Results of GLOSOLAN PT for Eurasia 2023. Soil organic carbon. Tyurin and Walkley-Black methods

Webinar

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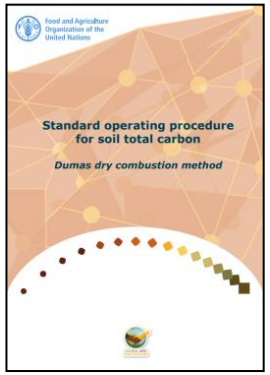
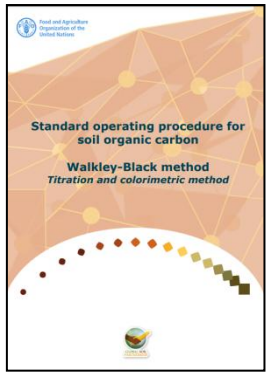
Tested methods

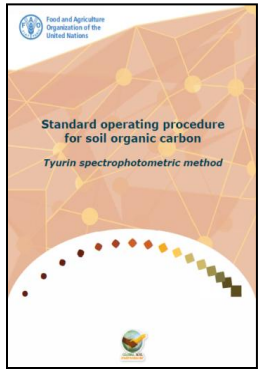
- Dry combustion on the analyzer (**DC**),
- Walkley-Black's method (**W-B**),
- Tyurin's method (**T**) – %SOC = **0.17-8.7**,

SOPs of GLOSOLAN

- Loss-on-ignition method **(LOI)** SOP of GLOSOLAN in progress







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Aim –
to identify factors influencing the quality of SOC measurements using the Tyurin and Walkley-Black methods

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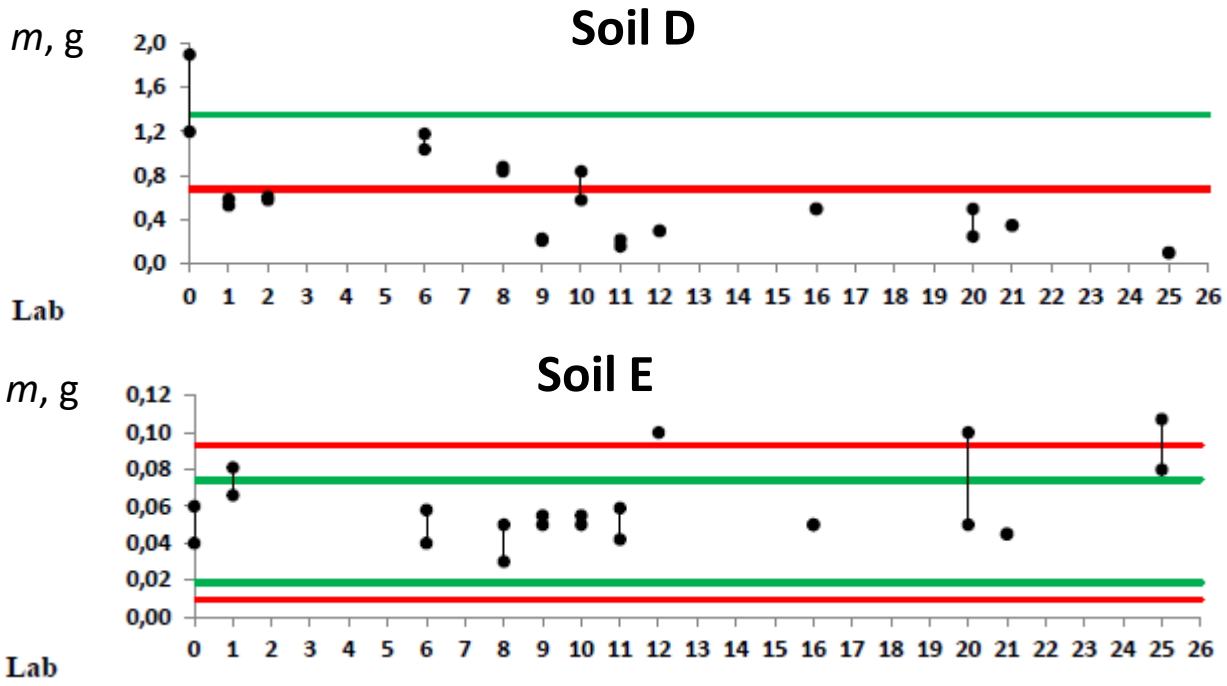
Misses

Control soils	%SOC	Misses
Soil A = Soil F = Soil I	6.44	no
Soil B = Soil G = Soil H	2.32	
Soil E	7.87	
Soil C	**0.17**	**29 of 54**
Soil D	**0.1**	

Lab code	Methods									
	T					W-B				
	Soils									
	AFI	BGH	C	D	E	AFI	BGH	C	D	E
Lab_1										
Lab_2										
Lab_3						–	–	–	–	–
Lab_4	–	–	–	–	–	–	–	–	–	–
Lab_5										
Lab_6										
Lab_7	–	–	–	–	–	–	–	–	–	–
Lab_8										
Lab_9										
Lab_10										
Lab_11										
Lab_12										
Lab_13						–	–	–	–	–
Lab_14	–	–	–	–	–	–	–	–	–	–
Lab_15						–	–	–	–	–
Lab_16										
Lab_17										
Lab_18						–	–	–	–	–
Lab_19	–	–	–	–	–					
Lab_20										
Lab_21										
Lab_22										
Lab_23						–	–	–	–	–
Lab_24										
Lab_25										

Factors Affecting the Quality of Results

1. Soil mass. Tyurin's method



Recommended weighed of soils (SOP)

Soil color	SOC	Weight of soil
		m
	%	mg
Whitish	From 0.17 to 0.6 incl.	From 500 to 900
Light gray, light brown	From 0.6 to 1.2 incl.	From 200 to 500
Gray, brown	From 1.2 to 3.0 incl.	From 100 to 200
Dark gray, brown	From 3.0 to 6.0 incl.	From 60 to 100
Dark brown, black	From 6.0 to 8.7 incl.	From 30 to 60

A = 0,05–0,5 – *Working range* of the Calibration curve

A = 0,1–0,4 – *Optimal range* of the Calibration curve

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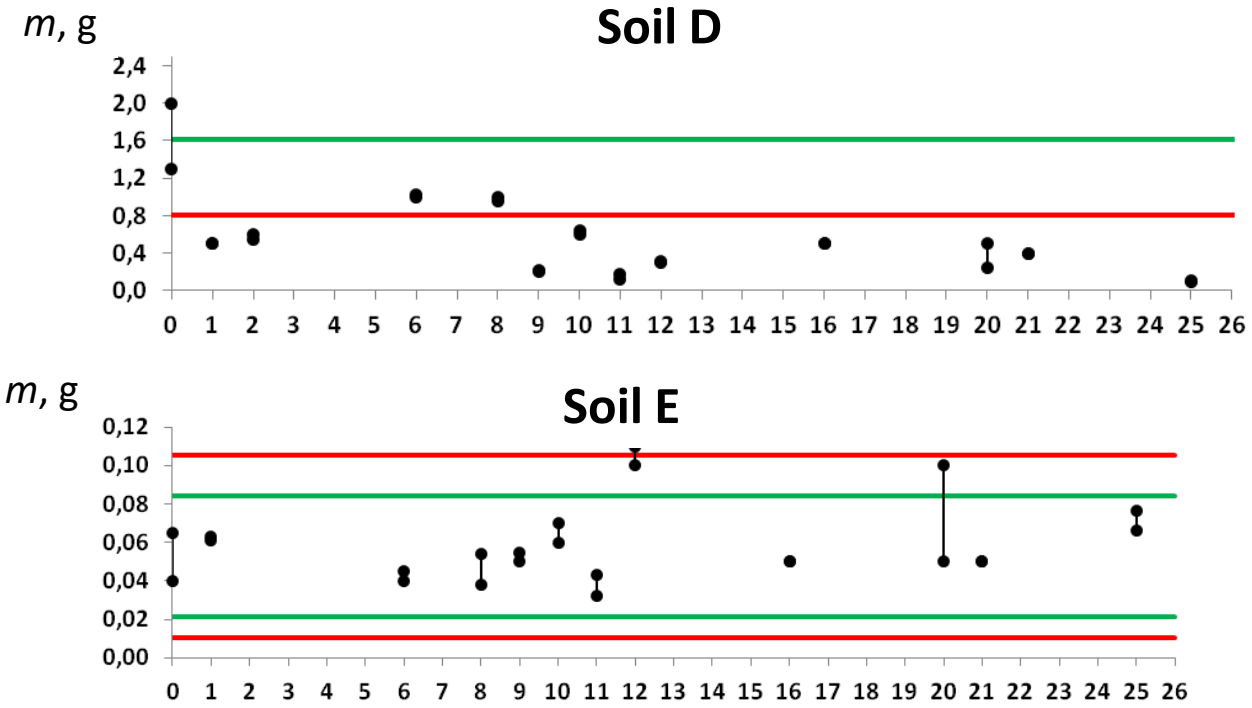
1. Soil mass. Walkley-Black's method



Recommended weighed of soils (SOP)

Weight, g	OC, %	Color
0.1	>2	black, dark gray, dark brown
0.25	≤2	brown - dark brown, gray - dark gray
0.5	<0.6	Brown

A = 0,05–0,5 – *Working range* of the Calibration curve

A = 0,1–0,4 – *Optimal range* of the Calibration curve

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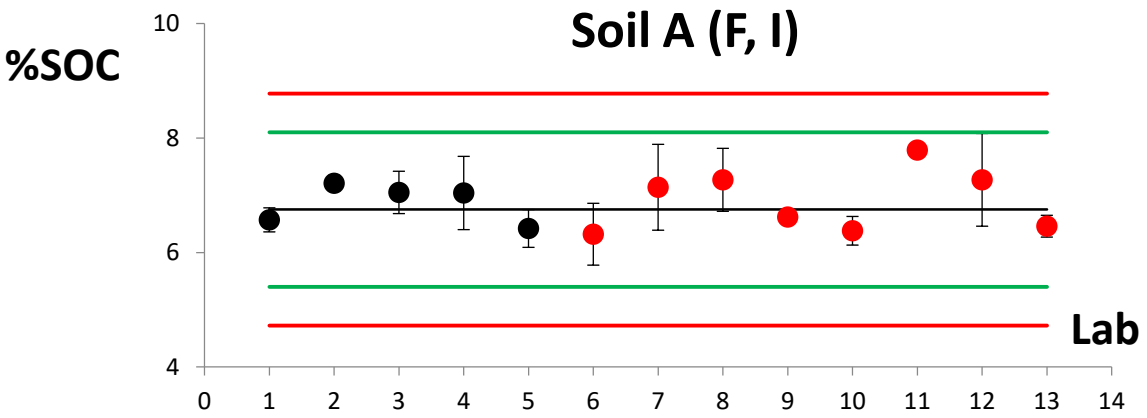
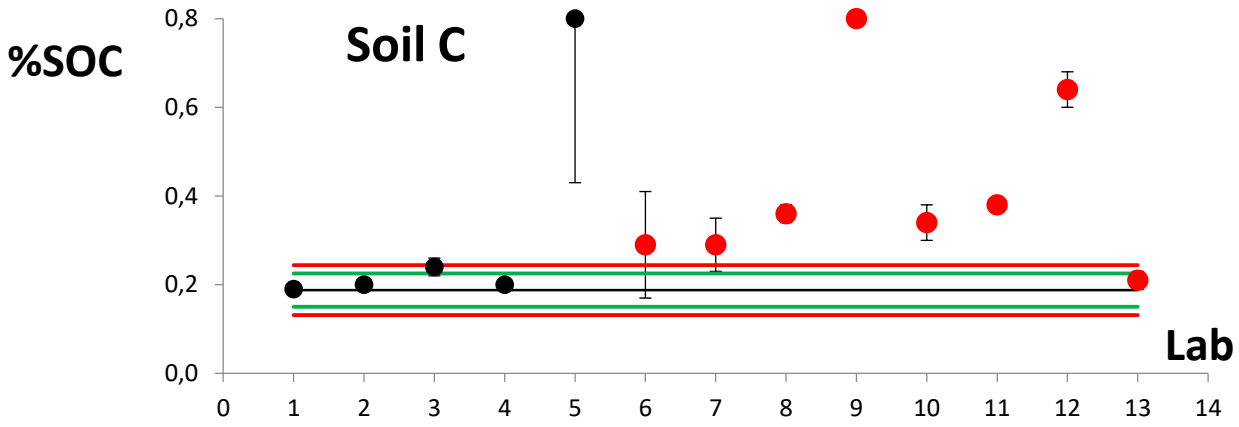
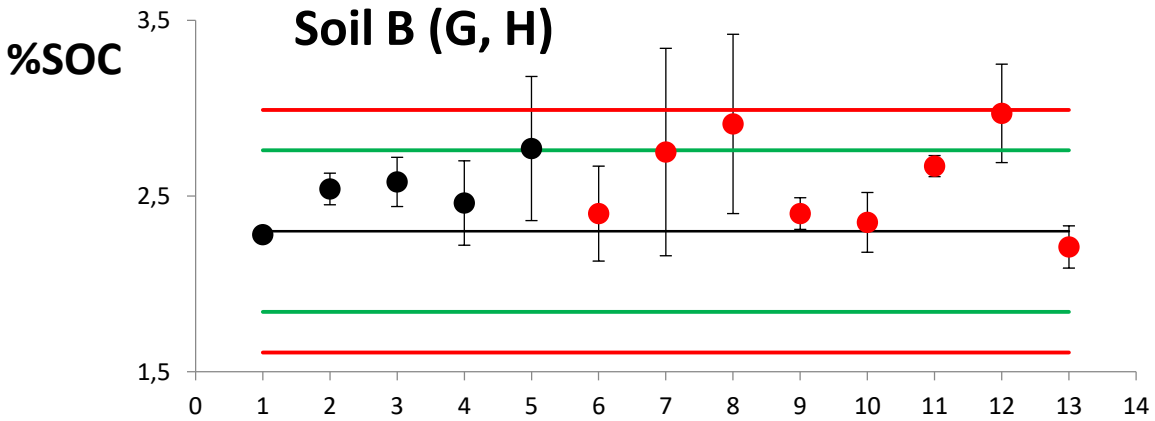
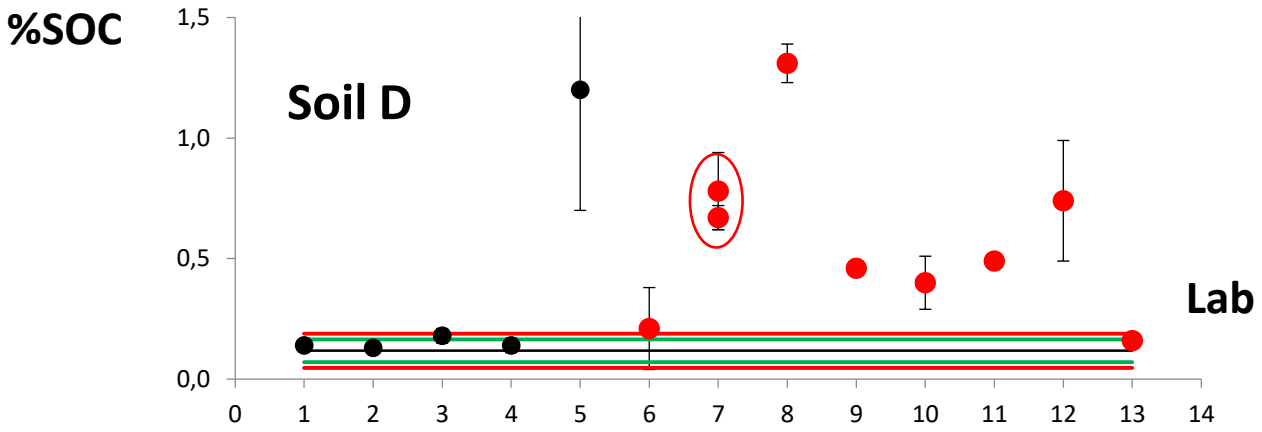
2. Separation of solid and liquid phases after oxidation of the SOC. Tyurin's method









– centrifugation (**SOP**)

– settling

Soils. Granulometric composition (Kachinsky's method)

Soils	H_2O	Acid soluble compounds	1–0.25	0.25–0.05	0.05–0.01	0.01–0.005	0.005–0.001	< 0.001
			mm					
	%							
Soil A(F, I)	2.80	5.08	5.01±0.02	13.4±1.5	50.6±4.2	4.0±0.9	9.5±0.5	14.8±0.5
Soil B(G, H)	1.52	1.61	2.14±0.20	11.3±0.9	64.3±0.5	3.9±0.9	4.9±0.2	15.1±1.9
Soil C	0.24	0.25	10.7±1.2	78.5±1.4	5.8±1.4	0.4±0.3	0.4±0.3	4.1±0.7
Soil D	2.38	1.40	8.5±0.4	29.8±0.9	20.4±2.5	4.3±1.0	11±4	25.0±2.1
Soil E	5.20	3.26	31.9±1.3	9.1±2.0	13.9±1.9	8.5±1.0	21.6±0.5	16.7±0.2

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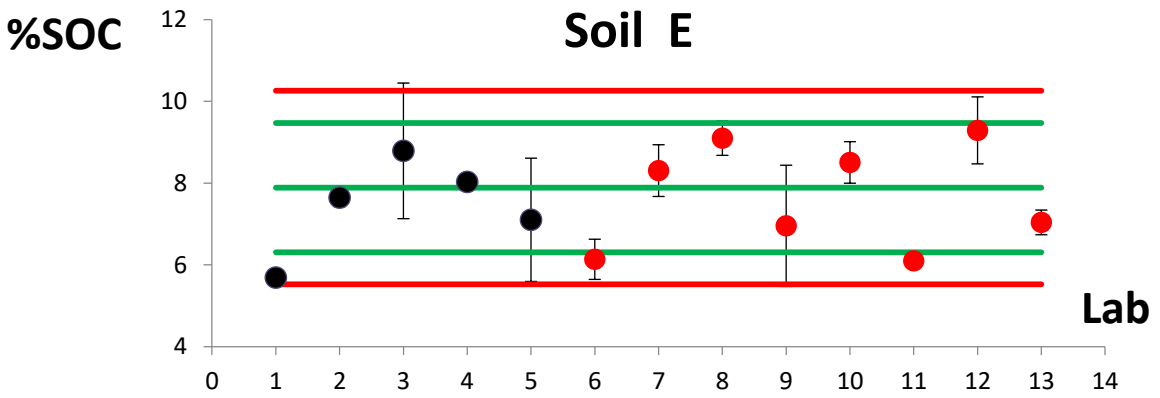
2. Separation of solid and liquid phases after oxidation of the SOC. Tyurin's method

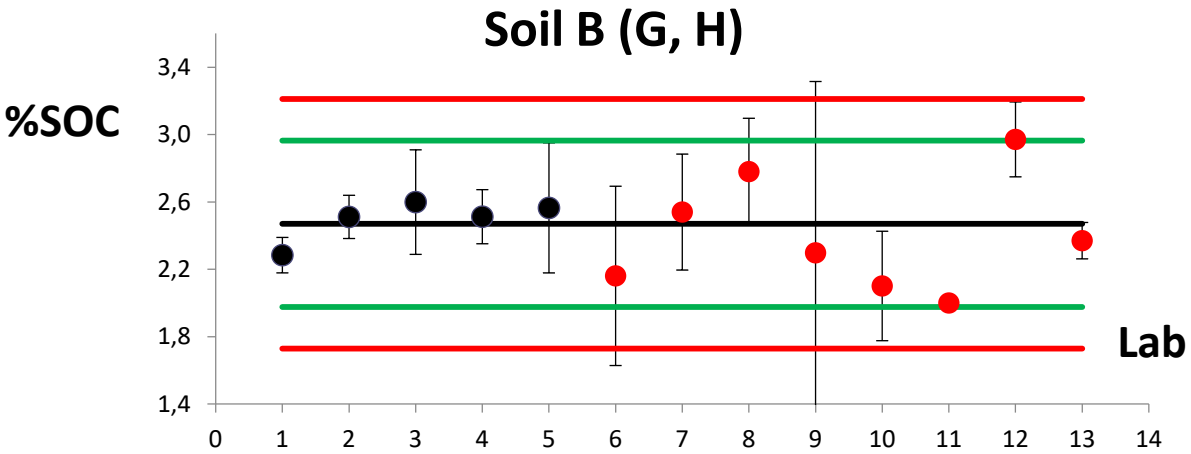
Settling / Centrifugation ???

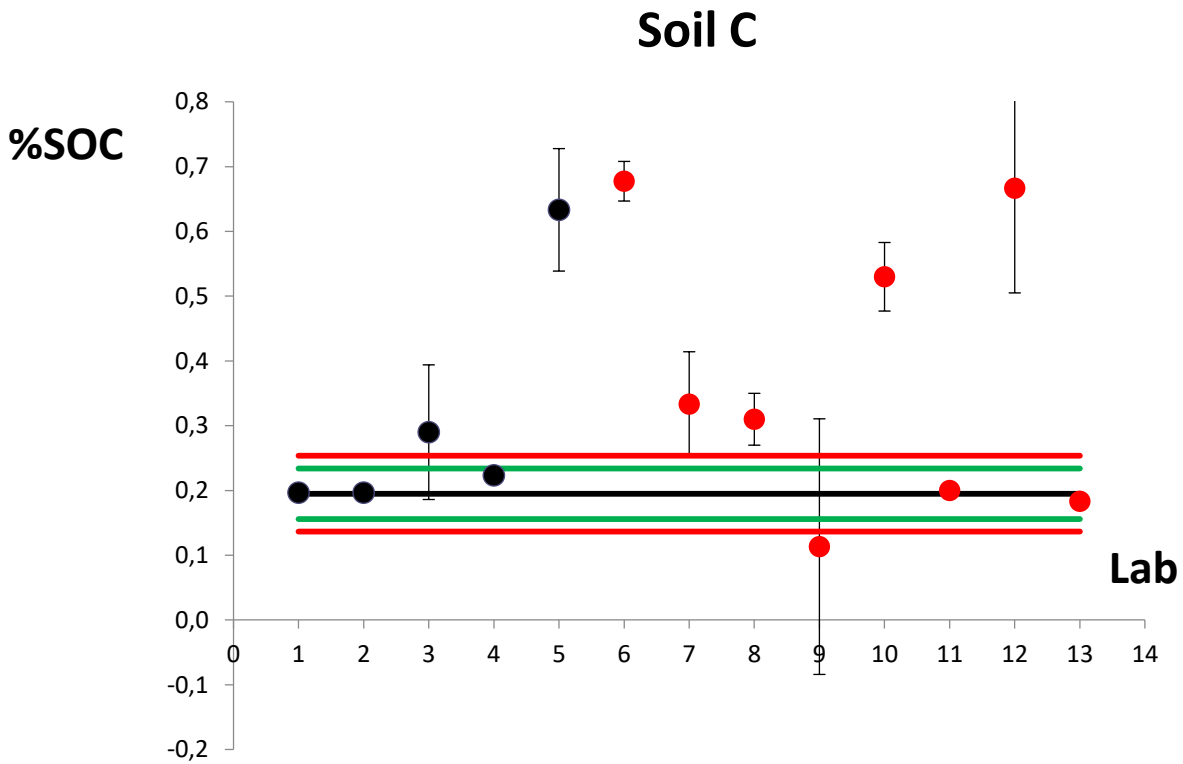
Soil D (Lab 9)				
%SOC$_1$	**%SOC$_2$**	**%SOC$_3$**	***U*, %**	**Settling**
0.66	0.65	0.70	540	experiment 1
0.69	0.81	0.84	640	experiment 2 (after 9 days)

U – offset from control value

2. Separation of solid and liquid phases after oxidation of the SOC. Walkley-Black's method





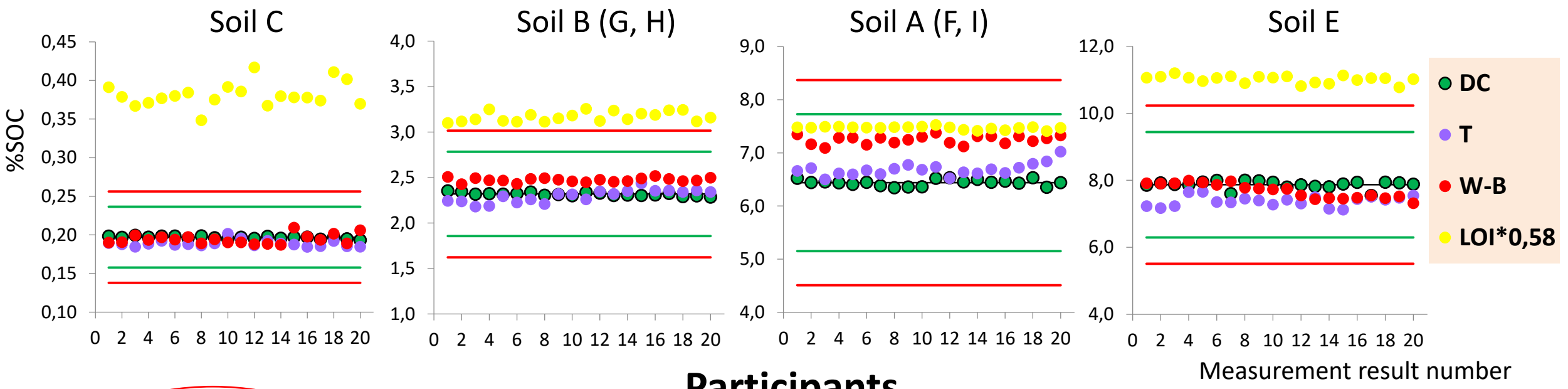


– centrifugation (**SOP**)

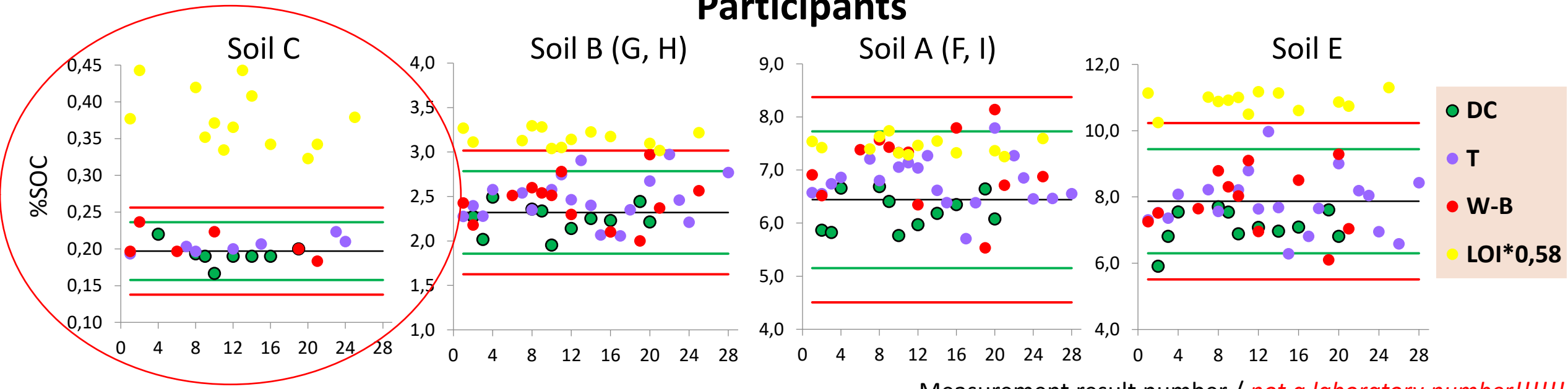
– settling

NatRefLab (RUSOLAN)

%SOM = %LOI, %SOC =%LOI * 0,58

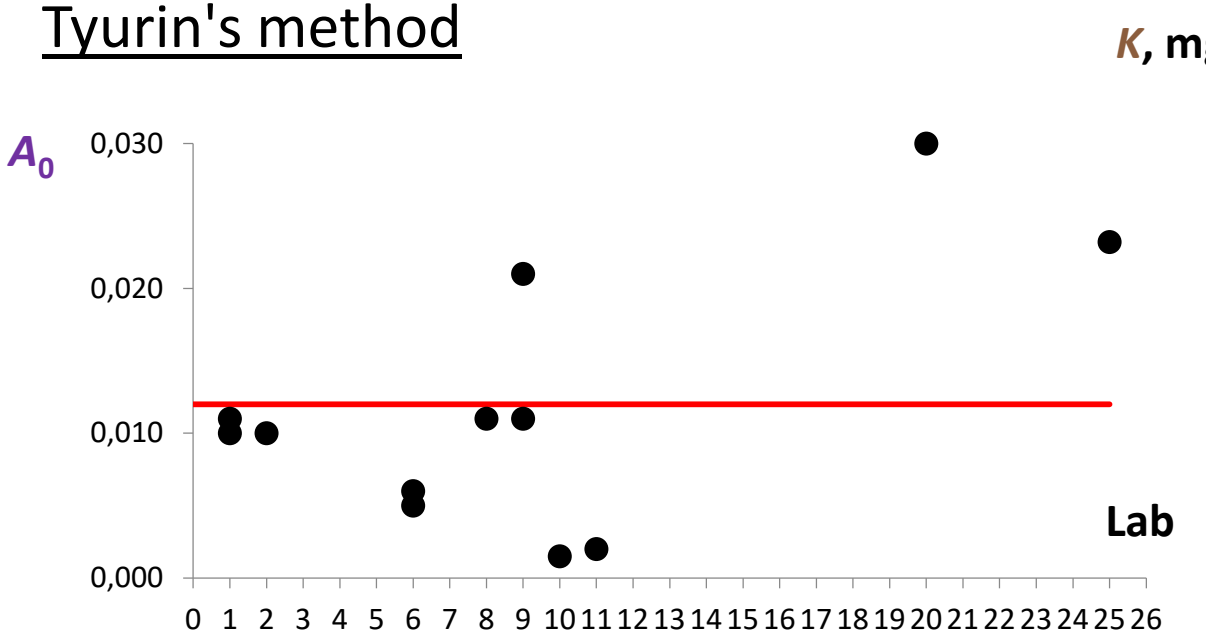


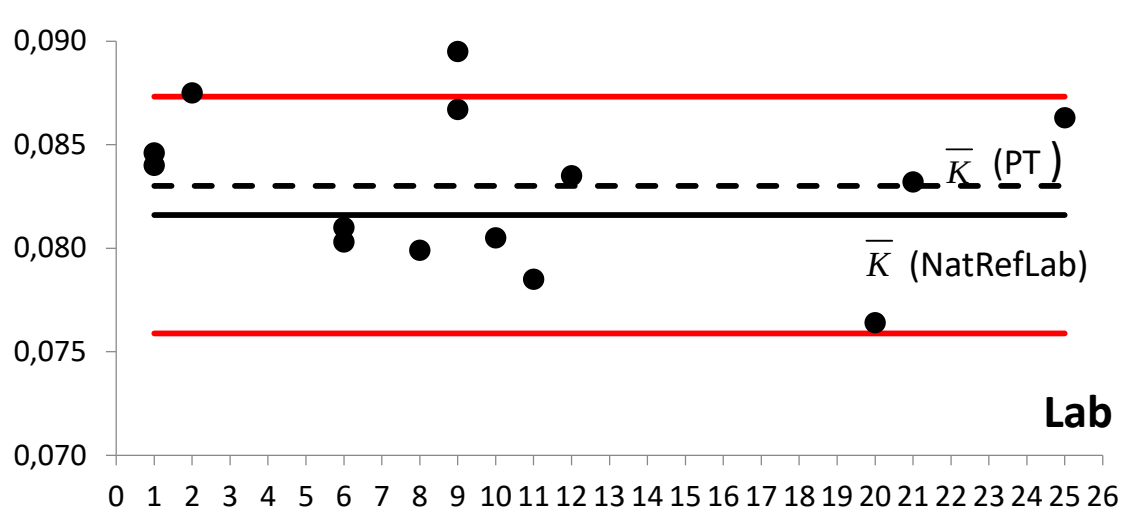
Participants



3. Calibration curve (CC) coefficients ($A = Km(C_{org}) + A_0$, R^2)

Tyurin's method



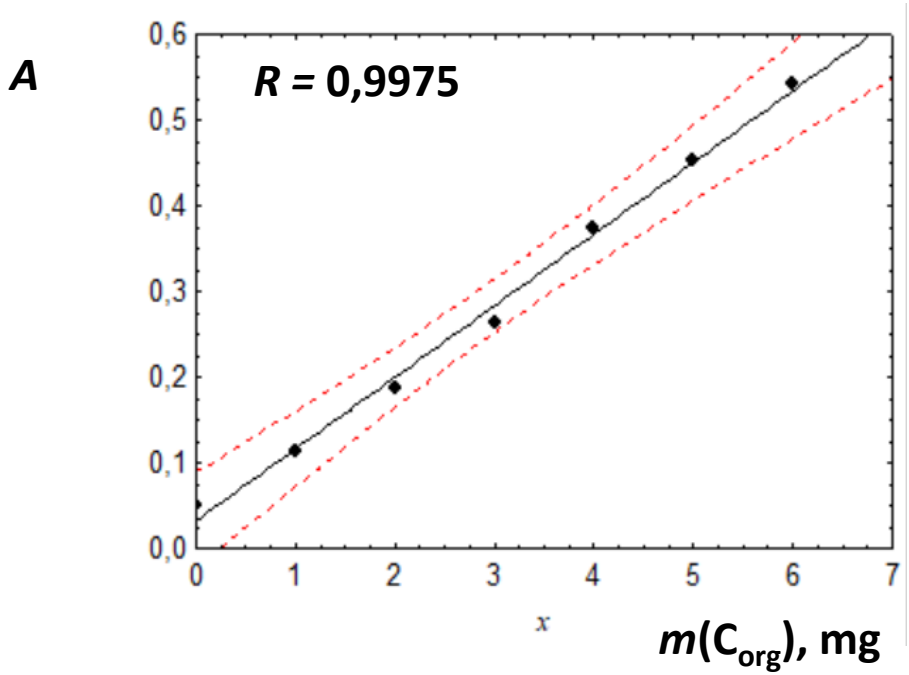


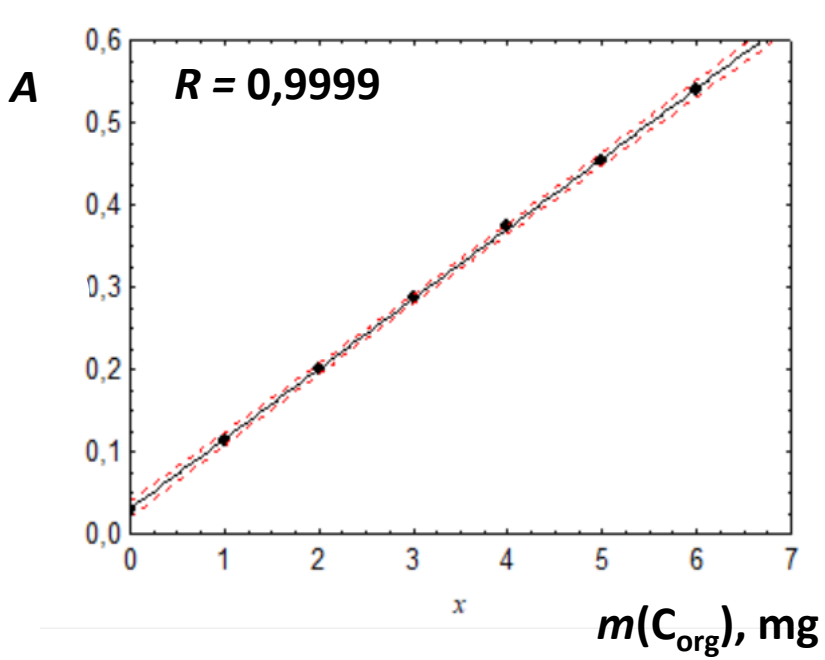
- cleanliness of cuvettes,
- correct preparation of blank solution,
- correct preparation of reducing agent solution

	Characteristics of CC			Data for the stability map of the CC coefficient				
	A_0	K, mg^{-1}	R		K, mg^{-1}	$\overline{K}$	$\overline{K}$ + 2S (K)	$\overline{K}$ - 2S (K)
1	0,011	0,0819	0,9996	1	0,0819	0,0828	0,0851	0,0804
2	0,009	0,0841	1,0000	2	0,0841	0,0828	0,0851	0,0804
3	0,011	0,0845	0,9999	3	0,0845	0,0828	0,0851	0,0804
4	0,021	0,0831	0,9999	4	0,0831	0,0828	0,0851	0,0804
5	0,022	0,0837	0,9997	5	0,0837	0,0828	0,0851	0,0804
6	0,016	0,0834	0,9998	6	0,0834	0,0828	0,0851	0,0804
7	0,007	0,0818	0,9997	7	0,0818	0,0828	0,0851	0,0804
8	0,005	0,0819	0,9998	8	0,0819	0,0828	0,0851	0,0804
9	0,008	0,0826	0,9999	9	0,0826	0,0828	0,0851	0,0804
10	0,006	0,0808	0,9995	10	0,0808	0,0828	0,0851	0,0804

3. Calibration curve (CC) coefficients ($A = Km(C_{org}) + A_0$, R^2)

Tyurin's method





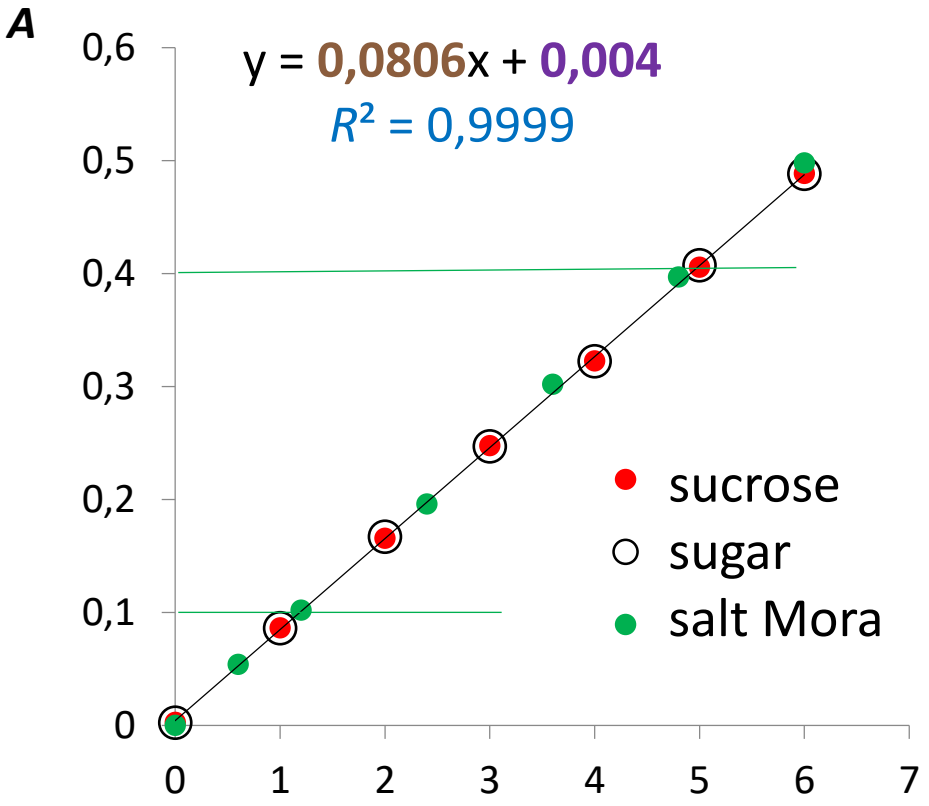
accuracy of preparation of each calibration solution

3. Calibration curve (CC) coefficients ($A = Km(C_{org}) + A_0$, R^2)

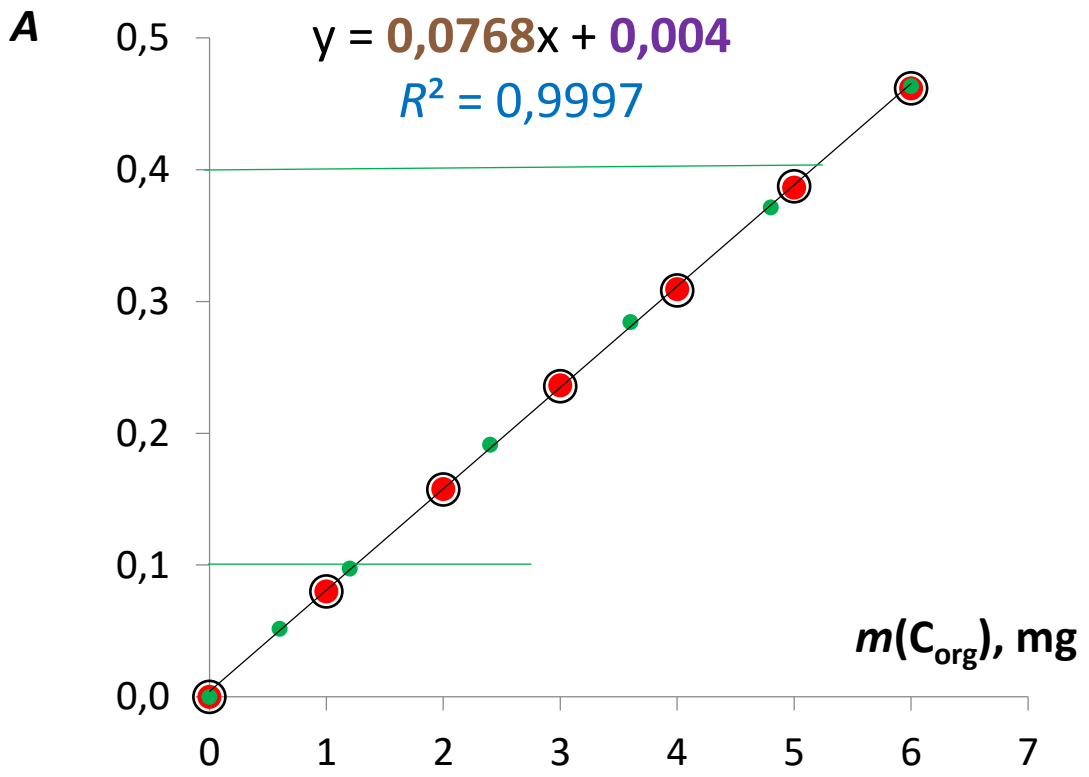
SOP: *Working range* of the Calibration curve – A = 0,05–0,5;

Optimal range of the Calibration curve – A = 0,1–0,4

Tyurin's method



Walkley-Black's method



4. Correction factors (modifications of Tyurin's method)

! The coefficient *f* = 1.15 was applied to all results.

	Soil A (F, I)	Soil B (G, H)	Soil C	Soil D	Soil E
Tyurin's method					
Experimental coefficient *f*	1,10	1,16	1,20	1,28	1,19
Walkley-Black's method					
Experimental coefficient *f*	1,16	1,22	1,31	1,49	1,30

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5. Problems with calculating (*rounding*) results

	Results			Precision	
	%SOC$_1$	**%SOC$_2$**	**%SOC$_3$**	**U_{abs}**	**U_{rel}**
Excel	0,207	0,207	0,253	0,0531	23,8904
when using , the "dropped" numbers are taken into account in further calculations					
Excel	 0,21	0,21	0,25	0,05	**24**
when re-transferring numbers to Excel after Word, the “discarded” numbers are not saved					
Excel	0,21	0,21	0,25	0,05	**21**

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How to get quality results?

Walkley-Black * 1,3 = Tyurin * 1,15 = Dry Combustion (*P* = 0,95)

1. Strict adherence to protocol (centrifugation, conversion factor)
2. Selection of the optimal soil mass (Absorbance *A* = 0,1-0,4)
3. Control of calibration curve coefficients ($A = \boldsymbol{K}m(C_{org}) + \boldsymbol{A_0}$, $\boldsymbol{R}$)

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Thank you for attention!

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