems to be more indirect, by affecting activation of Fe deficiency-related genes responsible for enhanced root acquisition and tissue mobilization of Fe. This work not only provides new evidence for the beneficial role of Si in iron nutrition, but, in perspective, can be of practical importance in the development of new sustainable measures for controlling Fe chlorosis in calcareous soils, which in general are low in available Si.

Acknowledgements: This work is dedicated to the memory of Professor Volker Römheld.

References:

Pavlovic J, Samardzic J, Masimovic V, Timotijevic G, Stevic N, Laursen KH, Hansen TH, Husted S, Schjoerring JK, Liang Y, Nikolic M (2013) Silicon alleviates iron deficiency in cucumber by promoting mobilization of iron in the root apoplast. *New Phytol* 198:1096-1107.

Bityutskii N, Pavlovic J, Yakkonen K, Maksimovic V, Nikolic M (2014) Contrasting effect of silicon on iron, zinc and manganese status and accumulation of metal-mobilizing compounds in micronutrient-deficient cucumber. *Plant Physiol Biochem* 74: 205-211.

S7P7

Effect of Si on the expression of miRNA398 and miRNA408 and its target gene, superoxide dismutase (CuSOD) in Fe deficient cucumber plants

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Silicon (Si) is a beneficial element in several crops enhancing growth and alleviating different biotic and abiotic stresses. Iron (Fe) deficiency stress in plants includes changes in the expression and the activity of certain antioxidative enzymes. Our previous study suggested the role of Si in alleviation of Fe deficiency stress by an increased root Fe acquisition (Pavlovic et al., 2013). MicroRNAs (miRNAs) are a class of endogenous small RNAs (21 to 24 nucleotides) playing a crucial role in the development of both plant and animals by downregulating gene expression at the post-transcriptional level. Here we studied the expression of miRNA398 and miRNA408 and its target gene superoxide dismutase (SOD) in Fe deficient cucumber (*Cucumis sativus* L.) plants grown with or without addition of Si. The expression of miRNAs and target gene was measured in roots, stems and leaves as well as in the leaves of different ages. Intercostal chlorosis in the young leaves was markedly decreased in the Si treatment. Plants treated with Si also showed increased expression of miRNA398 and miRNA408 in all organs, and consequently lower level of CuSOD transcripts. The expression of particular miRNAs followed this pattern; the highest level in the old fully developed leaves and the lowest level in young chlorotic leaves. Our results indicate that Si reduces (or at least respond on) the oxidative stress in Fe deficient cucumber plants on the posttranscriptional level mediated by miRNAs398 and 408.

Pavlovic J, Samardzic J, Masimovic V, Timotijevic G, Stevic N, Laursen KH, Hansen TH, Husted S, Schjoerring JK, Liang Y, Nikolic M (2013) *New Phytol* 198:1096-1107.