OPEN FiBL DAY

Organic agriculture and beyond

It's good to have you here.
We're starting soon.

Schön, dass Sie da sind.
Wir starten gleich.

Dolmetschen

Translation

This event will be simultaneously translated into English. Please select the appropriate audio channel. To hear only the interpreted speech, click [Mute Original Audio].

Übersetzung

Diese Veranstaltung wird simultan ins Englische übersetzt. Bitte wähle den entsprechenden Audiokanal. Um nur die gedolmetschte Sprache zu hören, klicke auf [Original-Audio stummschalten].

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Research Institute of Organic Agriculture (FiBL)
www.fibl.org

OPEN FiBL DAY
Organic agriculture and beyond




Nährstoffkreisläufe schliessen // Closing nutrient cycles

Examples from current projects at FiBL Switzerland (Soil / Crop / Livestock Sciences)

Open FiBL Day, 27.05.2021

Programme of this session

1. **Introduction** to nutrient cycles and recycled fertilizers (Else Bünemann)
2. **Gaseous emissions** after field application of recycled fertilizers (Norah Efosa)
3. The fate of **manure** nitrogen in the soil-plant system (Hanna Frick)

4. Availability of nitrogen in organic fertilizers to **apple trees** (Clémence Boutry)

5. Using sheep wool to produce **tomatoes** (Patricia Schwitter)

6. **Duckweed** for aquatic nutrient recycling (Timo Stadtlander)

7. Keeping plants healthy by using **compost** (Jacques Fuchs)

8. **Outlook**: future approaches to close nutrient cycles (Else Bünemann)
9. Questions / discussion

?

Plants and animals need nutrients

Mg

Ca

N

K

S

P

micronutrients

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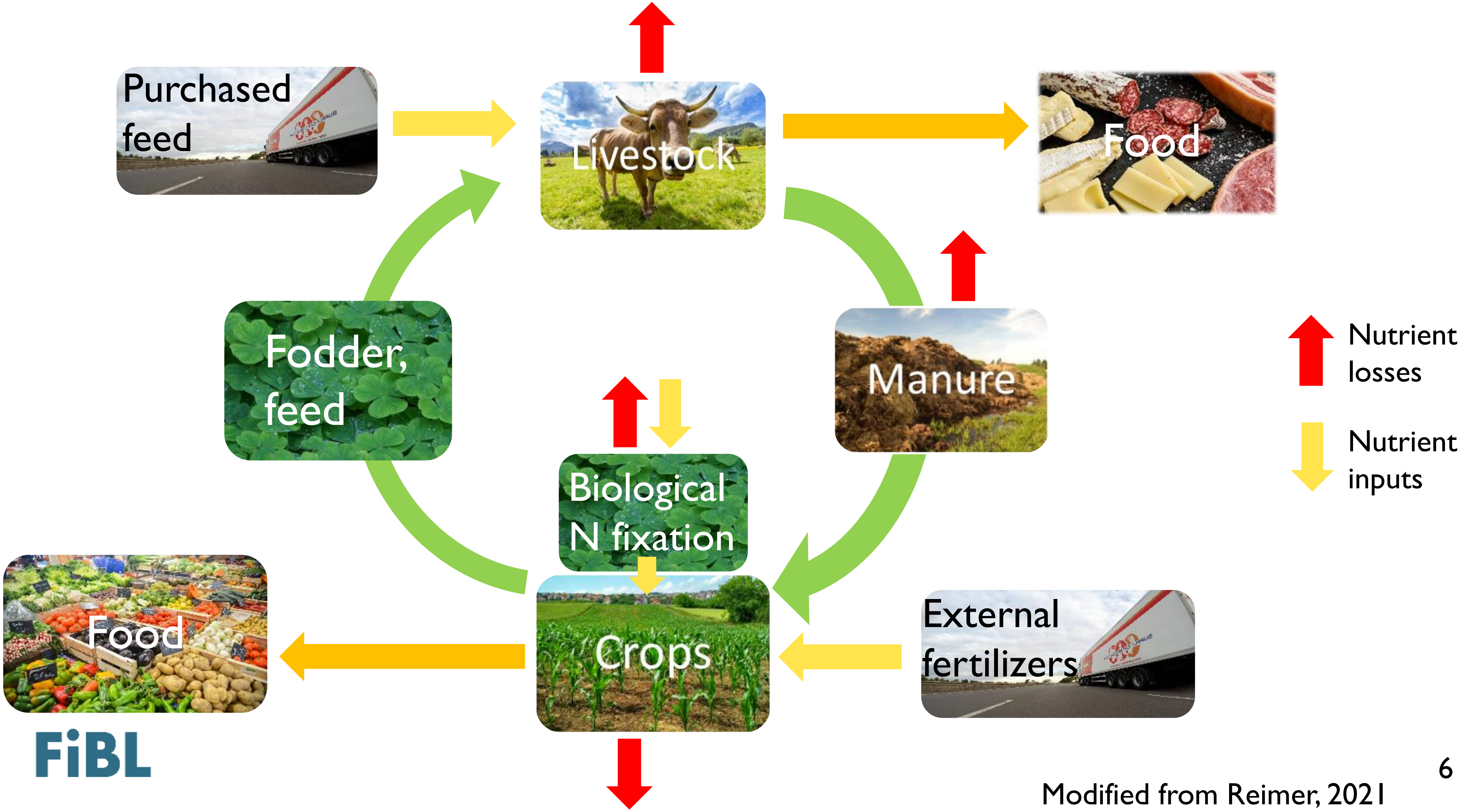
Nutrient cycle on a farm

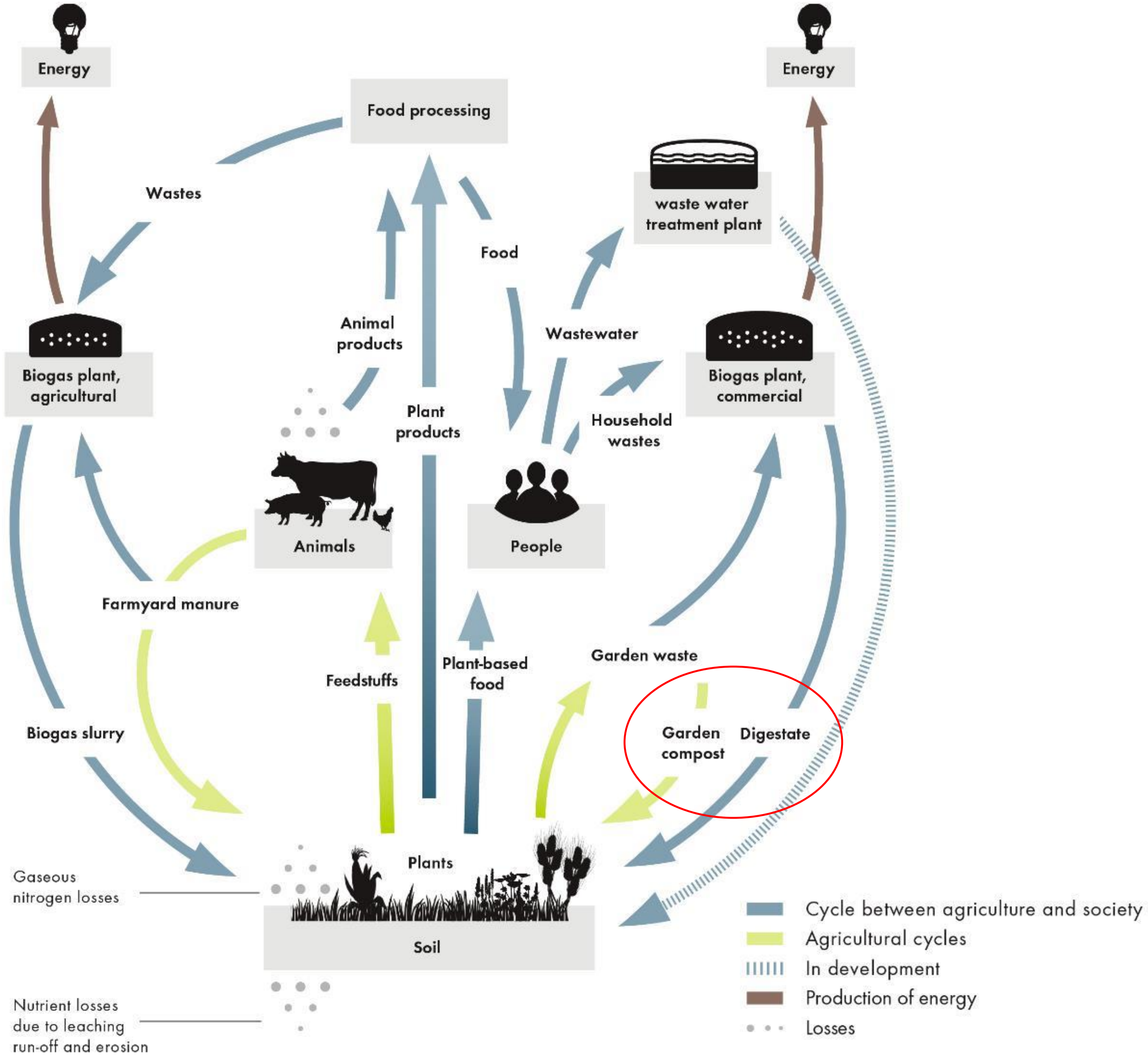


Modified from Reimer, 2021

Closing nutrient cycles

Switzerland
- 1.3 million tons of biowaste per year
- recycled through anaerobic digestion or composting:

• liquid digestate
• solid digestate
• compost



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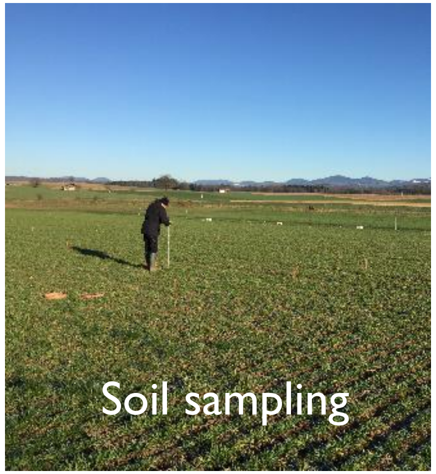
N use efficiency of recycled fertilizers in the field

Recycle4Bio


Composting


Fertilizer application


Yield assessment


Soil sampling

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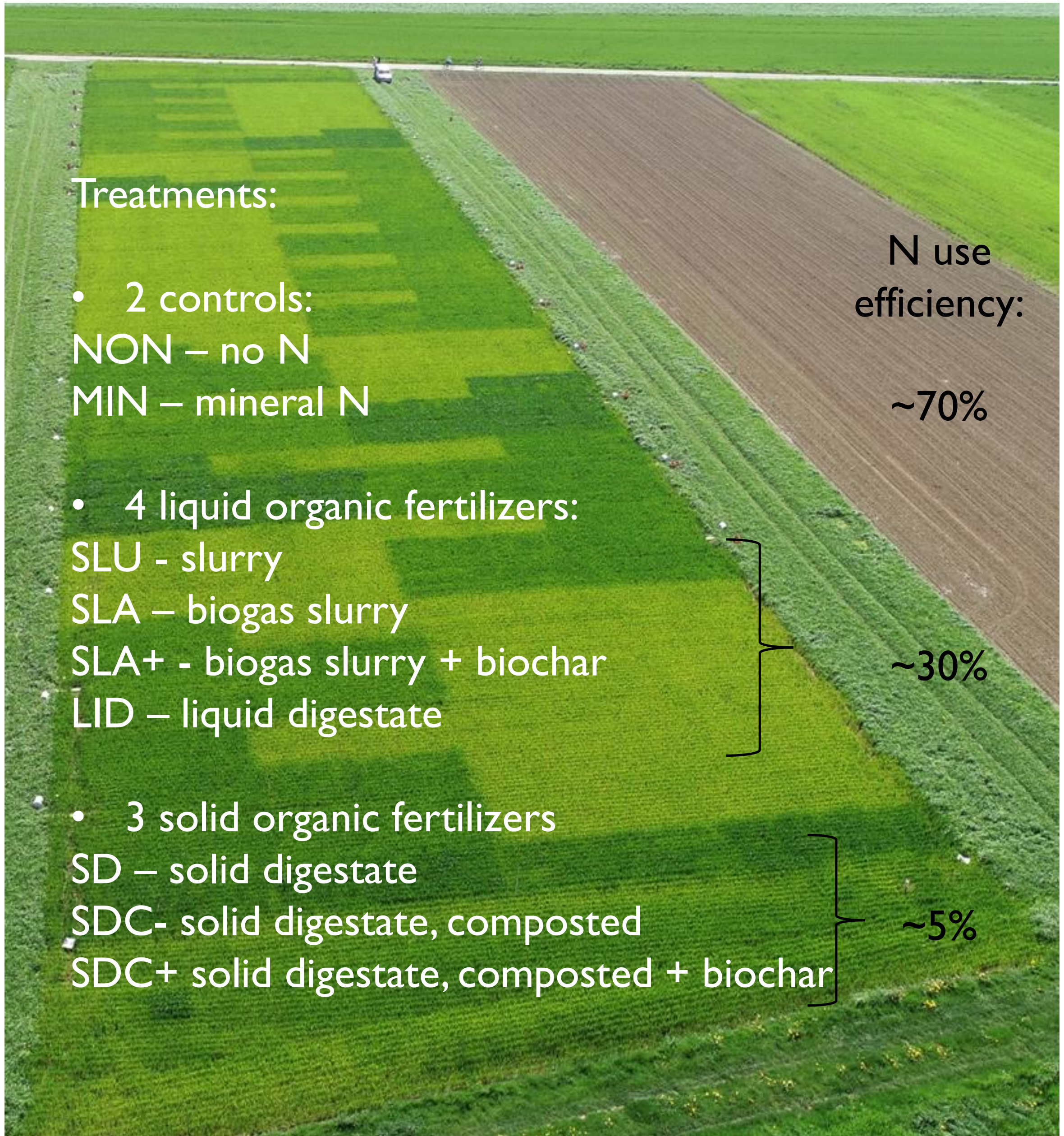


Treatments:

N use efficiency:

- 2 controls:

NON – no N

MIN – mineral N ~70%

- 4 liquid organic fertilizers:

SLU - slurry

SLA – biogas slurry

SLA+ - biogas slurry + biochar

LID – liquid digestate

~30%

- 3 solid organic fertilizers

SD – solid digestate

SDC- solid digestate, composted

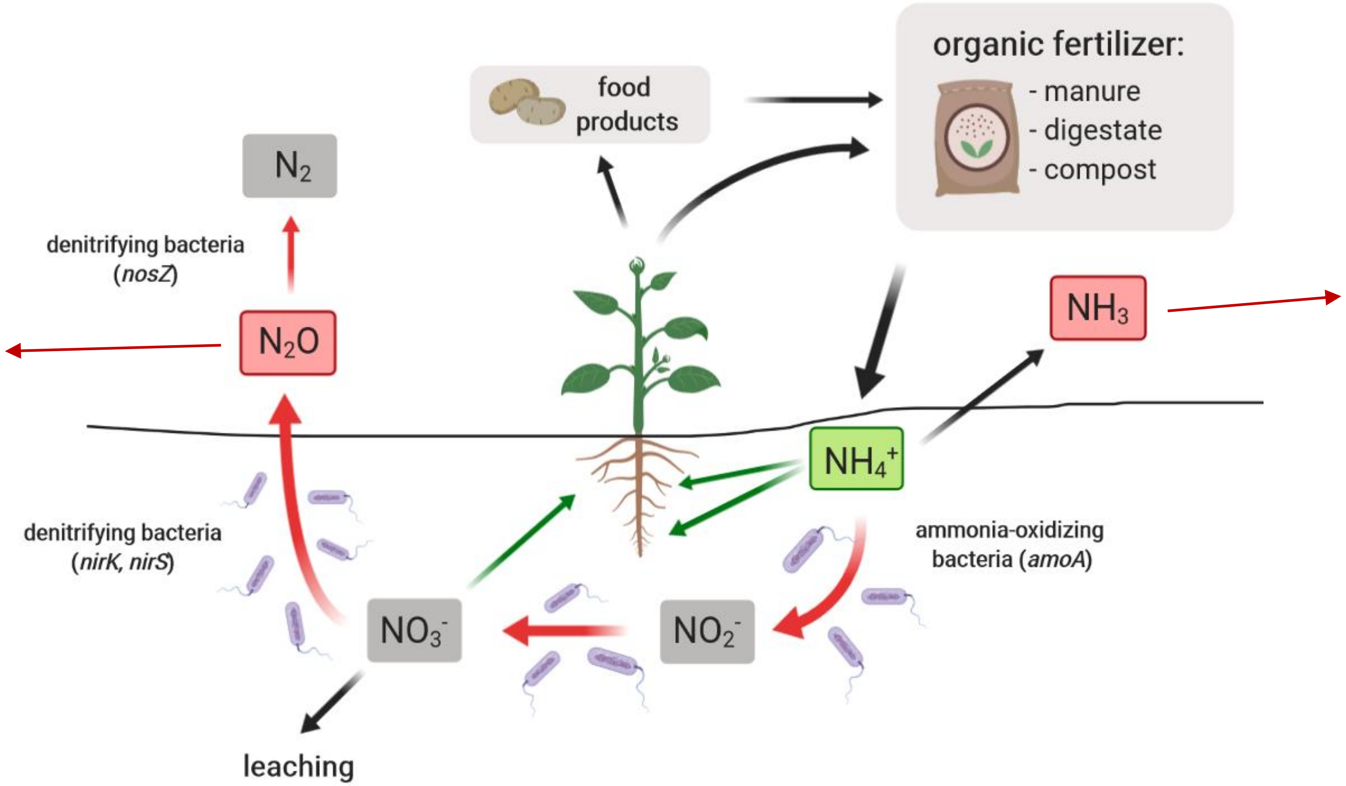
SDC+ solid digestate, composted + biochar

~5%

Gaseous emissions after field application of recycled fertilizers

N from fertilizers is lost due to nitrous oxide emission and ammonia volatilization.

Measuring nitrous oxide emissions.



Monitoring ammonia volatilization.

FiBL GHG-Recycle4Bio ETH zürich Sustainable Agroecosystems

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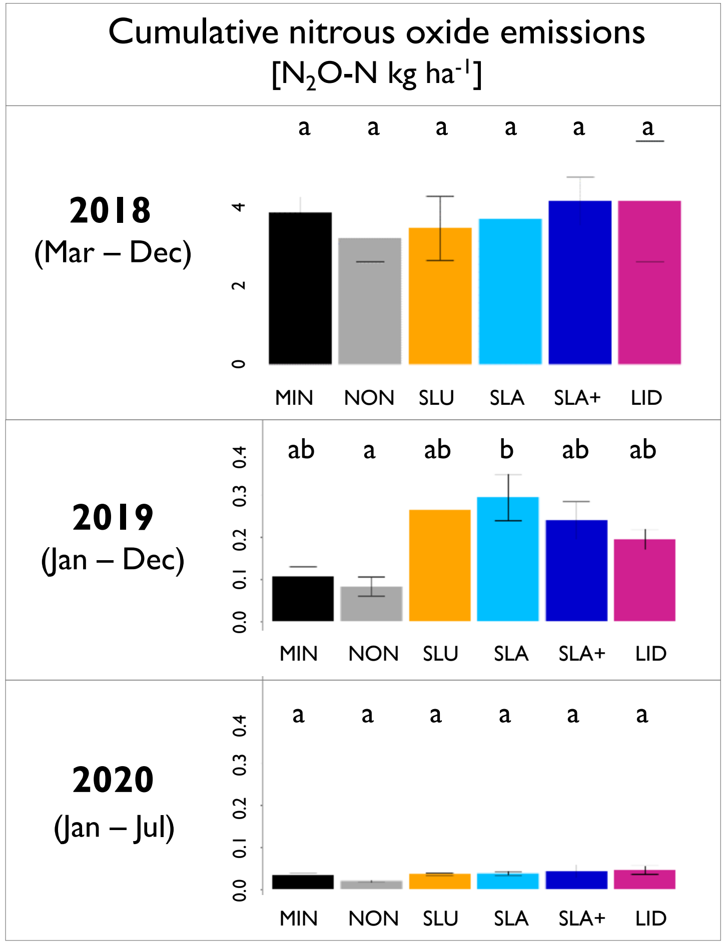
Confederaziun svizra

Swiss Federal Office of Energy SFOE
Federal Office for the Environment FOEN

Nitrous oxide emissions after field application of recycled fertilizers

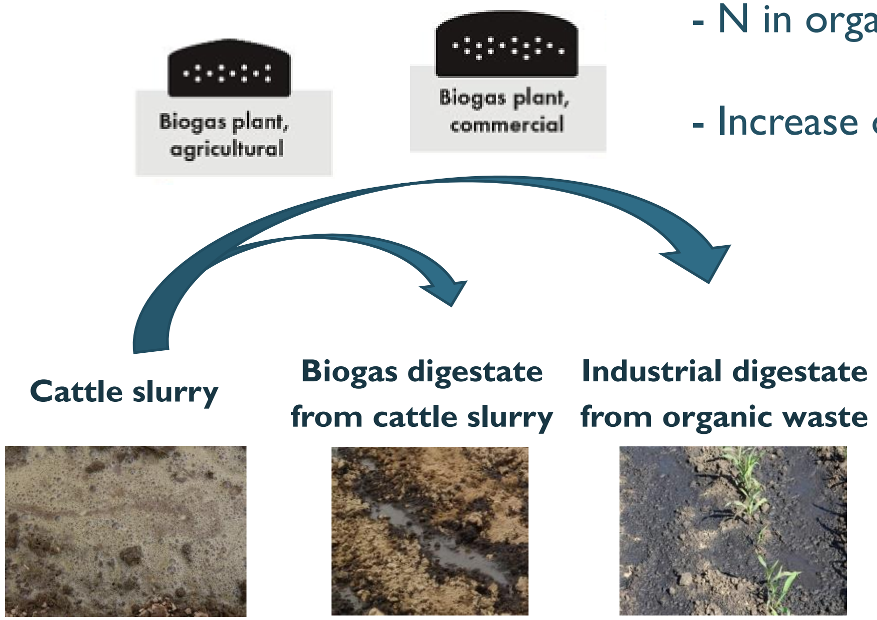


- Small differences between liquid organic fertilizers.
- Big differences between the years due to climate variation

	2018	2019	2020
Soil temperature	***	***	***
Soil moisture	*	***	**
Soil nitrate		***	
Soil ammonium		***	***

Significance levels: * $p<0.05$, ** $p<0.01$ and *** $p<0.001$

Ammonia volatilization after field application of recycled fertilizers



- N in organic compounds -> inorganic N (ammonium)

- Increase of pH

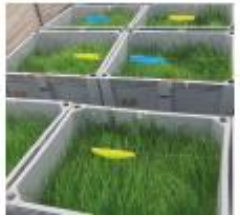
- More ammonia-N is lost from recycled fertilizers compared to cattle slurry.
- Ammonia-volatilization from recycled fertilizers continues for a longer period.

Gaseous emissions after field application of recycled fertilizers

Studying different N loss pathways is essential for optimizing nutrient management!

Individual climate settings should be considered during fertilization to reduce N losses!

The fate of manure nitrogen in the soil-plant system



^{15}N-labelled ryegrass

Feeding

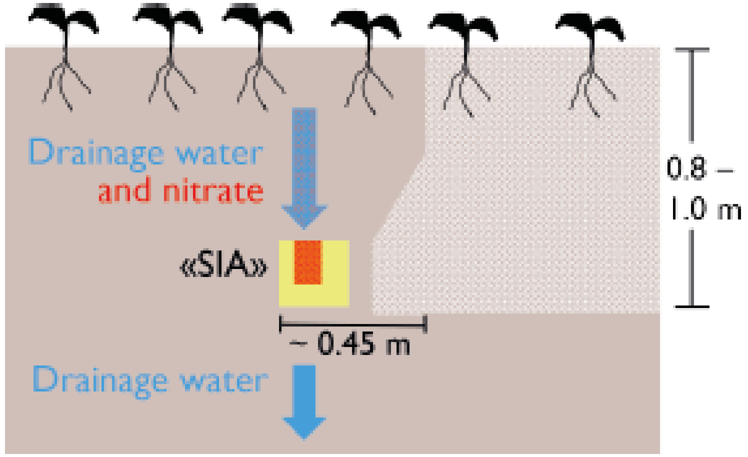
^{15}N cattle slurry

Year	Field A	Field B
2018	Grass-clover / Maize	Grass-clover
2019	Winter wheat	Grass-clover / Maize
2020	Cover crop	Winter wheat

N balance over 2 years at two field sites

Fertilizers

Con - 0N control
Min - ^{15}N mineral fertilizer
Slu - ^{15}N cattle slurry



«Self-integrating accumulators» for measuring nitrate leaching

Aim: Better understanding of N-dynamics, N use efficiency, residual effect & leaching losses of cattle slurry vs. mineral fertilizer

NitroGäu

^{15}N recovery in biomass

2018 | 2019 | 2020

Field A

Field B

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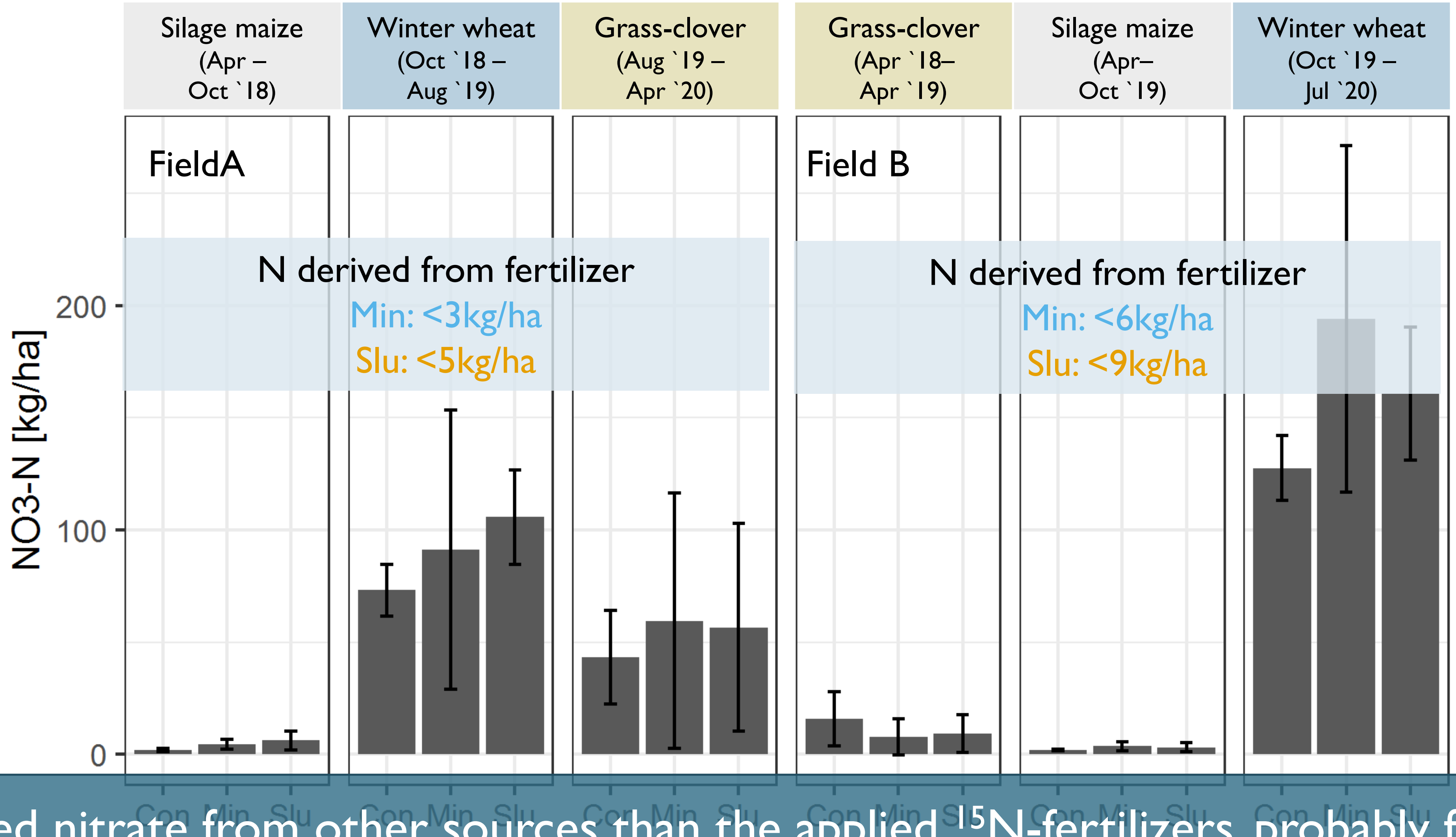
Nitrate leaching from animal manure vs mineral fertilizer

NitroGäu



Most of leached nitrate from other sources than the applied ^{15}N-fertilizers, probably from soil N. Soil N mineralization and turnover should be considered for controlling nitrate leaching.

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Availability of nitrogen in organic fertilizers to apple trees

Assess the **mineralization** dynamics of alternative fertilizers and their effect on apple tree **growth** and **leaf nutrient** content

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CORE organic DOMINO

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Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Departement für Wirtschaft, Bildung und Forschung WBF
Bundesamt für Landwirtschaft BLW

Availability of nitrogen in organic fertilizers to apple trees

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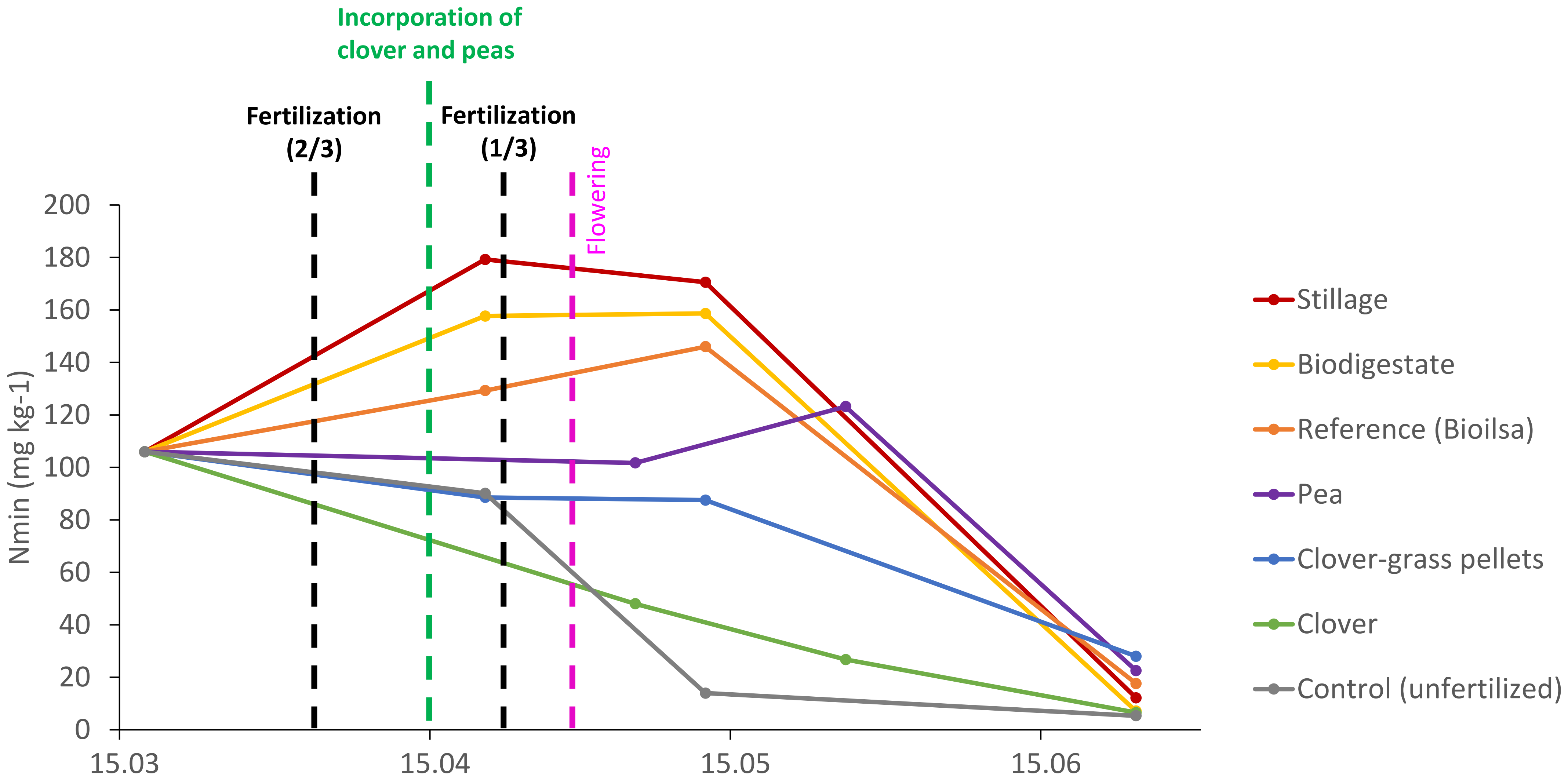
Availability of nitrogen in organic fertilizers to apple trees



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Availability of nitrogen in organic fertilizers to apple trees

- A combination of fast and slow nitrogen releasing sources could be used to cover the demand of the apple trees.
- Studies on the biomass and **C/N ratio** of peas are needed in order to systematically understand the mechanism of nitrogen supply from **peas**, identified as a promising alternative resource.
- Studies on the **yield and quality** of apples are required in order to find out the effect of organic resources on fruit harvesting.

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Using sheep wool, clover-grass and organic mulch to produce tomatoes

- Practice-orientated trial
- Testing farm-produced fertilisers

T1	T2	T3	T4
Plastic mulch		Organic Mulch	
Control	Sheepwool-pellets	Sheepwool-pellets	Incorporated Clover-Grass

- Sponsored by the Canton of Zürich

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Problems in greenhouse/tunnel:

- Intensive crop rotation, little variety
- Green manure rather rare
- Strongly dependent on external inputs

Aims:

- Use of locally produced fertilization to close nutrient cycle
- Revitalization of soil

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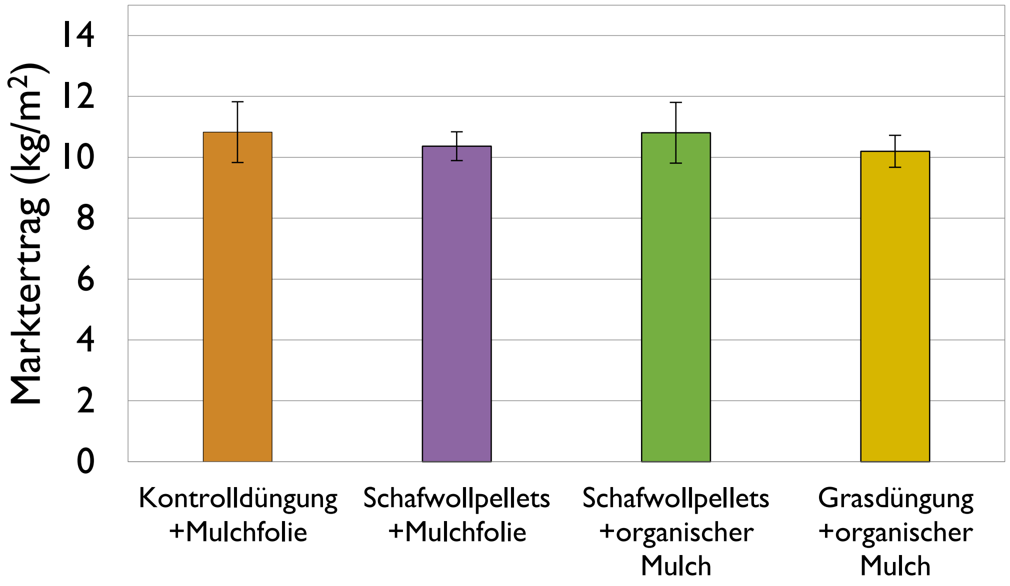

- Yield level could be maintained in this trial with the sheepwool as well as the clover-grass fertilization
- Keep nutrient balance in mind with mulch and incorporated clover-grass. High P and K levels might be brought into the system
- Mulch: Close monitoring needed

Duckweeds (Lemnaceae) for aquatic nutrient recycling

- 38 different species, 5 genera
- Global distribution in tropics, subtropics and temperate zones
- Grow very fast and produce large biomasses (10-75 DM t/ha/a)
- High protein content (18-45% in DM)
- Protein production 3 to 10-fold higher than soybeans
- Very efficient nutrient (N and P) uptake (70-98%)

Animal slurry as nutrient source for duckweed

- Duckweed can be succesfully grown on diluted animal manures (cows and pigs)
- NH_4 most important N-source for duckweed (ca. 20 mg/l → dilution factor)
- Heavy metals will be accumulated too (copper, zinc, lead, etc.)
- Direct contact between duckweeds and animal slurry → biosafety
- Sterilisation necessary

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Utilisation of duckweeds

- Animal feeds: can replace fishmeal or soy meal in fish feeds
- Bioethanol: duckweed can be produced with high starch content and used for bioethanol production
- Green manure: rice fields produced higher yields with duckweed
- Remediation: duckweeds used to clear nutrient rich or polluted water (e.g. mine run off)

Recycled fertilizer and plant health

- Indirect effects by improving the physical and chemical properties of the soil.
- Activation of biological soil activity by providing substrates for soil microorganisms
- Positive microorganisms that develop during the composting process can protect plants from pathogens ("suppressive effect")

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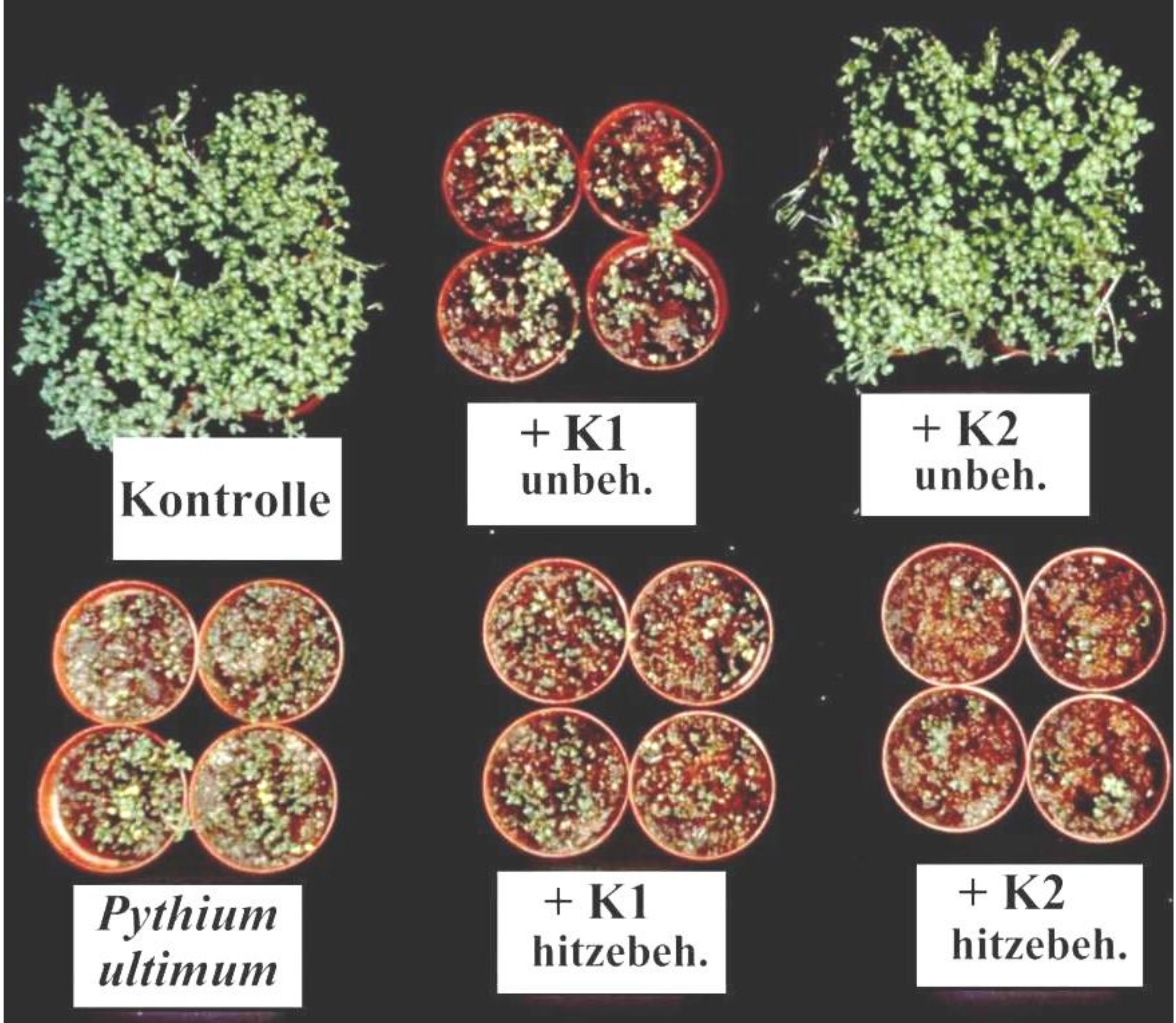
Recycled fertilizer and plant health

Compost
≠
Compost



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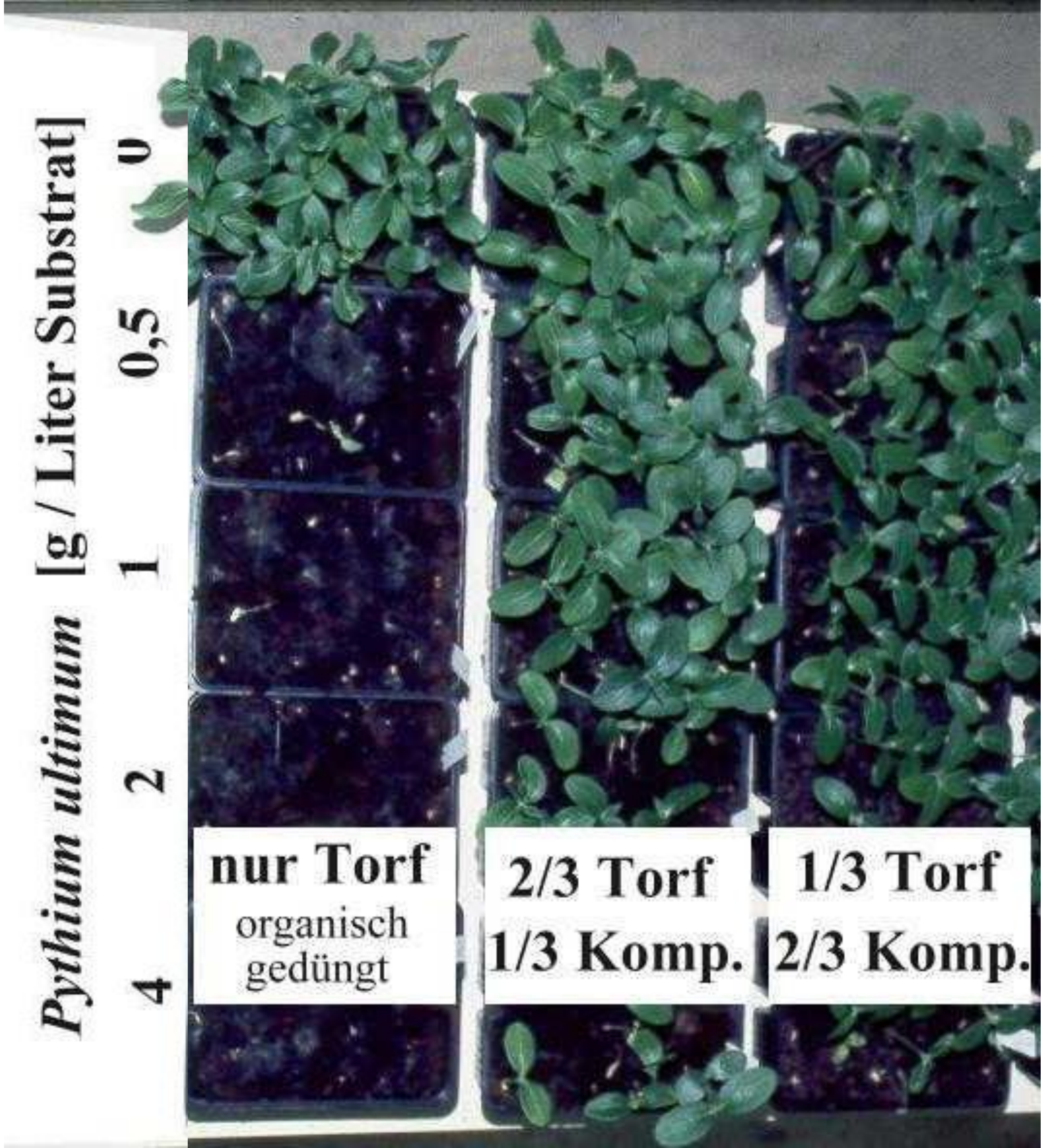
Recycled fertilizer and plant health

Example 1:

Compost in growing media



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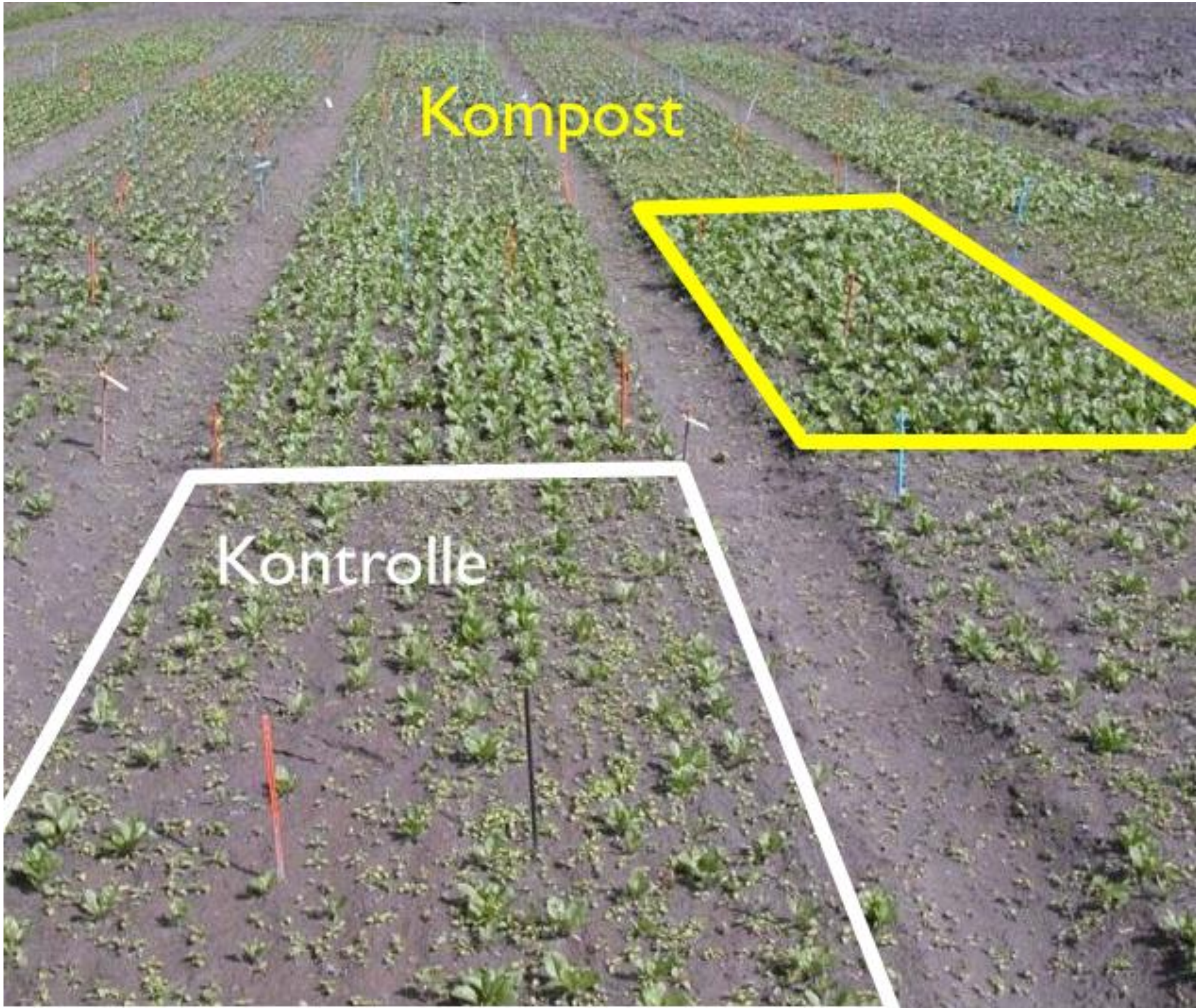
Recycled fertilizer and plant health

Example 2:

Control of emergence disease in spinach



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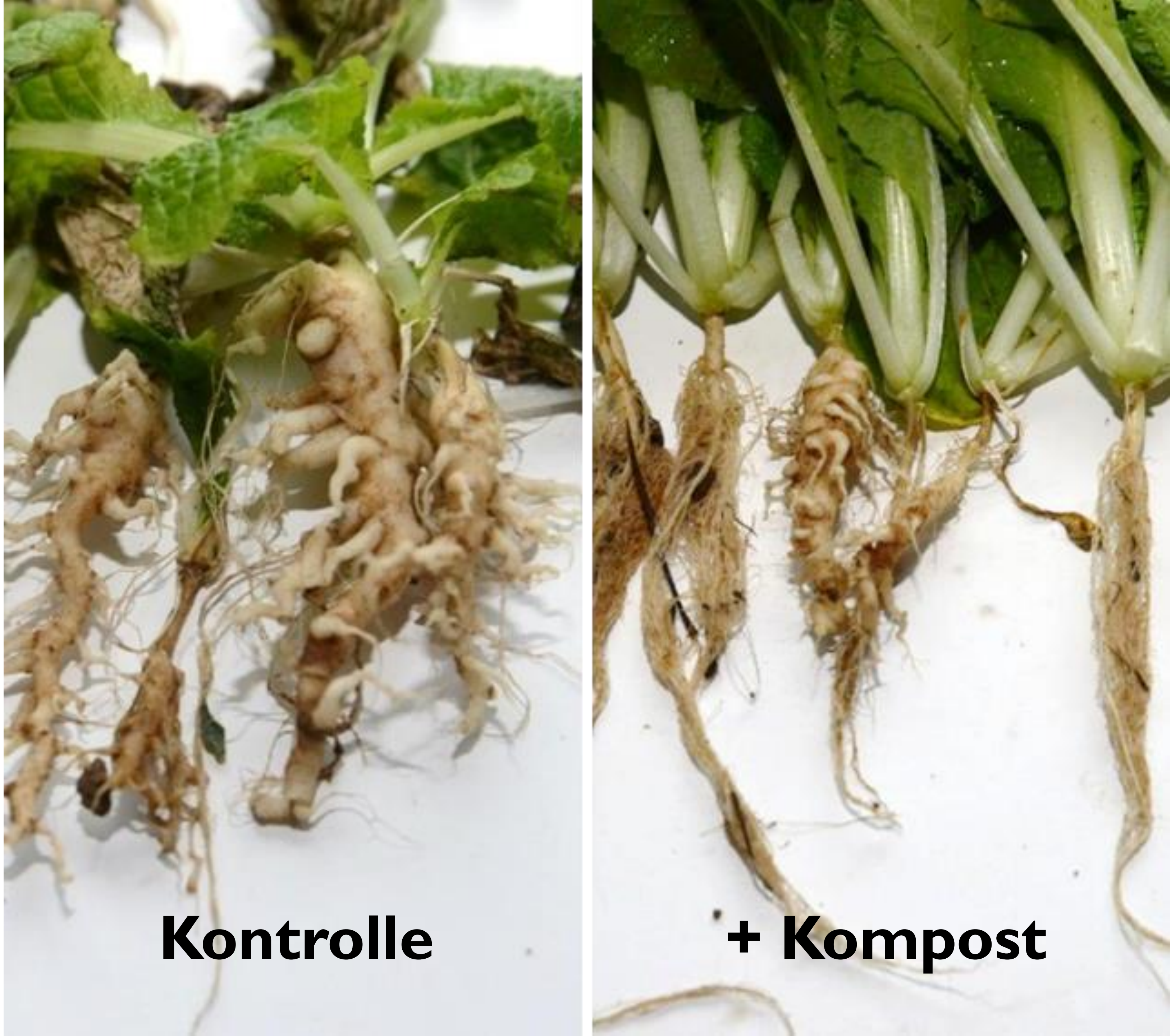
Recycled fertilizer and plant health

Example 3:

Control of cabbage club rot



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Quality of the recycled fertilizer: the prerequisite for success

From the collection concept of biowaste to the application of the final product

- Quality of raw materials
- Composition of the initial mixture
- Rotting management
  - Regulation of water content
  - Regulation of the air balance
- Product conditioning
- Product storage
- Correct choice of product and application strategy for the intended use

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Outlook

- Biological processes such as biological nitrogen fixation
- Acceptable nutrient sources for organic agriculture
- Nutrient recovery from waste water treatment plants
- Increased nutrient use efficiency = reduction in nutrient losses

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Do you have any questions?