Centre of Environmental Research Waste Management, Circular Economy and Environmental Security

WP 1.C Biodegradable Waste

Environment - Environment for Life 12. – 14. 9. 2022



TA CR Project SS02030008 Centre of Environmental Research: Waste Management, Circular Economy and Environmental Security is co-financed with the state support of the Technology Agency of the Czech Republic as part of the Environment for Life Program.

www.tacr.cz



The benefit of compost application to improve soil properties and support water retention

Ing. Miloš Rozkošný, Ph.D.¹, Ing. Josef Kratina, Ph.D.¹, Ing. Tomáš Chorazy, Ph.D.² & Ing. Ondřej Holubík ³

1 TGM Water Research Institute, p.r.i.

2 Brno University of Technology, Faculty of Civil Engineering, AdMaS Centre 3 Research Institute for Soil and Water Conservation, p.r.i.

Focus and main goals of work package 1C

A number of research and university organizations in the Czech Republic and abroad have been researching the benefits of adding organic matter to the soil, including composts, for a long time. Our goal was to collect information about these researches and their results and process them in a clear manner for the needs of the state administration (especially the Min. of Env. of the Czech Republic as the contractor and guarantor of the research center CEVOOH) and for practice.

1. Biolodegradable waste, their management and composting, compost applications

The issue of technological procedures for the processing of BRO from the point of view of compost quality (including its sorting and collection), proposal of measures to optimize technology, evaluation of sewage sludge composting technologies, evaluation of new technologies.

Research and assessment of the effect of composts on soil water retention and organic matter replenishment.

Processing of BRO in terms of compost quality (beyond current BAT).

2. Prevention of food waste

The issue of preventing food waste.

Development of a methodology for measuring the amount

and analyzing the composition of food waste.

Development of new procedures and ways of preventing food waste.

https://cevooh.cz/home/1-c-biologicky-rozlozitelne-odpady/

Working team – part 1 "Other Biowaste":

Ing. Miloš Rozkošný, Ph.D. (VÚV TGM) Prof. Ing. Dagmar Juchelková, Ph. D. (VŠB–TUO) Ing. Tomáš Chorazy, Ph. D. (VUT) Prof. RNDr. Tomáš Cajthaml, Ph.D. (UK) Prof. Ing. Helena Raclavská, CSc. (VŠB–TUO) Ing. Jana Růžičková, Ph.D. (VŠB–TUO) Ing. Stanislav Juráň (VÚV TGM) Ing. Pavel Sedláček (VÚV TGM)

Working team - part 2 "Food Biowaste":

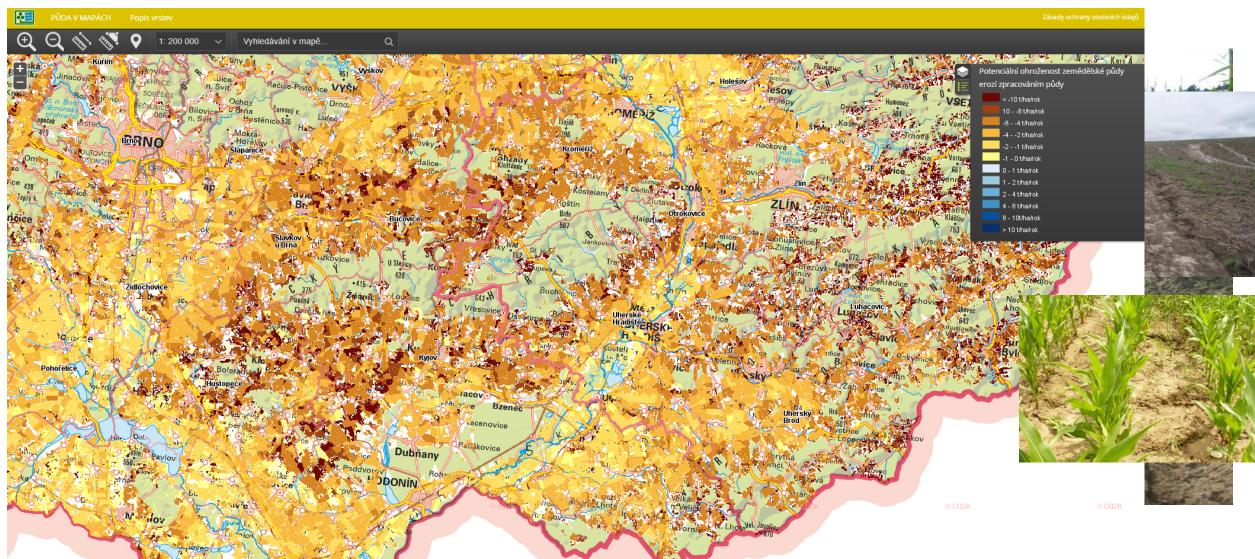
Ing. Dagmar Vološinová (VÚV TGM) Ing. Robert Kořínek, Ph.D. (VÚV TGM) Ing. Jiří Sobek, Ph. D. (ÚCHP) Ing. Jiří Valta (CENIA)

Methodology of partial research on the use of composts to support soil water retention

- Processing of composts for the purpose of studying the effect of composts on soils
 - Preparation of methodologies for the determination of C, N, P and selected forms biological availability
 - Laboratory analyzes of obtained composts (composts from composting plants of various sizes – small municipal to regional)
- Initiation of research solutions on the effect of composts on water retention and the supply of organic matter to soils
 - Research and processing of previous research and publications
 - In experimental (container trials) and field scale (soil applications)
 - Focus on soils threatened / affected by erosion
 - Focus od urban green areas and their soils
 - Preparation of the necessary equipment and measuring technique and its testing
 - In the field monitoring the benefit of compost application using thermal imaging, meteorological characteristics dataloggers

Reasons for the research - soil degradation in the Czech Republic







The organic component of soil

Influence on the productive functions of the soil

Basic aspects of soil care = reasons why we fertilize

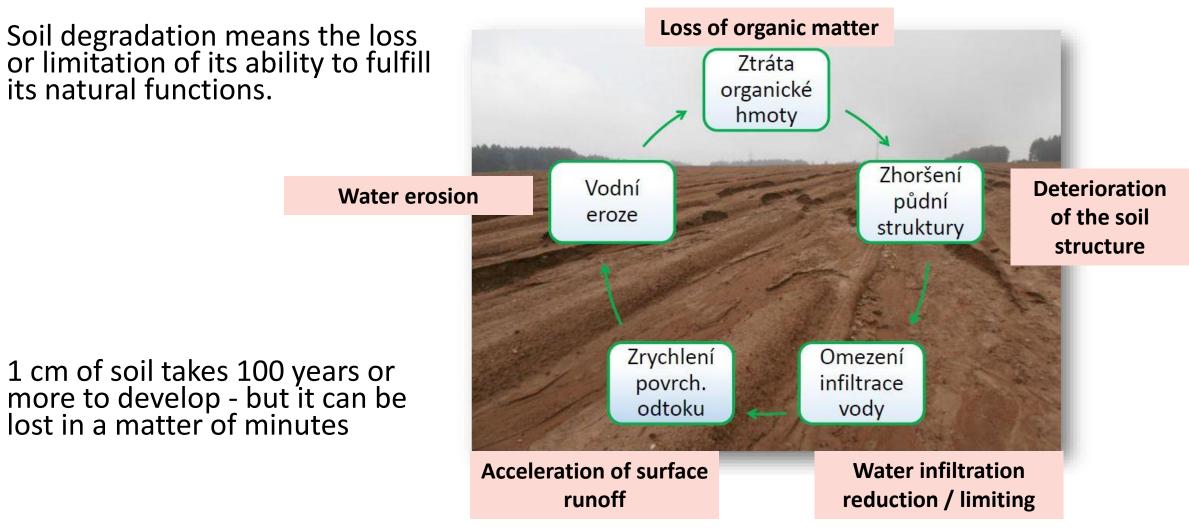
- 1) Application of nutrients for the needs of a specific crop
- 2) Maintenance of soil fertility

Maintaining the proportion and quality of organic matter (ploughing of postharvest residues, method of soil cultivation, application of organic fertilizers)

Maintenance of a suitable pH (liming, possibly with dolomitic limestone application of Mg)

Maintaining a sufficient supply of nutrients (stock fertilization: N, P, K, Mg, microelements)

The organic component of the soil and its transformation





Results of retrospective monitoring VÚMOP (Research Institute for Soil and Water Conservation)

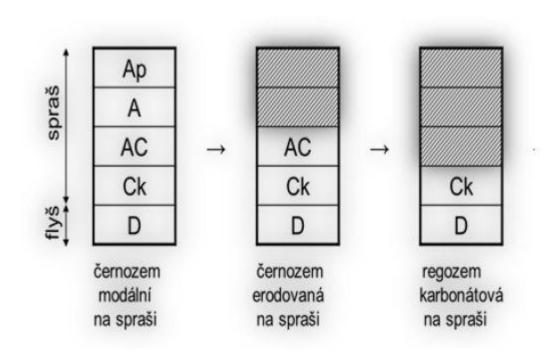


Evaluation of trends in changes in soil properties over 40 years -150 probes

Soil erosion: Noticeable manifestations especially in the territory of South Moravia Changes at the soil type level

1 ha of deep black soil It can store up to 3,500 m3 of water

Up to 50% of agricultural land is compacted



Biowaste composting Potential benefit for improving soil properties and water retention

Selected open access reports / guidances (in Czech):

Příručka pro kompostování. ZERA Agency, 2021.

Badalíková, B., Vašinka, M. Hodnocení obsahu organické hmoty v půdě a jejího vlivu na vodní erozi a půdní vlastnosti. Zemědělský výzkum, spol. s r.o., 2020. ISBN 978-80-88000-28-0.

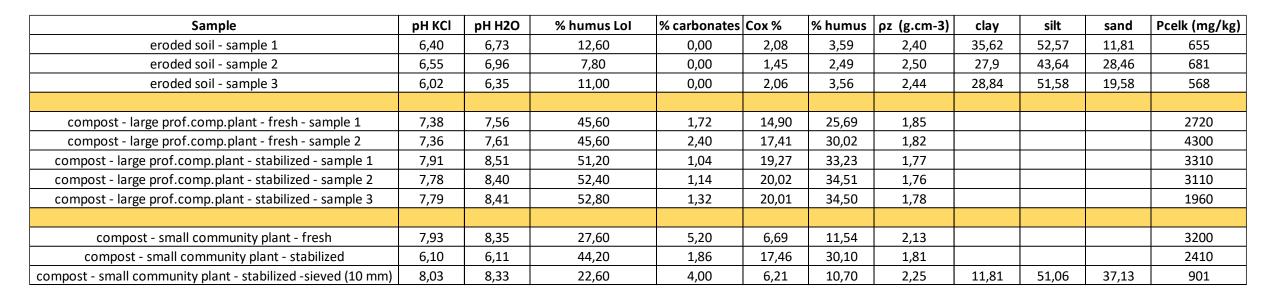
Manuál kvality kompostu. V rámci projektu QK1920177 "Nástroje pro lepší využívání kompostovacích zařízení s následným navýšením vyrobeného kompostu, aplikovaného na zemědělskou půdu". ZERA Agency & Mze ČR. ISBN 978-80-87226-41-4

Pilotní ověření účinnosti kompostu vyrobeného z bioodpadu v zemědělské praxi. Udržitelnost kompostování BRO v zemědělské praxi. Aplikace výzkumu v praxi: "Management využití kompostu vyrobeného z bioodpadu na zemědělských plochách - slabě a silně ohrožených erozí"

Hůla, J. a kol. Úprava fyzikálních vlastností půd a retenční schopnosti půdy zapravením kompostů z odpadní biomasy. Certifikovaná metodika, Praha: VÚZT, v.v.i. & Zemědělský výzkum, spol. s r.o. Troubsko. 2012

Organické hnojení základy dobré odborné praxe "Kompost pro zemědělství" (Tento materiál vznikl volným překladem publikace Rogasik J., Reinhold J.: Organishe Düngung, Bundesgütegemeinschaft Kompost e. V., Köln, 2005.)

Experimental & field research Compost composition analysis





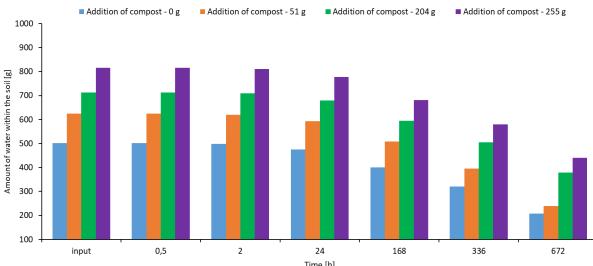








Effect of compost application on soil water retention



Tested doses of composts: 0 / 20 / 80 / 100 tons per hectare Embedding into the top layer of the soil Water saturation to full water capacity Monitoring the change in water content, soil subsidence and bulk density

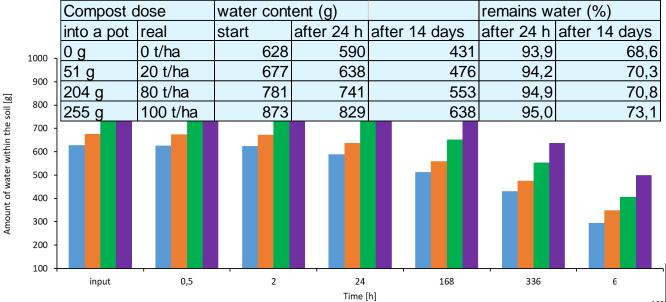
Compost dose		water content (g)			remains water (%)	
into a pot	real	start	after 24 h	after 14 days	after 24 h	after 14 days
0 g	0 t/ha	502	475	208	94,6	41,4
51 g	20 t/ha	625	592	240	94,7	38,4
204 g	80 t/ha	713	679	379	95,2	53,2
255 g	100 t/ha	816	777	440	95,2	53,9

The soil was quite dry at the beginning of the experiment Bulk density – 10 %

100 input 0,5 2 24 168 Time [h] Eroded soil – South Moravia Region

Source of compost – large professional plant

Effect of compost application on soil water retention

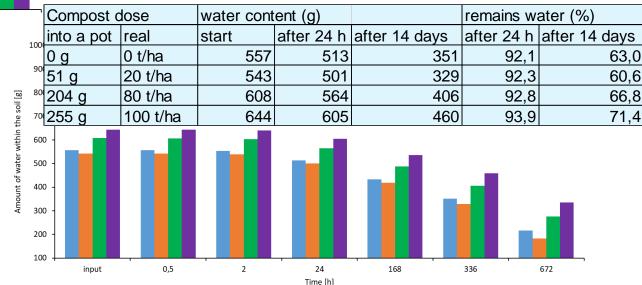


Not degraded soil – South Moravia Region Source of compost – large professional plant

The soil bulk density – 17 % at the beginning of the experiment

Tested doses of composts: 0 / 20 / 80 / 100 tons per hectare Embedding into the top layer of the soil Water saturation to full water capacity Monitoring the change in water content, soil subsidence and bulk density

Not degraded soil – South Moravia Region Source of compost – small village composting area



Results



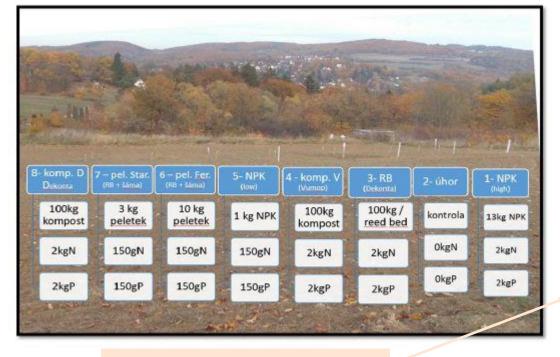
Hůla, J. a kol. (2012) Úprava fyzikálních vlastností půd a retenční schopnosti půdy zapravením kompostů z odpadní biomasy. Certifikovaná metodika, Praha: VÚZT, v.v.i. & Zemědělský výzkum, spol. s r.o. Troubsko. 2012:

"When evaluating the effect of graded doses of compost from waste biomass on the physical properties of the soil, a conclusion can be drawn after four seasons (2008 to 2011) about the favorable impact of incorporating a high dose of compost on the basic physical properties of the soil. Experiment results demonstrate the applicability of high doses of compost from waste biomass to partially correct the unfavorable soil condition caused by unwanted compaction. At the same time, however, the results show the limited possibilities of modifying the soil environment even with above-standard doses of compost. Direct mechanical application of the applied compost was limited to the soil layer into which the compost was incorporated."

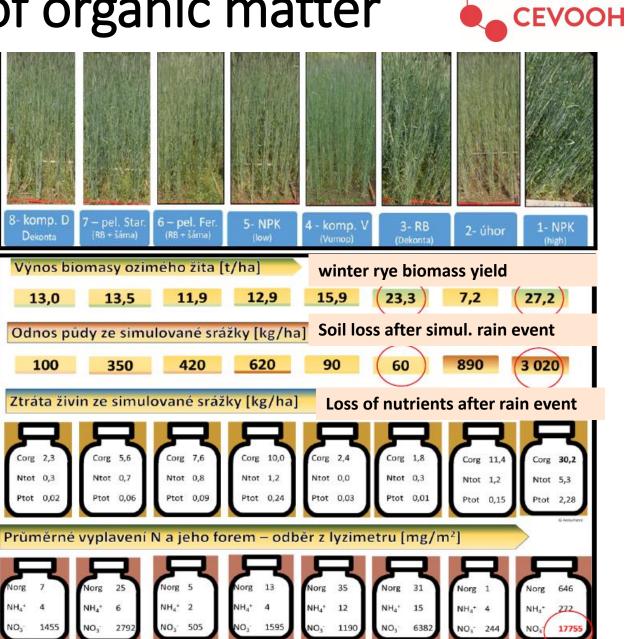
"Surface runoff during simulated rainfall is significantly reduced by incorporating compost into topsoil. In the case of intense rainfall lasting 1 hour, it decreased 5 times for the compost dose of 93 t/ha, and 10 times for the variant with a dose of 158 t/ha. Also, the beginning of the surface runoff was 5 times longer for the variants with incorporated compost."

• Must be verified in field trials and in practice!

Results of application of organic matter in agriculture



Average N and its form leaching



Results of application of organic matter in agriculture



The results of field trials show a positive effect of the application of processed biowaste on the biomass yield of winter rye:

- for the use of sludge after dewatering & stabilization, it shows comparable yields of winter rye as a 13-fold dose of NPK.
- variants with the use of pelleted fertilizers achieve comparable yields as variants with a standard dose of NPK
- however, variants with pelleted fertilizer show up to half a lower soil loss from simulated precipitation
- the results from the rain simulator show that the soil loss reaches almost 2 tons/ha in the variant with NPK with rye.
- on the other hand, in the variants with compost, the soil ratio is zero a high proportion of undecomposed residues covers the soil surface and prevents erosion
- the results of the lysimeter experiments indicate that the application of NPK with easily releasable nitrogen (N-NH4+) eutrophicates groundwater
- on the contrary, the application of N in the organo-mineral pellet reduces its leaching.



Summary

- Incorporation of compost has a positive effect on soil protection against water erosion, both with higher and lower doses of compost
- Compost ensures a higher infiltration capacity. When adding compost to the soil, the soil structure improves, the organic carbon content increases and the soil's ability to retain more moisture even in the dry season
- It is important to pay attention to choosing the appropriate dosage according to the type of soil and vegetation and considering the origin of the compost
- On the basis of field and container experiments, it can be used in practice to determine doses of composts to improve the unfavorable condition of compacted soils and to increase the soil's ability to receive water during intense rainfall
- It is necessary to take into account that the main effect can be seen only after a longer period of application.

Summary - goal: closing the cycle **CEVOOH** of biowaste **Biogas** plant Digestate, 7-8% of DM Slurry / manure - silage 1-y1 Separation Bioplynová stanice separace kejda/hnůj - senáž / siláž Digestát Livestock breeding suš. 7-8% Precizní aplikace organo-**Residual heat** minerálních hnojiv do zóny růstu zbytkové teplo Manure separát hnůj 1010 0. separát a armains chov hospodářských zvířat A PA Composting plant precise application of organo-mineral předsušení fertilizers in the growth zone kompost Pre-drying **Complex fertilizer** Compost hygienizace KOMPOSTÁRNA kalu ČOV komplexní hnojivo Sludge hygienization Production of pellets hygienizace kalu ČOV Sludge dewatering – different dosušení

Sludge drying

peletování

Stabilized sludge

upravený kal ČOV

Sludge hygienization



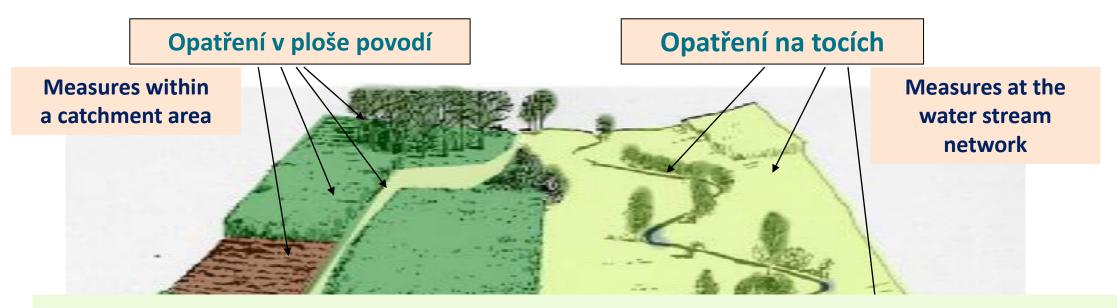
Small WWTP under 1,000 p.e.

REED-BED SYSTÉMY odvodnění kalu

technologies



Measures to improve the condition of the landscape – water & soil management



Support of complex solutions in the landscape



http://vodavkrajine.cz/



WP 1.C Biodegradable Waste

Environment - Environment for Life 12. – 14. 9. 2022

Contacts:

https://cevooh.cz/home/1-c-biologickyrozlozitelne-odpady/

https://cevooh.cz/en/1-c-wp/

<u>milos.rozkosny@vuv.cz</u> <u>dagmar.volosinova@vuv.cz</u>



TA CR Project SS02030008 Centre of Environmental Research: Waste Management, Circular Economy and Environmental Security is co-financed with the state support of the Technology Agency of the Czech Republic as part of the Environment for Life Program.

www.tacr.cz