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Field effects of sludge based compost application

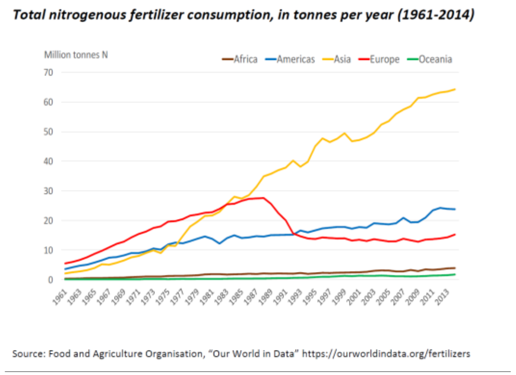
4th March, 2021

International Workshop **ECOLOGICAL SLUDGE PROCESSING AND REUSE**

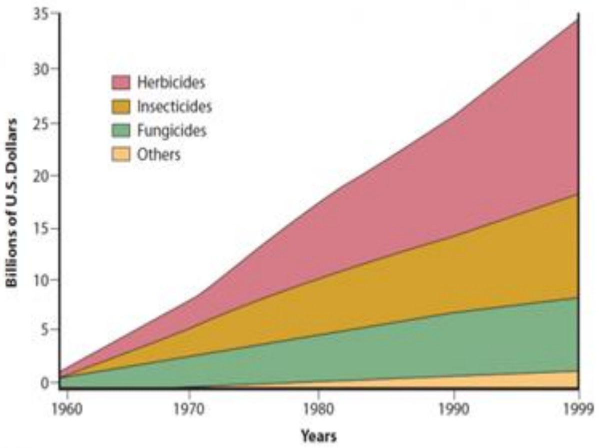
Context

Ambitious targets of EU startegies (Grean Deal, Biodiversity, Farm to Fork):

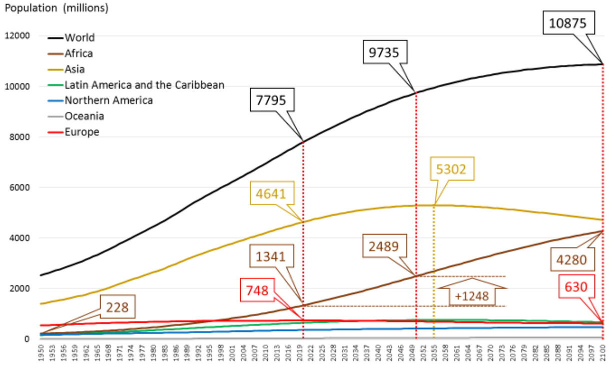
- **Reduction of synthetic fertilisers**
- **Reduction of pesticides**



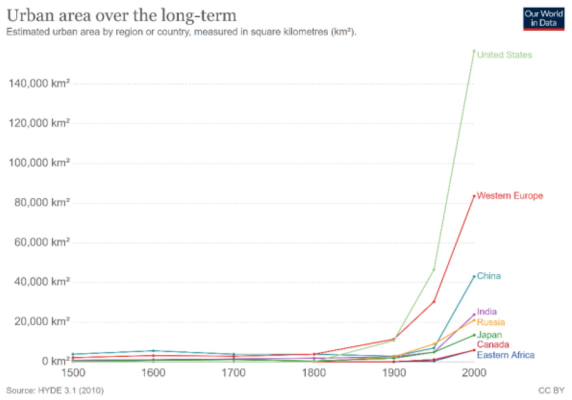
Fertilisers



Pesticides



Population

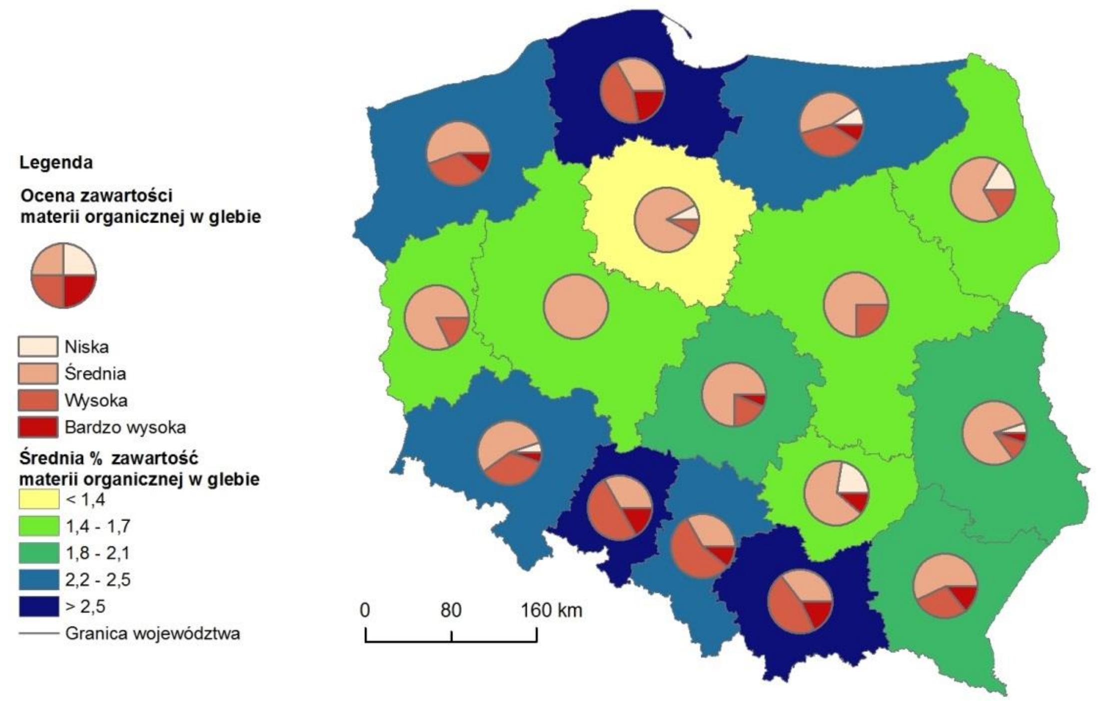


Urbanisation

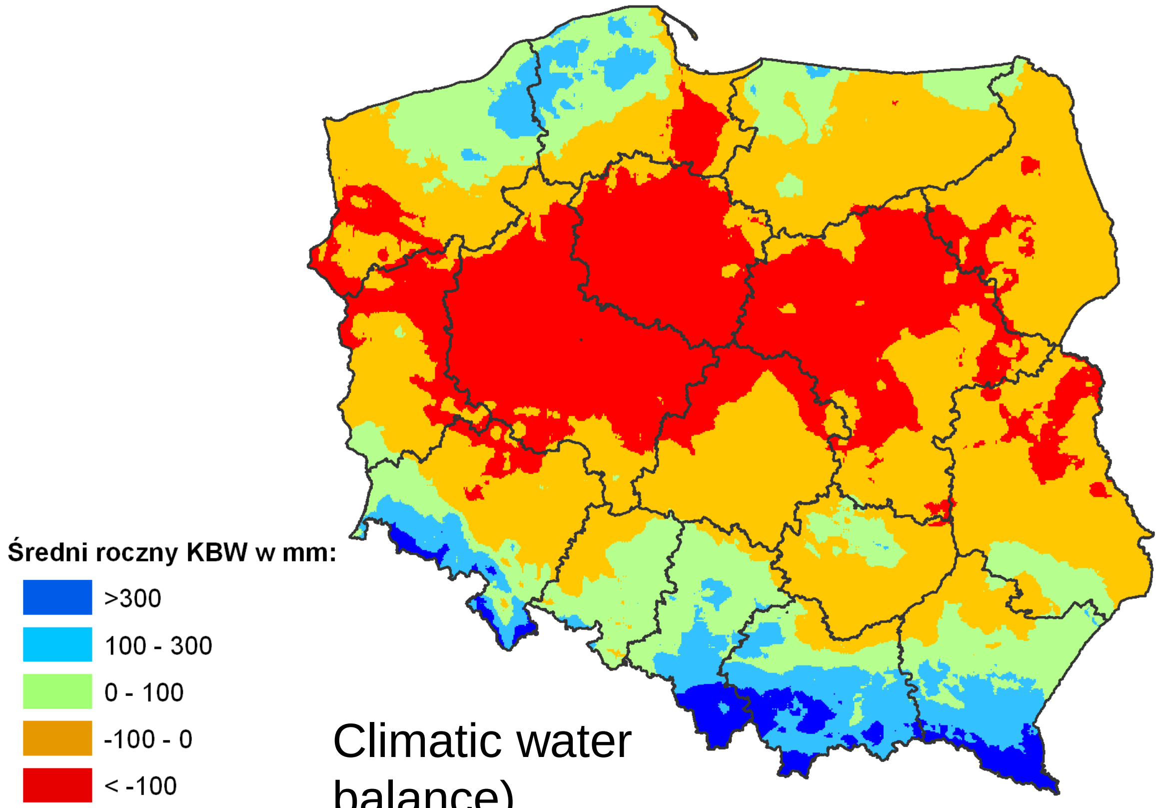
Soil is a key resource

and circular use of carbon and nutrients key actions to enable reaching the targets

Soil organic matter in Poland



SOM (%)



Climatic water balance)

Potential sources of exogenous C

- ✓ Manure
- ✓ Sewage sludge
- ✓ Compost
- ✓ Biochar
- ✓ Digestate
- ✓ Food waste

Nutrient value of sewage sludge

On average, municipal sludges produced in Poland contain 2.6% of nitrogen (N) and 1.83% of phosphorus (P) in dry matter (Siebielec and Stuczynski, 2008).

Assuming the forecasted sludge production at the level of 706.6 thousand tonnes, at national level they contain almost **18.5 thousand tonnes of N and 13 thousand tonnes of P**.

This amount of P would be sufficient to **replace mineral P fertilizers at the area of 618 thousand hectares** of arable land (**6.2% of total arable land**) since the average application rate of P in Poland is 20.9 kg/ha

Aim of field studies

The main objective of the study was to evaluate the effects of agricultural use of various composts produced in the GWIK wastewater treatment plant in Goleniów. The specific objectives were as follows:

- evaluation of the effects of using composts produced in a sewage treatment plant based on sewage sludge and straw on the properties and functions of soil,
- evaluation of the effects of using composts produced from sewage sludge and straw on plant yield and quality,
- evaluation of the possibility of agricultural use of compost,
- risk assessment of agricultural use of composts produced from sewage sludge and straw,
- comparison of composts effects obtained from different composting technologies,
- developing recommendations for the agricultural use of compost produced from sewage sludge and straw.

8 composts characterized by different C/N ratio and maturation time were tested

Compost no. 1 – produced autumn 2018, C/N ratio = 20, maturing time: 4 months

Compost no. 2 - produced autumn 2018; C/N ratio = 15, maturing time: 4 months

Compost no. 3 - produced spring 2019; C/N ratio = 20, maturing time: 8 months

Compost no. 4 - produced spring 2019 ; C/N ratio = 15, maturing time: 8 months

Compost no. 5 - produced spring 2019; C/N ratio = 20, maturing time: 4 months

Compost no. 6 - produced spring 2019; C/N ratio = 15, maturing time: 4 months

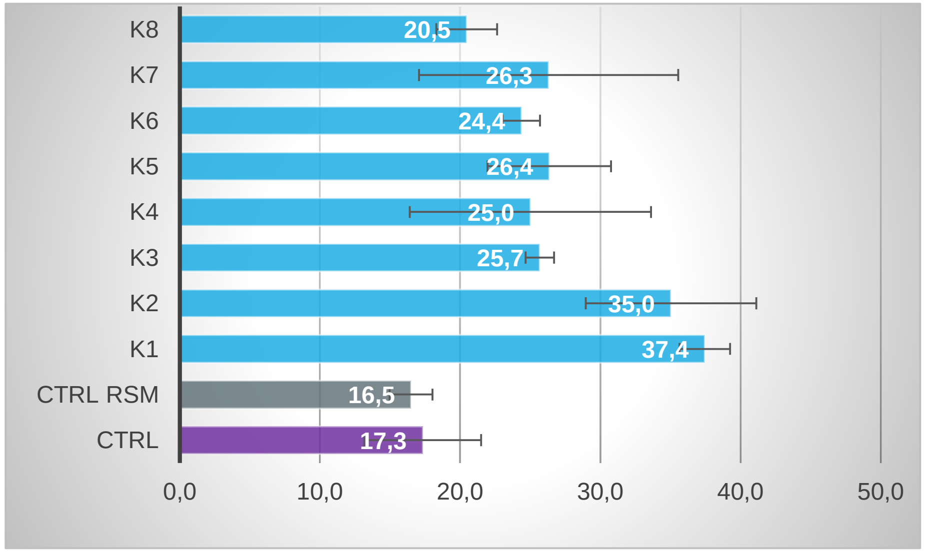
Compost no. 7 - produced autumn 2019; C/N ratio =20, maturing time: 8 months

Compost no. 8 - produced autumn 2019; C/N ratio = 15, maturing time: 8 months

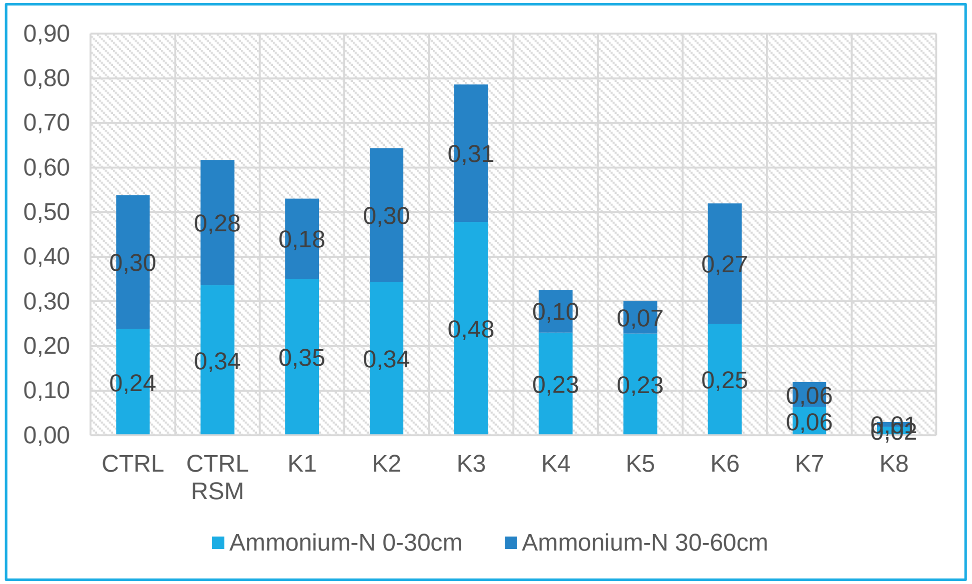
The field studies were conducted from autumn 2018 to autumn 2020 in the fields of the Agricultural Experimental Station in Baborówko, belonging to the Institute of Soil Science and Plant Cultivation, located in the Wielkopolskie Voivodship

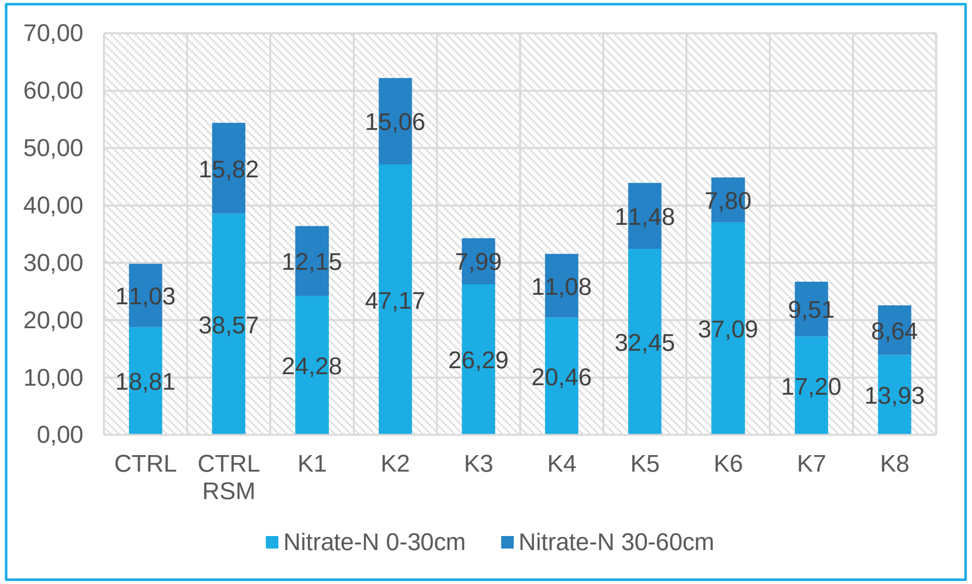
The total field experiment area was 0.07 ha, covering 30 fields of 21 m^2 (6 x 3.5 m). The plots formed a compact block with uniform soil cover. The experiment was carried out on soil with texture of sand and loamy sand , slightly acidic reaction (pH 5.7 - 6.3 in 1M KCl) and low organic carbon content (0.6 - 0.7%).

Short term effects



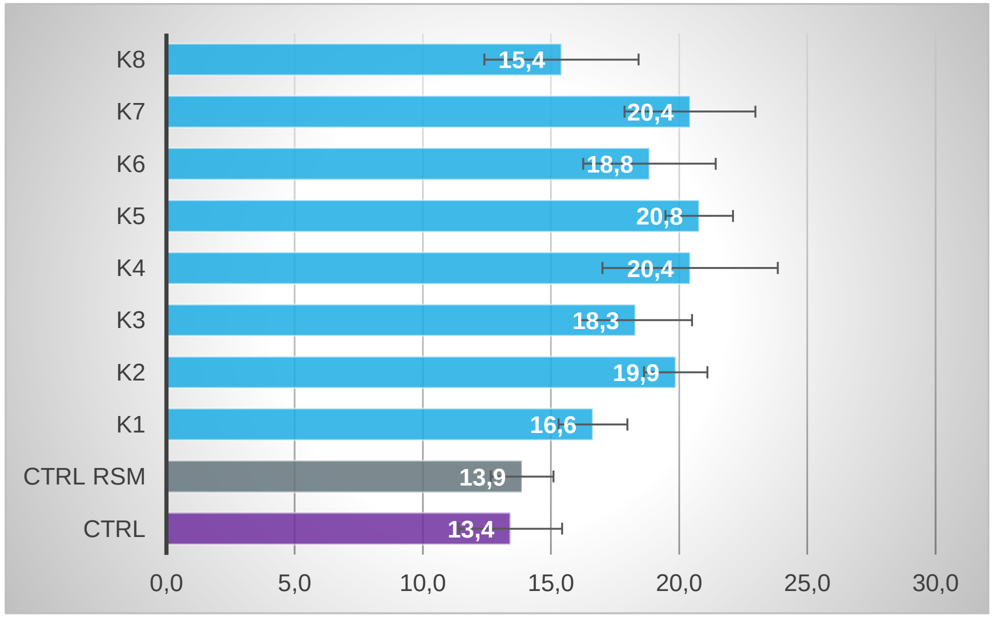
Available phosphorus content (mg P_2O_5/100 g) in soil in layer 0 - 30cm, 3 weeks after application



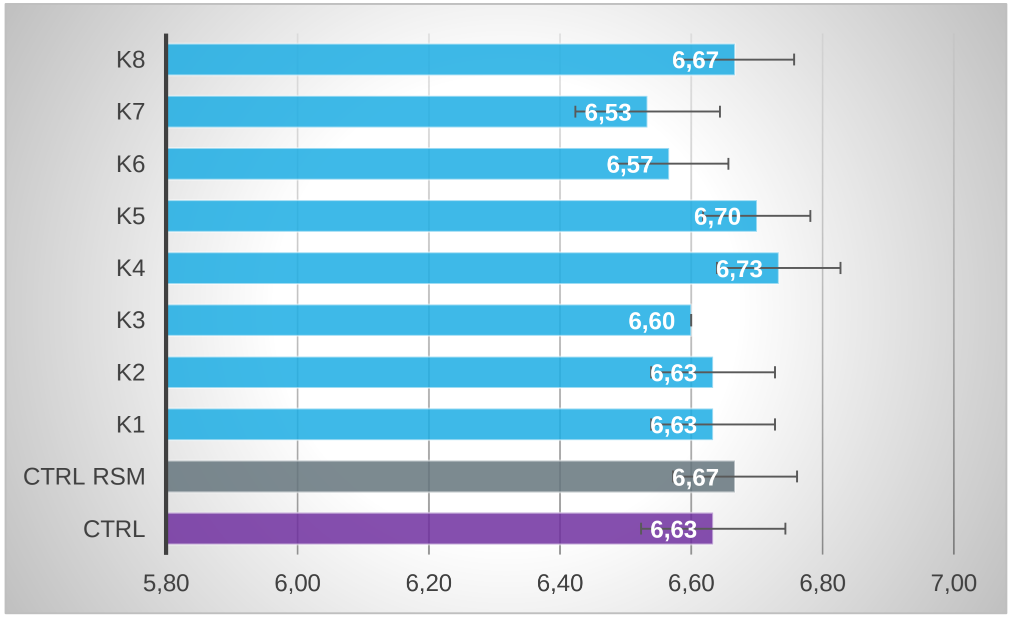


Ammonia and nitrate nitrogen content (mg N/kg) in the soil in layers 0 - 30 cm and 30 - 60 cm 3 weeks after applying the compost

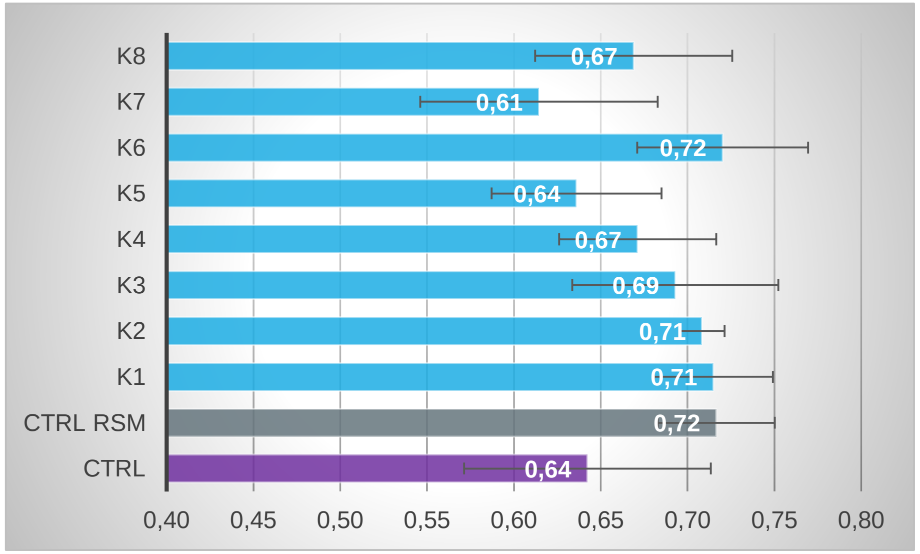
Long term effects



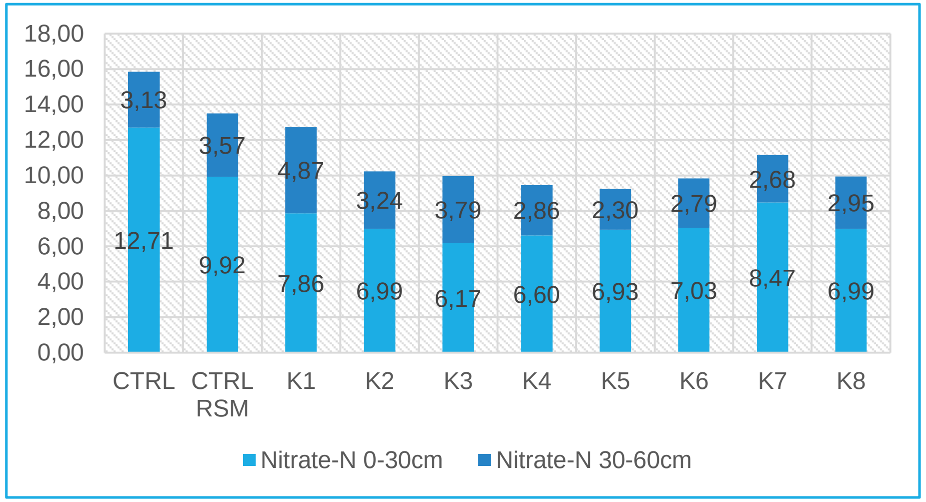
Available phosphorus content (mg P2O5/100 g) in the soil in the 0 - 30 cm layer in autumn 2020



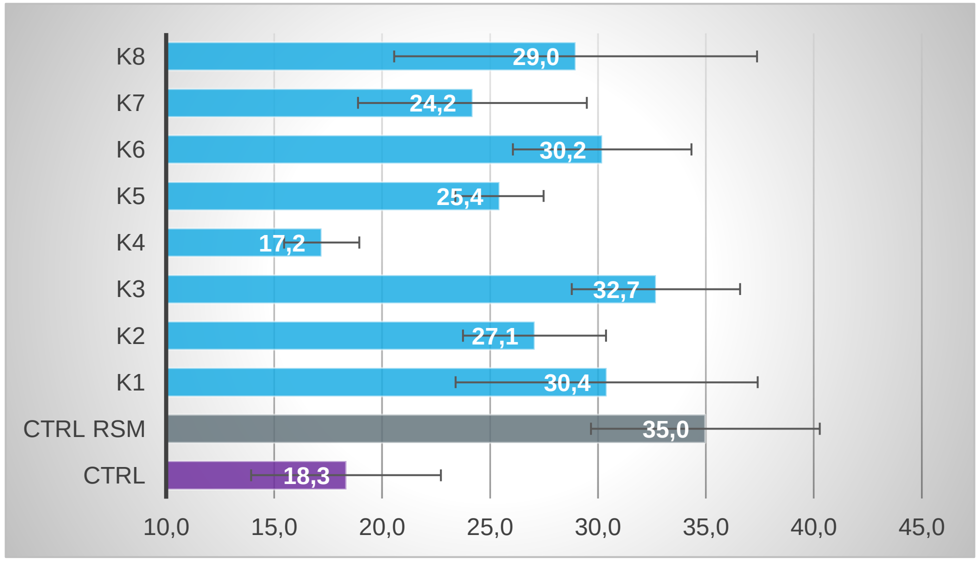
Soil reaction (pH in H_2O) in the 0 - 30 cm layer in autumn 2020



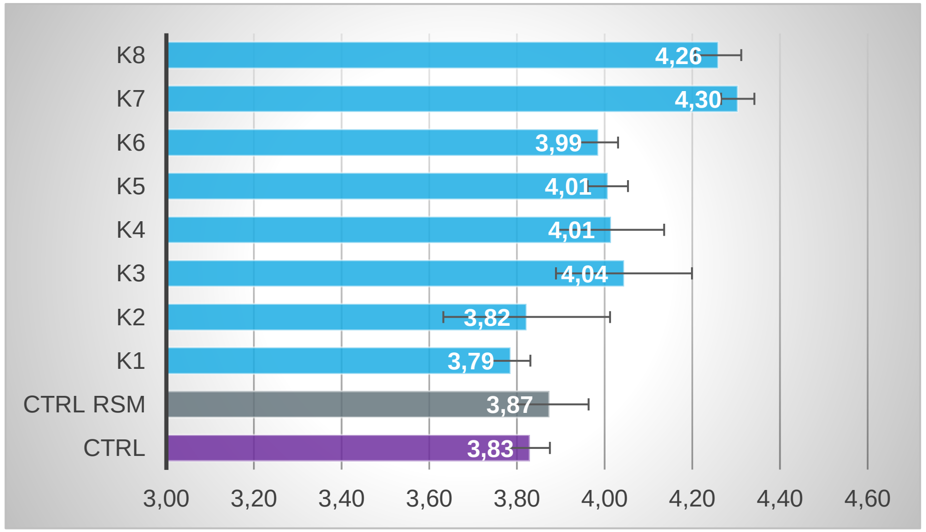
Soil organic carbon content (%) in the 0 - 30 cm layer in autumn 2020



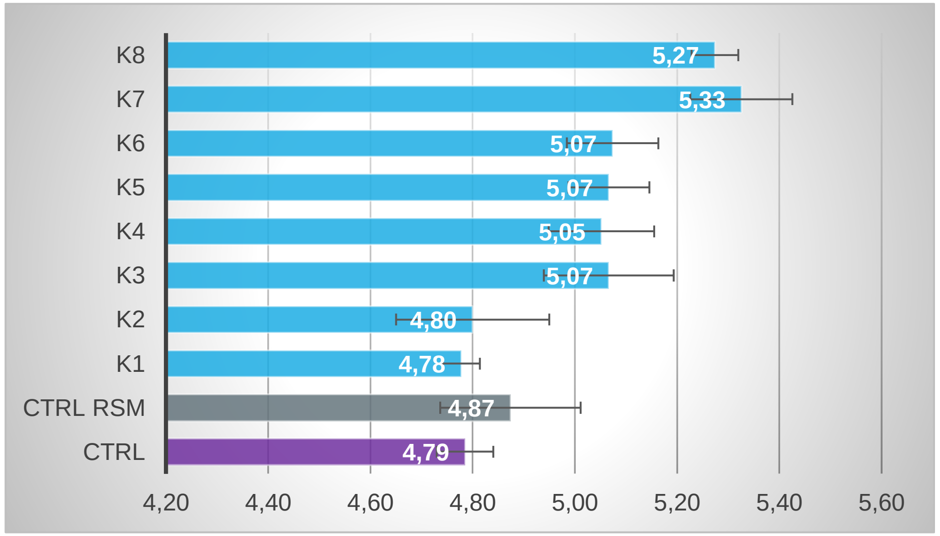
Nitrate nitrogen content (mg N-NO3/kg) in the soil in layers 0 - 30 cm and 30 - 60 cm in autumn 2020



Activity of dehydrogenases (µg TPF/g d.m.) in the topsoil layer in autumn 2020



Spring barley straw yield (t·ha^{-1}) in autumn 2020



Spring barley grain yield (t·ha^{-1}) in autumn 2020

Total trace element content (mg·kg^{-1}) in the top soil layer in autumn 2020

Combination	Cd	Zn	Ni	Cu	Pb	Cr
CTRL	0,131	26,05	3,31	3,74	12,66	6,03
CTRL RSM	0,143	27,88	3,65	4,06	13,79	7,10
K1	0,144	28,49	3,44	4,12	16,26	6,24
K2	0,154	28,00	3,61	4,28	13,75	7,09
K3	0,144	27,75	3,08	4,07	13,23	6,23
K4	0,140	26,56	3,38	4,02	13,01	6,55
K5	0,131	26,22	3,01	4,02	12,48	6,12
K6	0,134	27,81	3,16	4,13	13,16	6,38
K7	0,128	26,43	3,21	4,95	12,27	5,97
K8	0,141	25,85	3,04	3,86	13,20	5,97

Trace element content (mg·kg^{-1}) in spring barley straw in autumn 2020

Combination	Cd	Zn	Ni	Cu	Pb	Cr
CTRL	0,049	13,48	1,25	2,24	0,19	1,50
CTRL RSM	0,038	9,86	0,70	1,94	0,14	1,40
K1	0,038	11,79	0,67	2,13	0,14	0,79
K2	0,044	14,72	0,84	2,31	0,15	0,88
K3	0,044	12,39	0,60	2,35	0,18	1,48
K4	0,044	11,77	0,62	2,39	0,23	1,35
K5	0,049	11,76	1,07	2,36	0,17	1,89
K6	0,055	15,17	0,86	2,35	0,20	1,32
K7	0,038	10,24	0,87	2,20	0,21	1,90
K8	0,033	11,21	1,02	2,27	0,18	2,08

Trace element content (mg·kg^{-1}) in spring barley grains in autumn 2020

Combination	Cd	Zn	Ni	Cu	Pb	Cr
CTRL	0,016	22,68	0,19	3,02	0,04	0,27
CTRL RSM	0,016	24,51	0,29	3,30	0,09	0,39
K1	0,017	25,51	0,43	3,25	0,08	0,37
K2	0,016	23,10	0,20	3,28	0,09	0,44
K3	0,016	22,70	0,18	2,92	0,05	0,30
K4	0,017	23,27	0,24	2,87	0,07	0,33
K5	0,017	23,05	0,38	3,02	0,08	0,37
K6	0,022	26,33	0,33	3,16	0,05	0,40
K7	0,016	18,88	0,19	2,67	0,02	0,29
K8	0,016	21,56	0,28	3,31	0,05	0,30

Summary

- The use of the composts tested, produced in the process of heap composting sewage sludge and cereal straw, does not enrich the soil with undesirable elements. This is due to their low content in the feedstock used to produce the composts as well as application of balanced doses of compost.
- Compost application allows the production of uncontaminated grains, which do not differ in quality from grains produced by mineral fertilization.
- The tests have not demonstrated any risk for the environment and the quality of food and feed associated with trace elements.
- High doses of compost may cause a temporary decrease in soil pH, a phenomenon often observed after application of organic fertilization, associated with mineralization of organic matter.
- Composts generally increase soil biological activity.
- When applying the recommended doses, the use of compost does not pose a greater risk of excessive leaching of nitrates to water than the use of mineral fertilisation and straw ploughing.
- Compost application increases yields of barley straw and grain, especially in dry years, which should be associated with their positive effects on soil water retention and soil biological life, supporting the growth and resistance of plants to stress conditions.
- The use of compost ensures that the soil carbon level is kept constant despite the removal of all straw from the plots.
- The data obtained do not clearly indicate which of the tested compost production technologies gives the best results in terms of fertiliser effectiveness.

Thank you for your attention

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