

Publication of conference report

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**21<sup>st</sup> International Symposium of Iron Nutrition and Interactions in Plants (ISINIP 2024),  
Düsseldorf (Townhouse), 8.7. – 12.7.2024**



The 21<sup>st</sup> ISINIP conference brought together an international community of scientists and early career researchers with a common interest in understanding plant-related aspects of the acquisition and utilization of the critical micronutrient iron. The symposium (<https://www.isinip2024.de>) featured

- 8 scientific sessions
- 2 invited 40-minute Keynote Lectures
- 13 invited 20-minute lectures by expert scientists
- selected short talks (selected from abstracts of participants)
- selected flash talk poster presentations (selected from abstracts of participants)
- 2 poster sessions (abstracts of participants)

ISINIP 2024 provided a learning and networking opportunity especially to early career stage researchers. ISINIP 2024 supported them in identifying interesting areas for future scientific endeavours to solve global challenges, for example specific crop science topics, biofortification, plant-microbe interactions or specific molecular topics and synthetic biology approaches. Three themes highlighted the scientific significance of the event:

- 1) ISINIP 2024 emphasized the significance of iron research for food security. Micronutrient deficiencies remain a major barrier to quality nutrition and equity in many countries. This theme was introduced in a keynote presentation by Maryke Labuschagne (South Africa) on Nutritional Food Security in Africa.
- 2) A particular focus addressed environmental sustainability. The uptake of iron in calcareous and alkaline soils presents a particular challenge. The occurrence of such soil conditions is expected to increase with climate change. In this regard, Charlotte Poschenrieder (Spain) gave a keynote lecture on ecologically relevant genetic adaptations of plants to alkaline and calcareous soil conditions in Spain.
- 3) The ISINIP 2024 Symposium placed significant emphasis on deciphering the genetic factors and intricate regulatory mechanisms of iron uptake, allocation, and storage in crops and model plants, which are important for biofortification and crop improvement.

The ISINIP conference fulfilled important objectives: Due to the combined diverse scientific expertise ISINIP highlighted the relevance of iron nutrition research to solve global challenges based on scientific evidence. The conference highlighted the importance of proper iron nutrition for plant growth and crop production and strengthened the awareness of

global alkaline-calcareous and acidic soils which impact plant iron nutrition and global food production. ISINIP emphasized that plants develop nutritional disease symptoms when iron nutritional demands are not met. Several presentations addressed plant responses and treatments to low bio-availability of iron, wide-spread in alkaline and calcareous soils, as well as iron toxicity in regions with acidic and low redox potential soils. ISINIP also highlighted that human malnutrition due to low-iron-providing staple crops is very wide-spread and it emphasized that women (of child-bearing age and pregnant) and children are particularly vulnerable to iron deficiency anemia. Novel tools, strategies and application examples were reported that address iron biofortification, e.g. knowledge to select iron-rich crops and develop transgenic and gene-edited crops or alternatively to increase yield through specific physiological treatments or beneficial microbes applied to plants.

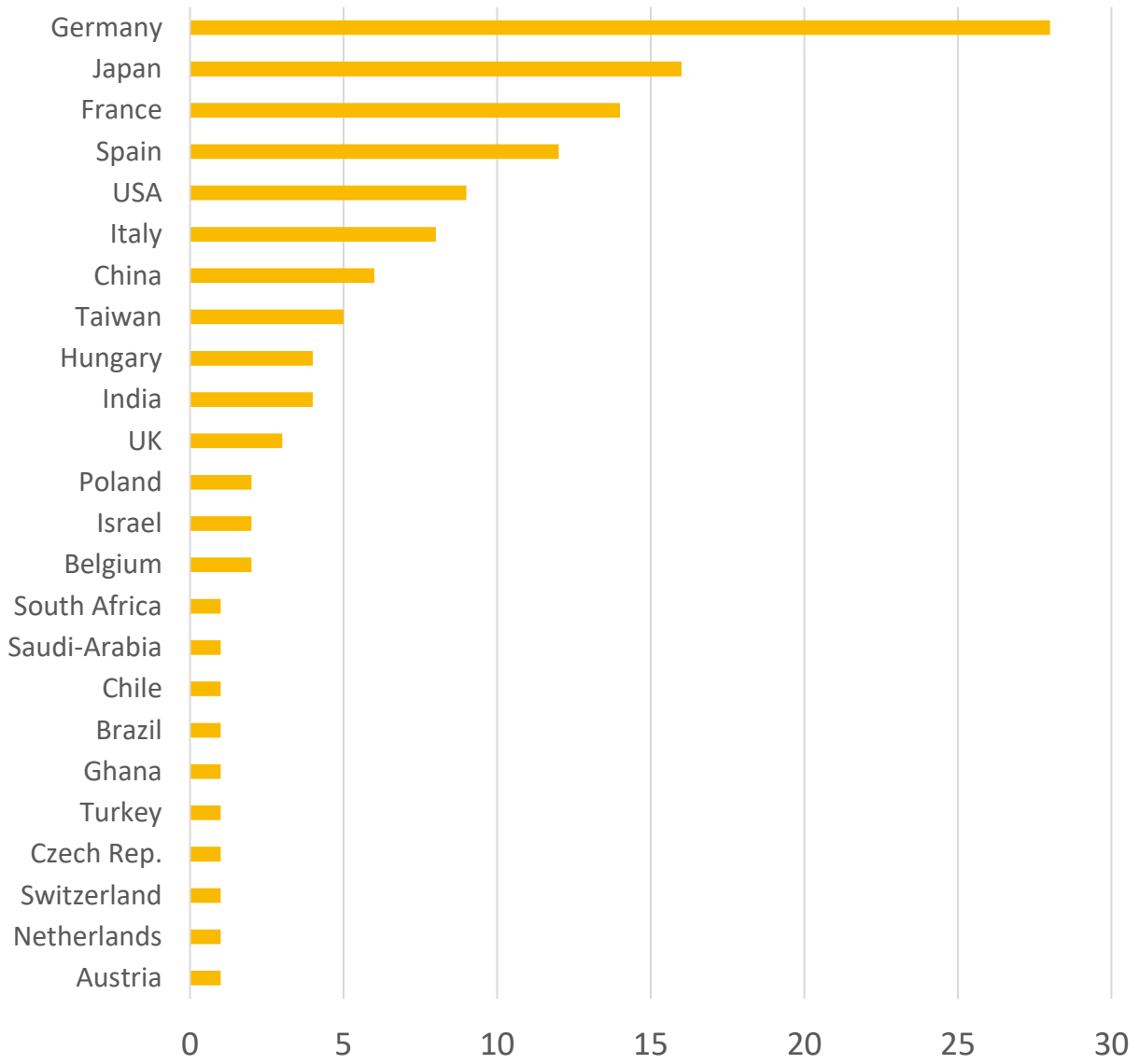
A lot of exchange and joint discussion took place to better understand the fundamental biology, soil ecology and biotechnology approaches of plant iron nutrition (through eight scientific sessions each introduced by invited speakers).

- Crop iron physiology: focused on nutrition physiology, breeding and solutions for iron deficiency remediation in crops in field and laboratory conditions.
- Micronutrient biofortification: highlighted new approaches to biofortify and select iron-biofortified crops, develop orphan crops with improved iron nutrition characteristics.
- Plant-soil-microbe interactions: contributed to the understanding of how the microbiome aids iron mobilization and growth promotion in different environments, especially alkaline soils, highlighted signaling between plants and their environment in response to iron supply, and investigated the roles of active compounds in plant exudates.
- Alkaline and acidic soil environments: shed light on the ecological constraints, genome-wide associations and genetic mechanisms for adaptation of wild and cultivated plants.
- Transcription factor networks: uncovered and discussed regulatory components, target genes and molecular mechanisms to understand signaling processes in response to iron nutrition.
- Iron acquisition and transport: identified components and activities for iron acquisition and regulated transport across membranes in cells and at molecular and protein structural level.
- Whole-plant iron physiology and regulation: shed light on the long-distance iron signaling and the integration of iron homeostasis in whole plant physiology including connections with light, abiotic or biotic stress, plant hormones, photosynthesis, metabolism and development.
- Iron physiology and interaction with other elements: discussed the interaction between different metals and elements in the soil and in the plant, e.g. the interconnections of iron nutrition with nitrogen and sulfur assimilation, phosphate uptake, other micronutrients and heavy metals, and highlighted how general plant nutrition impacts iron utilization in plants.

Hence, ISINIP helped to make the research on plant iron homeostasis impactful and to show approaches for basic and translational research. Techniques were reported to better recognize symptoms of disturbed iron nutrition, provide solutions to render crop plants iron-efficient or treat iron deficiency and toxicity of crops in the field. Reported experimental procedures and technologies encompassed population-wide, physiological and molecular studies.

ISINIP had a very international character, with key note and invited speakers stemming from 5 continents and 11 countries (excluding Germany). One Key note speaker and 3 invited speakers were from countries considered of the Global South. 5 travel fellowships were granted to early career stage scientists from India (2), Taiwan (2) and Japan (1). In total, the conference has been attended by 126 participants from a total of 24 countries, 93 of them with PhD and 33 without.

International attendance of ISINIP, representation of countries and numbers of attendees among 126 participants





Welcome and conference participants, © Steffen Köhler



Poster session, © Steffen Köhler





Conference dinner in brewery, © Steffen Köhler, Sanjib K. Panda



Closing session, © Felipe Ricachenevsky, Eltayb E. Abdellatef



Excursion to Neanderthal museum site, © Petra Bauer, Sanjib K. Panda, H. Masuda