**Nutrient recycling from human urine**

**Why recycle human urine?**
- Rich source of plant nutrients: 90% nitrogen (N) and 60% phosphorus (P) excreted by humans in urine fraction
- Phosphorus scarcity: uncertain remaining rock-phosphate reserves; need for alternative P fertilizers
- In developing countries, recovery of nutrients with fertilizer market value could trigger implementation of clean sanitation systems

**Aim of MSc project**
Evaluation of two urine based fertilizers (UBF), SNUS (Synthetic Nitrified Urine Solid) and Struvite as potential valuable recycling fertilizers. N & P plant uptake investigated with isotopic tracers $^{15}$N & $^{33}$P

**M & M + Results: How were both fertilizers produced and evaluated?**

1/ Production of synthetic urine & labeling with $^{33}$P + $^{15}$N

- **Struvite**
  - Magnesium ammonium phosphate
  - Processing: precipitation + filtration
  - Aim: recover all urine phosphate ions and a fraction of urine-N
  - P fertilizer

2/ Processing into Struvite & SNUS

- **SNUS**
  - Processing: nitrification + distillation
  - Newly developed by eawag, 1st time tested as plant fertilizer
  - Aim: recover all urine nutrients
  - Complete fertilizer rich in N

3/ Evaluate UBFs in plant growth study

**Conclusions**
- Struvite: equally effective as reference P fertilizer
- SNUS: similar N supply as reference N fertilizer
- Both UBFs are valuable N & P recycling fertilizers
- Further studies necessary with real human urine on other soils & crops

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*Fig 1: Struvite-P and reference water soluble $\text{KH}_2\text{PO}_4$-P taken up in equal amounts by plants $\text{P}_{\text{dff}} = \text{P derived from the fertilizer}$

*Fig 2: SNUS-N and reference water soluble $\text{NH}_4\text{NO}_3$-N were recovered equally by plants $\text{N}_{\text{dff}} = \text{N derived from the fertilizer}$

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* MSc candidate: Christophe Bonvin
  Supervisors: Oberson A., Frossard E., Etter B.

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