

The Group of Plant Nutrition

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Soils release and store nutrients essential for plant growth

Cambisol



<https://www.britannica.com/science/Cambisol>

Podzol



<https://epod.usra.edu/blog/2005/12/podzol-soil-profile.html>

Ferralsol



<https://www.ffpri.affrc.go.jp/labs/dfse/Profiles/ProfilesOver.html>

We develop methods to assess nutrient pools and their dynamics in soil/plant systems

Soils are diverse and fascinating systems;

We use isotopic, spectroscopic, biochemical and biological methods to study element (nitrogen, phosphorus, zinc, cadmium) fluxes and their forms in cultivated and non-cultivated soils;

We work under laboratory and field conditions. Our field sites are located across Switzerland, Burkina Faso, Colombia, Côte d'Ivoire, Denmark, Germany, and Sri Lanka...

But 'available' pools of soil nutrients are often not enough to sustain crop nutrition



<https://www.healthline.com/nutrition/red-clover>



<http://www.ecologyandfarming.com/towards-best-manure/>



Algal bloom in 2010 along the coast of Qingdao, eastern China (nationalgeographic.it/)

We design nutrient management strategies to improve crop productivity while minimizing nutrient losses

We study the contribution of legumes as a source of nitrogen in agroecosystems;

We quantify the amount of nitrogen and phosphorus in crops that are derived from organic and recyclable fertilizers;

We assess strategies to reduce phosphate losses to the environment.

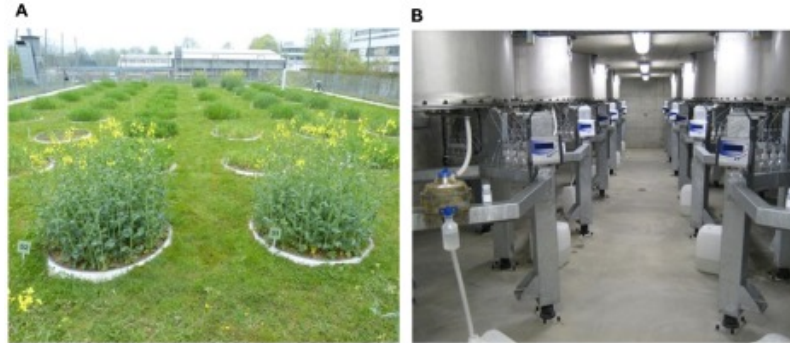
Crop element content is not only important for yield but also for human nutrition

Maize with sufficient Zn (top) and Zn deficiency (bottom)



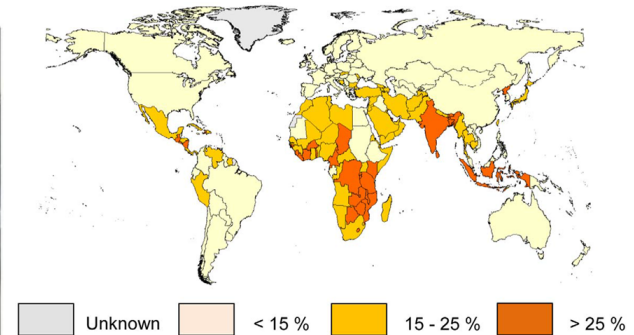
https://commons.wikimedia.org/wiki/File:Zinc-deficient_maize_plants.jpg

Lysimeters to study metal leaching (agroscope)



Oberholzer et al 2017

A map indicating the level of risk of human Zn consumption



Wessells & Brown 2012

We aim at increasing micronutrient contents in plants while minimizing contaminant uptake

Two billion people in the world suffer from micronutrient deficiencies;

We study the crop uptake of Zn and Cd from soils and fertilizers, including from organic matter inputs;

We study metal leaching from agricultural soils using lysimeters at Agroscope Reckenholz.

Three examples of systems studied by the group of plant nutrition

1. Nutrients cycling in Swiss cropping systems



Photo: Agroscope/FIBL



Photo: Andreas Hammelehle

Assess the N budget of biodynamic, organic and conventional systems in the DOK experiment

Nitrogen (N) offtake by harvested products exceeded N inputs from fertilizers across all treatments of the DOK experiment over decades.

The analysis of belowground N inputs by legumes has shown that they contributed more N as previously thought to the cropping system.

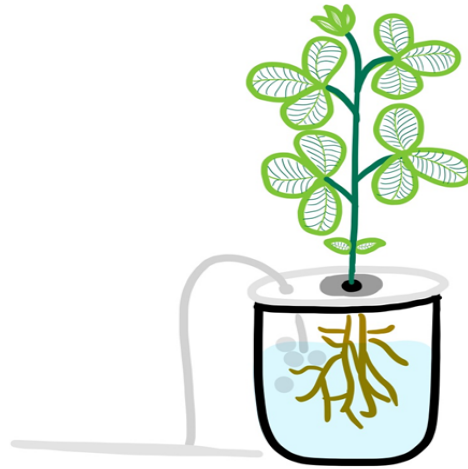
The decline in soil N stocks observed in most treatments indicates that also soil N acted as a significant N source for crops.

Completing the N budget requires quantification of N losses.

2. Towards a complete nutrient recycling for space flights



Grace Crain 2021



Grace Crain 2021



Thomas Pesquet, ESA/NASA

How far can recycling of human excreta contribute to grow plants in closed systems?

Plants are a source of food, oxygen, water, and can provide psychological benefits for the crew;

Urine can be treated to produce nitrate and phosphate rich fertilizers that can be used to grow crops in hydroponic systems;

But urine contains high concentrations of NaCl, which can be toxic to plants. This problem can be partly offset by growing halophytes (*Salicornia*);

Nutrient recycling of feces and plant residues for plant growth needs further study.

3. Improved crop management involves people and societies: Towards sustainable yam production in West Africa

Soil preparation



Growing crop



Tuber harvest



All pictures are from Nestor Pouya,
YAMSYS, University FHB and ETH

West Africa produces more than 90% of the global yam production

Yam, a tuber crop, has provided food, cash, and medicinal products in West Africa for about 7000 years;

Yam cropping systems in West Africa generally produce low yields and can degrade the environment;

Improving the sustainability of yam cropping systems requires sufficient nutrients from soil and/or fertilizer, proper planting material, storage capacity, knowledgeable extension services, and government support;

We work in an inter- and trans-disciplinary manner to ensure that results will be useful and relevant to all stakeholders.

Teaching & supervision activity

- Courses:
 - Plant Nutrition I: Nutrition Physiology and Fertilization
 - Plant Nutrition II: Integrated Nutrient Management
 - Current Aspects of Nutrient Cycles in Agro-ecosystems
 - Nutrient Fluxes in Soil-Plant Systems: the Case of Nitrogen
 - Chemical Nature of Nutrients and their Availability to Plants: the Case of Phosphorus
 - Water Quality and Agriculture
- Organization of excursions
- Contribution to: Scientific Writing, Lab Course, Interdisciplinary Project, Statistics, Alternative Crops
- Supervision of Bachelor, Master and Doctoral students' theses at ETH and visiting scientists from across the world
- Study Director for Agricultural Sciences from August 2021 onwards



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