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Comparison of different municipal sewage sludge products for potential ecotoxicity

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Abstract: To test the potential harmfulness of soils fertilized with sludge-based products to plant organisms, a biotest method using the physiological/biochemical reaction of the organisms to assess their toxicity was chosen. This paper presents the results of a preliminary ecotoxicological study of different products: a sludge-based fertilizer, a plant growth promoter, and a reclamation blend. The study was conducted using *Sinapis alba* L., a plant used in agriculture for intercropping and recommended for toxicological testing. Toxicity tests were performed in a gradient of concentrations of the indicated products (2.5%, 5%, and 10%). For comparison purposes, a trial containing a commercial fertilizer was used alongside the control soil (without additives). The fertilizer and the crop support agent were of low toxicity, but data analysis indicated toxicity of the so-called reclamation blend, which contained heavy metals among other things. The test products showed an increase in toxicity with the increasing dose used. This research represents an important step in assessing the usefulness of products created from sewage sludge and may help overcome the „psychological barrier" that prevents potential investors from investing capital that would allow production to spread.

Introduction

There has been a 62% increase in the weight of sludge obtained in Poland over the last two decades (GUS 2019). Although the amount of sewage sludge was estimated to be over 700,000 tons in 2018, the actual amount was much higher and exceeded 1,000,000 tons (GUS 2019). This increase is due not only to the increasing volume of wastewater being discharged but also to the need for highly efficient treatment methods. The resulting sludge must be managed in an appropriate manner. Sewage sludge is a valuable reservoir of nutrients, so it makes sense to convert it into a fertilizer or soil-forming product (Zawadzki, Głodniok 2020). This solution is attracting increasing interest, also in the context of a closed-loop economy (Grobelak et al. 2016, Smol et al. 2020). There is a strong market demand for technologies to convert sewage sludge into fertilizers.

The composition of municipal sewage sludge is variable and depends on the properties of the waste itself, the treatment technology applied, and the processing, and therefore may contain compounds harmful to the ecosystem, such as heavy metals, polycyclic aromatic hydrocarbons, halogenated organic compounds, polychlorinated biphenyls, dioxins and also pathogenic organisms (Rosik-Dulewska 2007). Also, the use of sludge as a fertilizer raises problems of coordinating the time of use with the time of sludge generation without landfilling. The conversion of sewage sludge into fertilizers, therefore, appears to be an important direction in the management of this waste (Kaszycki et al.2021).

Fertilizer products prepared on the basis of sewage sludge must comply with the standards set out in the Act on Fertilizers and Fertilizing of 10 July 2007 (Dz.U [Journal of Laws] 2007 No 147 item 1033) and the Regulation of the Minister of Agriculture and Rural Development of 18 June 2008 on the implementation of certain provisions of the Act on Fertilizers and Fertilizing (Dz.U. [Journal of Laws] 2008 No 119 item 765), where there are guidelines on the maximum content of contaminants that may be found in them. However, as they have impurities in their composition, they should be pre-tested toxicologically.

The aim of this study was the ecotoxicological evaluation of experimental fertilizer products and a reclamation blend. These products were studied for the first time, so there is lack of international literature on the subject. The effect of applied fertilizer products on the improvement of soil fertilizing properties was assessed based on national standards using higher plants indicated as target bioindicators in European guidelines (OECD/ OCDE 208). The bioassays planned for this study include phytotoxicity tests to assess soil quality following the application of fertilizers made from sewage sludge, based on modified procedures described in PN-EN ISO 11269-2:2013 and PN-EN ISO 11269-1:2013-06, used to assess the potentially toxic effects of chemical compounds on root growth, and emergence, early growth and development stages of various land plants. White mustard (*Sinapis alba* L.) was used in the ecotoxicological assessment – a plant with a wide range of applications in the feed, chemical, cosmetic, pharmaceutical, and energy industries (Sawicka and Kotiuk 2006), also in intercrops to improve soil properties (Sawicka and Kotiuk 2006, Harasimowicz-Hermann and Hermann 2006). *Sinapis alba* is also a plant widely used for toxicity tests and other comparative studies.

The seed germination and root elongation tests used in this study are, according to many authors, crucial due to the sensitivity and relative speed of the method (Ko et al. 2008, Miaomiao et al. 2009, Zeynep 2019). The method was also used to assess the maturity of composts (Jakubus 2012, Hase and Kawamura 2014). Some authors point out the need for additional tests to investigate the effects of product contaminants on seedling growth (Obidoska and Hadam 2008) to get a complete picture of the toxic effects of the tested products.

Materials and methods

Characteristics of the tested products and soil

Fertilizer products (fertilizer (F), crop aid (CA) and reclamation blend (R)).

The fertilizer products consisted of approximately 70% stabilized and dewatered municipal sewage sludge. The remaining part consisted of quicklime, dolomite meal, gypsum, and cellulose fibers mixed in different proportions. The fertilizer products were obtained in a process consisting of 5 steps: (1) dewatering of sludge on the press, (2) mixing, (3) homogenization, (4) granulation, and (5) drying. Fertilizer granules were obtained by dynamic counter-rotating mixing and granulation in a disc granulator. An intensive counter-rotating mixer is a tool enabling the production of a highly homogeneous mixture of fine-grained substances (e.g. dust, sludge) and shaping them into compact granules of grain size between 0.5 and 8 mm in one technological operation. Granulation resulted in granules with a dry matter content of approx. 45% DOM, which were dried in the open air in a sunny place and then further dried with a laboratory dryer.

The reclamation blend consisted of sewage sludge and ash from the combined heat and power plant (CHP plant). Ashes in the form of fine dust were mixed with stabilized sewage sludge at a ratio of 3:1 in a dynamic mixer. The dynamic mixing process resulted in complete homogenization of the substrates and initial granulation of the material into irregular agglomerates with a grain size of 0–3 mm (Tab. 1).

Chemical composition and physical analysis of the products and the soil on which the tests were carried out, are shown in Tab. 1. All analyses were carried out in an accredited laboratory according to the following procedures: PN-EN ISO 16171:2017-02, PN-EN ISO 6579-1:2017-04.

Table 1. Composition and properties of fertiliser products: (fertiliser (F), crop support agent (CA) and reclamation blend (R)

		Soil additives			
Component of the mixture		F	CA	R	
Sewage sludge		+	+	+	
Quicklime		+	–	–	
Dolomite flour		+		–	
Gypsum		–	+	–	
Cellulose fibers		+	+	–	
Ash		–	–	+	
Parameter	Unit	Soil additives			Soil Used
		F	CA	R	
pH	–	12.4	12.3	6.6	5.3
Org. matter	[% AW]	49	18	29	9
Dry matter	[% AW]	67	68	61	79
TOC	[% AW]	10.1	8.6	25.0	4.9
N total	[% AW]	1.35	1.05	1.72	0.44
Phosphorus (P)	[% AW]	0.72	0.72	1.91	0.30
Potassium (K)	[% AW]	0.09	0.06	1.90	0.81
Cadmium (Cd)	[$mg \cdot kg^{-1}$ AW]	0.5	0.5	4.0	2.0
Chromium (Cr)	[$mg \cdot kg^{-1}$ AW]	7.8	8.4	138.0	78.0
Copper (Cu)	[$mg \cdot kg^{-1}$ AW]	60.6	58.7	495.0	115.0
Nickel (Ni)	[$mg \cdot kg^{-1}$ AW]	6.1	6.2	245.0	14.0
Lead (Pb)	[$mg \cdot kg^{-1}$ AW]	9.1	10.0	590.0	74.0
Zinc (Zn)	[$mg \cdot kg^{-1}$ AW]	176.0	173.0	1170.0	347.0
Mercury (Hg)	[$mg \cdot kg^{-1}$ AW]	0.10	0.10	2.61	0.71

Abbreviations: F – fertiliser made from sewage sludge, CA – crop support agent made from sewage sludge, R – reclamation blend made from sewage sludge and ash

Table 2. Composition of the fertiliser (FC) used in the study

Commercial fertiliser (FC)	Unit	Content
Ammonium Nitrogen (N)	[% AW]	9.0
Total Nitrogen (N)	[% AW]	9.0
Phosphorus (P)	[% AW]	11.0
Potassium (P)	[% AW]	11.0
Magnesium (Mg)	[% AW]	5.5
Total Sulphur (S)	[% AW]	10.0

Abbreviations: FC- trial with commercial fertiliser

Table 2 also shows the composition of the commercial fertilizer (FC) used in the study. All products meet the relevant standards for their intended use. Fertilizers meet the requirements for fertilizer products following the Regulation of the Minister of Development and Rural Affairs of 18 June 2008 on the implementation of certain provisions on fertilizers and fertilization (Dz.U. [Journal of Laws] 2008 No 119 item 765), while the reclamation blend meets the standards for group IV of land, which includes, according to the regulation (Journal of Laws 2016 item 1395) among others, industrial land, fossil land, communication land, railway land, or land intended for the construction of public roads or railway lines.

Ecotoxicological testing methodology

Seed germination studies and the effects of the tested products on root and shoot growth were carried out based on the guidelines in the standards: PN-EN ISO 11269-1:06 and PN-EN ISO 11269-2:06. Commercially available, certified seeds of *Synapis alba* were used for the study (Dary Podlasia, Polska).

A total of 5 trials were prepared, each trial was carried out in 4 replicate-measurement series, and the mean values were given as the final result: control (soil without additives) (C); trial with commercial fertilizer (FC), with fertilizer made from sewage sludge (F), with crop support agent made from sewage sludge (CA), with reclamation blend made from sewage sludge and ash (R). Test samples were prepared in 3 concentrations: 2.5%, 5% and 10%.

Seed germination capacity

The tests carried out to assess the germination efficiency of *Sinapis alba* seeds were conducted based on a modified procedure described in the standard: PN-EN ISO 11269-2:2013-06. A modification of the method consisted of the growing the cultures on Petri dishes. The modification consisted in conducting the test on Petri dishes. The results were read on days 1, 3, 5, and 7 of the test, respectively. The effect of the solution of the tested products on the germination capacity of the seeds was expressed as a percentage of seed germination efficiency [%], according to the following formula (Equation 1):

$$\mathbf{Eg} = \frac{\mathbf{N_n}}{\mathbf{N_0}} * \mathbf{100}\ [\%] \qquad (1)$$

where:
Eg – the seed germination efficiency as determined for the products tested [%].
N_0 – number of seeds in the sample (40 pcs.)
N_n – the average number of seeds germinated in the samples [pcs].

Inhibition of root growth and growth of higher plants

Sinapis alba seeds were planted in 2.5 liter pots. The pots were filled with 2 kg of soil of known parameters. The soil was mixed with appropriate weights of the test products) and allowed to stabilize for 7 days.

The effect of the tested preparations on stimulation of growth of the above-ground (SS) part (equation 2) as well as the underground (SR) part (equation 3) was evaluated.

Determination of the degree of stimulation of the growth of the shoot part of the test plants

$$\mathbf{SS_{(C1\div Cn)}} = -\left(\frac{\mathbf{SL_c} - \mathbf{SL_{(C1\div Cn)}}}{\mathbf{SL_c}}\right)\mathbf{x100}, \% \qquad (2)$$

where:
S – shoot growth stimulation determined for individual
$S_{(C1\div Cn)}$ – concentrations of tested fertilizer products, %*
$C_1 \div C_n$ – concentrations of test samples, g/L
SL_c – mean shoot length in control sample, cm;
$SL_{(C1\div Cn)}$ – mean shoot length in test samples, cm.
* *Negative stimulation is understood as growth inhibition.*

Determination of the degree of stimulation of growth of the underground part of the test plants

$$\mathbf{SR_{C1\div Cn}} = -\left(\frac{\mathbf{RL_c} - \mathbf{RL_{(C1\div Cn)}}}{\mathbf{RL_c}}\right)\mathbf{x100\%} \qquad (3)$$

where:
S – root growth stimulation determined for individual
$R_{(C1\div Cn)}$ – concentrations of tested fertilizer products, %*
$C_1 \div C_n$ – concentrations of test samples, g/L
RL_c – mean root length in control sample, cm;
$RL_{(C1\div Cn)}$ – mean root length in test samples, cm.

Measurement of chlorophylls and carotenoids

Total chlorophyll content was determined according to the method of Vimala and Poonghuzhali 2015. The pigment content was measured in a CECIL 2000 spectrophotometer at 480, 645, and 663 nm. Chlorophyll concentrations were determined from the formulas:

Chlorophyll a ($\mu g \cdot ml^{-1}$) = 12.7 (A663) – 2.69 (A645)
Chlorophyll b ($\mu g \cdot ml^{-1}$) = 22.9 (A645) – 4.68 (A663)
Chlorophyll b ($\mu g \cdot ml^{-1}$) = 20.2 (A645) – 8.02 (A663)

Carotenoid concentrations were determined from the formula:

Carotenoids ($\mu g \cdot ml^{-1}$) = A480 + (0.114 × A663) – (0.638 × A 645)

The pigment content is expressed in $\mu g \cdot g^{-1}$ AW.

Measurement of the surface of the assimilation apparatus

The leaves of 7 individuals from each sample were analyzed. Fresh leaves without damaged blades were used in the measurements. The leaves were scanned using an Epson

V370 flatbed scanner (600 dpi resolution used). Surface measurements were taken using Image Pro Plus software (version 2.0.260; Media Cybernetics Inc., USA).

Results and discussion

A world that depends on consumption also depends on fertilizer production. As early as the 1990s, there were reports of soil nutrient depletion and the global demand for nutrients is increasing. The demand for nitrogen, potassium, and phosphorus is estimated to be over 318,000,000 tons in 2021, nearly 9% higher than in 2016 (FAO, 2019).

The primary source of organic matter input to the soil is natural fertilizers. However, these often fail to maintain the humus content at a relatively constant level, which makes the use of unconventional sources. One method of facilitating the return of nutrients to the soil is the production of fertilizers based on municipal sewage sludge. The possibility of using sewage sludge as a base for the creation of fertilizing products and soil-forming substrates was described in several works (Mahle et al., 2020, Zawadzki & Głodniok 2020, Kaszycki et al. in. 2021). The authors of the publication emphasize the role of sewage sludge as a rich source of nutrients (in particular biogenic compounds).

The tested fertilizer products consisted of nearly 49% organic matter, contained more than 1% nitrogen compounds and more than 0.7% phosphorus compounds (Tab. 1), and small amounts of potassium. They were low in heavy metals, which is important for the safety of these products. Heavy metals can be extracted from the soil into plants, as mentioned by many authors (Borgulat et al. 2018, Zhang et al. 2020, Borgulat 2020, Ren et al. 2021). The reclamation blend, which meets the standards for land category IV (Journal of Laws 2016 item 1395), consists of nearly 30% organic matter and, although it contains higher amounts of carbon, nitrogen, phosphorus, and potassium than in fertilizer products, it contains amounts of heavy metals that can have phytotoxic effects. In particular, this relates to lead, mercury, nickel, and chromium content. These fertilizer products also have an alkaline pH, which can be beneficial in retaining heavy metals in soil environment. The reclamation material has a lower pH of 6.6 than the fertilizer products. It is worth noting that brownfield sites are often characterized by an acidic pH, so this blend, with its nearly 30% organic matter content and pH of 6.6, can help retain heavy metals in the soil, making naturally-occurring contaminants less available to plants.

Fertilizers based on coffee grinds, blood meal and oak biomass ash contained nearly 93% organic matter, which the researchers found to be particularly beneficial (Ciesielczuk et al. 2018).

Ecotoxicology

Physico-chemical tests on products released into the environment may not be sufficient to determine the real impact of these blends on plant organisms. The toxic effects of blends may be due to the synergistic action of individual components in the blend. (Rosik-Dulewska et al., 2006). In this study, bioassays were carried out using the physiological response of the organisms themselves to assess their toxicity. The influence of the tested products on the germination process was investigated (Fig. 1).

There were no differences in germination efficiency between the control (C) and the fertilizer products (F, FC, CA) at the lowest concentration tested (2.5%), but reduced germination was noted for the reclamation blend (R). After 7 days of the test, the germination index of the plants growing on the 2.5% extract of the reclamation blend (R) was 10% lower than in the control trial (C).

For the other concentrations, differences in germination strength compared to the control were demonstrated from day 3 of the test. For the highest applied dose after 7 days, the difference varied between 10–20% for the crop support agent (CA) and the fertilizers (fertilizer (F) and commercial fertilizer (FC), respectively.

Analysis of the study indicated that higher concentrations of the tested products may show toxic effects on *Sinapis alba* during seed germination. The greatest toxic effect was noted for the reclamation blend (R). No effect on the germination efficiency of *Sinapis alba* seeds grown on different concentrations of fertilizers based on spent coffee ground, blood meal, and ashes from oak biomass burning was found by Ciesielczuk et al. (2018).

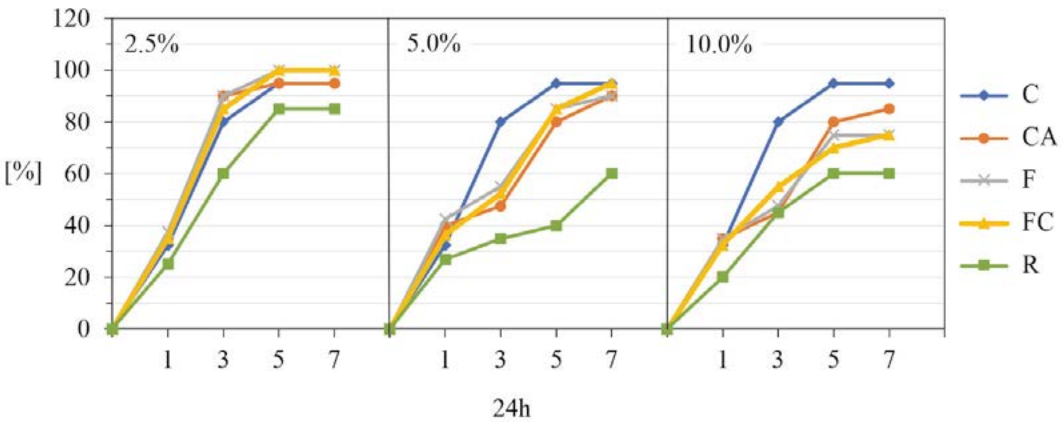

Fig. 1. Germination capacity of *Sinapis alba* on substrates with different soil additive contents. Abbreviations: C – control with unpolluted soil; FC – trial with commercial fertiliser, F – with fertiliser made from sewage sludge, CA – with crop support agent made from sewage sludge, R – with reclamation blend made from sewage sludge and ash.

A comparison of the relative root length of *Sinapis alba* growing on media with different soil additive contents with the control sample indicated a stimulating effect of the tested sludge-based fertilizer products on root growth at all tested concentrations (Fig. 2).

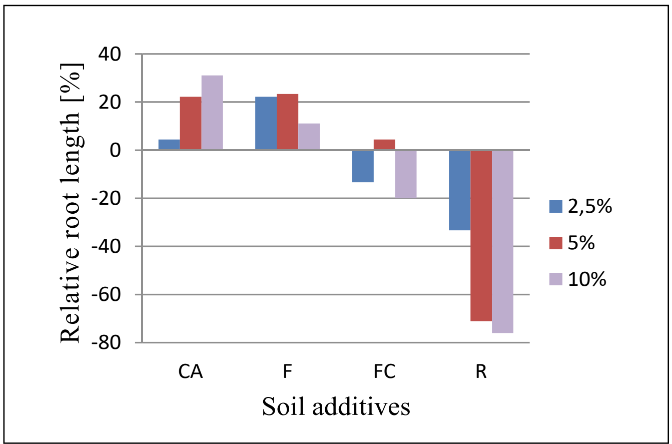

Fig. 2. Comparison of length against a control sample of *Sinapis alba* seedling root grown on media with different soil additive contents. Abbreviations: FC – trial with commercial fertiliser, F – with fertiliser made from sewage sludge, CA – with crop support agent made from sewage sludge, R – with reclamation blend made from sewage sludge and ash

Differences from the control group were shown for the crop support agent (CA) at concentrations of 5% and 10% and the fertilizer (F) at 5%. In contrast, the reclamation blend (R) showed an inhibitory effect on root growth (relative to the control group) at all concentrations tested (Fig. 2). A similar inhibitory effect of the reclamation blend (R) was also noted for the aboveground part (Tab. 3).

Plants growing on a substrate containing 2.5%, 5%, and 10% reclamation blend (R) had the lowest shoot length. A lower length of the growing shoot relative to the control was also recorded for plants growing on the medium supplemented with commercial fertilizer (5%). The inhibitory effect of the reclamation blend on the growth of the underground and aboveground parts of *Sinapis alba* may be due to the presence of heavy metals in the blend. Metallophytes grow in areas contaminated with these elements. There are also reports that heavy metal contaminated areas are also home to plants that are not only used for remediation but also utilitarian purposes, such as the energy plant *Miscanthus × giganteus* (Krzyżak et al. 2017, Pogrzeba et al. 2018, Tran et al. 2020).

Plants growing on commercial fertilizer (at all tested concentrations), on soil containing a soil-forming mixture (at all tested concentrations) and on soil with the addition of a plant cultivation aid made based on municipal sewage sludge (at concentrations of 2.5% and 10%) were also characterized by a small area of the assimilative apparatus. The basic element of the assimilatory apparatus is chlorophyll,

Table 3. Comparison of morphometric parameters and assimilation pigment content in leaves of *Sinapis alba* grown on media with different soil additive contents (mean ± st. dev, ANOVA, Tukey's *post-hoc* test, p<0.05)

	Additives amount	Soil additive				
		C*	CA	F	FC	R
Shoot length [cm]	2.5%	29.6±6.5b	26.9±2.9b	31.7±5.1b	24.7±4.9ab	17.0±3.3a
	5.0%	29.6±6.5c	27±4.2bc	25.3±4.4bc	21.2±2.7ab	16.1±2.3a
	10.0%	29.6±6.5b	31.6±4.1b	31.3±5.5b	24.2±5.1b	10.5±2.3a
Root length [cm]	2.5%	5.3±0.7b	5.9±0.9b	6.0±1.1b	4.9±0.6ab	3.9±0.7a
	5.0%	5.3±0.7b	6.8±1.0c	7.1±0.8c	6.1±0.5bc	1.3±0.1a
	10.0%	5.3±0.7c	7.5±0.7d	5.8±0.6c	4.0±0.5b	1.3±0.2a
LA [mm²]	2.5%	250±27b	155±22a	217±42b	141±18a	124±21a
	5.0%	250±27b	208±26b	213±43b	154±7a	116±14a
	10.0%	250±27c	164±26b	254±42c	146±25b	87±10a
Chl. a+b [μg·g⁻¹AW]	2.5%	540±93a	927±92b	908±93b	650±88a	892±135b
	5.0%	540±93a	718±111b	771±97b	688±67ab	660±93ab
	10.0%	540±93a	736±89b	661±127ab	481±68a	800±155b
Car. [μg·g⁻¹AW]	2.5%	19±3a	35±5c	29±4bc	27±3b	34±6bc
	5.0%	19±3a	39±4b	36±6b	23±4a	40±8b
	10.0%	19±3a	42±8b	39±4b	35±7b	57±4c

Abbreviations: control soil (C); commercial fertiliser (FC), fertiliser made from sewage sludge (F), crop support agent made from sewage sludge (CA), reclamation blend made from sewage sludge and ash (R), LA – leaf area, Chl. a+b – the content of chlorophyll a and b in leaves, Car. – carotenoid content of the leaves.
*Control test without soil additives

which determines photosynthesis. It is therefore essential for the proper functioning of the plant and can be considered a measure of plant health. The addition of a crop support agent (CA) or fertilizer (F) to the soil increased the chlorophyll a and b content of the leaves of the plants tested compared to that found in the control group (Tab. 3). Also in the sample containing the reclamation blend (R) at 2.5% and 10%, an increase in chlorophyll a and b was found compared to the amount recorded in plants from the control group (C). Carotenoids are other photosynthetic pigments and also nonzymatic stress indicators for plants. Increased levels of these pigments were found in all the products tested, which may indicate that the plants were stressed despite being in good nutritional condition. This requires further research (Tab. 3).

A principal component analysis showing the similarity of the plants growing on the substrate containing 2.5% additives indicated (Fig. 3a) that the plants growing on the fertilizer and control soil were characterized by large leaf area, shoot and root length in contrast to the plants growing on the substrate containing the reclamation blend (R).

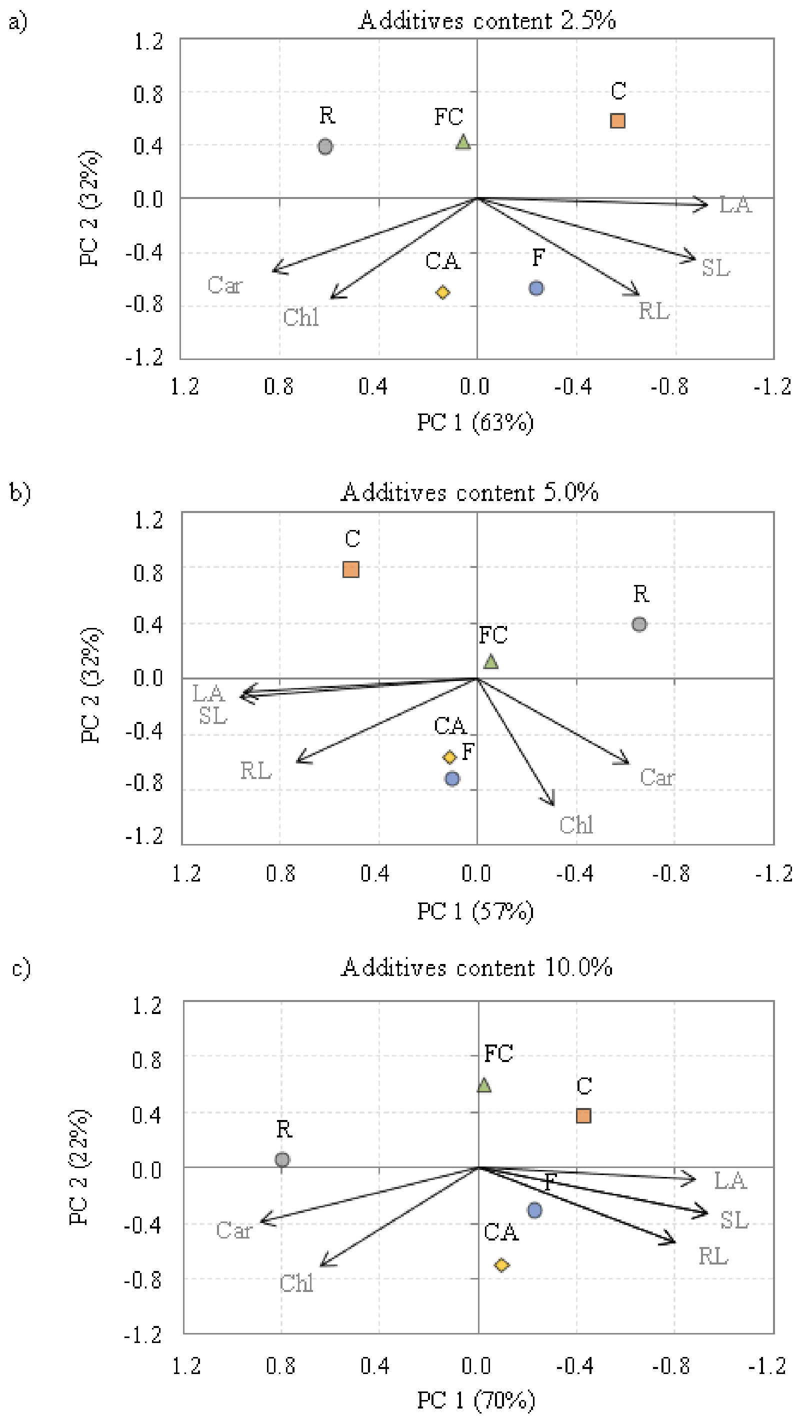

Fig. 3. Principal component analysis (PCA) showing the similarity of *Sinapis alba* seedlings growing on media with different soil additive contents (2.5%, 5.0%, 10.0%). Abbreviations: Car – carotenoids, Chl – chlorophyl a + b, LA – leaf area, SL – shoot length, RL – root length, C – control with unpolluted soil; FC – trial with commercial fertiliser, F – with fertiliser made from sewage sludge, CA – with crop support agent made from sewage sludge, R – with reclamation blend made from sewage sludge and ash.

In the case of the samples containing 10% of additives, this analysis again indicated (Fig. 3c) that the highest surface area of the assimilation apparatus, shoot and root length were characteristic of the plants growing on the fertilizer and in the control group, but also on the medium containing the crop support agent (CA). Plants growing on soil with 10% reclamation blend content, on the other hand, were characterized by a high content of carotenoids and chlorophyll a and b.

The stimulating effect of fertilizer mixtures (fertilizer, crop support agent) and the lack of toxicity indicate that these fertilizers can have a wide range of applications. The reclamation blend had an inhibitory effect on the growth and germination of *Sinapis alba*, which may be due to the presence of heavy metals in the blend in the amounts which are toxic to the plant under study. However, it should be remembered that in industrial areas, e.g., rich in zinc and lead, plants that tolerate heavy metals even in high concentrations grow (Skubała 2011, Wójcik et al. 2017, Preite et al. 2019, Sarkheil and Azimi 2020).

Conclusion

The study indicated that there was no toxic effect of the plant cultivation aid and fertilizer prepared on the basis of sewage sludge on the growth of the aboveground and underground parts of *Sinapis alba* in contrast to the reclamation blend, which had an inhibitory effect on these parameters concerning the control group. There was also no toxic effect affecting the germination of the fertilizer products tested at the lowest concentration tested (2.5%), but reduced germination was noted for the reclamation blend (R). For other concentrations, differences in germination strength compared to the control were demonstrated from day 3 of the test. For the highest applied dose after 7 days, the difference varied between 10–20% for the crop support agent (CA) and the fertilizers (fertilizer (F) and commercial fertilizer (FC), respectively). Given the above, studies of the reclamation blend carried out on plants growing on galmanic soils seem justified. As the mixture has a fertilizing character, due to the presence of nitrogen, potassium, and phosphorus, it would also seem reasonable to carry out tests on plants tolerant to heavy metals in the environment and having a utilitarian function (e.g. for biomass production). The study also noted increased carotenoid content in the tested groups, which may indicate the occurrence of stress reactions in these plants, not morphologically manifested, and requires further more detailed research.

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Porównanie rożnych produktów powstałych na bazie komunalnych osadów ściekowych pod kątem potencjalnej ekotoksyczności

Streszczenie: Porównanie różnych produktów powstałych na bazie komunalnych osadów ściekowych pod kątem potencjalnej ekotoksyczności. W celu sprawdzenia potencjalnej szkodliwości gleb nawożonych produktami powstałymi na bazie osadów ściekowych na organizmy roślinne posłużono się metodą biotestów – wykorzystano reakcję fizjologiczną/biochemiczną samych organizmów do oceny ich toksyczności. W niniejszej pracy przedstawiono wyniki wstępnych badań ekotoksykologicznych różnych produktów: powstałych na bazie osadów ściekowych: nawozu, środka wspomagającego wzrost roślin oraz mieszkanki rekultywacyjnej. Badania przeprowadzono z wykorzystaniem *Sinapis alba* L. – rośliny wykorzystywanej w rolnictwie do międzyplonów oraz zalecanej do wykonywania testów toksykologicznych. Testy toksyczności wykonano w gradiencie stężeń wskazanych produktów (2,5%, 5% oraz 10%). Dla celów porównawczych, obok gleby kontrolnej (bez dodatków) zastosowano także próbę zawierającą nawóz komercyjny. Nawóz i środek wspomagający uprawę roślin cechowały się niską toksycznością, analiza danych wskazała jednak na toksyczność tzw. mieszkanki rekultywacyjnej, zawierającej w swoim składzie m.in. metale ciężkie. Badane produkty wykazywały wzrost toksyczności wraz ze wzrostem zastosowanej dawki. Niniejsze badania stanowią ważny etap w ocenie przydatności produktów stworzonych na bazie osadów ściekowych i mogą być pomocne w pokonaniu „bariery psychologicznej" jaka powstrzymuje potencjalnych inwestorów w lokacie kapitału, który pozwoliłby na upowszechnienie produkcji.