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Agroscope

Nitrate leaching under vegetables with different crop residue management

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Initial situation and objectives

- Measurement data on nitrate leaching from field vegetable are still scarce and often not transferable to Swiss conditions (e.g. much rainfall).
- Some vegetable species have high amounts of N in the crop residues, which increases the risk of nitrate leaching when incorporated into the soil.
- In a 3-year lysimeter experiment with vegetables, two forms of crop residue management were compared:

  a) incorporation of crop residues

  b) removal of above-ground crop residues from the field

Lysimeter experiment

- 12 lysimeters (surface area of 3 m^2; 2.5 m deep)
- 2 different types of repacked soils:
  sandy-loamy Cambisol ("gravel soil") and
  loamy Cambisol ("moraine soil")
- 2 treatments of crop residue management
- 3 replicates
- Measurement data on nitrate leaching are reported from April 2017 to March 2020:

  nitrate concentration of seepage water was measured every 2 weeks

Crop rotation and management

Crop rotation:

year 1: broccoli + lettuce 1 + 2

year 2: chinese cabbage + leek

year 3: cabbage + sugar loaf

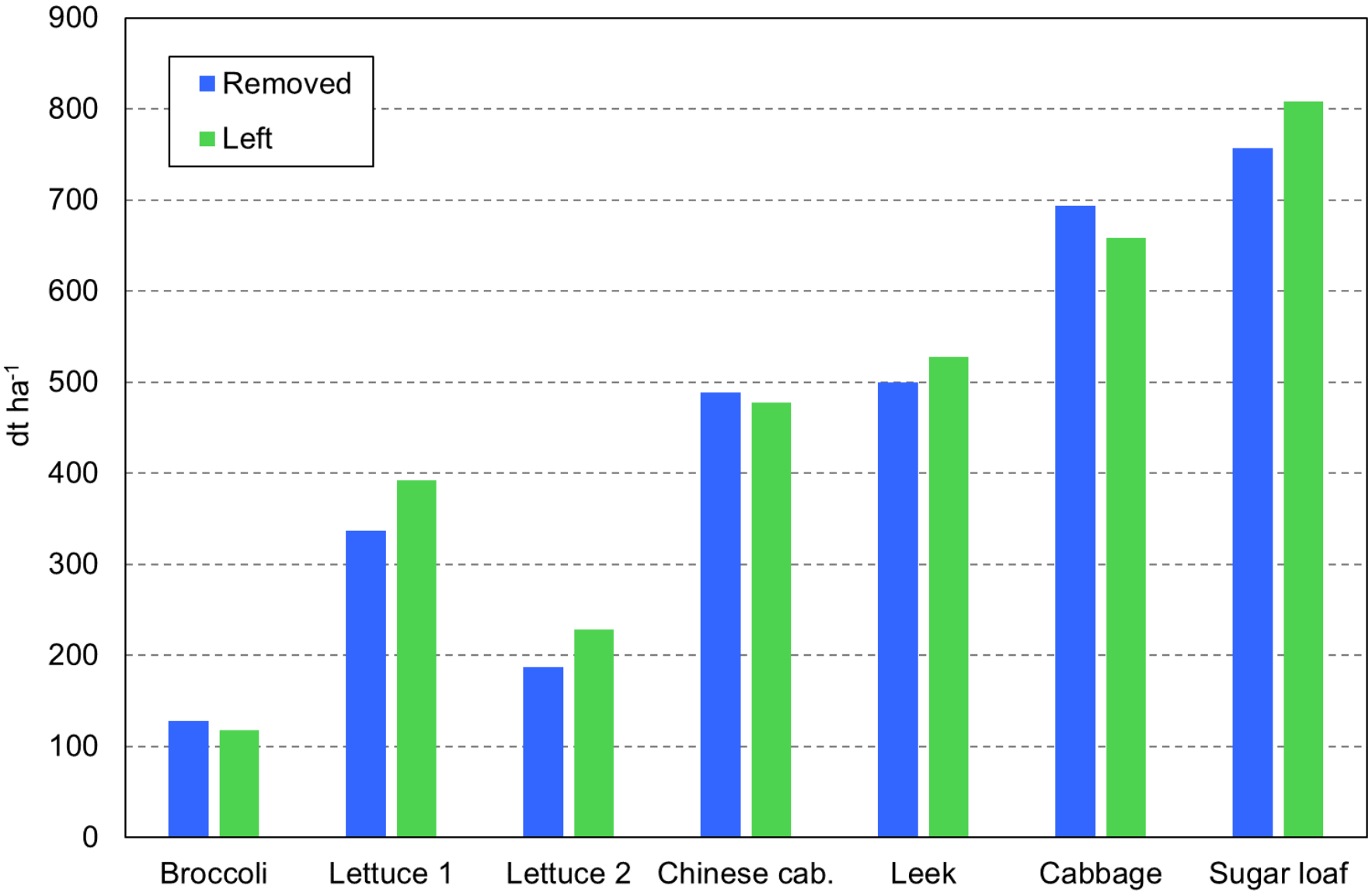
bare soil over winter

Crop management as far as possible in accordance with standard practice

Official N fertilizer recommendations were reduced by 20% of N in crop residues, if residues were not removed.

Precipitation: 928 mm year^{-1} (range: 826 – 981)
Irrigation: 164 mm year^{-1} (range: 135 – 200)
Total: 1092 mm year^{-1}

Marketable yields



Seepage volume and nitrate leaching

	Gravel soil		Moraine soil		Overall mean:			
	Removed	Left	Removed	Left	Removed		Left	Difference
Seepage volume (mm):								
2017/18	489	491	450	443				
2018/19	469	479	478	462	512	=	507	1%
2019/20	582	593	605	571				
Nitrate concentration (mg NO_3^- L^1):								
2017/18	99	132	116	85				
2018/19	56	71	43	56	102	<	119	-14%
2019/20	77	108	200	236				
Amount of nitrate leached (kg N ha^{-1}):								
2017/18	109	146	118	85				
2018/19	60	77	46	58	118	<	136	-13%
2019/20	101	144	273	305				

Diff. 18 kg N ha^{-1}

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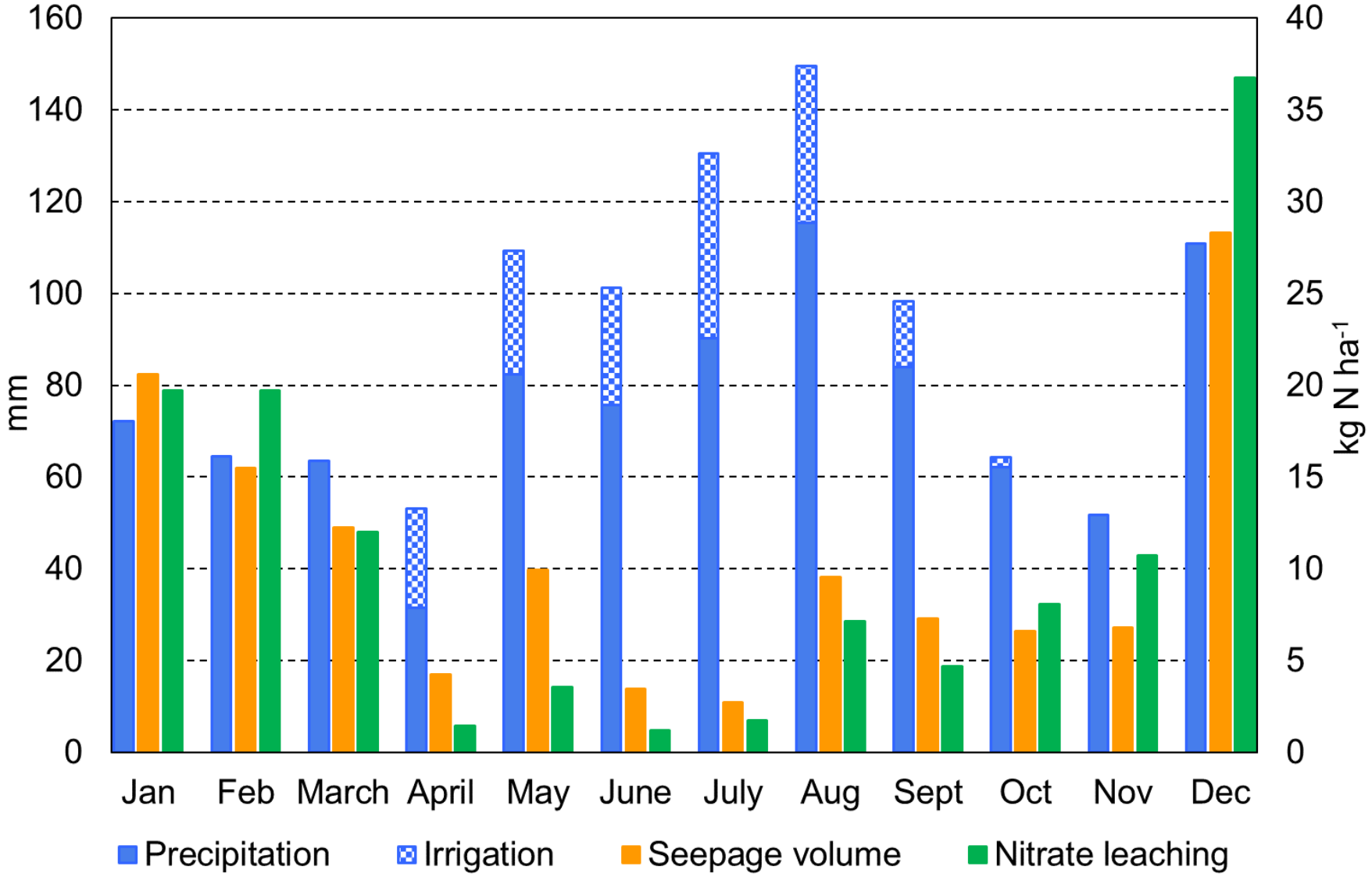
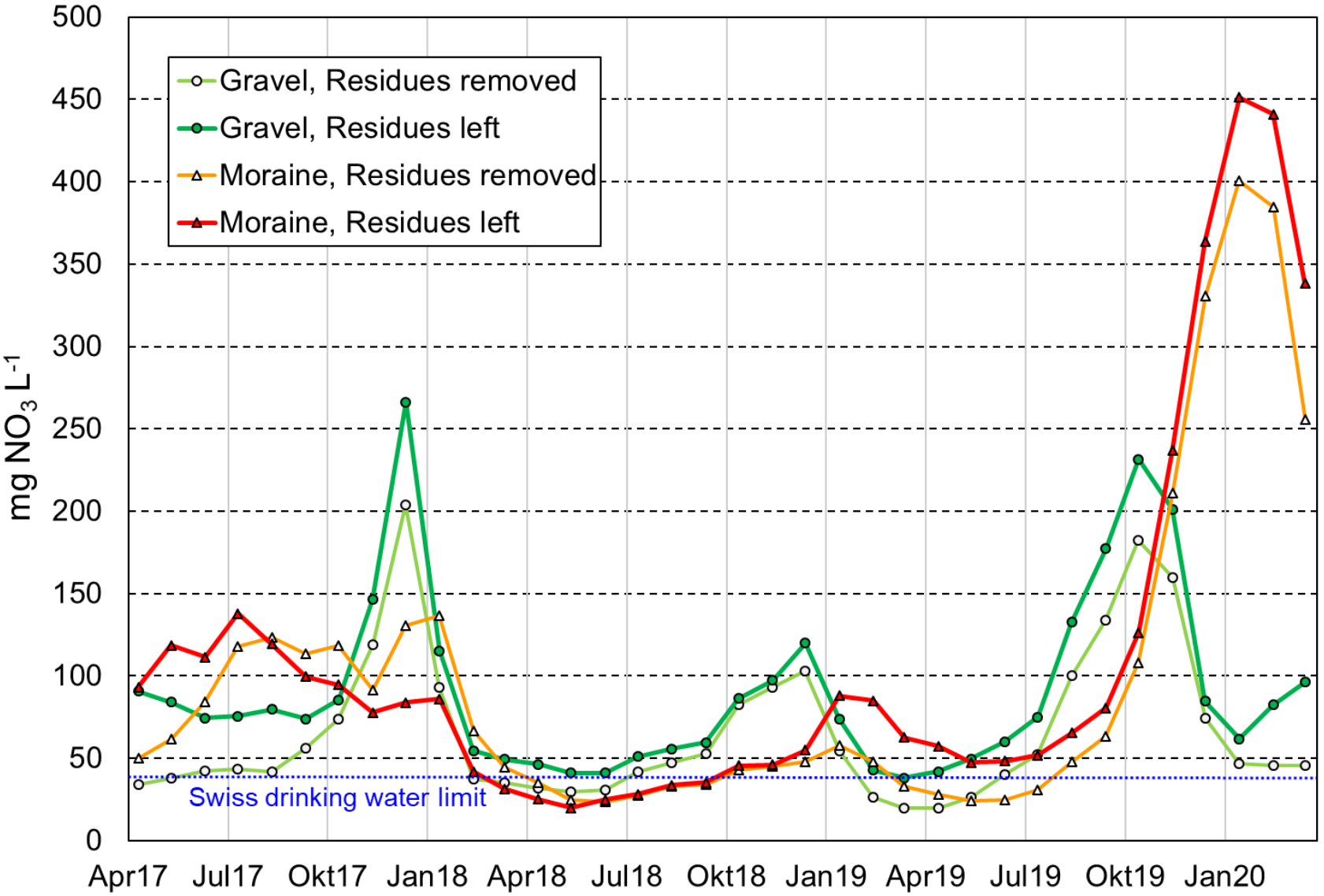
Precipitation, irrigation, seepage volume and amount of N leached



Development over time of nitrate concentration of seepage water



N balance (kg ha^{-1})

	N balance						N in crop residues
	Residues removed			Residues left			
	Fertilizer	Removal	Balance	Fertilizer	Removal	Balance	
Broccoli	250	230	20	245	71	174	156
Lettuce 1	120	96	24	90	74	16	28
Lettuce 2	120	65	55	110	48	62	19
Year 1	**490**	**390**	**100**	**445**	**193**	**252**	**203**
Chinese cab.	180	268	-88	175	125	50	135
Leek	220	226	-6	200	178	22	73
Year 2	**400**	**495**	**-95**	**375**	**302**	**73**	**208**
Cabbage	220	217	3	200	130	70	80
Sugar loaf	140	226	-86	110	145	-35	95
Year 3	**360**	**443**	**-83**	**310**	**275**	**35**	**175**
3-yr mean	**417**	**443**	**-26**	**377**	**257**	**120**	**195**

Diff. 146 kg N ha^{-1}

Conclusions:
1) General remarks

Mean nitrate concentration >100 mg NO_3 L^{-1}
→ above limit for drinking water quality

Amount of nitrate leached: 50 – 300 kg N ha^{-1} $year^{-1}$
→ field vegetables > arable crops > grassland

2) Influence of removing crop residues

equal:

crop yield (marketable yield and crop residues)

seepage volume

somewhat smaller:

nitrate concentration	- 14%
amount of nitrate leached	- 18 kg N ha^{-1}

much smaller:

N balance	- 146 kg N ha^{-1}

What happens to the 128 kg N ha^{-1} not accounted for? Increase in soil N, ammonia volatilization, denitrification, increasing vegetable yields and/or leaching losses in future?

→ We prolong our lysimeter experiment.

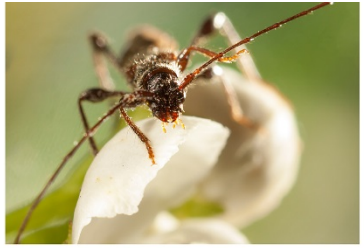
3) Other consequences

Removing crop residues reduces nitrate leaching,

but:

- increases workload and production costs
- what do we do with the crop residues removed?
  aerobic or anaerobic fermentation (compost, biogas), other solutions?
- humus balance of soil: Do we have to replace the crop residues removed by other organic matter?
  What is the impact of applying compost on nitrate leaching?












Thank you for your attention

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