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PRESSEMITTEILUNG

Sustainable Use of Phosphorus: DFG Extends German-Chinese Research Training Group

PhD students from the University of Hohenheim and China Agricultural University in Beijing are conducting research on resource-efficient phosphate use based on the example of maize cultivation

Around 7 million euros to promote more sustainable use of the world's limited phosphate supply: The German-Chinese Research Training Group AMAIZE-P can continue its research on phosphorus as one of the most important nutrient elements for plants. The German Research Foundation (DFG) has approved a second funding period of another 4.5 years. Since 2018, junior researchers from the University of Hohenheim in Stuttgart and China Agricultural University (CAU) in Beijing have been conducting joint research. Plants take up phosphorus from soils and fertilizers in the form of phosphates, and research in the group concentrates on how to optimize the use of phosphate reserves while avoiding overfertilization. It uses the example of maize-based agricultural production systems for food, feed, and biomass production. Info: https://amaize-p.uni-hohenheim.de

Nine years of AMAIZE-P: When the international research training group concludes in 2027, more than 40 PhD students and postdocs on the German side and more than 50 on the Chinese side will have been trained as experts in the field of resource-efficient phosphate utilization. To date, almost 100 publications in peer-reviewed journals already attest to the high-caliber qualifications obtained at the two top universities.

"All PhD students and postdocs at the University of Hohenheim have at least one tandem partner at the CAU," explained Prof. Dr. Torsten Müller, spokesperson for the German side. "In the new funding period, the third group will start. It will be expanded compared to the first two by one additional PhD student each from Germany and China." These students will also add to the graduate program by examining the market economy aspect of the topic.

Global phosphate shortage threatens food security

The war in Ukraine has given the issue additional significance. "The war is making fertilizer scarce and expensive. Global food security is more at risk than ever," Prof. Dr. Müller stated. "In addition, phosphate deposits are limited, so it is possible that prices for this increasingly scarce resource will increase greatly in the coming decades."

China is currently still focusing on mining areas in its own country, but these will be exhausted in about 35 years. "This also has consequences for the global market. If Chinese agriculture imports its phosphate in the future, that will also drive up prices."

On the one hand, phosphorus is irreplaceable as a scarce but essential nutrient element. On the other hand, environmental problems often occur in areas with high livestock density because too much phosphate is spread on the fields there via farm manure, especially slurry. AMAIZE-P is looking for solutions to this complex global problem using maize production systems as an example. The objective is to create a sustainable circular economy in line with the principles of the bioeconomy.

“Research conducted in Germany and China at the same time is the perfect complement," said Prof. Dr. Müller, explaining the approach. "In Germany, larger farms dominate, while Chinese agriculture is still mostly small-scale. The climate conditions of the two countries are also very different. This means that together we can cover almost all production systems that play a role worldwide."

Strategies for more efficient phosphate use

In field trials, the researchers compare different fertilization strategies and crop rotations in terms of their effect on phosphate availability in the soil. "We can already state, for example, that recycled phosphate fertilizer is capable of replacing mineral phosphate fertilizer," Prof. Dr. Müller said when discussing the interim results. "We are also currently investigating whether legumes increase phosphate availability to maize in rotation or when grown simultaneously in the same field."

The researchers are also focusing on genetic aspects: For example, genetic differences in phosphate use efficiency were found in modern and traditional maize varieties. In the future, this can serve as a basis for breeding new maize varieties that can use the nutrient more efficiently.

The researchers also use drone flights and three-dimensional simulations of maize plants to determine the exact nutrient requirements in individual subplots. This allows them to apply the fertilizer only where it is really needed.

Circular economy conserves resources

To achieve a circular economy, the researchers also have an eye on the further path of phosphate: They are investigating how phytate content in maize and thus in feed affects chickens and pigs, as phytate is the main phosphorus storage form in plants. "The interaction of microorganisms in the animals' digestive tract plays a particularly important role here," stated Prof. Dr. Müller.

To close the loop, waste and residual materials are also being reassessed:
"Phosphorus-containing biomass can be converted via a technical process known as hydrothermal conversion (HTC)," said the research training group spokesperson. In a pilot plant, a biorefinery in the Swabian Alb, new carbon materials are being produced, for example for electrodes. On the other hand, work is being done on recovering the phosphorus as the mineral fertilizer struvite, which in turn can be used in crop production.

Objective: Recommendations for action for politics and society

Ultimately, the researchers would like to derive recommendations for policy and agricultural practice for the efficient management of phosphate. "To do this, we are simulating how a shortage of phosphate will affect agricultural and food markets," said Prof. Dr. Müller. “That way we can assess what the implications are for global food security."

By modeling different future scenarios, they compare the efficiency of phosphate fertilizer use. This allows for an analysis of how different land use systems affect Germany and China economically and ecologically.

BACKGROUND: DFG Research Training Group "Adaptation of maize-based food-feed-energy systems to limited phosphate resources" AMAIZE-P

The German-Chinese international research training group AMAIZE-P ("Adaptation of maize-based agricultural production systems for food, feed and biomass production to limited phosphate supplies", GRK 2366) started on 1 Oct 2018. The second funding period begins on 1 Apr 2023 and runs through 30 Sept 2027. The German Research Foundation (DFG) supports the research training group at the University of Hohenheim with funding totaling approximately 10.5 million euros in project funds and 2.3 million euros in program allowances over both funding periods (9 years). China Agricultural University (CAU) in Beijing is contributing its own co-funding to the project. Homepage: https://amaize-p.uni-hohenheim.de

The spokesperson on the Chinese side is Prof. Dr. Fusuo Zhang from CAU. On the German side, the following persons and working groups of the University of Hohenheim are involved in the second funding period:

- Spokesperson: Prof. Dr. Torsten Müller, Department of Fertilization and Soil Chemistry
- Assistant Spokesperson: Prof. Dr. Joachim Müller, Department of Agricultural Engineering in the Tropics and Subtropics and State Institute for Agricultural Engineering and Bioenergy

and (in alphabetical order):

- Prof. Dr. Enno Bahrs, Department of Farm Management
- Dr. Kirsten Boysen-Urban, Department of International Agricultural Trade and Food Security
- Jun.-Prof. Dr. Amélia Camarinha da Silva, Department of Livestock Microbial Ecology
- Prof. Dr. Jan Frank, Department of Biofunctionality
- Prof. Dr. Simone Graeff-Hönninger, Department of Agronomy
- Prof. Dr. Andrea Kruse, Department of Conversion Technologies of Biobased Resources
- Prof. Dr. Uwe Ludewig , Department of Nutritional Crop Physiology
- Prof. Dr. Waltraud Schulze, Department of Plant Systems Biology
- Prof. Dr. Andreas Schweiger, Department of Plant Ecology
- Prof. Dr. Tobias Würschum, Department of Plant Breeding

Additional participants:

- Prof. Dr. Markus Rodehutscord, Department of Animal Nutrition

- Dr. Hans Oechsner, State Institute for Agricultural Engineering and Bioenergy

and other scientists from the relevant fields.

BACKGROUND: China Agricultural University (CAU)

China Agricultural University (CAU) in Beijing is the leading university in Asia in the field of agricultural sciences and is always among the top-ranked universities in global rankings. CAU conducts research in the fields of agricultural economics, life sciences, resources, environment, electronic data processing, computer science, agricultural engineering, management, and social sciences. The University of Hohenheim and the CAU maintain one of the oldest existing German-Chinese university partnerships - since 1979.

BACKGROUND: Bioeconomy at the University of Hohenheim

Bioeconomy is the leading topic at the University of Hohenheim in research and teaching across all three faculties. In order to strategically develop this focus, the University of Hohenheim has appointed a Chief Bioeconomy Officer (CBO). Implementing the topic in a targeted and sustainable manner at the university is the task of the Bioeconomy Research Center.

The University of Hohenheim is internationally networked, among other things through the European Bioeconomy University (EBU), in which it has joined forces with five other leading universities in Europe in the bioeconomy. Statewide, the University of Hohenheim sets important accents in the research program Bioeconomy Baden-Württemberg, and the program’s head office is located at the University of Hohenheim.

It will take a new generation of experts to restructure our economy into a bioeconomy. The University of Hohenheim therefore sees it as a social task to convey its expertise to students and young scientists in specific Bachelor’s and Master’s programs. More information: https://biooekonomie.uni-hohenheim.de/en/

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