Experience of the Institute of Biology in Harmonization of Methods for Measuring of Soil Organic Carbon

Webinar

26 September 2023

Shamrikova E.*, Vanchikova E.

*Chairman of RUSOLAN

shamrikovaelena@yandex.ru

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Introduction

Today, world soil science has a number of national schools that *differ in*:

- principles of soil diagnostics,
- approaches (methodology) of study,
- research methods.

The diversity of schools has historically been caused by:

- the independent development of soil science in individual countries,
- a wide variety of soils,
- uneven distribution of soils on the earth's surface,
- technical and economic constraints,
- suitability of the method for the soils of the region.

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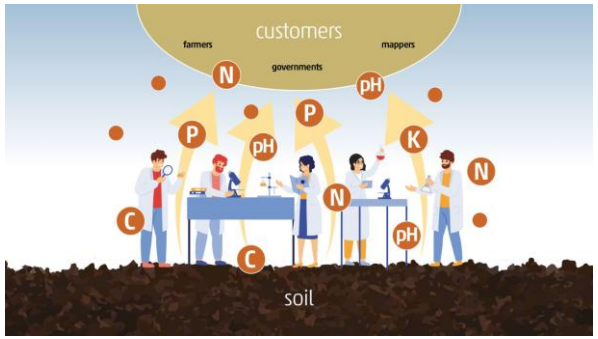
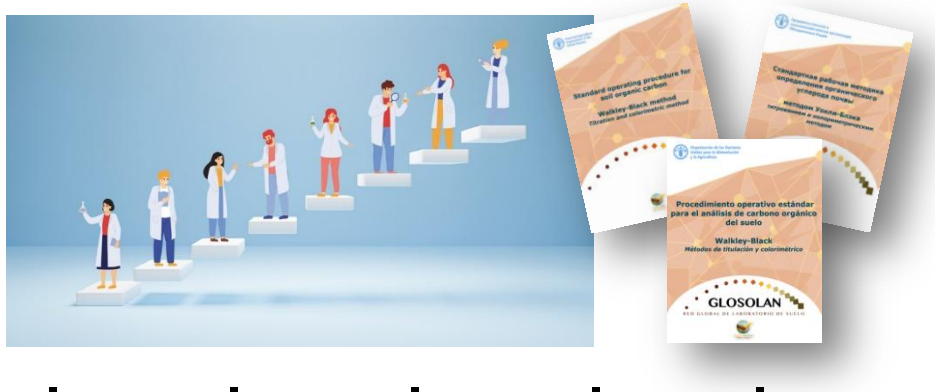
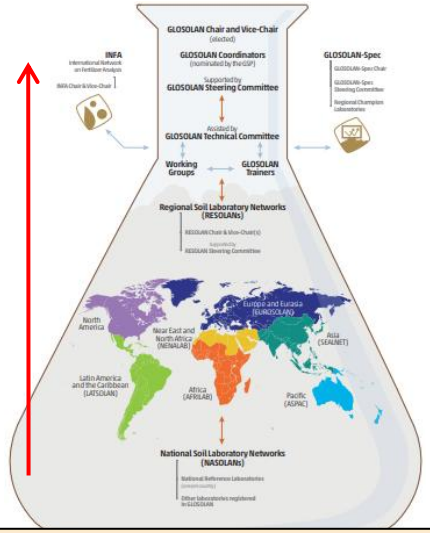


GSP

GLOSOLAN



2011 2013 2015 2017 2019 2021 2023



960 laboratories in the world

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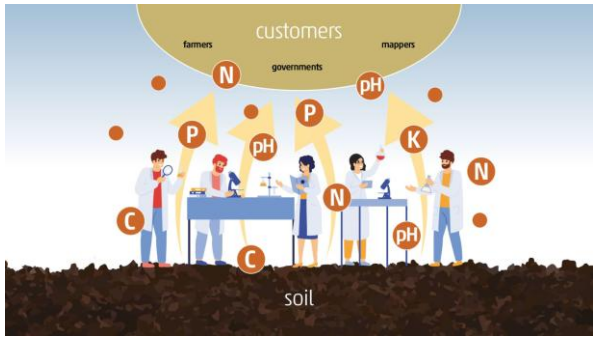

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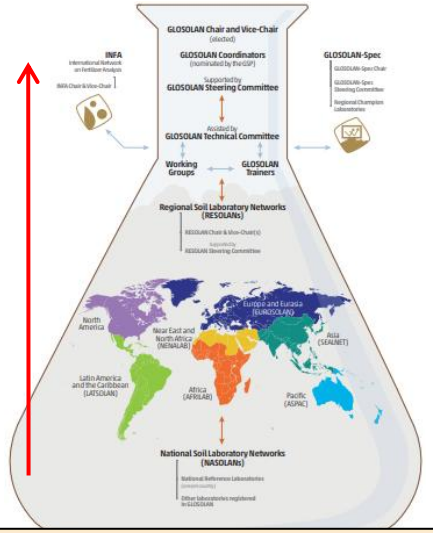

960 laboratories in the world

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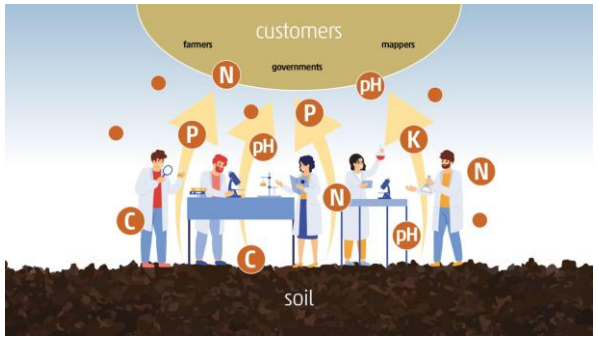

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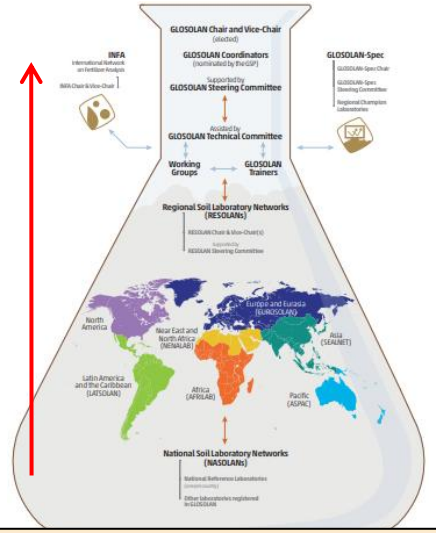
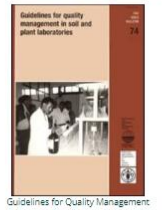


960 laboratories in the world

The organization of the GLOSOLAN proficiency test (PT)



Guidelines for Quality Management in Soil and Plant Laboratories. (FAO Soils Bulletin - 74)

Basic guidelines on how to produce a soil sample for proficiency testing
AR | EN | ES | FR | RU | ZH | TR

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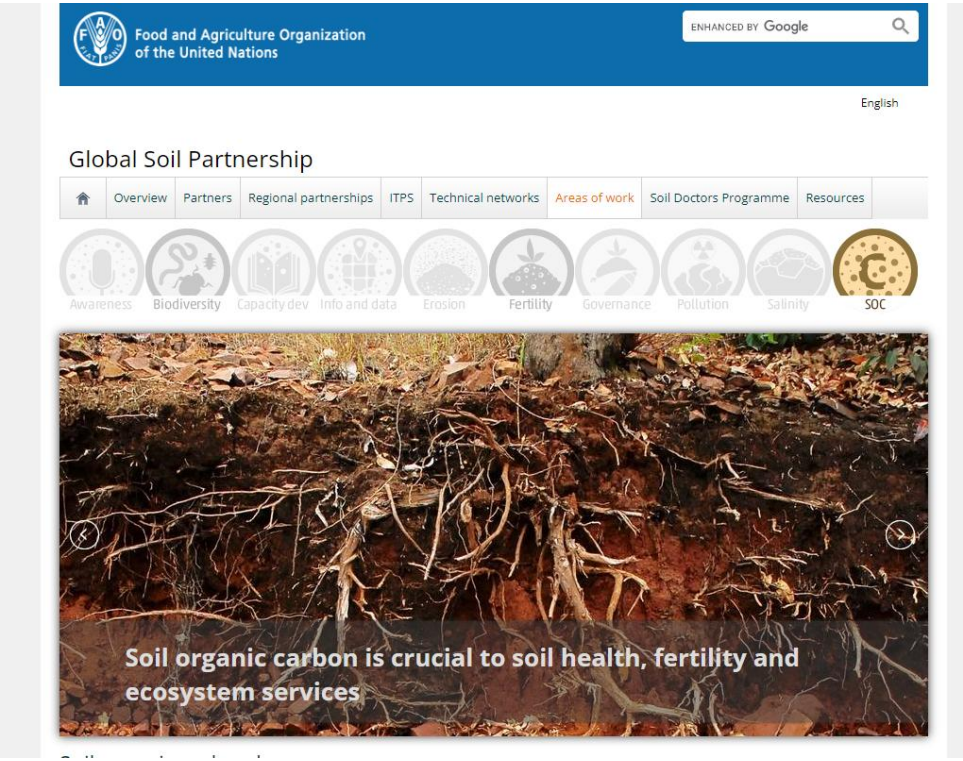
Why SOC?

SOC is one of the **most important components of soils.**

In the age of global changes in the environment, monitoring SOC is of outmost importance.

Under the Global Soil Partnership initiative of the Food and Agriculture Organization of the United Nations (FAO), the availability of non-harmonized data is one of the reasons for the low accuracy of the global SOC map (*Peralta et al., 2022*).

This is especially true for regions such as Eurasia where data are sparse.



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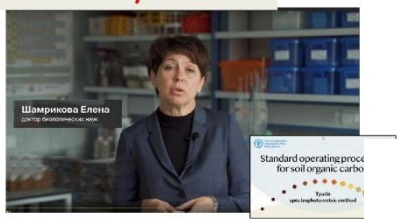
www.fao.org/global-soil-partnership/glosolan/

Tested methods

- Tyurin's method (**T**) ,
- Walkley-Black's method (**WB**),
- Dry combustion on the analyzer (**DC**),
- Loss-on-ignition method (**LOI**)

Almost 9000 views in one year!



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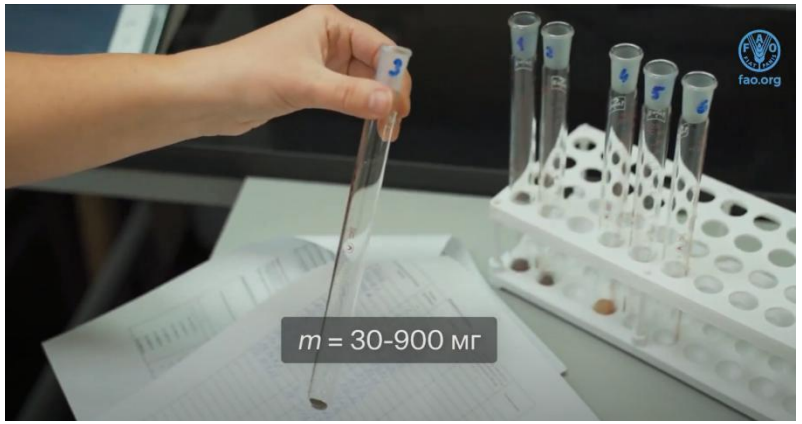
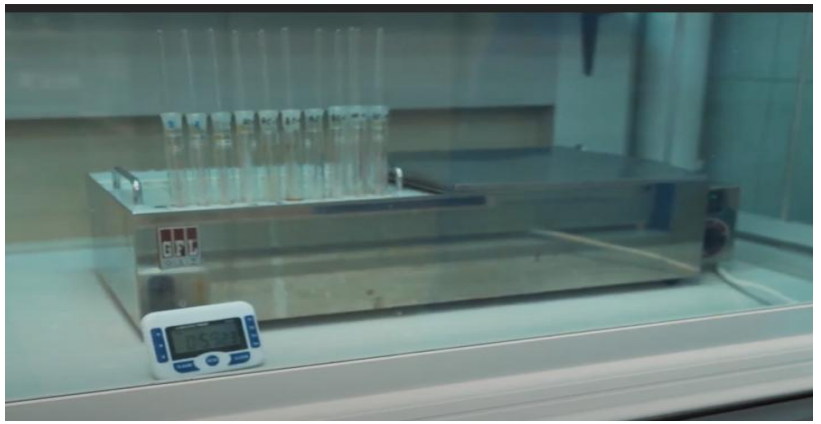
Tyurin's method (Institute of Biology)

1





2

3

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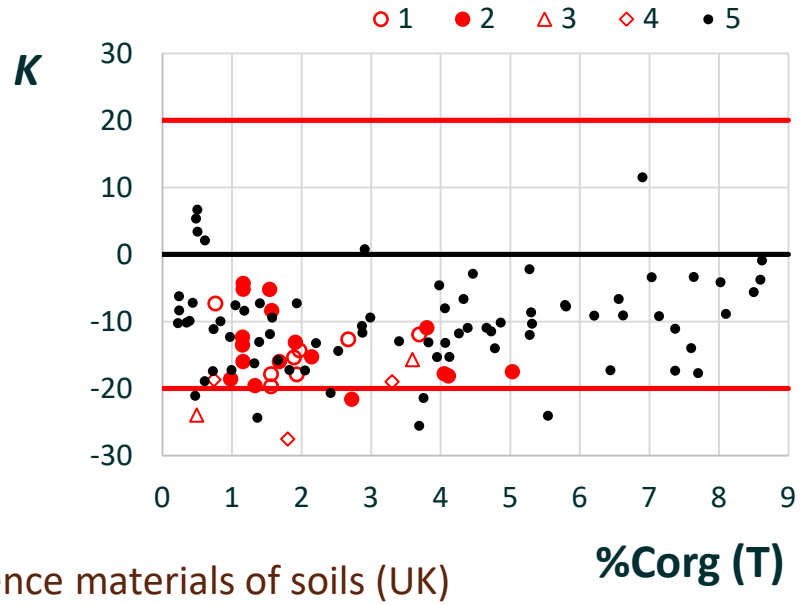
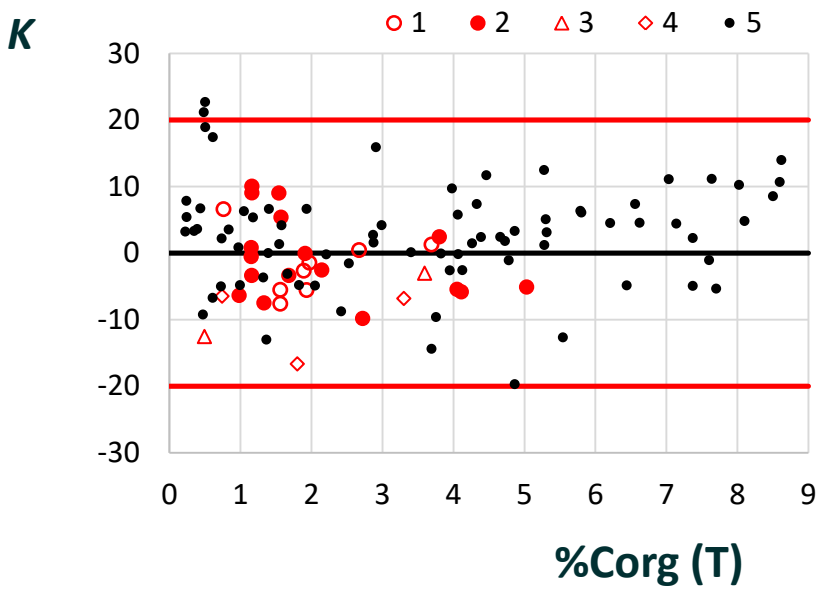
Quality control of measurements %Corg (Tyurin)

without taking into account the *f* = 1.15



taking into account the ***f* = 1.15**



1 – reference materials of soils (UK)
2, 3 – standard soil samples (Russia)
4 – soil samples from GLOSOLAN
5 – soil samples of various types

more than 120 soil samples in total

%Corg (T)	*K*, % (*P* = 0.,95)
0.170 – 8.,7	20

$$K = 100\% * \frac{|\%Corg\ (T) - \%Corg\ (DC)|}{\%Corg\ (DC)}$$

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Quality control of measurements %Corg (Tyurin)

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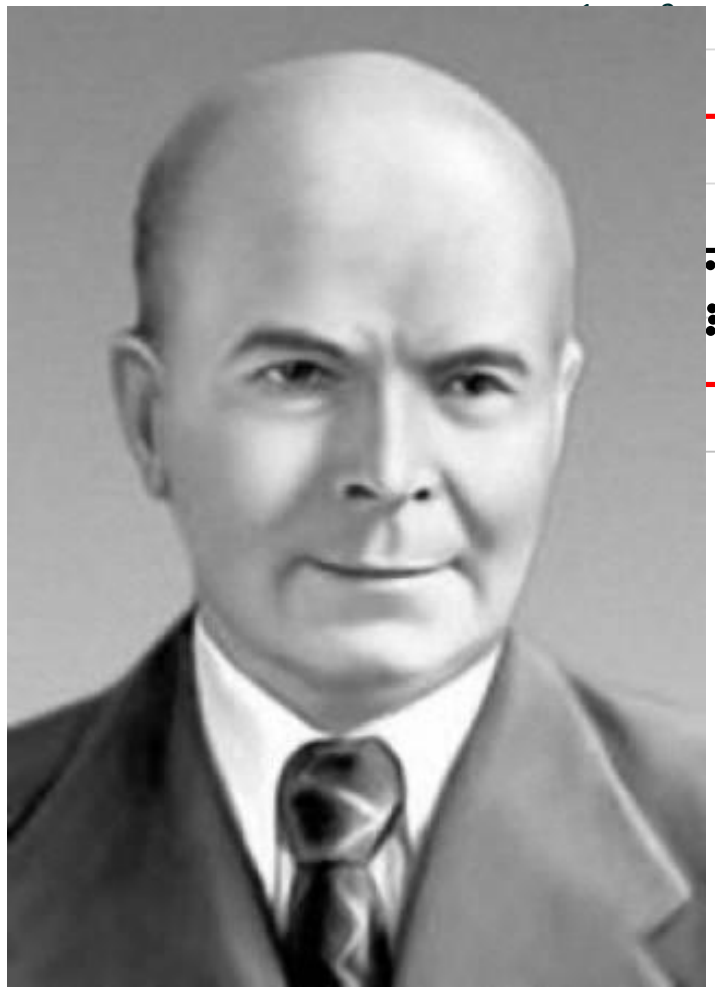

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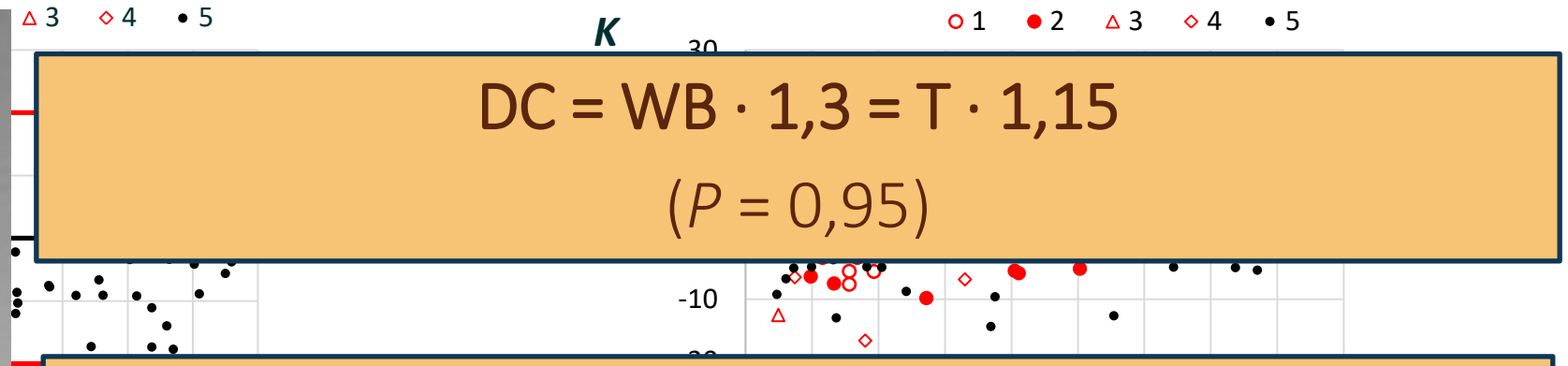

$$DC = WB \cdot 1{,}3 = T \cdot 1{,}15$$

(P = 0,95)

Ivan Vladimirovich Tyurin (1892-1962)

f = 1.17 (Arinushkina, 1962)

%Corg (T)	*K*, % (*P* = 0.95)
0.170 – 8.7	20

$$K = 100\% * \frac{|\%Corg\ (T) - \%Corg\ (DC)|}{\%Corg\ (DC)}$$

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$$DC = WB \cdot 1.3 = T \cdot 1.15$$

($P = 0.95$)

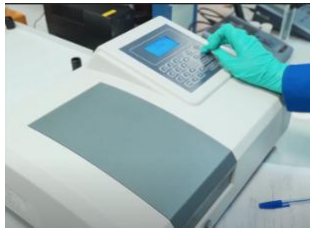
! In the Walkley-Black method, the amount of $K_2Cr_2O_7$ and H_2SO_4 is equal to the same characteristics as in the Tyurin method, but the concentration of these components of the mixture is 1.5 times higher

!! Heating of the reaction mixture occurs due to the exothermic effect that occurs when a concentrated solution of H_2SO_4 is mixed with distilled water.

In the Tyurin method, compared to WB, additional dispersion of the solid phase occurs







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$$DC = WB \cdot 1.3 = T \cdot 1.15$$

$$(P = 0.95)$$

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Contents lists available at ScienceDirect

Geoderma

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Transferability between soil organic matter measurement methods for database harmonization

E.V. Shamrikova [a], B.M. Kondratenok [a], E.A. Tumanova [a], E.V. Vanchikova [a], E.M. Lapteva [a], T. V. Zonova [a], E.I. Lu-Lyan-Min [a], A.P. Davydova [a], Z. Libohova [b,*], N. Suvannang [c]

[a] Institute of Biology Komi SC UrD RAS, Kommunisticheskay 28, Syktyvkar, Russian Federation
[b] USDA-ARS Dale Bumpers Small Farms Research Center, 6883 S. Hwy 23, Booneville, AR 72927, United States
[c] Land Development Department, 2003/61 Phaholyothin Road, Chatuchak, Bangkok 10240, Thailand

ARTICLE INFO

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ABSTRACT

Soil organic matter (SOM) is one of the most important soil-forming factors and complex with a chemical

Catena xxx (xxxx) 107151

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Catena

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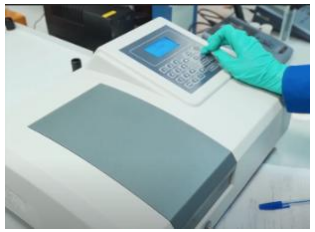
Which method to choose for measurement of oranic and inorganic carbon content in carbonate-rich soils? Advantages and disadvantages of dry and wet chemistry

E.V. Shamrikova, E.V. Vanchikova, E.I. Lu-Lyan-Min, O.S. Kubik, E.V. Zhangurov

Institute of Biology Komi SC UrD RAS, Kommunisticheskay 28, Syktyvkar, Russian Federation



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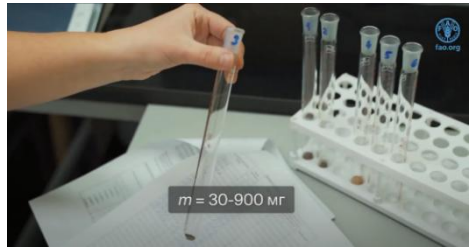
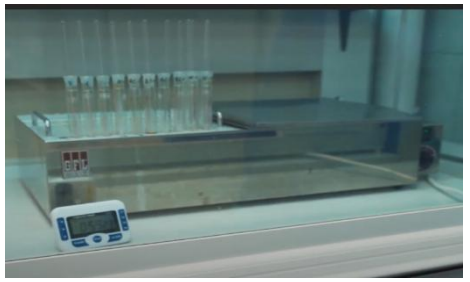
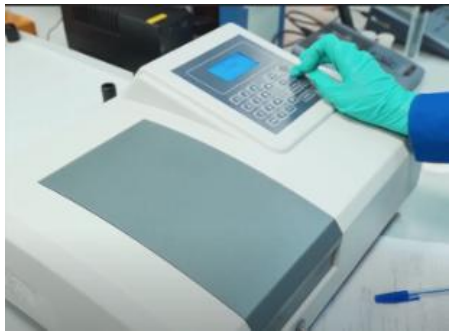
Dichromatometric method (T, WB)







Advantages:

- cheapness,
- significant amounts of data on the world's soils

Disadvantages:

- limited measurement range %Corg from **0.17 to 8.7%**,
- incomplete oxidation of carbon of organic compounds
(taking into account the incomplete oxidation of Corg - using universal *ƒ*),
- labor intensity,
- toxicity.

Relative measurement error: ±δ = 20%.

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Dry combustion on the analyzer

$$4C_xH_yO_z + (4x + y - 2z)O_2 = 4xCO_2 + 2yH_2O$$

$$CaCO_3 = CaO + CO_2$$

Advantages:

- measuring range $\%C_{tot}$ from 0.1 to 100%,
- high accuracy of measurement results:

$\pm\delta$ = 23, 15, 10 и 3,5% для $\%C_{tot}$ = (01–2); (2–5) и (5–30) и >30 %,

- complete oxidation of carbon of organic and inorganic compounds,
- availability of standard samples for analyzer calibration,
- rapidity (batch up to 100 samples),
- selectivity

Reference method

Disadvantages:

High cost of the device, consumables and maintenance

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Loss-on-ignition method

Advantages:

- cheapness,
- measuring range %Ctot from 0.1 to 100%,
- rapidity

Disadvantages:

- ?? f for SOM → SOC (SOC = SOM /1.724),
- the presence of mineral compounds that decompose at T = 105-550˚C with the release of gaseous products

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Method	Soil A			Soil B			Soil C			Soil D			Soil E			Soil F			Soil G			Soil H			Soil I		
1 - T	$A1_1$	$A1_2$	$A1_3$	$B1_1$	$B1_2$	$B1_3$	$C1_1$	$C1_2$	$C1_3$	$D1_1$	$D1_2$	$D1_3$	$E1_1$	$E1_2$	$E1_3$	$F1_1$	$F1_2$	$F1_3$	$G1_1$	$G1_2$	$G1_3$	$H1_1$	$H1_2$	$H1_3$	$I1_1$	$I1_2$	$I1_3$
2 - WB	$A2_1$	$A2_2$	$A2_3$	$B2_1$	$B2_2$	$B2_3$	$C2_1$	$C2_2$	$C2_3$	$D2_1$	$D2_2$	$D2_3$	$E2_1$	$E2_2$	$E2_3$	$F2_1$	$F2_2$	$F2_3$	$G2_1$	$G2_2$	$G2_3$	$H2_1$	$H2_2$	$H2_3$	$I2_1$	$I2_2$	$I2_3$
3 - DC	$A3_1$	$A3_2$	$A3_3$	$B3_1$	$B3_2$	$B3_3$	$C3_1$	$C3_2$	$C3_3$	$D3_1$	$D3_2$	$D3_3$	$E3_1$	$E3_2$	$E3_3$	$F3_1$	$F3_2$	$F3_3$	$G3_1$	$G3_2$	$G3_3$	$H3_1$	$H3_2$	$H3_3$	$I3_1$	$I3_2$	$I3_3$
4 - LOI	$A4_1$	$A4_2$	$A4_3$	$B4_1$	$B3_2$	$B3_3$	$C3_1$	$C3_2$	$C3_3$	$D3_1$	$D3_2$	$D3_3$	$E3_1$	$E3_2$	$E3_3$	$F3_1$	$F3_2$	$F3_3$	$G3_1$	$G3_2$	$G3_3$	$H3_1$	$H3_2$	$H3_3$	$I3_1$	$I3_2$	$I3_3$

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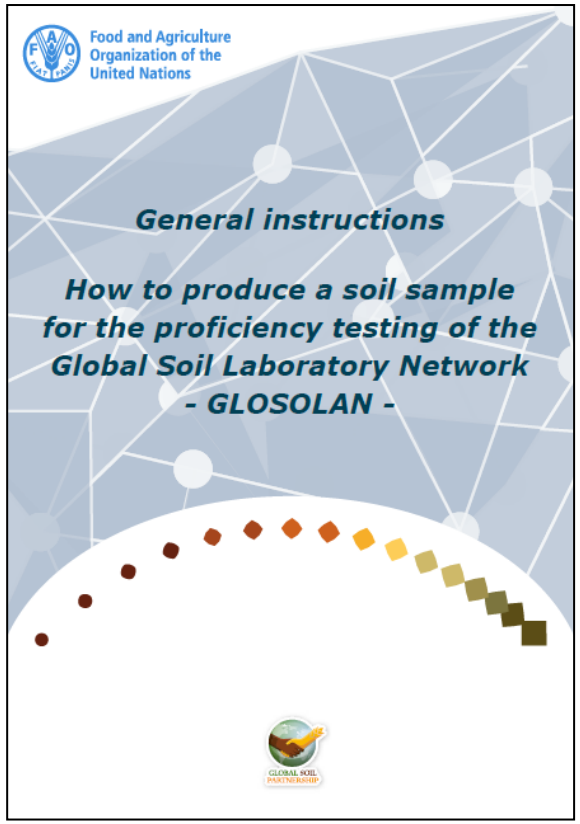
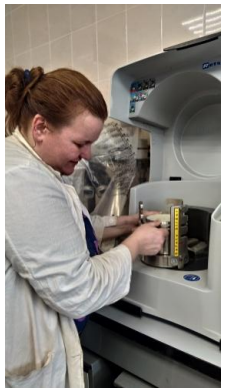
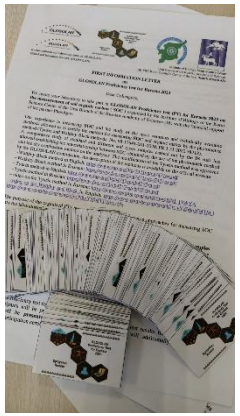
Before the start of PT

Preparation of soil samples for PT







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Before the start of PT

Homogeneity

We carry out BEFORE mailing the soil to the participating laboratories.

10 times 2 parallel repetitions for each sample for each method.

= 20 measurements for each sample for each method.

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During PT

Stability

which determines the period life of the soils.
10 times 1-2 parallel replicates for each sample for each method.
= 10-20 measurements for each sample for each method.
The measurement period is from the beginning of PT to the end of PT.
1 or 2 times a week.
Later we will calculate the frequency of measurements.

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Conclusion

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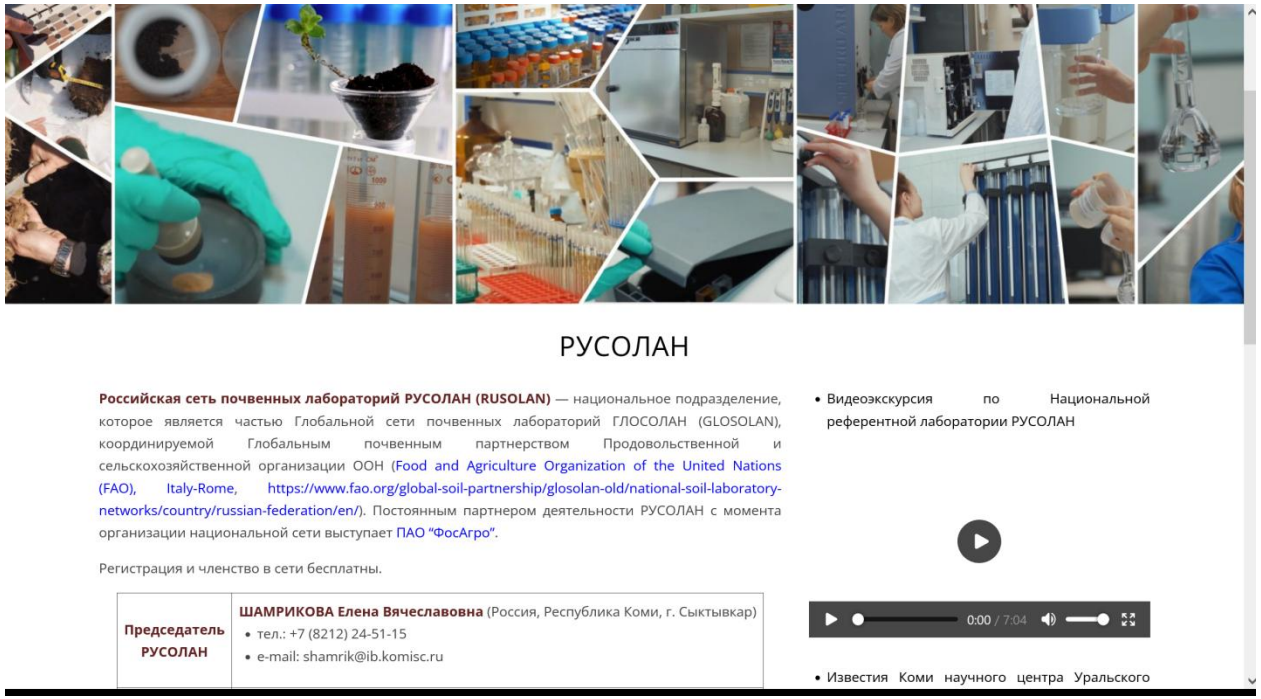
https://ib.komisc.ru/rusolan/



GLOSOLAN Proficiency test for Eurasia 2023 are held **free of charge.**

All PT participants will be provided with a final report in which test results from participating laboratories will be **presented anonymously**.

Every participant will additionally receive an individual PT ***participation certificate***.

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Acknowledgments

ФИЦ КОМИ НЦ УрО РАН

PHOSAGRO

THANK YOU FOR ATTENTION!

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