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ISOP 2025

INNOVATIVE SOIL TESTS FOR ASEESSING SOIL HEALTH

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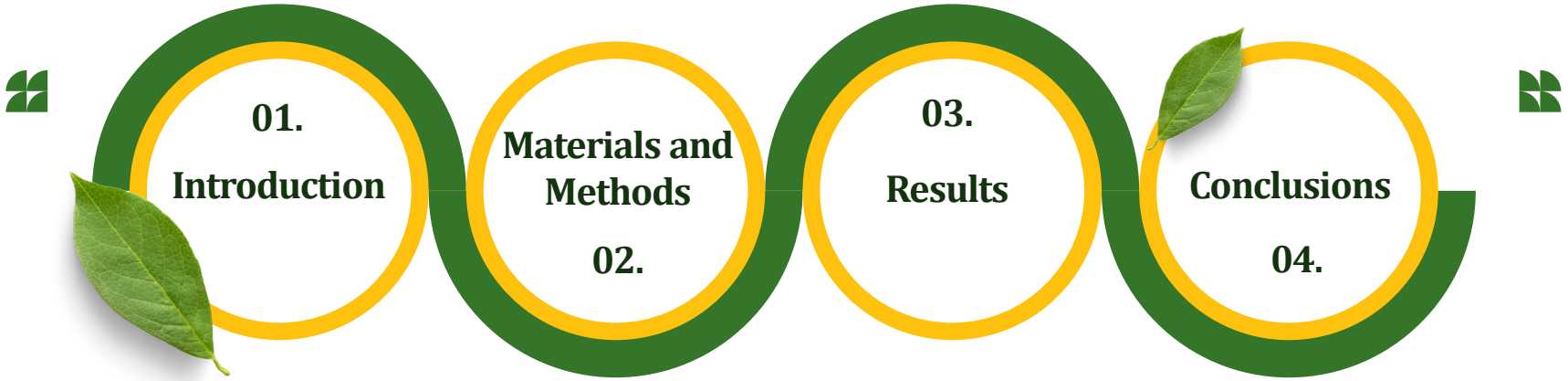
eurofins | Sac Ky Hai Dang

Can Tho University, 3rd - 6th November 2025

Our Value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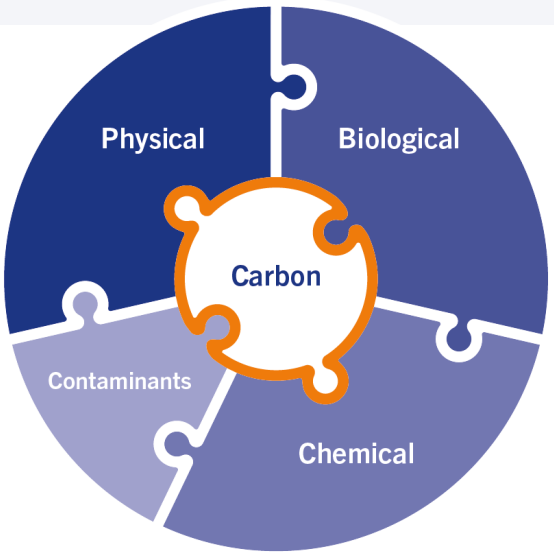
Introduction



- ✓ Conventional soil tests are laborious and expensive
- ✓ New broad-spectrum soil tests offer the potential to assess many soil characteristics quickly
- ✓ But often face challenges with calibration and validation.

An over 20-year research program aimed at overcoming the aforementioned challenges.

- ✓ A three-step approach was applied:
  1. Establishing two contrasting rapid broad-spectrum soil tests,
  2. Relating these new test results to results of conventional tests for a wide variety of soils, and
  3. Validating the new soil test results through field trials and communicating the results.

NIRS and multi-nutrient 0.01 M $CaCl_2$ extraction as broad-spectrum techniques were used, extensively calibrated and validated for physical, chemical and biological characteristics of soil and for 'plant available' nutrients, respectively.

Soil Carbon, Soil Health and Soil Life…

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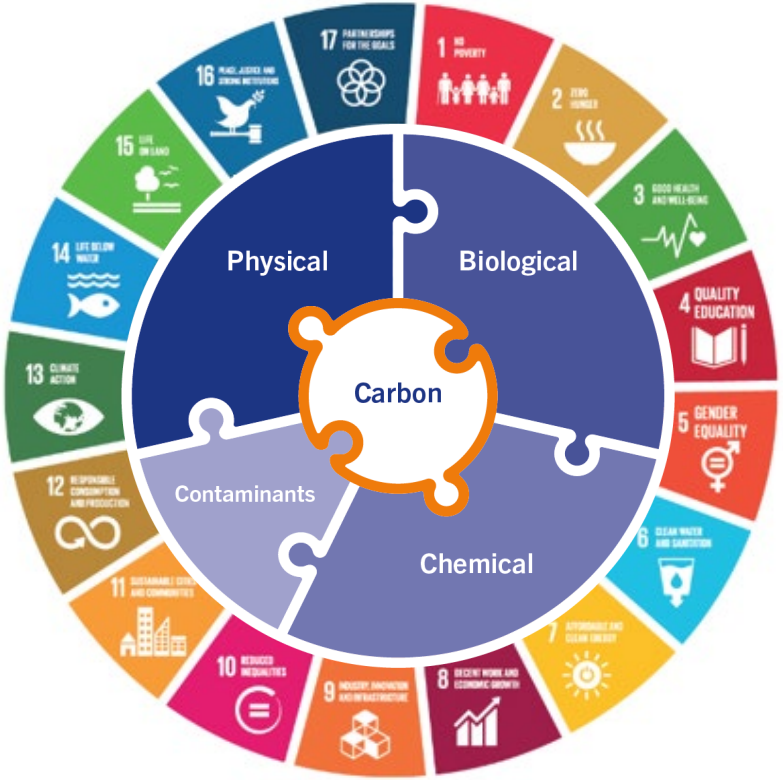

Decrease greenhouse gas emissions for climate change mitigation. Thus, sequestration of C in soils will be promoted as strategy to SDG 13.

Also, the dynamics of SOM have significant functions for food production and quality (SDGs 2 and 3), water quality (SDG 6), biodiversity and soil health (SDG 15).

Materials and Methods

A three-step approach:

Step 1: establishment and selection

- Near Infrared Spectroscopy (NIRS) for measuring key soil physical, chemical (soil quantity), and biological characteristics,
- While multi-nutrient extractions with 0.01 M $CaCl_2$ for assessing plant available nutrients.

Step 2: first-step agronomic calibration

- Results of NIRS and multi-nutrient extractions were related to the results of a wide range of conventional soil tests carried out using advanced statistical methods.

Step 3: improved agronomic calibration and validation

- Validated field experiments were performed to test whether the new soil tests resulted in more accurate predictions of soil fertility and improved fertilization and soil management recommendations. Simultaneously, the new soil test results were implemented stepwise in practice along with farmers' field schools.

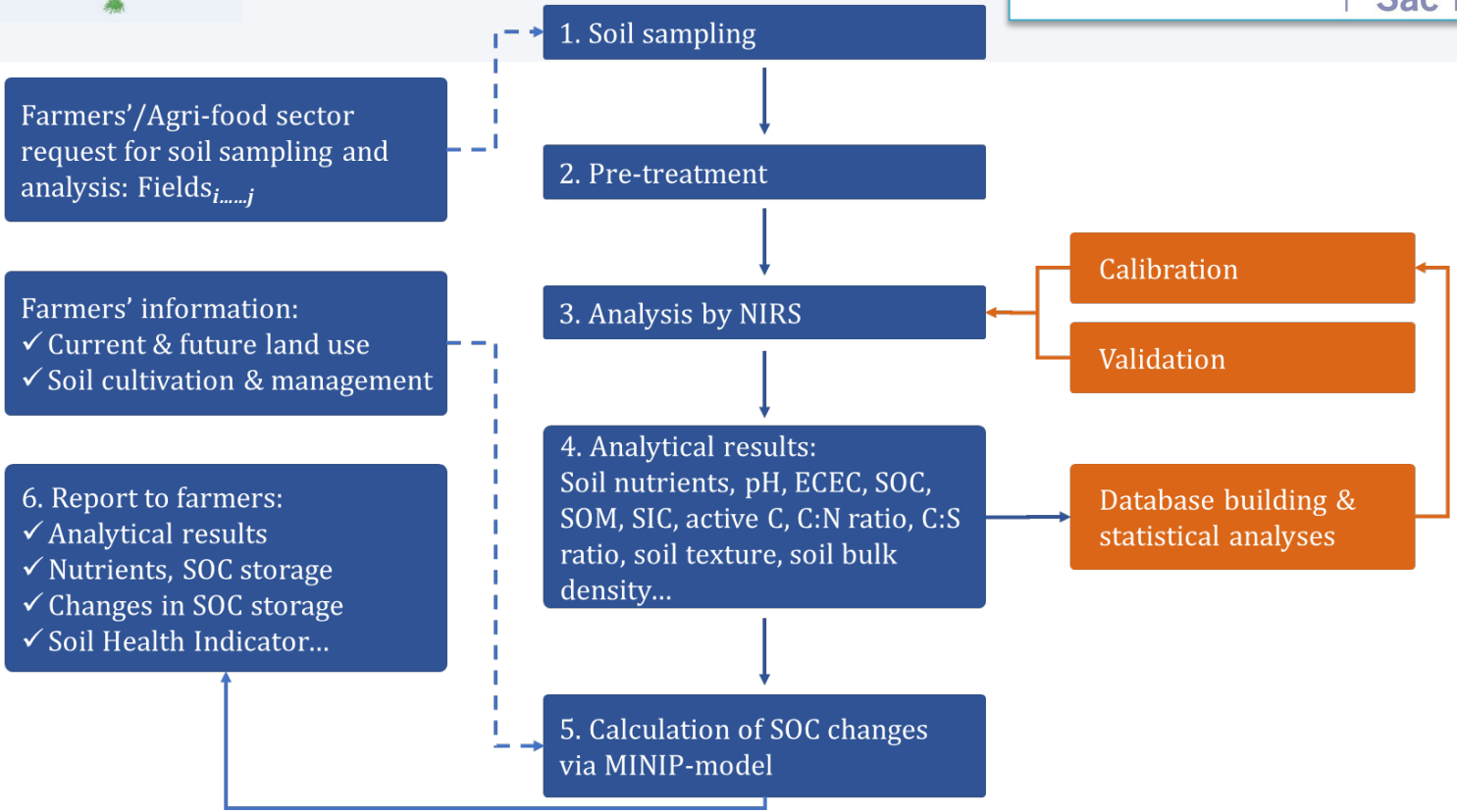

Fig 1. Conceptual framework of NIRS for Soil Carbon Check, Soil Health Indicator and Soil Life Monitor

Analytical procedures

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- ✓ Soil samples taken from various countries in Europe, China, New Zealand and Vietnam.
- ✓ Simply by NIRS and $CaCl_2$ determinations and calculations with the MINIP (**Mi**neralization **Ni**trogen, **P**hosphorus and Carbon) model.
- ✓ Calibration and validation of NIRS determinations based on the database built-up over 10 years those are results of standard soil analysis methods.
- ✓ MINIP model allows making estimations of SOC changes over time as function of soil type, characteristics, climate and SOM management.
- ✓ Mathimatical analysis using standard deviation (SD), relative percentage difference (RPD), correlation coefficients (R^2) and root mean squared error of prediction (RMSEP; average difference between predicted and measured values).

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Results

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Table 1. Descriptive statistics of the 0.01 M $CaCl_2$ extractions (1:10 soil to solution ratio; w/v)

Soil property ($CaCl_2$ 0.01M)	Year	Reporting limit	First quartile	Median	Third quartile	Average	St. Dev.	n	Unit	*Analyses/References*
DON	2007	3.0	19	26	40	31.9	18.6	7175	mg kg^{-1}	*DA; NEN-ISO 15923-1*
NH_4-N	2004	0.5	4.4	6.7	9.9	7.7	4.7	7175	mg kg^{-1}	*DA; NEN-ISO 15923-1*
NO_3-N	2004	1.2	3.4	6.3	14	11.2	12.2	7175	mg kg^{-1}	*DA; NEN-ISO 15923-1*
S	2017	2.0	3.7	5.5	10.1	18.4	78	16,085	mg kg^{-1}	*ICP-AES; NEN 6966*
P	2004	0.2	1.1	2.0	3.8	3.0	3.2	326,957	mg kg^{-1}	*DA; NEN-ISO 15923-1*
K	2004	8.0	58	83	121	100	67	310,417	mg kg^{-1}	*ICP-AES; NEN 6966*
Mg	2004	4.5	76	127	216	170	132	310,048	mg kg^{-1}	*ICP-AES; NEN 6966*
Na	2004	5.0	9.0	15	27	25	46	239,181	mg kg^{-1}	*ICP-AES; NEN 6966*
Si	2012	3.0	4.1	6.3	12	13	16	45,750	mg kg^{-1}	*ICP-MS; NEN 17294-2*
Fe	2012	2.0	2.1	3.0	3.1	3.4	2.4	45,724	mg kg^{-1}	*ICP-AES; NEN 6966*
Zn	2004	0.1	0.4	1.3	2.2	1.5	1.5	66,541	mg kg^{-1}	*ICP-MS; NEN 17294-2*
Mn	2004	0.25	1.5	4.1	8.1	6.2	7.4	80,001	mg kg^{-1}	*ICP-AES; NEN 6966*
Cu	2004	20	21	30	43	37	34	73,128	µg kg^{-1}	*ICP-MS; NEN 17294-2*
Co	2004	2.5	4.6	10	21	17	24	58,556	µg kg^{-1}	*ICP-MS; NEN 17294-2*
B	2004	75	103	145	219	203	197	72,897	µg kg^{-1}	*ICP-AES; NEN 6966*
Mo	2012	3.0	3.8	4.0	4.2	4.9	5.2	45,725	µg kg^{-1}	*ICP-MS; NEN 17294-2*
Se	2008	2.0	2.1	2.8	3.9	3.5	2.5	58,528	µg kg^{-1}	*ICP-MS; NEN 17294-2*
pH	2004	-	5.0	5.3	6.2	5.6	0.90	354,187	-	*Potentiometric; ISO 10390*

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Table 2. Results of calibration and validation of the determination of SOC contents (%) by NIRS

Type	Country	*n*	P5	Mean	SD	P95	R^2	RPD	RMSEP
Calibration	/	21,976	0.7	1.99	1.7	4.88	0.99	12.9	0.49
Validation	China	138	0.5	1.1	1.0	2.7	0.96	4.7	0.23
	New Zealand	153	2.0	5.9	5.4	13.0	0.99	14.3	0.31
	Belarus	87	1.2	7.5	6.7	18.9	1.00	13.7	0.49
	Finland	109	0.9	3.3	2.9	9.9	1.00	15.5	0.19
	Germany	100	0.8	1.5	1.6	2.1	0.93	3.5	0.16
	France	48	0.6	1.4	0.6	2.5	0.96	–	0.13
	Lithuania	100	0.7	2.3	2.8	5.2	0.99	6.4	0.44
	Norway	50	1.8	2.9	1.1	5.1	0.97	–	0.23
	Sweden	49	0.9	5.4	4.9	16.0	0.99	–	0.40
	UK	54	1.6	3.0	1.6	6.7	0.97	–	0.24
	Vietnam	77	0.4	1.3	0.6	2.3	0.96	4.8	0.13
	The Netherlands	1840	0.8	2.5	1.9	6.2	0.98	6.4	0.30

Note: the 5th (P5), and 95th (P95) percentiles, mean, standard deviation (SD), determination coefficient (R^2), relative percentage difference (RPD; for n ≥ 75), and root mean squared error of prediction (RMSEP). SOC, soil organic carbon; NIRS, near-infrared spectroscopy.

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Table 3. Results of calibration and validation of the determination of SIC contents (%) by NIRS

Type	Country	*n*	P5	Mean	SD	P95	R^2	Bias	RMSEP
Calibration	/	15,864	0.03	0.25	0.44	0.97	0.97	0.001	0.145
Validation	China	120	0.00	0.17	0.21	0.68	0.95	0.03	0.050
	New Zealand	153	0.02	0.09	0.05	0.19	0.46	0.00	0.043
	Belarus	77	0.01	0.09	0.17	0.15	0.95	0.06	0.062
	Finland	243	0.02	0.16	0.38	0.28	0.98	0.01	0.057
	Germany	96	0.04	0.19	0.26	0.72	0.98	0.02	0.061
	France	48	0.00	0.33	0.83	1.04	0.99	0.00	0.071
	Lithuania	100	0.02	0.21	0.27	0.86	0.96	- 0.05	0.060
	Norway	55	0.03	0.14	0.04	0.15	0.98	0.00	0.033
	Sweden	41	0.01	0.09	0.10	0.17	0.72	0.04	0.059
	UK	54	0.07	0.62	1.38	4.70	1.00	0.06	0.139
	Vietnam	134	0.00	0.08	0.13	0.13	0.91	0.01	0.040
	The Netherlands	1863	0.03	0.22	0.31	0.94	0.96	- 0.01	0.061

Note: the 5th (P5), and 95th (P95) percentiles, mean, standard deviation (SD), determination coefficient (R^2), bias, and root mean squared error of prediction (RMSEP). SIC, soil inorganic carbon; NIRS, near-infrared spectroscopy.

Table 4. Results of calibration and validation of the determination of SOM contents (%) by NIRS

Type	Country	*n*	P5	Mean	SD	P95	R^2	Bias	RMSEP
Calibration	/	24,825	1.60	5.45	7.34	18.0	1.00	0.00	0.6
Validation	China	137	0.59	4.09	2.80	9.95	0.98	0.00	0.4
	New Zealand	153	5.54	14.1	10.28	26.7	1.00	- 0.04	0.4
	Belarus	87	2.67	15.2	13.6	40.6	0.98	0.02	1.0
	Finland	243	2.56	8.02	8.12	18.7	0.97	0.60	1.2
	Germany	100	2.75	4.70	1.25	6.77	0.97	0.02	0.2
	France	48	1.78	4.18	1.71	7.44	0.97	- 0.15	0.3
	Lithuania	100	2.17	5.40	5.52	11.4	0.99	0.05	0.6
	Norway	59	3.96	5.65	2.11	9.78	0.98	- 0.09	0.3
	Sweden	49	2.25	10.3	8.57	27.1	0.99	0.02	0.7
	UK	54	4.51	7.69	3.45	14.7	0.98	0.50	0.4
	Vietnam	167	2.10	5.71	1.85	8.24	0.99	- 0.01	0.2
	The Netherlands	2259	2.06	5.86	4.63	14.3	0.99	0.00	0.5

Note: the 5th (P5), and 95th (P95) percentiles, mean, standard deviation (SD), determination coefficient (R^2), bias, and root mean squared error of prediction (RMSEP). SIC, soil inorganic carbon; NIRS, near-infrared spectroscopy.

Table 5. Results of calibration and validation of the determination of clay contents (%) by NIRS

Type	Country	*n*	P5	Mean	SD	P95	R^2	Bias	RMSEP
Calibration	/	49,121	1.0	11.1	11.2	38.0	0.98	0.07	1.8
Validation	China	47	15.9	30.6	11.0	49.4	0.98	- 0.04	1.8
	New Zealand	147	2.3	17.1	11.1	38.5	0.99	- 0.23	1.5
	Belarus	87	1.0	3.4	1.9	6.9	0.77	0.04	1.1
	Finland	243	1.4	15.9	12.9	42.1	0.97	- 0.87	2.6
	Germany	96	7.8	17.0	5.9	28.2	0.94	- 0.01	1.5
	France	48	2.4	19.2	12.6	41.8	0.99	- 0.90	2.0
	Lithuania	100	2.1	8.7	3.9	14.8	0.93	0.01	1.1
	Norway	59	2.1	10.5	8.0	27.1	0.96	0.14	1.6
	Sweden	50	1.2	17.7	14.8	42.8	0.99	- 0.02	1.9
	UK	54	10.2	21.4	9.9	34.7	0.81	0.83	4.7
	Vietnam	168	8.1	36.1	15.6	57.6	0.99	0.00	2.0
	The Netherlands	1852	1.0	10.3	10.9	31.9	0.99	0.05	1.3

Note: the 5th (P5), and 95th (P95) percentiles, mean, standard deviation (SD), determination coefficient (R^2), bias, and root mean squared error of prediction (RMSEP). NIRS, near-infrared spectroscopy.

Table 6. NIRS calibration statistics based on results of conventional methods

Soil characteristic	Calibration							
	n	Year	R^2	RPD	RMSE	Bias	Sres	*Reference*
N-total	55,947	2004	0.99	8.6	0.53	0.002	0,53	*ISO 13878; NEN 6966*
S-total	37,783	2004	0.97	5.5	0.21	-0.000	0,21	*NEN 15587-2 ; NEN 6966*
K-CEC	16,144	2006	0.79	2.0	2.19	-0.040	2,19	*ISO 23470; NEN 6966*
Ca-CEC	15,742	2006	0.97	5.5	17.53	0.483	17,52	*ISO 23470; NEN 6966*
Mg-CEC	15,732	2006	0.88	2.7	6.32	-0.015	6,32	*ISO 23470; NEN 6966*
pH-$CaCl_2$	89,075	2013	0.97	5.3	0.18	-0.004	0,18	*Potentiometric; ISO 10390*
SOC	21,976	2004	0.99	12.9	4.93	0.066	4,93	*ISO 10694*
SOM	24,825	2004	1.00	17.5	6.46	0.007	6,46	*NEN 5754*
SIC	15,864	2004	0.97	5.6	1.45	0.001	1,45	*NEN-EN 15936*
Clay	49,121	2004	0.98	7.0	17.99	0.664	17,97	*NEN 5753*
Sand	8,419	2015	0.96	4.7	58.39	1.390	58,37	*NEN 5753*
ECEC	16,122	2005	0.97	5.8	20.44	0.125	20,44	*ISO 23470, 2018; NEN 6969*

Number of samples (n), year of introduction into routine soil testing, determination coefficient (R2), RPD, root mean squared error (RMSE), average difference between NIRS and reference (bias), standard deviation of residuals (Sres), and references of the reference methods for the calibration data set.

Table 7. NIRS calibration statistics based on results of conventional methods

Soil characteristic			Reference *vs* NIRS							Reference *vs* Reference	
	n	β	R^2	RPD	RMSE	Bias	SE	F	*p* (0.05)	R^2	RMSE
N-total	1502	0.94	0.97	5.4	0.26	-0.05	0.01	0.98	0.32	0.98	0.21
S-total	1497	0.93	0.90	3.0	0.11	-0.01	0.00	0.79	0.38	0.95	0.08
K-CEC	1934	1.05	0.69	1.4	1.68	0.09	0.04	1.17	0.28	0.99	0.28
Ca-CEC	1930	0.94	0.97	5.7	14.21	-0.89	0.32	0.11	0.74	0.99	5.62
Mg-CEC	1922	1.01	0.91	3.1	4.61	-0.05	0.11	0.01	0.92	0.99	0.96
pH	1843	0.94	0.95	4.4	0.21	-0.04	0.00	1.72	0.19	0.99	0.07
SOC	1840	0.98	0.98	6.4	2.98	-0.12	0.07	0.04	0.85	0.98	3.11
SOM	2259	0.99	0.99	10.6	4.62	-0.02	0.10	0.00	0.99	0.99	4.14
SIC	1863	0.98	0.96	5.1	0.61	-0.11	0.01	1.22	0.27	0.99	0.33
Clay	1852	0.98	0.99	8.5	13.24	0.45	0.31	0.02	0.90	0.99	8.20
Sand	1796	0.95	0.97	5.3	46.73	4.91	1.10	0.34	0.56	0.99	15.71
ECEC	1981	0.95	0.97	6.0	15.26	0.35	0.34	0.01	0.90	0.99	7.79

Number of samples (n), slope (β), determination coefficient (R^2), RPD, root mean squared error (RMSE) of the average difference between NIRS and reference (bias), standard error of bias (SE bias), F- and p-values (ANOVA) of the reference versus NIRS, and R2 and RMSE of the reference versus the reference (duplicate) for the validation data set.

Validation of soil inorganic carbon (SIC) content and clay content

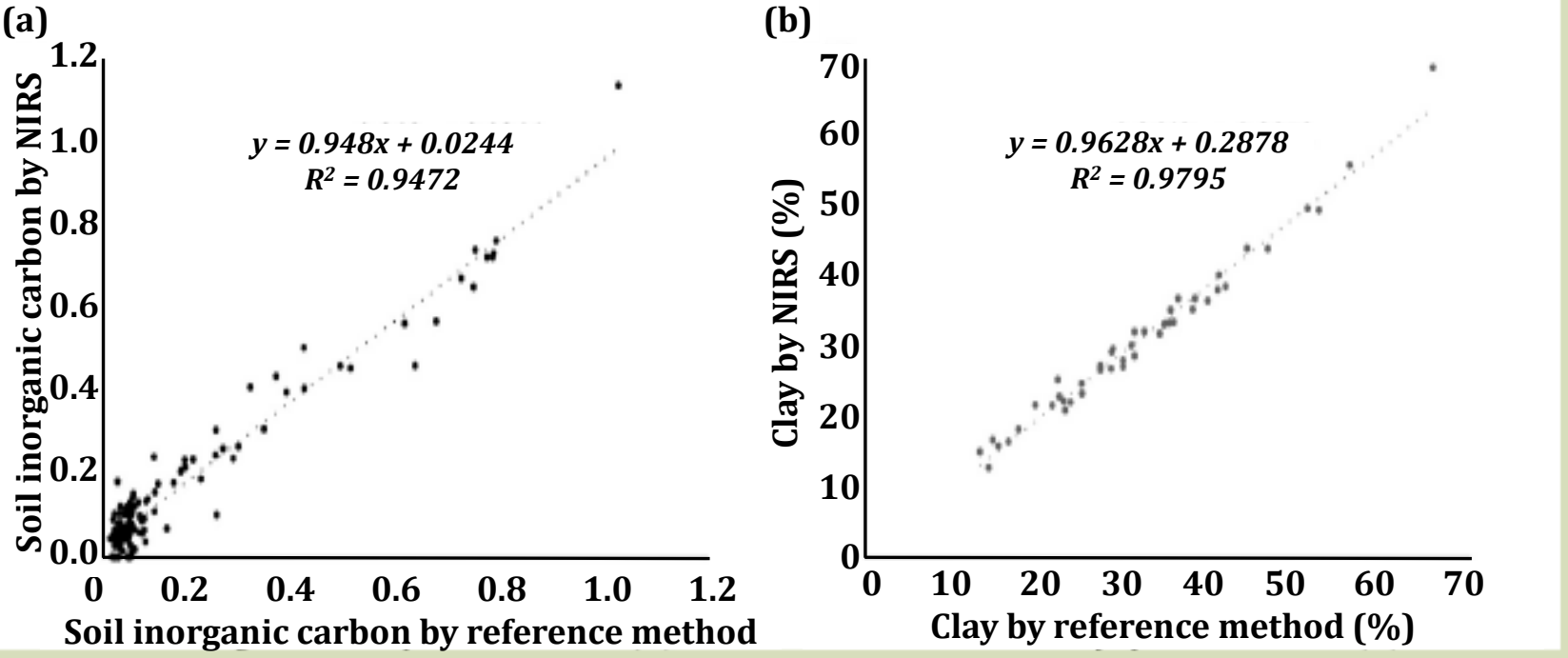

Fig 2. Validation of soil inorganic carbon (SIC) content (a) and clay (< 2 µm) content (b) determinations using NIRS for samples taken in China versus reference methods

Relationships between SIC and Bulk density

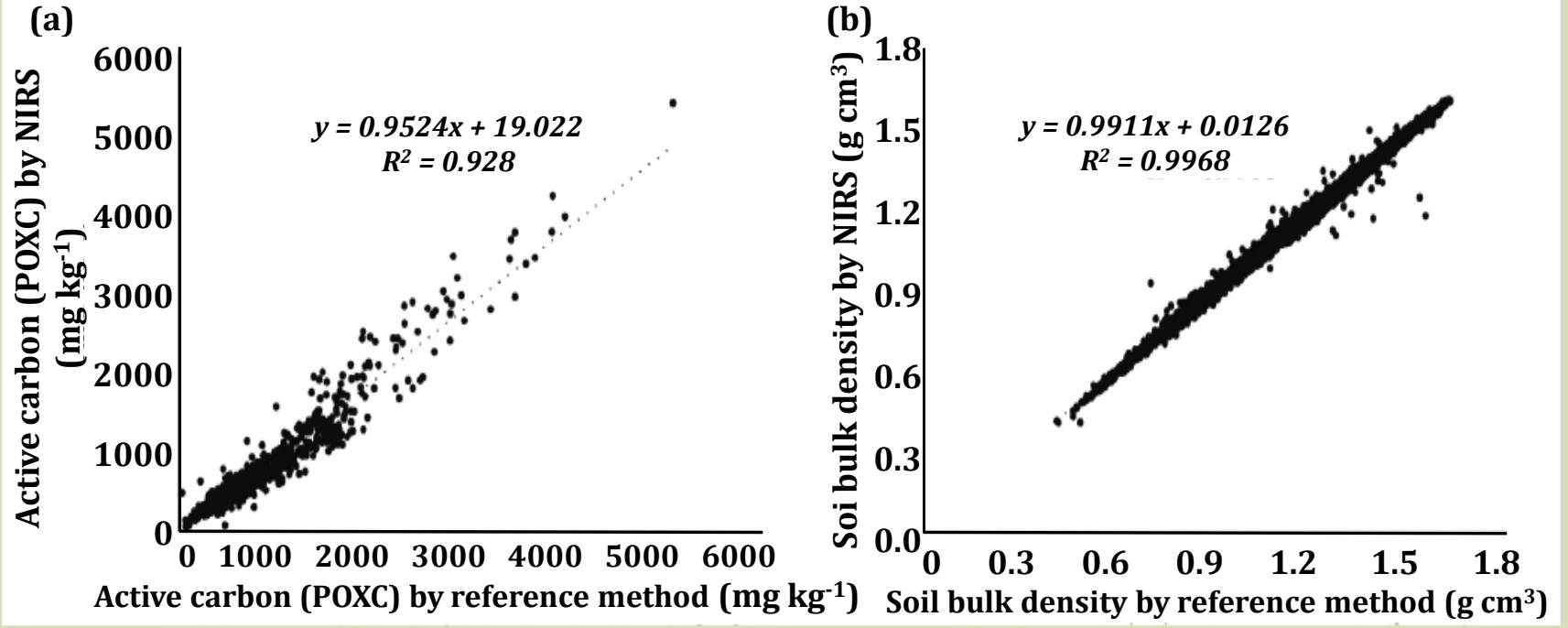

Fig 3. Validation of active carbon (POXC) (a) and soil bulk density (b) determinations by NIRS versus reference methods

NIRS *vs* Reference methods

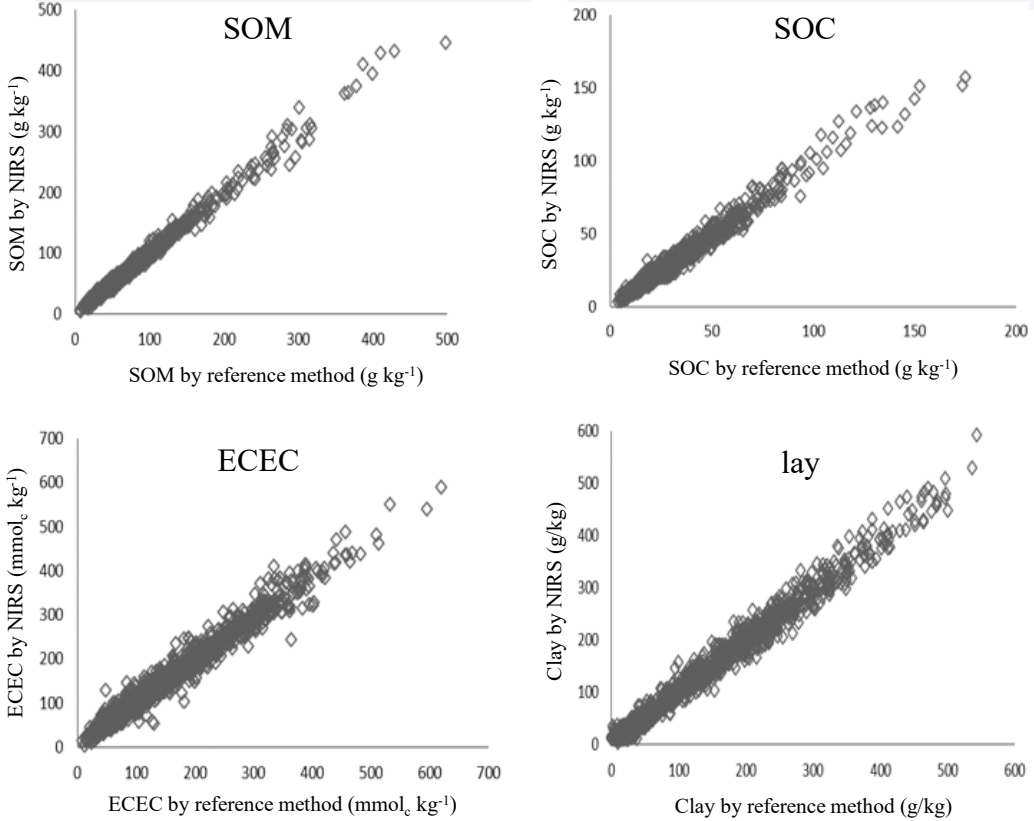

Fig 4. Validation of SOM, SOC, ECEC and Clay determinations by NIRS versus reference methods

Relationships between SIC and SOC contents/clay contents

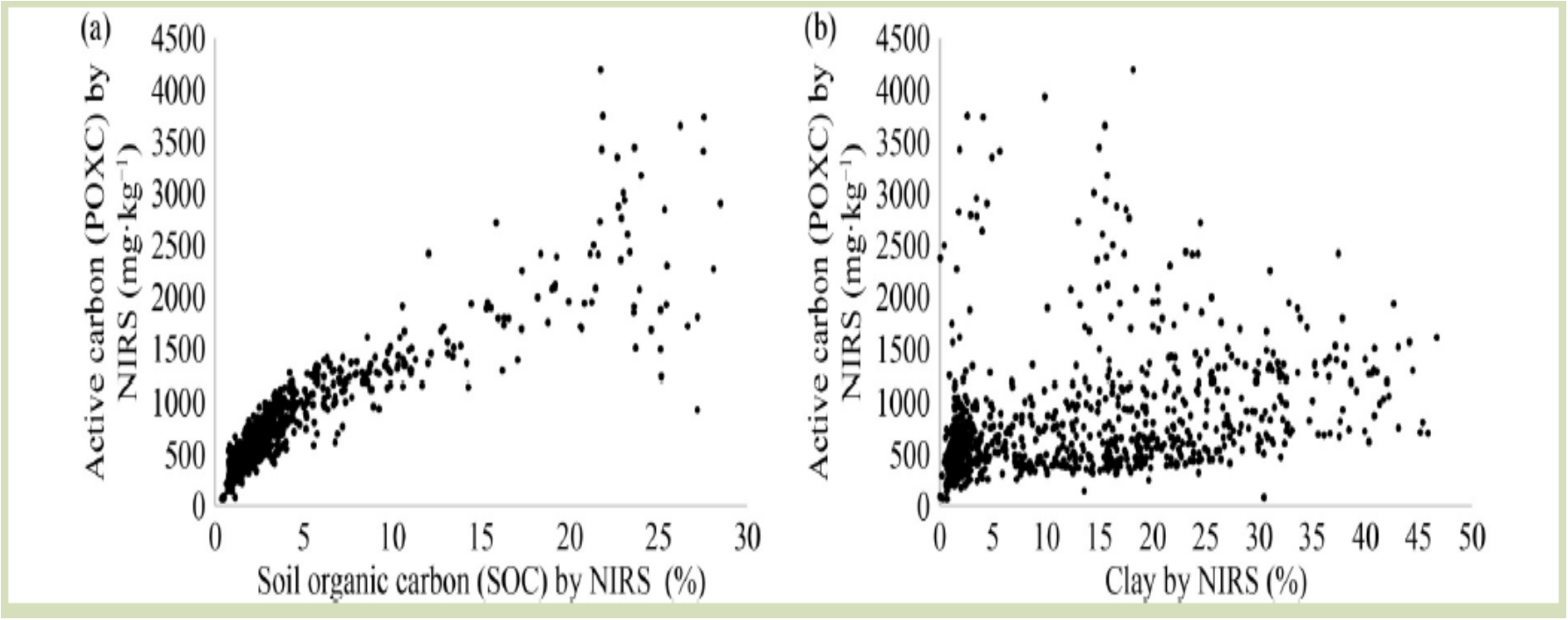

Fig 5. Relationships between SOC content and active carbon (a), clay content and active carbon (b)

Running the MINIP model

Table 8. Calculated mean SOC breakdown (% per year) with the MINIP model, using results of 30,451 soil tests of samples taken in the Netherlands

Initial values	P5	Mean	SD	P95
SOC (%)	0.83	3.19	3.17	9.12
SOM (%)	1.70	5.96	5.92	16.9
N-total (mg N kg^{-1})	750	2,552	2,377	7,395
C:N	9.0	12.5	3.7	19
pH	4.8	6.1	0.95	7.4
Amount of C (kg ha^{-1})	24,900	95,556	95,106	273,600
C breakdown (%)	2.20	2.84	0.36	3.40
SOC after 25 years (%)	0.13	1,07	1.25	3.56

Note: The MINIP model inputs included soil organic carbon (SOC), soil organic matter (SOM), N-total, and pH. The expected SOC content after 25 years (without carbon input) is also presented .

Soil Carbon Check

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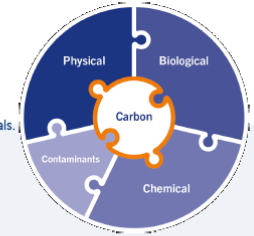
Soil Carbon Check



Carbon Check is part of Eurofins Soil Health Solutions. The healthier the soil, the better the contribution to Sustainable Development Goals. You can understand more about:

1. How much carbon is captured in your soil.
2. How stable is your soil carbon.
3. How can you improve soil carbon by 4 per 1000.
4. How is your soil carbon content developing overtime.

Name | Soil

Soil Carbon 4
Sustainalbe Development
GOALS

Client code: LT0000038
Date Report: 9/19/2022

Date sampling: 9/9/2022
Sample-/order number: 528-2022-09090001

Soil layer: 0-30 cm
Density: 1215 kg/m³

Contact Eurofins: See QR code
Geo reference of sampled field: See QR code

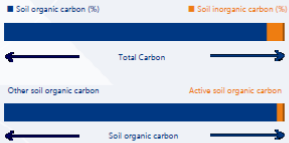
1. How much carbon is captured in my soil?

		kg per hectare	ton per hectare
Soil organic carbon (SOC)	1.60 %	58320	58.3
this equals			
Carbon dioxide (CO_2)		214034	214.0

2. How stable is my soil carbon?

Soil organic matter (SOM)	3.10 %	112995	113.0
Carbon percentage in soil organic matter is	52 %		

Soil organic carbon (SOC)	1.60 %		
Soil inorganic carbon (SIC)	0.10 %		
Total Carbon (TC)	1.70 %		



Active carbon	359 mg per kg	
Active carbon percentage of SOC	2.2 %	
C/N ratio	10/1	
C/S ratio	62/1	
Clay	10 %	
Clay/SOC ratio	6/1	

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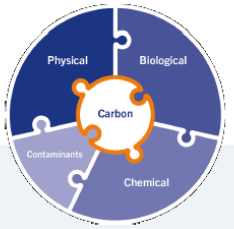
Towards 4‰ soil carbon increase



If the amount of carbon stored by soils increases by 4 per 1000 (so 0.4% or 4‰) per year, the annual increase of carbon dioxide (CO_2) in the atmosphere would be significantly reduced. This will slow down the greenhouse effect and prevent further climate change, as agreed in (among others) the Paris climate agreement (COP 21).

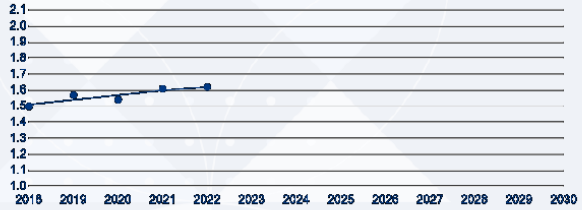
3. How can I improve soil carbon by 4 per 1000?

Current soil carbon status:	**58320**	kg C per hectare	= 214	ton CO_2 per hectare
Output: expected breakdown (mineralisation)	**1750**	kg C per hectare	= 6.4	ton CO_2 per hectare
Input: Input: needed to maintain soil organic carbon status	**1750**	kg C per hectare	= 6.4	ton CO_2 per hectare
Input: Input: Additional input needed to improve by 4 per 1000 ‰	**233**	kg C per hectare	= 0.9	ton CO_2 per hectare
Total required carbon input	**1983**	kg C per hectare	= 7.3	ton CO_2 per hectare

Scan QR-code or follow hyperlink (email) to optimise your personal carbon management

4. How is my soil carbon content developing overtime?

Soil organic carbon, %



In the last 4 years there is a significant increase in soil organic carbon %. The increase has been 3.7 ton CO_2 per hectare per year, so 4 carbon credits per hectare.

ISOP 2025

Soil Health Indicator

Sac Ky Hai Dang

eurofins

Soil Health Indicator

Soil Health Indicator is part of Eurofins Soil Health Solutions.The healthier the soil, the better the contribution to Sustainable Development Goals.

ABCDE

Name | 781790
Street nr. 3
94002 Nove Zamky

Client code: T10000003 **Sampling date:** 02/01/2024
Reporting date: 20/09/2024 **Sample number:** 202-2024-00000001
Soil layer: 0 - 25 cm

The Foundation

Prudent use of water and nut

Soil composition %
Clay 1
Silt 6
Sand 90
Carbonate lime ($CaCO_3$) <0.2
Soil organic matter (SOM) 2.5

pH -
pH_CaCl2 6.5
pH_water 7.0

Soil structure Score
Risk soil slaking 7.5
Risk on wind erosion 3.1
Risk soil structural degradation 10

Soil density g/cm³
Soil bulk density 1.5

Salt indices
Na-plant available 9
Na-soil stock, kg/ha 87
Electrical conductivity (EC), mS/cm25°C 0.7
Exchangeable sodium, % (ESP) <2
Sodium absorption ratio (SAR) 0.04

Water holding capacity
Plant available water, mm 35
Field capacity (pF 2.0), % 16.1
Irrigation point (pF 3.3), % 4.3
Wilting point (pF 4.2), % 2.1

Cation Exchange Complex
Effective CEC, mmol⁺/kg 50
Ca-CEC, % 79
Mg-CEC, % 13
K-CEC, % 6
Na-CEC, % <2
Base saturation, % 100

Legend soil structure triangle
optimal structure
good structure
moderate structure

AR-24-T1-000001-01

Carbon Storage

Beat climate change

		low	rather low	good	rather high	high
Soil organic matter, SOM, %	2.5					
Carbon in soil organic matter, %	60					
Nitrogen in soil organic matter, %	4.6					
Sulphur in soil organic matter, %	0.8					
C/N ratio	13					
C/S ratio	76					
Clay/SOC ratio	0.9					
SOC/clay ratio	1.07					

	%
Soil organic carbon, SOC	1.5
Soil inorganic carbon, SIC	<0.1
Total soil carbon, TC	<1
C in microbial biomass	24
C in bacterial biomass	88
C in fungal biomass	47
Active C (POXC)	64

Soil Biodiversity

Regenerate soils

	mg PLFA/kg	low	rather low	good	rather high	high
Total bacteria	9.3					
Gram positive	3.3					
Actinomycetes	1.1					
Gram negative	6					
Total fungi	1.2					
Saprophytes	0.2					
Mycorrhiza	1					
Protozoa	0.11					

Microbial biomass, mg PLFA/kg
Microbial activity, mg N/kg
Fungi/bacteria ratio
Gram(+)/Gram(-) ratio
Diversity index

Essential nutrients

High food & feed qua

Main nutrients	mg/kg	kg/ha
N-plant available (mineral N)	50	187
Total N stock	1160	4330
N-supplying capacity	42.2	
S-plant available	5	18.8
Total S stock	199	745
S-supplying capacity	9.2	
P-plant available	21.2	31.8
Total P stock	746	2790
Ca-plant available	46.5	174
Ca-soil stock	800	2990
Mg-plant available	94	350
Mg-soil stock	81	302

Micro nutrients	µg/kg	g/ha
Fe-plant available	2000	7490
Zn-plant available	240	899
Ni-plant available	<20	75
Mn-plant available	400	1500
Cu-plant available	41	154
B-plant available	120	449
Mo-plant available	6	22.4

Beneficial nutrients	µg/kg	g/ha
Si-plant available	9110	34117
Co-plant available	6	22
Se-plant available	<2	7.5

Potential contaminants

Prevent health risks

Bio available metals	µg/kg	g/ha
Aluminium (Al)	3000	11200
Titanium (Ti)	110	400
Vanadium (V)	45	170
Arsenic (As)	33	120
Cadmium (Cd)	<2	7.5
Chromium (Cr)	<20	75
Lead (Pb)	<10	37
Tin (Sn)	<1	3.7

Not available
Low
Rather low
Rather high
High

Bio available
Soil stock
Al Ti V

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Crop based guidelines

Optimise crop yield and quality

Main nutrients	Broccoli	Iceberg lettuce	Leek Late autumn
Exp. yield (ton/ha)	11	13	
N, kg/ha	140	48	110
S, kg/ha	44	20	48
P, kg/ha	0	0	0
K, kg/ha	22	27	82
Ca, kg/ha	24	5	41
Mg, kg/ha	0	0	0
Micro nutrients			
Fe, kg/ha	Rather low	Rather low	Rather low
Zn, kg/ha	1	0	1
Mn, kg/ha	Low	Low	Low
Cu, kg/ha	0	0	0
Ni, kg/ha	Rather low	Rather low	Rather low
B, kg/ha	1	0	0
Mo, kg/ha	Very low	Very low	Very low
Beneficial nutrients			
Si, kg/ha	Good	Good	Good
Co, kg/ha	Good	Good	Good
Se, g/ha	6	6	6
Na, kg/ha	0	0	0
Bio available heavy metals			
Al	Low amounts - no effect on crop growth and/or health risks are expected.		
Ti	Negligible amounts – no effect on crop growth and/or health risks are expected.		
V	Considerable amounts - no effect on crop growth and/or health risks are expected. H of input.		
As	Considerable amounts - no effect on crop growth and/or health risks are expected. H of input.		
Cd	Negligible amounts – no effect on crop growth and/or health risks are expected.		
Cr	Negligible amounts – no effect on crop growth and/or health risks are expected.		
Pb	Negligible amounts – no effect on crop growth and/or health risks are expected.		
Sn	Negligible amounts – no effect on crop growth and/or health risks are expected.		

Soil based guidelines

	Year	Rotation (4 Years)
P, kg/ha	0	0
K, kg/ha	0	0
Ca, kg/ha	59	230
Mg, kg/ha	0	0
Target pH (6.5), kg NV/ha		0
0.1 pH increase, kg NV/ha		160
Max. irrigation recommendation, mm		30 (pF 3.3 - pF 2.0)
Fungi/Bacteria ratio		

This soil is highly dominant in bacteria. This results in rapid orga nutrient mineralization. To increase the fungi/bacteria ratio, add C/N ratio like straw, compost and solid manure. Implement cons to promote the fungal community.

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Physical Biological Carbon Chemical Contaminants

Soil Organic Carbon Balance

0% 54942 1.47 1525 1.51 226 1.52 %

Current soil carbon status:	56467	kg C per hectare	= 207.2	ton CO_2 per hectare
Output: expected breakdown (mineralisation)	1525	kg C per hectare	= 5.6	ton CO_2 per hectare
Input: Needed to maintain soil organic carbon status	1525	kg C per hectare	= 5.6	ton CO_2 per hectare
Input: Additional input needed to improve by .4 per 1000	226	kg C per hectare	= 0.8	ton CO_2 per hectare
Total required carbon input	1751	kg C per hectare	= 6.4	ton CO_2 per hectare

Scan QR-code or follow hyperlink (email) to optimize your personal carbon management

Risk of P-leaching

P-binding capacity, kg/ha 1500
P-saturation, % 98

Legislation

Moisture	5.21	g/kg air dw	
Titanium (Ti)	106	µg/kg air dw	
Silicium Si	9.11	mg/kg air dw	

Example text for legislation

Methods

Test	Code	Method	Performed by	Accreditation
Plant-available elements	TW0NV	ICP-MS (ICP-MS)	Eurofins Agro Testing Wageningen	
NIRs soil	TW0QY	Spectrophotometry (NIR) (Spectrophotometry (NIR))	Eurofins Agro Testing Wageningen	

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This report has been released under the responsibility of Jeroen Neuckermans, National Business Line Leader
This report has been electronically validated by Jeroen Neuckermans

Contact Eurofins:

Eurofins Agro Testing Belgium NV
Nazareth
BELGIUM

Jeroen Neuckermans
National Business Line Leader

Soil Life Monitor

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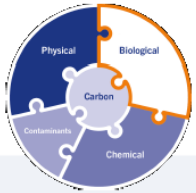
Soil Life Monitor

Soil Life Monitor is part of Eurofins Soil Health Solutions. The healthier the soil, the better the contribution to Sustainable Development Goals.



Name | Soil
Test Account
Test Line1
test 22r
Test City

Client code: LT0000001
Date report: 04/05/2023
Date sampling: 09/02/2023
Sample-/order number: 528-2023-02090005
Soil layer: 0 - 30 cm
Contact Eurofins:
Contact Sample taker:

	Result	Unit mg PLFA per kg
Microbial biomass	13	
Total Bacteria	10	
Gram positive	5	
Actinomycetes	1.5	
Gram negative	6	
Total Fungi	1.3	
Saprophytes	0.5	
Mycorrhiza	0.8	
Protozoa	0.16	

Optimal

	Result	Unit
Diversity Index	1.36	-
Carbon in microbial biomass	269	mg C kg^{-1}
Carbon in bacterial biomass	99	mg C kg^{-1}
Carbon in fungal biomass	91	mg C kg^{-1}
Fungi/bacteria ratio	0.9	-
Gram(+)/Gram(-) ratio	0.8	-
Acidity (pH)	6.2	-
Soil organic matter (SOM)	2.3	%
Clay	9	%

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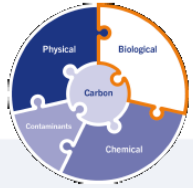
Diversity Index

Soil biodiversity represents the variety of life belowground.
A diverse mix of soil life creates healthy soils, with increased resilience.



Explanation

The biological parameters are based on the phospholipid fatty acids (PLFAs) that are present. PLFAs occur in the cell walls of living organisms. Different functional groups have a unique composition of PLFAs. By measuring the composition of the PLFAs, a fingerprint of the microbial community can be given. The target values are corrected based on the organic matter percentage.

Microbial biomass
The sum of all PLFAs is an indication of the amount of microbes. Because PLFAs are rapidly degraded after an organism dies, it mainly represents the living microbial biomass. The microbial biomass is an indicator of the general disease suppression. The more microorganisms there are, the more competition there is with pathogens for space and food. The microbial biomass can be increased by adding effective organic matter such as compost, solid manure, green manures or cultivating grains (incl. straw). Other examples of measures are reduced soil tillage, permanently covering the soil, temporary grassland or less ploughing up of permanent grassland.

Bacteria
Certain groups of bacteria break down (simple) organic material, fix nutrients, bind atmospheric nitrogen, convert ammonium into nitrate nitrogen, form stable aggregates, increase disease resistance and form breakdown products that can weaken or kill pathogens. Bacteria are stimulated by easily degradable materials with a low C/N ratio such as slurry.

Actinomycetes
Actinomycetes are a group of Gram positive bacteria that form threads that resemble fungal hyphae and are able to break down complex materials. Actinomycetes are important for disease resistance, because some species can excrete antibiotics or parasitize pathogens. They can also compete with pathogenic fungi for space and food. Actinomycetes prefer airy conditions and develop poorly in compacted soil or acid conditions (pH <5).

Fungi
Fungi cause degradation of complex forms of organic material, form stable aggregates, excrete organic acids which improve the availability of some nutrients and increase disease resistance through competition or predation. Fungi are stimulated by recalcitrant materials with a high C/N ratio such as straw and compost.

Arbuscular Mycorrhiza
The PLFA analysis gives insight in the biomass of the active mycelium (network of hyphae) of arbuscular mycorrhiza. These fungi live in symbiosis with plant roots and thereby increase the root surface. In exchange for sugars, the plant receives water and nutrients such as phosphorus and potassium. Crops that are not able to form a symbiosis with arb. mycorrhiza are crucifers (e.g. cabbage and yellow mustard) and the goosefoot family (e.g. spinach and beet). A high available phosphate content will reduce the development of mycorrhizas.

Protozoa
Protozoa are single-cell micro-organisms that contain a cell nucleus (eukaryotes). The most important function of protozoa is to make nutrients available to the plant by "grazing" on microorganisms (mainly bacteria). The activity of protozoa is highly dependent on the presence of moisture in the soil. The radius of action of protozoa is limited to water films and water-filled pores.

Fungi/bacteria ratio
The fungi/bacteria ratio indicates the proportion between the fungal and bacterial biomass (expressed in mg C / kg). In general, undisturbed ecosystems have a higher fungi/bacteria ratio than disturbed systems. Organic and low-input systems have a higher fungi/bacteria ratio compared to enriched conventional systems. Disturbances such as tillage and removal of crop residues can lower the fungi/bacteria ratio.

PLFA diversity
The Diversity Index (Shannon - Wiener index) is an indicator of the diversity of the soil life. The index uses the number of species and their abundance as inputs. Higher diversity is often related to better stability and resilience. Disturbances, lack of diverse input from food sources and an intensive crop rotation can decrease the diversity.

Gram(+)/Gram(-) ratio
Gram(+) bacteria are generally larger than Gram(-) bacteria and can form spores. This makes them more resistant to drought and water stress. Gram(+) dominant populations (>1) are more common at the start of the growing season and typically move to a more balanced community when the soil conditions become more favorable throughout the growing season. Gram(-) dominant populations (<1) are often associated with other forms of stress such as plowing and pesticide use. Gram(-) bacteria can better tolerate these forms of disturbance due to the presence of an outer membrane.

Contact & info

After this report has been sent, the sample will be stored for another two weeks for you at Eurofins Agro, if the nature and testmethod of the sample so permit. Within that period you may complain and/or request additional tests.

Conclusions

- ✓ These two broad-spectrum soil tests have improved soil testing routine, contributed to increased insights into soil fertility; thereby led to more sustainable soil management and to achieve Sustainable Development Goals.
- ✓ Also, contributed to sustainable agriculture and environment.
- ✓ Soil carbon check, soil health indicator and soil life monitor can be done quickly and cost effectively.
- ✓ Have been verified by VERRA.

Organo Rice

ISOP 2025

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Thank You

SUSTAINABILITY

Sercuring Sustainable Development Goals
& Caring for the Next Generation

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Keep in Touch