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IMPACT OF STABILIZED SEWAGE SLUDGE-BASED GRANULATED FERTILIZER ON SINAPIS ALBA GROWTH AND BIOMASS CHEMICAL CHARACTERISTICS

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INTRODUCTION

Municipal sewage sludge is a problematic waste that needs to be managed. Modern wastewater treatment plants (WWTPs) generate stabilized sewage sludges with good chemical and biological parameters. Plenty of WWTPs digest sewage sludge in fermentation chambers for two purposes – the use of biogas and thermal sludge stabilization. The fermented sewage sludge can be utilized for organic or organo-mineral fertilizer production. The Central Mining Institute (CMI, GIG Research Institute) from Katowice (Poland) has developed a proprietary technology for production of a granulated organo-mineral fertilizer from the stabilized sewage sludge.

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PRODUCTION OF GRANULATED FERTILIZER FROM THE STABILIZED SEWAGE SLUDGE

The technology of fertilizing products production is based on full homogenization and precise mixing of the components: sewage sludge and mineral additives and bringing them into the form of a durable granulate with a grain size of 1-6 mm

Using the GIG technology the following products can be obtained:

- organic fertilizer,
- mineral-organic fertilizer,
- an agent promoting plant cultivation,
- soil-forming material.

The technological process requires two-stage operations, whose key elements are substrate homogenization (I), granulation and drying (II).

GIG is the owner of the technology, which is protected by a patent. The first implementations in Poland are currently underway. The technology is fully scalable and can applied using the amount of sludge ranging from tens to even thousands of Mg per year.

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MATERIALS AND METHODS

Micro-field tests were conducted at WWTP in Żory (southern Poland) and carried out on five fields (5m^2 each). To evaluate the effectiveness of plant growth, drone photos were taken to show field coverage upon vegetation, and the plant dry mass was determined after harvest.

In order to study the effect of white mustard (*Sinapis alba* L.) fertilization the experimental field was split into five replicate plots for each of the following treatments: 1) Control (C); 2) GIG fertilizer I (I) 3) Commercial fertilizer (N COM); 4) GIG fertilizer II (II); 5) GIG fertilizer III (III). In order to study the effect of white mustard (*Sinapis alba* L.) fertilization with the tested granulated fertilizer containing different additives (see table below), the experimental field was split.

MICRO-FIELD TEST AT WWTP

MATERIALS AND METHODS

		1	2	3	4	5
Experimental plot		CONTROL (C)	GIG Fertilizer I (I)	Comertial fertilizer (N COM)	GIG Fertilizer II (II)	GIG Fertilizer III (III)
composition (% w/w)	Sewage sludge	x	74	x	74	64
	Calcium oxide/quicklime	x	5	x	x	5
	Dolomite flour	x	20	x	x	30
	Gypsum	x	x	x	25	x
	Cellulose fibers	x	1	x	1	1

(Legend to previous slide)

1. Test site at the Żory WWTP
2. Test plots with numbers of experimental variants (see table)
3. *Sinapis* plants
4. Plants harvest
5. Plant analysis

For each plot ($25m^2$), 40 g of *Sinapis alba* L. seeds were sown and fertilizers variants (as shown in the table above) were introduced at doses of 5 Mg/ha each.

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MICRO-FIELD TEST AT THE ŻORY WWTP

White mustard (*Sinapis alba*) test plants

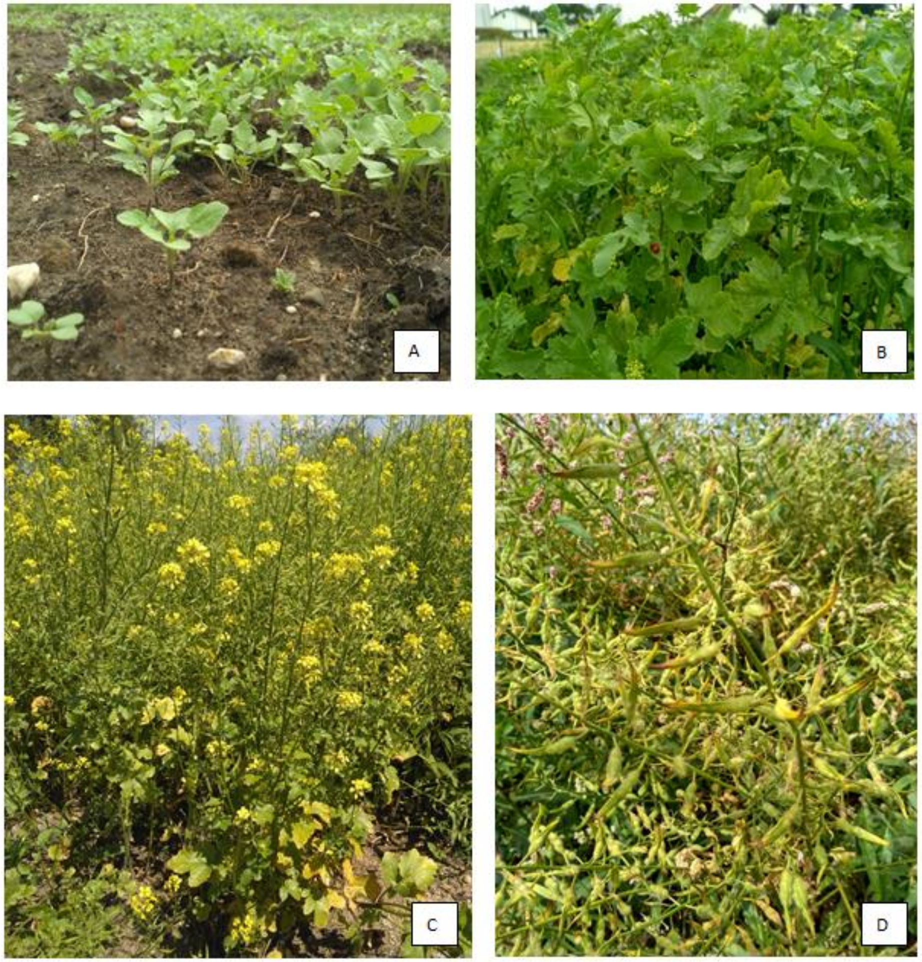
Test fields photos:

A) on day 11 from sowing (14.06.2019)

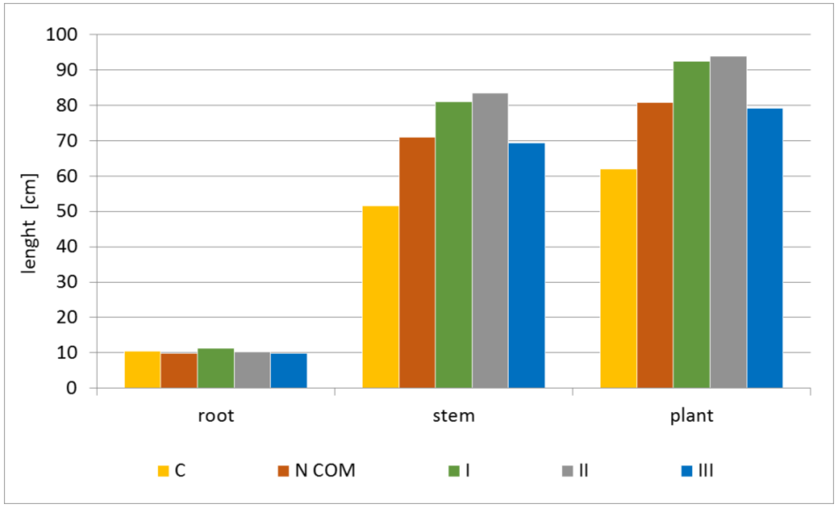
B) on day 25 from sowing (28.06.2019)

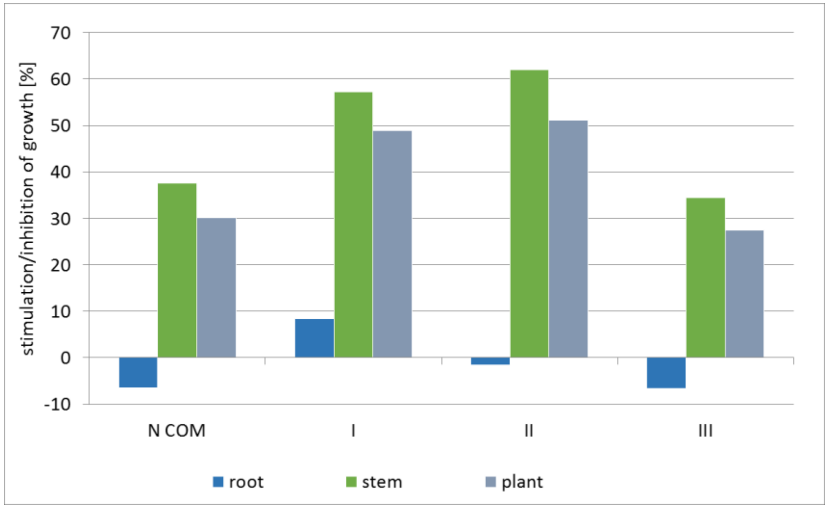
C) on day 52 from sowing (25.07.2019)

D) on day 71 from sowing (13.08.2019)



RESULTS AND DISCUSSION





Control (C)	GIG Fertilizer I (I)	Commercial fertilizer (N COM)	GIG Fertilizer II (II)	GIG Fertilizer III (III)

The use of all GIG-elaborated fertilizers, that is GIG I, GIG II and GIG III products, as well as the commercial fertilizer resulted in plant growth stimulation. The highest % of stimulation was obtained for plants fertilized with the product II (51,2%) and fertilizer I (49%). In plants fertilized with the commercial fertilizer and plant cultivation agents, a slight inhibition of root growth was identified in relation to the control plants. In the case of plants fertilized with the GIG fertilizer I, the root growth was stimulated by 8,4%.

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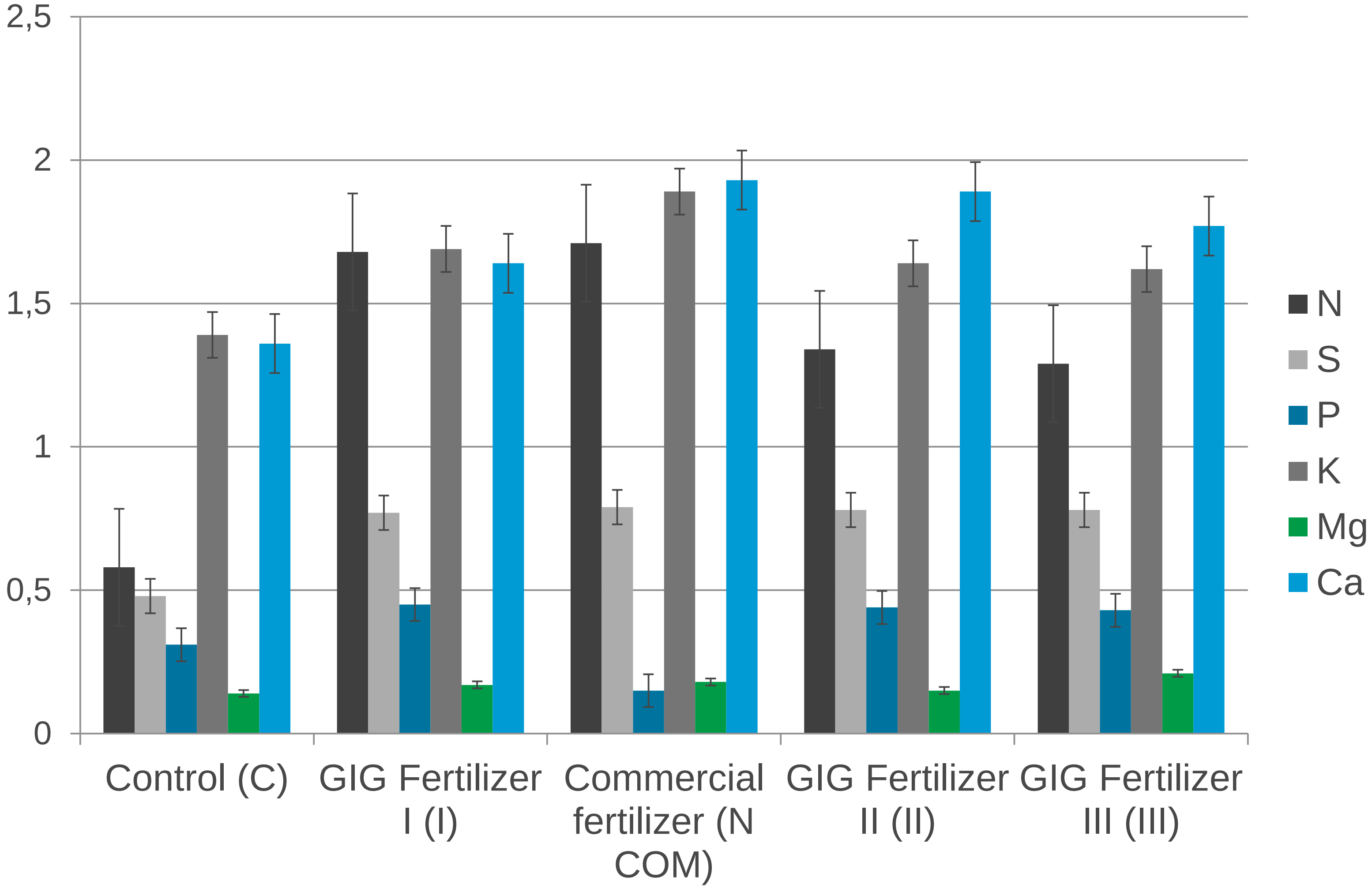
RESULTS AND DISCUSSION



RESULTS AND DISCUSSION

Dry mass analyses showed significant changes in biomass chemical composition: the N concentration was 289,6% of the control and 98,2% of commercial fertilizer, whereas the respective P content was 145,1% and 300%. The results prove that the GIG fertilizer produced from municipal sewage sludge is highly competitive with other available commercial products.

Also, it is important to notice that concentration of N and P in soil from the test fields was 0,44% for N and 0,30% for P, fertilizers used for tests had N and P concentration as follows:

GIG fertilizer (I): N - 1,35%; P - 0,93%,

Commercial organo-mineral fertilizer: N - 9%; P - 6%.

Nitrogen concentration in commercial fertilizer was 6,6 times higher than in GIG fertilizer (I) based composed of municipal sewage sludge. Then, the test results show equal concentration of N in dry mass of plants as well as equal plant growth which clearly provides that N absorption from organic waste was much more effective than from commercial product, thus indicating higher N **bioavailability**. This is of particular importance in terms of implementing the concept of Green Deal and idea of Circular Economy.

Thank you for your attention

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