

PROF. DR. MICHAEL FREI - CURRICULUM VITAE

Surname: Frei
Given name: Michael
Title: Prof. Dr. sc. agr.



Professional Experience

Since Jan. 2018: Professor (substitute) for Crop Science, Institute for Crop Science and Resource Conservation (INRES), University of Bonn, Germany

Oct. 2011 – Dec. 2017: Junior professor (non-tenured) for Abiotic Stress Tolerance in Crops, Institute for Crop Science and Resource Conservation (INRES), University of Bonn, Germany

Oct. 2009 - Sept. 2011: Postdoc at INRES, University of Bonn (Germany)
Topic: Abiotic stress tolerance in crops

June 2007 - Aug. 2009: Postdoc at the Japan International Research Center for Agricultural Sciences (JIRCAS), Crop Production and Environment Division, Tsukuba (Japan)
Topics: Adaptation of rice to zinc deficiency and tropospheric ozone

Oct. 2002 - May 2007: Research assistant and PhD student at the University of Hohenheim (Germany)
Topic: Carbon and nitrogen cycling in integrated rice-fish systems

Academic Education

Oct. 2002 - Jan. 2007: PhD studies at the University of Hohenheim, highest possible grade *Summa cum laude*

Oct. 1996 - Apr. 2002: Diploma (master equivalent) in Agricultural Sciences (specialization in Tropical Agriculture), University of Hohenheim

Additional International Research and Work Experience

May 2005 - May 2006: Field experiments at the Bangladesh Agricultural University, Mymensingh (Bangladesh)
Topic: Carbon and nitrogen cycling in integrated rice fish systems

Dec. 2001 - March 2002: Research at CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) in Montpellier (France)
Topic: Genetic variability of starch quality in rice

Aug. 2000 – Dec. 2000: Field experiments in the province of Aklan (Philippines)
Topic: Genetic variability in grain quality of rice landraces

Research Interests

- Crop stress physiology
- Harnessing genetic diversity to adapt crops to abiotic environmental stresses
- Oxidative stress and redox homeostasis in crops
- Crop quality for human and animal nutrition
- Integrated cropping systems

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Academic Awards and Scholarships

- Emmy Noether award from the Deutsche Forschungsgemeinschaft (DFG) (2011-2016)
- Postdoctoral scholarship from the Alexander von Humboldt Foundation (2009/10)
- Josef G. Knoll European Science Award 2008 from *fiat panis* Foundation
- Postdoctoral scholarship from the Japan Society for the Promotion of Science (JSPS) (2007-2009)
- PhD scholarship from the German Merit Foundation (Studienstiftung des deutschen Volkes) (2002-2004)

Teaching and Mentoring Experience

- Coordinator of the MSc modules *Crop Abiotic Stresses, Genes Seeds and Biodiversity* and *Recent Advances in Plant Nutrition*
- Current teaching load of nine hours per week ('Semesterwochenstunden')
- First supervisor of three postdoctoral researchers, six PhD and >twenty master students

Memberships and Reviewing

- Deutsche Gesellschaft der JSPS Stipendiaten e.V. (JSPS Alumni Association)
- Alumni der Studienstiftung e.V.
- German Society for Plant Nutrition e.V. (DGP)
- Associate editor for Journal of plant Nutrition and Soil Science
- Member of the editorial boards of Agriculture, Ecosystems, and Environment and Frontiers in Plant Nutrition
- *Ad hoc* reviewer for numerous journals, including PNAS, Global Change Biology, New Phytologist, Plant Journal, Journal of Experimental Botany, Plant Cell and Environment, Plant Molecular Biology, Environmental Pollution, Field Crops Research, Science of the Total Environment, Annals of Botany, PlosOne, Plant Physiology and Biochemistry, Journal of Agronomy and Crop Sciences, Plant and Soil, Nutrient Cycling in Agroecosystems, European Journal of Agronomy, Journal of Plant Nutrition and Soil Science, etc.
- Reviewer for German Research Foundation (DFG)
- Reviewer for the PhD program of German Merit Foundation (Studienstiftung des deutschen Volkes)
- Reviewer for Alexander von Humboldt Foundation
- Reviewer for the PhD program of the German Academic Exchange Service (DAAD)
- Jury-member for the Hans H. Ruthenberg award of Foundation *fiat panis* for excellent master theses contributing to global food security (2013-2018)
- Member of the advisory board of Foundation *fiat panis*

Additional Qualifications

- Languages: German (native), English (fluent), French (very good), Japanese and Bangla (basic)
- Hobby: Playing Saxophone

PROF. DR. MICHAEL FREI – LIST OF PUBLICATIONS

Articles in Peer-reviewed Journals

For current citation metrics visit:

<http://scholar.google.de/citations?user=HmrL6nkAAAAJ&hl=de&oi=ao> (Google Scholar), or

<http://www.researcherid.com/rid/K-5511-2013> (Researcher ID)

Ali B, Pantha S, Acharya R, Ueda Y, Wu LB, Ashrafuzzaman LB, Ishizaki T, Wissuwa M, Bulley S, **Frei M** (2019) Abiotic stress tolerance of a transgenic high yielding rice (*Oryza sativa* L.) variety expressing an ascorbate biosynthesis gene from *Actinidia chinensis* Planch. *Journal of Plant Physiology*, in press.

Wu LB, Holtkamp F, Wairich A, **Frei M** (2019) Potassium ion channel *OsAKT1* affects iron translocation in rice plants exposed to iron toxicity. *Frontiers in Plant Science*, doi: 10.3389/fpls.2019.00579.

Rakothoson T, Ergezinger L, Rajonandraina T, Wu LB, **Frei M** (2019) Physiological investigations of management and genotype options for adapting rice to iron toxicity in Madagascar. *Journal of Plant Nutrition and Soil Science* 182, 485-495.

Ashrafuzzaman MD, Haque Z, Ali B, Mathew B, Peng Y, Hochholdinger F, de Abreu Neto J, McGillen M, Ensikat HJ, Manning W, **Frei M** (2018) Ethylendiurea (EDU) mitigates the negative effects of ozone on rice: insights into its mode of action. *Plant Cell and Environment* 41, 2882-2898.

Mills G, Sharps K, Simpson D, Pleijel H, **Frei M**, Burkey K, Emberson L, Uddling J, Broberg M, Feng Z, Kobayashi K, Agrawal M (2018) Closing the global ozone yield gap: quantification and co-benefits for multi-stress tolerance. *Global Change Biology* 24, 4869-4893.

Zhao X, Zhou N, Lai S, **Frei M**, Wang Y, Yang L (2018) Elevated CO₂ improves lodging resistance of rice by changing physicochemical properties of the basal internodes. *Science of the Total Environment* 647, 223-231.

Jardim-Messeder D, Caverzan A, Rauber R, Cunha JR, Carvalho FEL, Gaeta ML, da Fonseca GC, Costa JM, **Frei M**, Silveira JAG, Margis R, Saibo NJM, Margis Pinheiro M (2018) Thylakoidal APX modulates hydrogen peroxide content and stomatal closure in rice (*Oryza sativa* L.). *Environmental and Experimental Botany* 150, 46-56.

Shrestha A, Dziwornu AK, Ueda Y, Wu LB, Mathew B, **Frei M** (2018) Genome-wide association study to identify candidate loci and genes for Mn toxicity tolerance in rice. *PlosOne* 13(2) e0192116.

Dziwornu AK, Shrestha A, Matthus E, Ali B, Wu LB, **Frei M** (2018) Responses of contrasting rice genotypes to excess manganese and their implications for lignin synthesis. *Plant Physiology and Biochemistry* 123, 252-259.

Ashrafuzzaman MD, Lubna FA, Holtkamp F, Manning WJ, Kraska T, **Frei M** (2017) Diagnosing ozone stress and differential tolerance in rice (*Oryza sativa* L.) with ethylendiurea (EDU). *Environmental Pollution* 230, 339-350.

Naz AA, Reinert S, Bostanci C, Seperi S, Leon J, Böttger C, Südekum KH, **Frei M** (2017) Mining the global diversity in bioenergy traits of barley straw: genome-wide association study under varying plant water status. *GCB Bioenergy* doi:10.1111/gcbb.12433.

De Abreu Neto JB, Hurtado-Perez MC, Wimmer M, **Frei M** (2017) Genetic factors underlying boron toxicity tolerance in rice: genome-wide association study and transcriptomic analysis. *Journal of Experimental Botany* 68, 687-700.

Wu LB, Ueda Y, Lai SK, **Frei M** (2017) Shoot tolerance mechanisms to iron toxicity in rice (*Oryza sativa* L.). *Plant Cell & Environment* 40, 570-584.

Ueda Y, Frindte K, Knief C, **Frei M** (2016) Effects of elevated tropospheric ozone concentrations on the bacterial community in the phyllosphere and rhizosphere of rice. *PlosOne* 11, e0163178.

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Frei M, Tetteh RN, Razafindrazaka AL, Fuh MA, Wu LB, Becker M (2016) Responses of rice to chronic and acute iron toxicity: genotypic differences and biofortification aspects. *Plant and Soil* 408, 149-161.

Gebauer J, Adam YO, ..., **Frei M**, ..., Wrage-Mönning N, Kehlenbeck K (2016) Africa's wooden elephant: the baobab tree (*Adansonia digitata* L.) in Sudan and Kenya: a review. *Genetic Resources and Crop Evolution* 63, 377-399.

Jing L, Dombinov V, Shen S, Wu Y, Yang L, **Frei M** (2016) Physiological and genotype-specific factors associated with grain quality changes in rice exposed to high ozone. *Environmental Pollution* 210, 397-408.

De Abreu Neto J, **Frei M** (2016) Microarray meta-analysis focused on the response of genes involved in redox homeostasis to diverse abiotic stresses in rice. *Frontiers in Plant Science* 6:1260.

Ueda Y, Siddique S, **Frei M** (2015) A novel gene *OZONE RESPONSIVE APOPLASTIC PROTEIN1* enhances cell death in ozone stress in rice (*Oryza sativa* L.). *Plant Physiology* 169, 873-889.

Matthus E, Wu LB, Ueda Y, Höller S, Becker M, **Frei M** (2015) Loci, genes and mechanisms associated with tolerance to ferrous iron toxicity in rice (*Oryza sativa* L.). *Theoretical and Applied Genetics* 128, 2085-2098.

Höller S, Ueda Y, Wu LB, Wang Y, Hajirezaei MR, Ghaffari MR, von Wirén N, **Frei M** (2015) Ascorbate biosynthesis and its involvement in abiotic stress tolerance and plant development in rice (*Oryza sativa* L.). *Plant Molecular Biology* 88(6), 545-560.

Frei M (2015) Breeding of ozone resistant rice: relevance, approaches, and challenges. *Environmental Pollution* 197, 144-155.

Ueda Y, Frimpong F, Qi Y, Matthus E, Wu LB, Höller S, Kraska T, **Frei M** (2015) Genetic dissection of ozone tolerance in rice (*Oryza sativa* L.) by a genome-wide association study. *Journal of Experimental Botany* 66, 293-306.

Höller S, Meyer A, **Frei M** (2014) Zinc deficiency differentially affects redox homeostasis of rice genotypes contrasting in ascorbate level. *Journal of Plant Physiology* 171, 1748-1756.

Wu LB, Shhadi MY, Gregorio G, Matthus E, Becker M, **Frei M** (2014) Genetic and physiological analysis of tolerance to acute iron toxicity in rice. *Rice*, 7(1):8.

Wang Y, Yang L, Höller M, Zaisheng S, Pariasca-Tanaka J, Wissuwa M, **Frei M** (2014) Pyramiding of ozone tolerance QTL *Oz78* and *Oz79* confers enhanced tolerance to season-long ozone exposure in rice. *Environmental and Experimental Botany* 104, 26-33.

Wang Y, Song Q, **Frei M**, Shao Z, Yang L (2014) Effects of elevated ozone, carbon dioxide, and the combination of both on the grain quality of Chinese hybrid rice. *Environmental Pollution* 189, 9-17.

Höller S, Hajirezaei M, von Wirén N, **Frei M** (2014) Ascorbate metabolism in rice genotypes differing in zinc efficiency. *Planta* 239, 367-379.

Frei M (2013) Lignin – characterization of a multi-faceted crop component. *The Scientific World Journal* doi.org/10.1155/2013/436517.

Ueda Y, Wu L, **Frei M** (2013) A critical comparison of two high-throughput ascorbate analyses methods for plant samples. *Plant Physiology and Biochemistry* 70, 418-423.

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Rose MT, Rose TJ, Pariasca-Tanaka J, Yoshihashi T, Neuweger H, Goesmann A, **Frei M**, Wissuwa M (2012) Root metabolic response of rice (*Oryza sativa* L.), genotypes with contrasting tolerance to zinc deficiency and bicarbonate excess. *Planta* 236, 959-973.

Frei M, Wissuwa M, Pariasca-Tanaka J, Chen CP, Südekum KH, Kohno Y (2012) Leaf ascorbic acid level – is it really important for ozone tolerance in rice? *Plant Physiology and Biochemistry*, 59, 63-70.

Frei M, Kohno Y, Tietze S, Jekle M, Hussein MA, Becker T, Becker K (2012) The response of rice grain quality to ozone exposure during growth depends on ozone level and genotype. *Environmental Pollution* 163, 199-206.

Wang Y, **Frei M**, Song Q, Yang L (2011) The impact of atmospheric CO₂ concentration enrichment on rice quality – a research review. *Acta Ecologica Sinica* 31, 277-282.

Chen CP, **Frei M**, Tanaka JP, Kohno Y, Wissuwa M (2011) Rising tropospheric ozone levels pose a new threat to yield stability in rice: tolerance mechanisms and underlying genetic factors. *Genes, Genomes and Genomics* 6, 8-15.

Wang Y, **Frei M** (2011) Stressed food – the impact of environmental stresses on crop quality. *Agriculture, Ecosystems and Environment* 141, 271-286.

Chen CP, **Frei M**, Wissuwa M (2011) The OzT8 locus in rice protects leaf carbon assimilation rate and photosynthetic capacity under ozone stress. *Plant, Cell and Environment* 34, 1141-1149.

Frei M, Kohno Y, Wissuwa M, Makkar HPS, Becker K. (2011) Negative effects of tropospheric ozone on the feed value of rice straw are mitigated by an ozone tolerance QTL. *Global Change Biology* 17, 2319-2329.

Frei M, Tanaka JP, Chen CP, Wissuwa M (2010) Mechanisms of ozone tolerance in rice: characterization of two QTLs affecting leaf damage by gene expression profiling and biochemical analyses. *Journal of Experimental Botany* 61, 1405-1417.

Widodo, Broadley MR, Rose T, **Frei M**, Pariasca-Tanaka J, Yoshihashi T, Thomson M, Hammond JP, Aprile A, Close TJ, Ismail AM, Wissuwa M (2010) Response to zinc deficiency of two rice lines with contrasting tolerance is determined by root growth maintenance and organic acid exudation rates, and not by Zn-transporter activity. *New Phytologist* 186, 400-414.

Arnold T, Kirk GJD, Wissuwa M, **Frei M**, Zhao FJ, Weiss DJ (2010) Evidence for the mechanisms of zinc acquisition by rice using isotope discrimination. *Plant, Cell and Environment* 33, 370-381.

Frei M, Wang Y, Ismail AM, Wissuwa M (2010) Biochemical factors conferring shoot tolerance to oxidative stress in rice grown in zinc deficient soil. *Functional Plant Biology* 37, 74-84.

Frei M, Makkar HPS, Becker K, Wissuwa M (2010) Ozone exposure during growth affects the feeding value of rice shoots. *Animal Feed Science and Technology* 155, 74-79.

Wang Y, **Frei M**, Wissuwa M (2008) An agar nutrient solution technique as a screening tool for tolerance to zinc deficiency and iron toxicity in rice. *Soil Science and Plant Nutrition* 54, 744-750.

Frei M, Tanaka JP, Wissuwa M (2008) Genotypic variation in tolerance to elevated ozone in rice: dissection of distinct genetic factors linked to tolerance mechanisms. *Journal of Experimental Botany* 59, 3741-3752.

Oehme M, **Frei M**, Razzak MA, Dewan S, Becker K (2007) Studies on nitrogen cycling under different nitrogen inputs in rice fish systems in Bangladesh. *Nutrient Cycling in Agroecosystems*, 79, 181–191.

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Frei M, Khan MAM, Razzak MA, Hossain MM, Dewan S, Becker K (2007) Effects of a mixed culture of common carp, *Cyprinus carpio* L., and Nile tilapia, *Oreochromis niloticus* (L.), on terrestrial arthropod population, benthic fauna, and weed biomass in rice fields in Bangladesh. *Biological Control* 41, 207-213.

Frei M, Razzak MA, Hossain MM, Oehme M, Dewan S, Becker K (2007) Performance of common carp, *Cyprinus carpio* L., and Nile tilapia, *Oreochromis niloticus* (L.) in integrated rice-fish culture in Bangladesh. *Aquaculture* 262, 250-259.

Frei M, Razzak MA, Hossain MM, Oehme M, Dewan S, Becker K (2007) Methane emissions and related physicochemical soil and water properties in rice-fish systems in Bangladesh. *Agriculture, Ecosystems and Environment* 120, 391-398.

Frei M, Becker K (2005) Integrated rice-fish production and greenhouse gas emission under greenhouse conditions. *Agriculture, Ecosystems and Environment* 107, 51-56.

Frei M, Becker K (2005) Integrated rice-fish culture: coupled production saves resources. *Natural Resources Forum* 29, 135-143.

Frei M, Becker K (2005) A greenhouse experiment on growth and yield effects in integrated rice-fish culture. *Aquaculture* 244, 119-128.

Frei M, Becker K (2005) Fatty acids and all-trans- β -carotene are correlated in differently colored rice landraces. *Journal of the Science of Food and Agriculture* 85, 2380–2384.

Frei M, Becker K (2004) Agro-biodiversity in subsistence-oriented farming systems in a Philippine upland region: nutritional considerations. *Biodiversity and Conservation* 13, 1591-1610.

Frei M, Siddhuraju P, Becker K (2003) Studies on the in vitro starch digestibility and the glycemic index of six different indigenous rice cultivars from the Philippines. *Food Chemistry* 83, 395-402.

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Invited Lectures

Frei M (2019) The challenges of mineral nutrition in plants facing environmental stresses: molecular aspects (tentative). The XVII Latin American Congress of Genetics – Genome Architecture: its Expression in Phenotypes and Populations. 6th to 9th October 2019, Mendoza, Argentina.

Frei M (2018) Africa: iron toxicity in crops. Invited flash talk. Humboldt Evening. 11th October 2018, Hochschule Rhein-Waal, Kleve, Germany.

Frei M (2018) Adapting cereal crops to abiotic stresses. Invited lecture. Graduate Program in Genetics and Molecular Biology of the Federal University of Rio Grande do Sul – UFRGS, 5th September 2018, Porto Alegre, Brazil.

Frei M (2018) Exploiting genetic resources for adapting cereal crops to abiotic stresses. Invited lecture. XXII International Congress of Genetics, 10th to 14th September 2018, Foz do Iguaçu, Brazil.

Frei M (2017) Involvement of ascorbate in stress tolerance of cereal crops. Invited lecture. Minisymposium 'Role of ROS in Plant Stress Signaling', 7th to 8th December 2017, Bonn, Germany.

Frei M (2017) Interactions of iron as a redox active transition metal with plant antioxidants. Invited key note lecture. VISCEA conference - Plant Nutrition, Growth and Environment Interactions III, 20th to 21st February 2017, Vienna, Austria.

Frei M (2016) Using genetic resources to adapt cereal crops to changing environments. Invited speaker. Humboldt Kolleg 'Utilizing and Conserving Natural Resources Under Climate Change in Africa', 5th to 7th December 2016, Cotonou, Benin.

Frei M (2016) How crop biotechnology can help us to face the challenges of global change. Conference 'Thoughts for Food: Technological and Social Innovations for Sustainable Food Production', 9th to 10th October 2016, Cairo, Egypt.

Frei M (2016) Understanding redox biology for adapting rice to abiotic stresses. Invited plenary speaker. Plant Biology Europe EPSO/FESPB 2016 congress, June 26th to 30th 2016, Prague, Czech Republic.

Conference Contributions

Holtkamp F, Wu LB, **Frei M (2018)** Confirmation and functional characterization of potassium ion channel gene for iron toxicity tolerance in rice. Poster presentation. Tropentag, 17th to 19th September 2018, Ghent, Belgium.

Wu LB, Holtkamp F, **Frei M (2018)** Iron toxicity tolerance in rice (*Oryza sativa* L.) – loci, mechanisms and genes. Poster presentation. XXII International Congress of Genetics, 10th to 14th September 2018, Foz do Iguaçu, Brazil.

Frei M, Ueda Y, Ashrafuzzaman MD, Begum H, Naz AA (2018) Breeding of ozone tolerant cereal crops: progress and prospects. Oral presentation. 2nd Ozone and Plants Conference, 21st to 25th May 2018, Florence, Italy.

Ashrafuzzaman MD, **Frei M (2018)** Insights into the mode of action of ethylene diurea as an antiozonant in rice (*Oryza sativa* L.). Oral presentation. 2nd Ozone and Plants Conference, 21st to 25th May 2018, Florence, Italy.

Ashrafuzzaman MD, Haque Z, Mathew B, Manning WJ, Yu P, Hochholdinger F, Ensikat HJ, **Frei M (2017)** Test of ethylene diurea (EDU) as a biomonitoring and screening tool to assess ozone damage in rice (*Oryza sativa* L.). Poster presentation. 3rd Asian Air Pollution Workshop, 20th to 22nd October 2017, Tokyo, Japan.

Ergezinger L, Rajonandraina T, Wu LB, Rakotoson T, **Frei M (2017)** Management and Genotype Effects on Resistance to Iron Toxicity in Lowland Rice in Madagascar. Oral presentation. Tropentag, 20th to 22nd September 2017. Bonn, Germany.

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Wu LB, **Frei M** (2016) Physiological tolerance mechanisms to iron toxicity in rice. Oral presentation. Annual Meeting of the German Society for Plant Nutrition. From Model Plants to Crops and Crop Systems, 28th to 30th September 2016, Hohenheim, Germany.

Ali B, **Frei M** (2016) Does free intracellular zinc mediate programmed cell death in different genotypes of rice? Poster presentation. Annual Meeting of the German Society for Plant Nutrition. From Model Plants to Crops and Crop Systems, 28th to 30th September 2016, Hohenheim, Germany.

Shrestha A, Dziwornu AK, **Frei M** (2016) Genome-wide association study to understand the genetics of manganese toxicity tolerance in rice. Poster presentation. Tropentag, 18th to 21st September 2016, Vienna, Austria.

Wu LB, Matthus E, Ueda Y, Höller S, **Frei M** (2015) Several lines of evidence that ascorbate acts as a pro-oxidant in rice plants exposed to iron toxicity. Oral presentation. 12th International Conference on Reactive Oxygen and Nitrogen Species in Plants: From Model Systems to Field, 23rd to 26th June 2015, Verona, Italy.

Ueda Y, Siddique S, **Frei M** (2015) Characterization of *OSORAP1*, a novel positive regulator of cell death under ozone stress in rice (*Oryza sativa* L.). Poster presentation. 12th International Conference on Reactive Oxygen and Nitrogen Species in Plants: From Model Systems to Field, 23rd to 26th June 2015, Verona, Italy.

Frei M, Ueda Y, Höller S, Wu LB, Wang Y (2014) Using functional genomics to study adaptation of rice to oxidative stress. Oral presentation. 12th International Symposium on Rice Functional Genomics, 16th to 19th November, Tucson, USA.

Matthus E, Wu LB, Razafindrazake A, Fuh M, Asante M, Ueda Y, Höller S, Saijise AGC, Gregorio G, Becker M, **Frei M** (2014) Genetic basis of iron toxicity tolerance in rice (*Oryza sativa* L.). Oral presentation. Tropentag, 17th to 19th September 2014, Prague, Czech Republic.

Höller S, Hajirezaei M, von Wirén N, **Frei M** (2014) Differences in ascorbate levels affect abiotic stress tolerance, development, and photosynthesis in rice. Poster presentation. Plant Nutrition 2014 International Conference, 10th to 12th September 2014, Halle, Germany.

Matthus E, Wu LB, Ueda Y, Höller S, Becker M, **Frei M** (2014) Iron toxicity in rice (*Oryza sativa* L.) – a genome-wide association study (GWAS) to dissect genetic tolerance mechanisms. Poster presentation. XVII International Symposium on Iron Nutrition and Interaction in Plants, 6th to 10th July 2014, Gatersleben, Germany.

Wu LB, Lai S, **Frei M** (2014) Dual stress – revealing tolerance mechanisms to iron toxicity and zinc deficiency in rice by transcriptomic and physiological analyses. Poster presentation. Plant Nutrition 2014 International Conference, 10th to 12th September 2014, Halle, Germany.

Frei M, Ueda Y, Wang Y, Yang L, Kohno Y, Chen CP, Tanaka JP, Wissuwa M (2014) Breeding of ozone resistant rice using a QTL based approach. Oral presentation. International Conference on Ozone and Plants, 18th to 21st May 2014, Beijing, China.

Ueda Y, Frimpong F, Qi Y, Matthus E, Wu L, Höller S, Kraska T, **Frei M** (2014) A genome wide association study (GWAS) reveals genetic factors underlying ozone tolerance in rice (*Oryza sativa* L.). Oral presentation. International Conference on Ozone and Plants, 18th to 21st May 2014, Beijing, China.

Frei M (2014) Adaptation to environments causing oxidative stress. Oral presentation, 3rd GRISP Phenotyping Workshop, 24th to 28th March 2014, Montpellier, France.

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Matthus E, Wu LB, Gregorio G, Becker M, **Frei M** (2013) A genome-wide association study (GWAS) to identify genes associated with tolerance of iron toxicity in rice (*Oryza sativa* L.). Poster presentation. 7th International Rice Genetics Symposium, 5th to 8th November 2014, Manila, Philippines.

Wu LB, Shhadi Y, Matthus E, Gregorio G, Becker M, **Frei M** (2013) Genetic and Physiological Aspects of Resistance to Iron Toxicity in Rice. Oral presentation. XVII International Plant Nutrition Colloquium, 17th to 22nd August 2013, Istanbul, Turkey.

Höller S, **Frei M** (2013) Ascorbate biosynthesis as a limiting factor in tolerance to zinc deficiency in rice. Poster presentation. XVII International Plant Nutrition Colloquium, 17th to 22nd August 2013, Istanbul, Turkey.

Ueda Y, Wang Y, **Frei M** (2013) The role of ascorbate oxidase in ozone stress in rice. Poster presentation. 11th International POD Conference – Reactive Oxygen and Nitrogen Species in Plants, 17th to 19th July 2013, Warsaw, Poland. **Best poster award (1st price).**

Frei M, Höller S, Ueda Y, Wu LB (2013) The ascorbate metabolism as a target for the breeding of stress resistant rice. Poster presentation. 11th International POD Conference – Reactive Oxygen and Nitrogen Species in Plants, 17th to 19th July 2013, Warsaw, Poland.

Frei M, Höller S, Wu LB, Ueda Y (2013) Die Rolle von Ascorbat für die Toleranz gegen abiotische Stresse bei Reis. Vortrag. Jahrestagung der Deutschen Gesellschaft für Pflanzenernährung, 9th to 10th May 2013, Freising.

Ueda Y, Wissuwa M, Wang Y, **Frei M** (2013) Genetic approaches to increase tolerance to ozone in rice. Oral presentation. 26th Task Force Meeting of the ICP Vegetation, 28th to 30th January 2013, Halmstad, Sweden.

Frei M (2012) Antioxidants and tolerance to abiotic stresses. Oral presentation. Second Global Rice Phenotyping Network Meeting, 22nd to 24th November 2012, International Rice Research Institute, Los Banos, Philippines.

Höller S, Hajirezaei MR, von Wirén N, **Frei M** (2012) Ascorbate metabolism in rice genotypes differing in zinc efficiency. Oral presentation. International Workshop and Meeting of the German Society of Plant Nutrition, September 5th to 7th 2012, Bonn, Germany.

Wu LB, Oldgee P, Gregorio G, Becker M, **Frei M** (2012) Iron exclusion as a mechanisms to iron toxicity in rice: genetic and physiological aspects. Poster presentation. International Workshop and Meeting of the German Society of Plant Nutrition, September 5th to 7th 2012, Bonn, Germany. **Best poster award (1st price).**

Frei M, Wu LB, Engel K, Becker M (2012) Dissection of physiological and genetic mechanisms of tolerance to iron toxicity in rice. Oral presentation. International Workshop and Meeting of the German Society of plant Nutrition, September 5th to 7th 2012, Bonn, Germany.

Pariasca-Tanaka J, Rose M, Rose T, Widodo, **Frei M**, Wissuwa M (2012) Differential response of rice (*O. sativa*) genotypes with contrasting tolerance to Zn deficiency. Oral presentation. Annual Meeting of the Japanese Society of Soil Science and Plant Nutrition, 4-6 Sept, Tottori, Japan.

Frei M, Kohno Y, Tietze S, Jekle M, Hussein MA, Becker T, Becker K (2011) Effect of elevated tropospheric ozone on the grain quality of rice. Oral presentation. Tropentag, 5th to 7th October 2011, Bonn, Germany.

Frei M, Becker M, Wissuwa M (2011) The significance of oxidative stress tolerance in the breeding of stress resistant rice. Oral presentation. 10th International Conference on Reactive Oxygen and Nitrogen Species in Plants, 5th to 8th July 2011, Budapest, Hungary.

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Shhadi YM, Becker M, Engel K, **Frei M** (2010) Dissection of genetic and physiological factors associated with tolerance to iron toxicity in rice. Poster presentation. Symposium on Genetics of Plant Mineral Nutrition, 30th September to 2nd October 2010, Hannover, Germany.

Frei M, Engel K, Becker M (2010) Role of antioxidants in developing rice varieties tolerant to iron toxicity. Poster presentation, Tropentag, 14th to 15th September 2010, Zürich, Switzerland.

Frei M, Kohno Y, Makkar HPS, Becker K (2010) The effect of elevated tropospheric ozone on the feeding value of rice straw. Poster presentation. 23rd Task Force Meeting of ICP Vegetation, 1st to 3rd February 2010, Tervuren, Belgium.

Frei M (2009) Adaptation of crop production to environmental stress. Oral presentation. Network Meeting of the Alexander von Humboldt Foundation, 24th to 26th November 2009, Heidelberg, Germany.

Frei M, Wissuwa M (2008) Ozone pollution and rice production in Asia: significance, physiological response and development of tolerant genotypes. Oral presentation, Tropentag, 7th to 9th October 2008, Hohenheim, Germany.

Wissuwa M, **Frei M**, Arnold T, Weiss DJ, Kirk GJD (2008) Zinc (Zn) isotope discrimination patterns reveal different uptake mechanisms in Zn efficient and inefficient rice genotypes. Oral presentation. Annual Meeting of the Japanese Society of Soil Science and Plant Nutrition, 9th September 2008, Nagoya, Japan.

Frei M, Wissuwa M. (2008) Effect of ozone on rice and genetic factors associated with tolerance. Oral presentation. International Symposium on Agricultural Meteorology, 22nd – 23rd March 2008, Shimonoseki, Japan.

Frei M, Wang Y, Wissuwa M (2007) Agar nutrient solution as a growth medium for mimicking anaerobic rhizosphere conditions of paddy soils in laboratory studies. Poster presentation. 9th Conference of the International Society for Plant Anaerobiosis, 18th – 23rd November 2007, Matsushima, Japan.

Frei M, Tanaka M, Wissuwa M (2007) QTL mapping for leaf bronzing and stomatal conductance under ozone stress in a Nipponbare/Kasalath rice mapping population. Poster presentation. The 5th International Symposium of Rice Functional Genomics, 15th – 17th October 2007, Tsukuba, Japan.

Frei M, Dewan S, Becker K (2006) Effect of stocking fish on methane emissions from rice paddies: results from greenhouse and field experiments. Oral presentation. 2nd International Rice Congress, October 9th-13th, New Delhi, India.

Frei M, Becker K (2004) Controlled greenhouse experiments on integrated rice-fish culture. Poster presentation. FAO Rice Conference, February 12th-13th, Rome, Italy

PROF. DR. MICHAEL FREI – LIST OF PUBLICATIONS

Coverage in Popular Media

- Documentary 'Greenhouse Farming' highlighting our research on ozone stress in rice and screening of rice wild relatives as part of the television series 'Kheti pardes ki' (agriculture abroad), an educational series for farmers broadcast by the Indian government TV channel Doordarshan Kisan. Broadcast date: January 2018.
- Article in 'Humboldt Cosmos' (the magazine of the Alexander von Humboldt Foundation, October 2017) highlighting research on stress adaptation of rice; <https://www.humboldt-foundation.de/web/future-on-our-plates.html>
- TV documentary about our research on ozone tolerance in rice produced and distributed by 'Deutsche Welle'; broadcast in 2016 in the following TV stations: Indonesia Indonesia cable TV Association, Bali TV, Elshinta TV, INTV, Matrix TV, Riau Televisi, PT.Satelit Televisi Nusantara, Tempo TV, Topas TV, TV Muhammadiyah; India Dorrdarshan; Bangladesh Ekushey television.
- Article in 'Welt am Sonntag' (one of Germany's leading daily newspapers, January 2015) about research on ozone tolerance in rice; <https://www.welt.de/wissenschaft/umwelt/article136314252/Deutsche-Forscher-suchen-nach-dem-Super-Reis.html>
- Interview in 'Deutschlandfunk' (one of Germany's leading radio stations, November 2014) about research on ozone tolerance in rice; http://www.deutschlandfunk.de/ackerbau-ozonbelastung-schaedigt-reispflanzen.676.de.html?dram:article_id=302464

PROF. DR. MICHAEL FREI – EXTERNAL PROJECT FUNDING

Funding organization	Duration	Status	Project title	Project number	Amount (EUR)
German Research Foundation (DFG)	01.08.2019-31.07.2022	ongoing	Ozone-tolerant Rice for Bangladesh – from Molecular Understanding of Tolerance Mechanisms to Application in the Field	FR2952/5-1	323 416,-
European Union (ERA-NET SusCrop framework) ¹	01.03.2019-28.02.2022	ongoing	Developing Resilience and Tolerance of Crop Resource Use Efficiency to Climate Change and Air Pollution	---	301 000,-
German Academic Exchange Service (DAAD) ²	01.01.2018-31.12.2019	ongoing	Wild Rice Species for Fe Tolerance and Biofortification of Cultivated Rice	---	19 880,-
Foundation <i>fiat panis</i>	01.04.2017-31.12.2017	completed	Screening of Rice Wild Relatives for Tolerance to Fe Toxicity and Grain Quality Traits	11/2017	3 430,-
German Research Foundation (DFG)	01.04.2016-31.06.2018	completed	Validation and Functional Characterization of Candidate Genes for Iron Stress Tolerance in Rice (<i>Oryza sativa</i> L.)	FR 2952/2-1	231 201,-
Alexander von Humboldt Foundation ²	01.04.2016-31.03.2018	completed	Factors Affecting Oxidative Stress and Cell Death Under Zinc Deficiency in Cereal Crops	---	82 800,-
Bayer Science Foundation ²	1.10.2017-30.9.2018	completed	Use of Ethylene Diurea as a Biomonitoring Tool for Ozone Tolerance in Rice	---	6 000,-
German Research Foundation (DFG)	1.3.2011-31.12.2016	completed	Mechanisms of Oxidative Stress Tolerance in Rice and Their Application in the Molecular Breeding of Genotypes Adapted to Stress Environments	FR2952/1-1	1 044 000 ,-
German Academic Exchange Service ²	01.10.2015-31.12.2018	completed	More Rice for Bangladesh: Genetic and Physiological Factors of Ozone Stress Tolerance in Rice (<i>Oryza sativa</i>)	---	39 000,-

PROF. DR. MICHAEL FREI – EXTERNAL PROJECT FUNDING

Funding organization	Duration	Status	Project title	Project number	Amount (EUR)
Bayer Science Foundation ²	1.10.2015-30.9.2016	completed	Genome-Wide Association Study to Map Loci for Manganese Toxicity Tolerance in Rice	---	6 000,-
Alexander von Humboldt Foundation ²	1.4.2014-31.3.2016	completed	Search for Key Genes of Plant Signaling and Response Using Microarray Meta-Analysis of Antioxidant Pathways in Rice Plants Exposed to Different Abiotic Stresses	BRA 1155600 STPCAPES-2	82 800,-
German Academic Exchange Service (DAAD)	1.1.2013-31.12.2014	completed	The Impact of Ozone Stress on Rice Quality and Possible Quality Management Strategies	56010148	14 556,-
Robert Bosch Foundation	1.9.2011-15.1.2013	completed	Adaptation Strategies of Rice to Tropospheric Ozone and Their Effects on Crop Quality	32.5.8003.0101.0	14 060,-
<i>Fiat panis</i> Foundation	1.4.2014-31.12.2014	completed	Identification and Characterization of Loci Conferring Tolerance to Iron Toxicity in Rice	---	19 660,-
<i>Fiat panis</i> Foundation	1.2.2013-31.12.2013	completed	Association Mapping of Genes Related to Abiotic Stress Tolerance in Rice	---	8 556,-
Alexander von Humboldt Foundation	1.10.2009-30.09.2010	completed	Adaptation of Crop Production to Abiotic Stress	---	37 200,-
Japan Society for the Promotion of Science (JSPS)	1.6.2007-31.5.2009	completed	Studies on Physiological and Genetic Factors Leading to Zinc Efficiency in Different Rice (<i>Oryza sativa</i> L.) Genotypes	---	89 000,-

1. As Co-Principal Investigator

2. As host

PROF. DR. MICHAEL FREI – TEACHING AND MENTORING

Teaching Experience

Courses I have taught since my appointment as a junior professor at the University of Bonn in 2011

Module title	Course	Semesters ²	Function	SWS ³
Genes, Seeds and Biodiversity	ARTS ¹	WS12/13, WS13/14, WS14/15, WS15/16, WS16/17, WS17/18, WS18/19	Coordinator, lecturer	5
Crop Abiotic Stresses	ARTS, M.Sc. Crop Science	WS11/12, WS12/13, SS14, SS15, SS16, SS17, SS18, SS19	Coordinator, lecturer	4
Recent Advances in Physiological Plant Nutrition	M.Sc. Crop Science	SS12, SS13, SS14, SS15, SS16, SS17, SS18, SS19	Coordinator, lecturer, supervisor	2
Recent Advances in Plant Nutrition – Ecology and Crop Management	M.Sc. Crop Science	WS16/17, WS17/18, WS18/19	Lecturer	1
Product and Process Quality	M.Sc. Crop Science	WS17/18, WS18/19	Lecturer	0.5
Natural Resource Management	M.Sc. Crop Science, ARTS	SS18, SS19	Lecturer, supervisor	2
Crop Physiology	M.Sc. Crop Science	SS13, SS14, SS18, SS19	Lecturer, supervisor	1
Crop Ecology	ARTS, M.Sc. Crop Science	WS18/19	Lecturer	1
Responses of Crop Plants to Abiotic Stresses	M.Sc. Crop Science, M. Sc. Plant Science	WS11/12, WS12/13	Lecturer	1
Free Modules	M.Sc. Crop Science	SS13, SS14, SS15	Supervisor	1
Pflanzenproduktion II	B.Sc. Agrarwissenschaften	SS18, SS19	Lecturer	2
Anbau, Ertragsbildung und Ertragsfaktoren landwirtschaftlicher und gärtnerischer Kulturpflanzen	B.Sc. Agrarwissenschaften	WS18/19	Lecturer	1
Produktion und Qualitätseigenschaften pflanzlicher und tierischer Grundnahrungsmittel	B.Sc. Ernährungs- und Lebensmittelwissenschaften	WS18/19	Lecturer	0.5

1. Master in Agriculture Agriculture and Resource Management in the Tropics and Subtropics
2. SS = summer semester, WS = winter semester
3. SWS Semesterwochenstunden; indicates my approximate contribution to each module in hours per week during the respective semesters

PROF. DR. MICHAEL FREI – TEACHING AND MENTORING

Mentoring Experience *(in italics: as second supervisor)*

Student's name	Course	(Tentative) Title	Status
Stefanie Höller	PhD	The Ascorbate Metabolism as a Factor Affecting Tolerance to Zinc Deficiency in Rice	completed ²
Lin-Bo Wu	PhD	Dissection of Genetic and Physiological Factors Associated with Tolerance to Iron Toxicity in Rice	completed ^{2,3}
Yoshiaki Ueda	PhD	Genetic and Molecular Analysis of Ozone Tolerance Mechanisms in Rice	completed ⁴
MD Ashrafuzzaman	PhD	Breeding Ozone Tolerant Rice for Bangladesh	completed
Varunseelan Murugaiyan	PhD	Investigations on Arsenic Tolerance and Uptake in Rice	completed
Eusha Nafi	PhD	Effects of Tillage and Contour Ridges on Soil Fertility and Nutrient Use Efficiency of Cotton and Maize	ongoing
<i>Julia Holbein</i>	<i>PhD</i>	<i>Deciphering the Role of Apoplastic Root Barriers in the Interaction Between Sedentary Nematodes and Arabidopsis</i>	<i>completed</i>
<i>Shumaila Muzzamil</i>	<i>PhD</i>	<i>Genetic Dissection of Shoot Traits Under Control and Drought Conditions in Barley</i>	<i>completed</i>
<i>Stefan Hey</i>	<i>PhD</i>	<i>Genetic and Genomic Dissection of Maize (Zea maize L.) Root Hair Development</i>	<i>completed</i>
<i>Sajid Ali Khan Bangash</i>	<i>PhD</i>	<i>Subcellular Glutathione Homeostasis and Characterization of Glutathione Transport Across the Plasma Membrane in Arabidopsis thaliana</i>	<i>completed</i>
<i>Nina Opitz</i>	<i>PhD</i>	<i>Transcriptomic Plasticity in the Maize (Zea maize L.) Primary Root and its Tissues Upon Water Deficit</i>	<i>completed</i>
<i>Zaiful Islam</i>	<i>PhD</i>	<i>Impact of Technological Innovation on the Poor: Integrated Aquaculture-Agriculture in Bangladesh</i>	<i>completed</i>
<i>Charles Yaw Okyere</i>	<i>PhD</i>	<i>Water Quality in Multipurpose Water Systems, Sanitation, Hygiene, and Health Outcomes</i>	<i>completed</i>
Yusser M. Shhadi	ARTS ¹	Dissection of Genetic Factors Linked to Tolerance to Iron Toxicity in Rice	completed
Meike Höller	MSc Crop Science	Effects of QTL OzT8 and OzT9 on Ozone Tolerance in Rice	completed
<i>Benjamin Zedler</i>	<i>MSc Crop Science</i>	<i>Assessing the Potential of Spider Plants (Cleome ssp.) as Potential Trap Crops for the Management of Specialist Feeders on Vegetable Brassicas</i>	<i>completed</i>
Elsa Matthus	MSc Plant Science	A Genome-Wide Association Study (GWAS) to Identify Loci Associated with Iron Tolerance in Rice	completed ⁵
Felix Frimpong	ARTS	A Genome-Wide Association Study (GWAS) to Identify Loci Associated with Ozone Tolerance in Rice	completed
Ando Lailana Razafindrazaka	ARTS	Rice Genotype Responses and Adaptation Mechanisms to Different Conditions of Iron Toxicity during Vegetative Phase	completed

PROF. DR. MICHAEL FREI – TEACHING AND MENTORING

Student's name	Study course	(Tentative) Title	Status
Vitalij Dombinov	MSc Plant Science	Investigations of Physiological Processes During Grain Filling Affecting Rice Quality Under Ozone Stress	completed
Richmond Narh Tetteh	ARTS	Effects of Acute and Chronic Iron Toxicity on Yield and Iron Uptake of Different Rice Varieties	completed
Maria Clara Hurtato	ARTS	Genetic and Physiological Factors Underlying Tolerance of Boron Toxicity in Rice	completed
Lubna Farzana	ARTS	Use of Ethylene Diurea (EDU) as a Tool to Screen Rice Germplasm for Ozone Tolerance	completed
Asis Shresta	ARTS	Genetic Factors Associated with Manganese Toxicity in Rice	completed ⁶
Ambrose Kwaku Dziwornu	ARTS	Effects of Manganese Toxicity on the Lignification of Rice Straw	completed
Bahare Seperi	ARTS	Genome-wide Association Study of Bio-energy Related Traits in Barley Straw Under Varying Water Status	completed
Lara Ergezinger	MSc Crop Science	Field Evaluation of Contrasting Rice Genotypes in Iron Toxic Conditions in Madagascar	completed
Belqees Rashid	MSc Crop Science	Evaluation of Stress Tolerance of Transgenic Barley Overexpressing Ascorbate Biosynthesis Genes from Kiwi Fruits	completed
Sumitra Pantha	ARTS	Evaluation of Stress Tolerance of Transgenic Rice Overexpressing Ascorbate Biosynthesis Genes from Kiwi Fruits	completed
Melle Tagele	ARTS	Screening Rice Wild Relatives for Tolerance to Iron Toxicity	completed
Birgit Bierschenk	MSc Crop Science	Screening Rice Wild Relatives for Grain Quality Traits	completed
Juliane Metterhausen	Master of Education	<i>Handlungsorientiertes Unterrichten am Berufskolleg am Beispiel der Unterrichtsreihe 'mineralische Grunddüngung in der Fruchtfolge'</i>	completed
Zahidul Haque	MSc Crop Science	Physiological Effects of Ethylenediurea (EDU) on Contrasting Rice Genotypes Exposed to Ozone	completed
Roshan Acharya	ARTS	Responses of Transgenic Rice Overexpressing Ascorbate Biosynthesis Genes from Kiwi Fruits to Mineral Disorders	ongoing
Felix Holtkamp	ARTS	Involvement of a Potassium Ion Channel Gene OsAKT1 in Iron Toxicity Tolerance in Rice	completed
Esraa Abdelmonem Gabal	ARTS	Exploiting the Evolutionary Process and Diversification of <i>Triticum araraticum</i>	completed
Jill Lucas	MSc Crop Science	Effects of Elevated CO ₂ Concentration on Growth and Quality of Wheat	completed
Muhammad Shahedul Alam	ARTS	Genome-wide Association Study for Ozone Tolerance Loci in Wheat	ongoing
Lamin Gassama	ARTS	Screening Rice Wild Relatives for Salinity Tolerance	ongoing
Louisa Weber	MSc Crop Science	Physiological Mechanisms of Salt Tolerance in Interspecific Crosses of Rice	ongoing
Ambika Pandey	ARTS	Drought Tolerance of Barley Plant Overexpressing Ascorbate Biosynthesis genes from Kiwifruit	ongoing
Mugabi Jerome Kiggundu	ARTS	Transcript Expression Profiling of Dehydrin Plant Proteins in Cucurbitacea Family Crops Under Different Phytohormonal Abiotic Stress Factors	ongoing

PROF. DR. MICHAEL FREI – TEACHING AND MENTORING

Student's name	Study course	(Tentative) Title	Status
Sebar Mohammed	BSc Agric.	Nutzung von Dialysetechniken zur Abschätzung der Phosphatdüngereffizienz	ongoing
Clemes Coenen	BSc Agric.	Vergleich des All-in One Kartoffelanbauverfahrens mit herkömmlichen Verfahren	ongoing
Ilja Illert	BSc Biologie	Effect of Hydrological Regime and Organic Matter on Formation of Iron Toxicity in Rice Plants Grown in Ferrallitic Soil	completed
Felix Holtkamp	BSc Agric.	Evaluation of Ethylenediurea (EDU) as a Screening Tool for Ozone Tolerance in Rice	completed
Ann Christin Weiler	BSc Agric.	<i>The Influence of Different Crop Management Options in Lowland Rainfed Rice Systems on Soil Organic Nitrogen and Nitrogen Uptake in West Africa</i>	completed
Philine Friederike Lenz	BSc Agric.	<i>Einfluss von wiederholtem Trockenstress auf Wachstum, Zellschädigung und Chlorophyllgehalt der Zuckerrübe (B. vulgaris L.)</i>	completed
Richard Johannes Lange	BSc Agric.	<i>Effekte ausgewählter Biostimulatoren auf Nutzpflanzen</i>	completed

1. Master of Agriculture and Resource Management in the Tropics and Subtropics
2. Received the PhD thesis award of the German Society for Plant Nutrition (EUR 1000,-)
3. Received the faculty award for highest impact publication during PhD (EUR 500,-)
4. Graded with *summa cum laude*
5. Received the Hans H. Ruthenberg European Science award from *fiat panis* Foundation (EUR 2500,-)
6. Received the thesis award from German Academic Exchange Service (DAAD)