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Quality of Swiss compost – Interrelations of parameters characterising agronomic quality

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What is compost Quality?

Compost Quality			
Soil Quality	Plant nutrition	Plant disease suppression	Environmental quality
Pollutants: • heavy metals • organic pollutants Soil organic matter Soil structure Soil biology Soil acidity	Macro nutrients Micro nutrients N availability	Direct suppression: • compost-plant interaction Indirect suppression: • compost-soil-plant interaction	Processing, storage, application: • NH ₃ volatilisation • N ₂ O volatilisation • CH ₄ volatilisation Odour

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Objectives

- Screening of quality of Swiss composts and digestate
- Evaluation of relations between analytical parameters to predict
 - compost nitrogen dynamics
 - compost maturity
 - plant disease suppression

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Material & methods

100 samples of compost and digestate all over Switzerland

Characteristics	Classification	No. samples
Product	• solid digestate	3
	• liquid digestate	11
	• compost agriculture	34
	• compost horticulture	36
	• compost glasshouse / private gardens	16
Composition	• green waste only	52
	• green waste with bio-waste	49
Process intensity	• > 0 – 1 turnings per week	65
	• 2 – 3 turnings per week	29



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Material & methods

100 samples of compost and digestate all over Switzerland

Characteristics	Classification	No. samples
System	• methanisation (thermophilic; mesophilic)	20
	• triangular piles (< 2m; > 2m)	41
	• table piles	7
	• aerated boxes	5
	• aerated canal or shed	4
	• edges of field	9
	• vermicomposting	3
Origin	• urban	59
	• rural	21

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Material & methods

Analytical parameters: agronomic quality

Soil Quality	Plant nutrition	Plant disease suppressivity	Environmental quality
<ul style="list-style-type: none"> • Organic matter • pH (H₂O, 1:2 v/v) • C_t, N_t / ¹⁵N, ¹³C • H₂O-, NaOH-, pyro-phosphate extracts • DOC, DN (H₂O, CaCl₂) • Microbial biomass(CFE) • Respiration ratio (4;28d) • FDA-hydrolysis • Enzyme activities • Humic acids • FTIR spectroscopy 	<ul style="list-style-type: none"> • Macro nutrients: - N, P, K, Mg, Ca • Micro nutrients: - Fe, Mn, Cu, Zn • Mineral N: - NH₄⁺, NO₃⁻, NO₂⁻ (H₂O, CaCl₂) • N-mineralization (56d, 25°C) 	<ul style="list-style-type: none"> Phytotoxicity: - Cress test (open, closed) - Salad test - Raygrass test - Bean test - Salt content Suppressivity: - Phytium cucumber - Rhizoctonia basil 	<ul style="list-style-type: none"> • Anaerobic gas potential • Acetate

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Characteristics of Swiss composts

Key parameters of compost and solid digestate (n = 97)

	Median	Min.	Max.	10% Perc.	90% Perc.
Organic matter [%]	42	17	80	25	56
N _t [g kg ⁻¹ DM]	16	8.6	28	11	20
C:N ratio	14	8.9	29	11	21
P [g kg ⁻¹ DM]	3.1	1.3	13	2.1	4.0
K [g kg ⁻¹ DM]	12	2.2	28	6.9	16
pH (H ₂ O)	8.4	7.4	8.7	8.0	8.6
Salt [mg KCl 100g ⁻¹ FS]	3030	675	7575	1552	4320

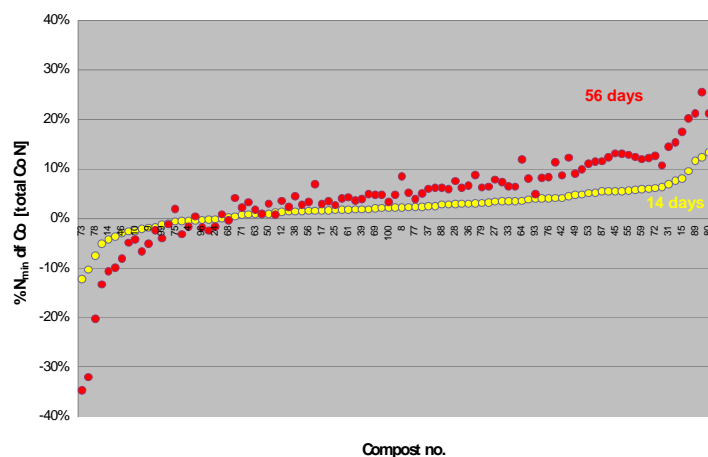
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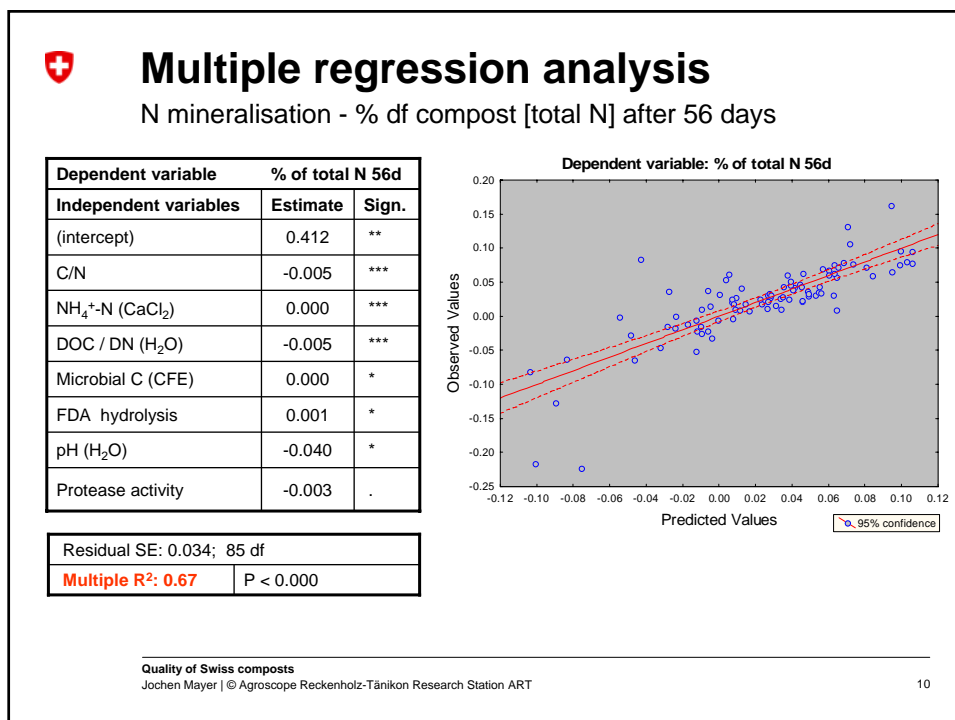
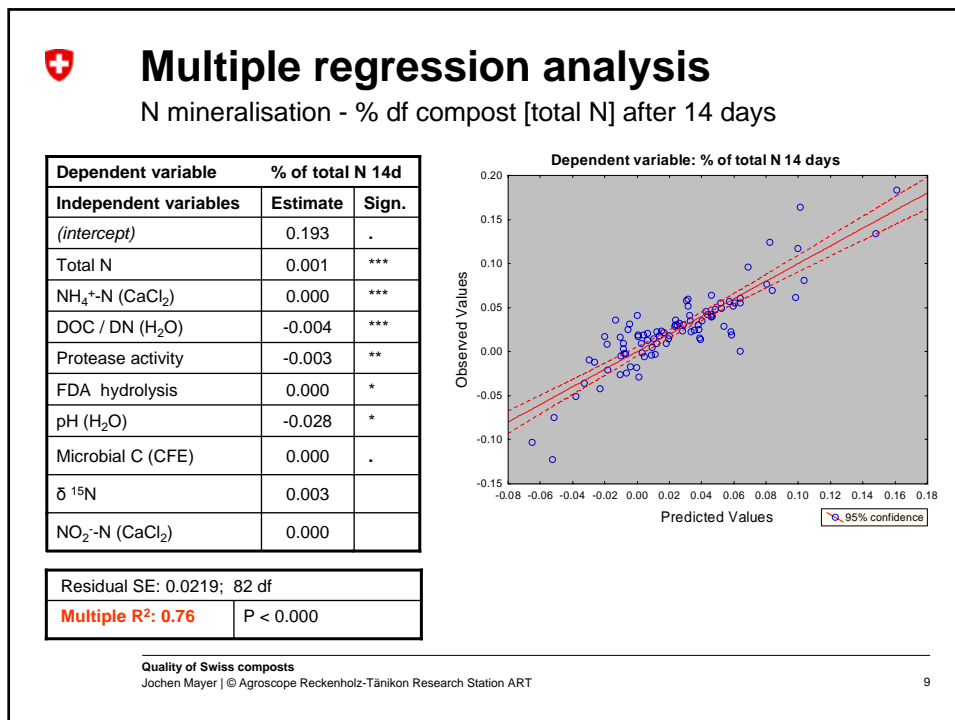
Compost N mineralisation

Incubation experiment, 14 and 56 days, 25°C



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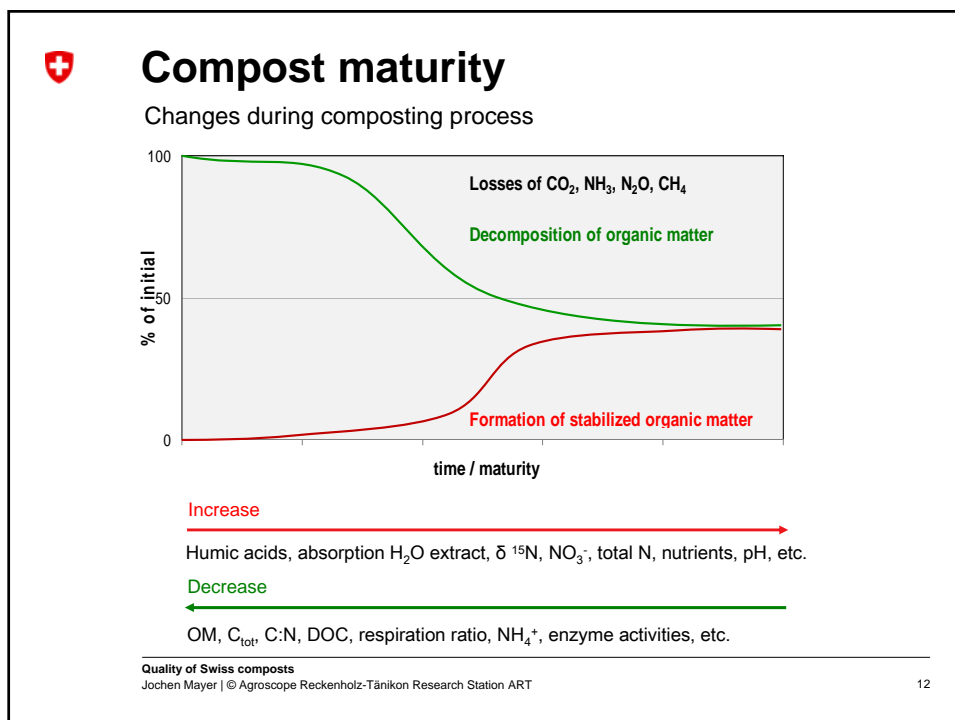
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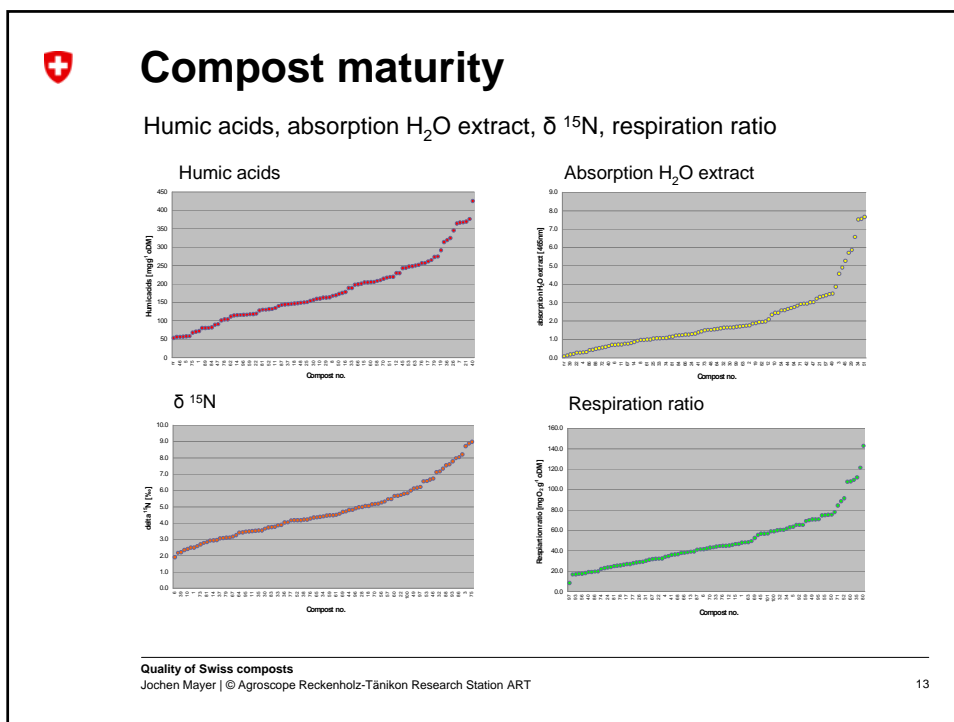


Summary regressions mineral N

	% N _{min} df compost [total N] 14 days	P	% N _{min} df compost [total N] 56 days	P
NH ₄ ⁺ -N (CaCl ₂)	X	***	X	***
DOC / DN (H ₂ O)	X	***	X	***
FDA hydrolysis	X	*	X	*
pH (H ₂ O)	X	*	X	*
C / N			X	***
Microbial C (CFE)	X	.	X	*
Protease activity	X	**	X	.
Total N	X	***		
δ ¹⁵ N	X			
NO ₂ ⁻ -N (CaCl ₂)	X			
Multiple R²	0.76		0.67	

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Compost maturity

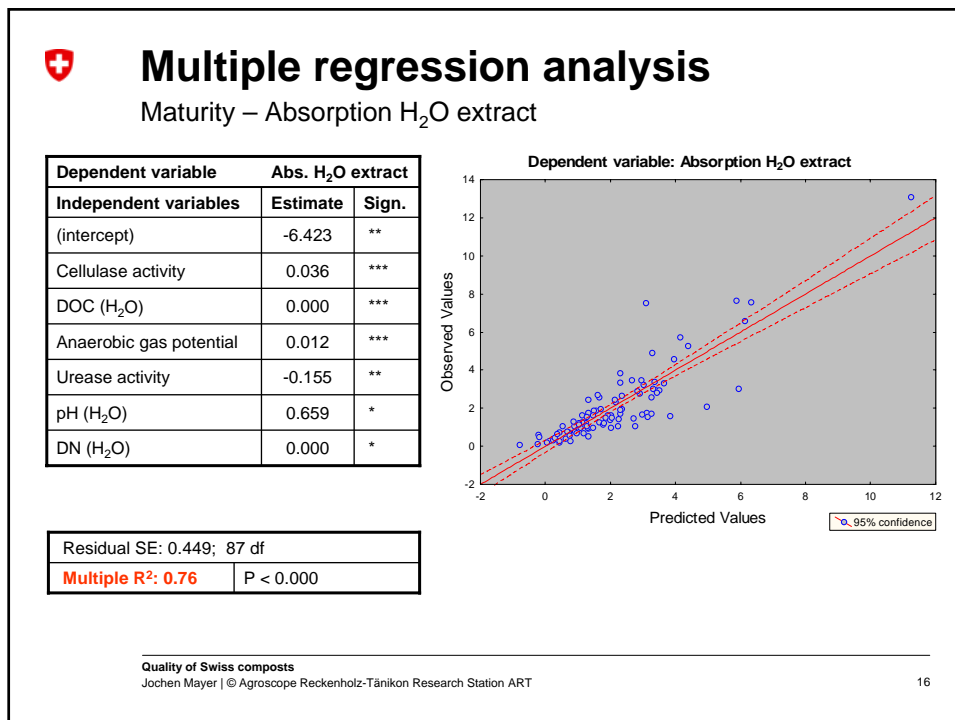
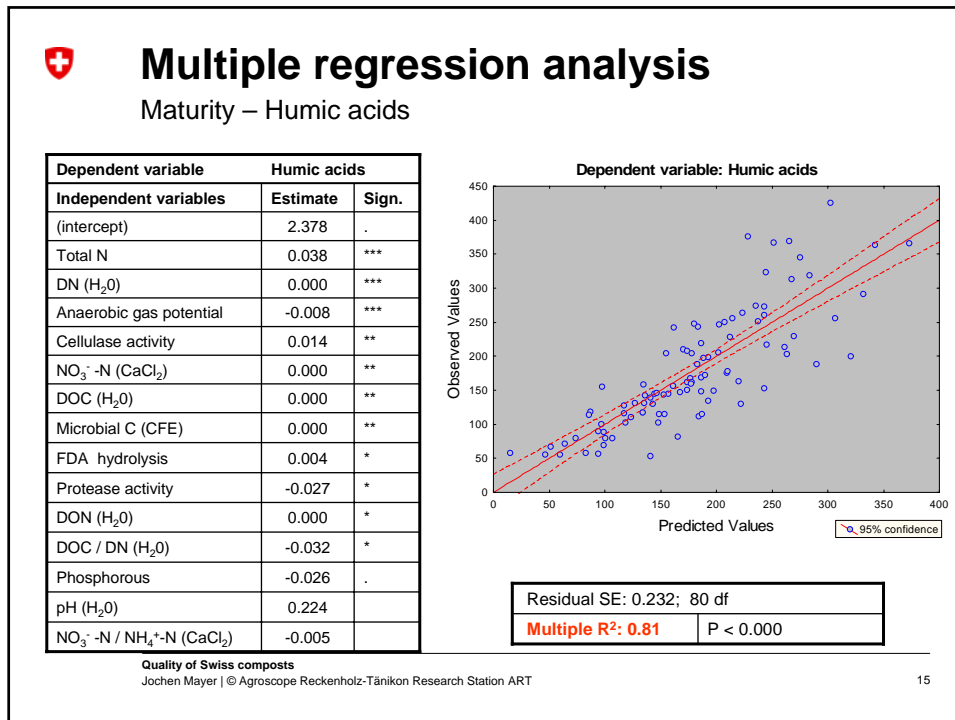
Humic acids, absorption H₂O extract, δ¹⁵N, respiration ratio

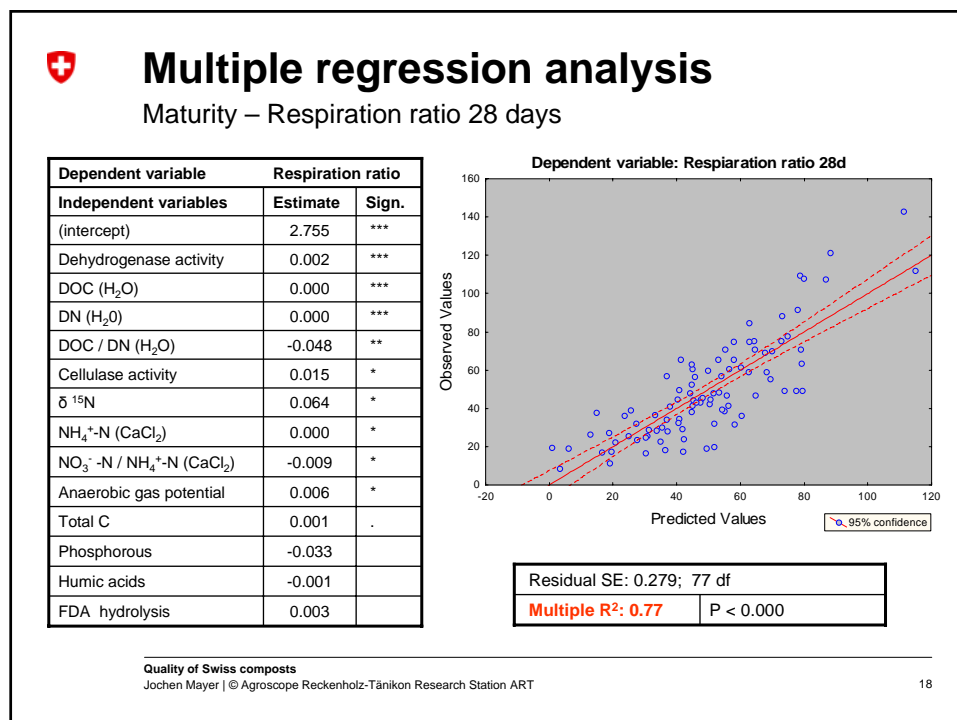
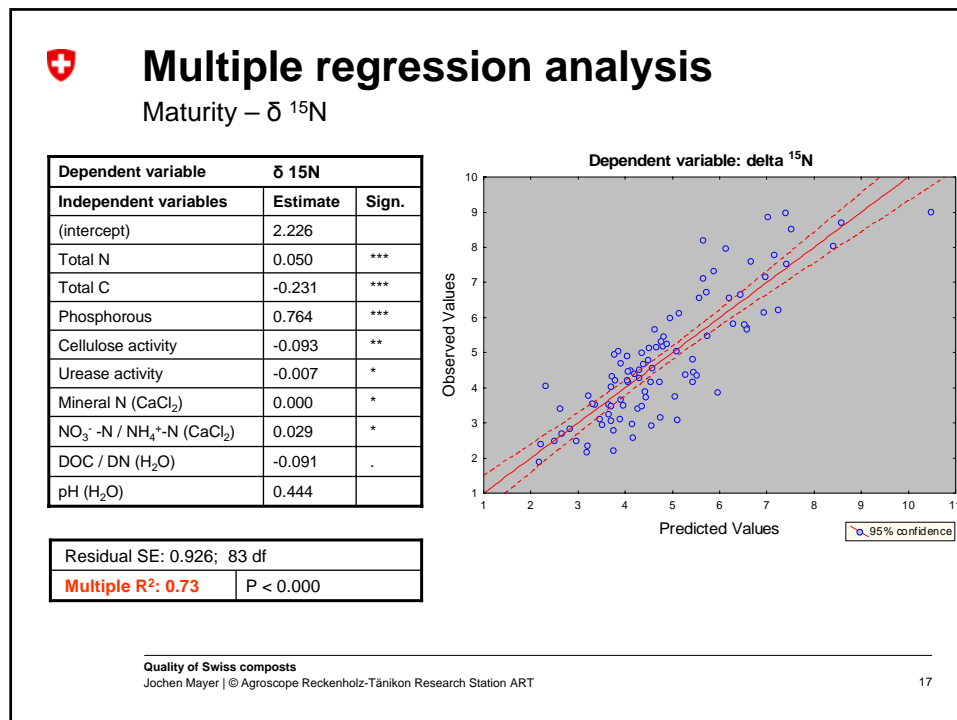
Correlation matrix


	Humic acids	Absorption H ₂ O extract	δ ¹⁵ N	Respiration ratio (28d)
Humic acids		0.20	-0.05	0.20
Absorption H ₂ O extract	0.20		0.01	0.52*
δ ¹⁵ N	-0.05	0.01		-0.09
Respiration ratio (28d)	-0.20	0.52*	-0.09	

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 **Summary regressions maturity**

	Humic acids	P	Absorp. H ₂ O extract	P	δ ¹⁵ N	P	Respiration ratio	P
Cellulase activity	X	**	X	***	X	**	X	*
Anaerobic gas potential	X	***	X	***			X	*
DN (H ₂ O)	X	***	X	*			X	***
DOC (H ₂ O)	X	**	X	***			X	***
DOC / DN (H ₂ O)	X	*			X	.	X	**
NO ₃ ⁻ -N / NH ₄ ⁺ -N (CaCl ₂)	X				X	*	X	*
Total N	X	***			X	***		
Multiple R²	0.82		0.76		0.73		0.77	

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 **Summary regressions maturity**

	Humic acids	P	Absorp. H ₂ O extract	P	δ ¹⁵ N	P	Respiration ratio	P
Dehydrogenase activity							X	***
DON (H ₂ O)	X	*						
FDA hydrolysis	X	*					X	
Microbial C (CFE)	X	**						
Mineral N (CaCl ₂)					X	*		
NH ₄ ⁺ -N (CaCl ₂)							X	*
NO ₃ ⁻ -N (CaCl ₂)	X	**						
pH (H ₂ O)	X		X	*	X			
Phosphorous	X	.			X	** *	X	
Protease activity	X	*						
Total C					X	** *	X	.
Urease activity			X	**	X	*		
δ ¹⁵ N							X	*
Humic acids							X	
Multiple R²	0.82		0.76		0.73		0.77	



Conclusions

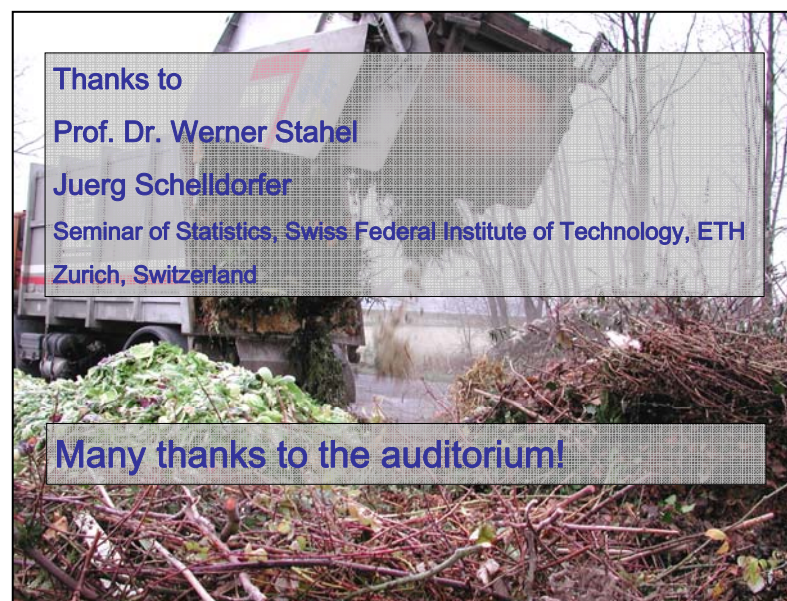
- Composts and digestate are generally characterised by a great variability in quality parameters
- Prediction of functional characteristics by a random sample as
 - N mineralisation
 - maturity is possible
- Initial N mineralisation and maturity parameters can be predicted by multiple regression equations,
- however simple linear correlations were not found
=> difficult for use in practice
- Considered maturity parameters are not or weak related!

How can we characterise maturity?

A lot of work has to be done!

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