

The Effect of Fertilizer Application of Granulated Organic-Mineral Fertilizers Formed from Spent Mushroom Substrate on Crop of Common Cabbage (*Brassica oleracea* L.)

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The aim the research is to estimate the influence of granulated organic-mineral fertilizers formed from spent mushroom substrate (SMS) on the common cabbage crop. Fertilizers and composted spent mushroom substrate are using on two doses on account of applicationed nitrogen content, these doses are 100 and 200 kg N ha⁻¹. 10 fertilizers combinations on four replications are used in experiment. The test plant was common cabbage.

After harvest were estimated yield of green matter and dry matter yield. Statgraphics 4.0. program was using to statistic data processing of the results. Dry matter yield of cabbage depends on the kind and dose of fertilizers applied in the experiment. The greatest yields are obtained from object manured by fertilizer formed from spent mushroom substrate with supplement urea and powdery superphosphate and potassium salt, also fertilizer formed from spent mushroom substrate with supplement ammonium salpeter. Other granuled organic-mineral fertilizers have a positive influence on increasing cabbage yield in comparison to the control object, however, their yield effect is similar.

Keywords and phrases: organic-mineral fertilizers, spent mushroom substrate, common cabbage.

Introduction

The problem of contemporary agriculture is too lower soil organic matter content [1], soil influenced and decided about soil fertility. Therefore aimed to find simultaneously cheap and safeguarde organic matter source [2, 3]. The wastes from industry or agroculture, contented above 8% of organic substance there can be an alternative to farm manure application, which shortage comes from limit of livestock population. Spent mushroom substrate, manufactured from peat mixed with straw and horse dung, and with mineral fertilizer supplement is a nutrient-rich organic waste [4]. The composition of these wastes is suitable for farming utilization [5, 6]. Spent mushroom substrate comprised component nutrient for plant growing [7]. Annually, about 900 [Mg] of fresh weight these wastes is generated in Poland [8–10]. In the subsequent process composted manurial product having desirable functional quality is obtained. SMS causes beneficial effect on plant. On this phase obtained compost is suitable for immediate bring into cultivation [11–13]. At present is the possibility of

adding mineral fertilizers to the compost obtained from SMS and the production of organic-mineral fertilizers is being investigated. During the process of composting spent mushrooms substrate is possibility to manage municipal sewage sludge. Then the mixture from both ingredients can be prepared before composted. This product is prepared to formation organic-mineral fertilizers [12].

The only mineral fertilizer application causes negative effects. Therefore, a significance of organic-mineral amendments' application increases [3, 14, 15]. Organic-mineral fertilization causes yield increment. The simultaneous application of organic and mineral fertilizer is better than only mineral fertilization [16].

The soil organic matter immediately influences on physico-chemical and biochemical soil properties. It is hydrophilic and is a feature of large water capacity, that is particural essential to mineral fertilization, because nutrients composed organic-mineral compounds become more nutrient availability to plants [15, 17–20]. The supplement of SMS causes an increasing in the number of total actinomycetes and bacteria of

the rhizosphere [21]. The soil organic matter prevents cation leaching out and bonds heavy metals. Besides, it improves buffer capacity of a soil [15, 19, 22]. Therefore one should find a source of organic matter to soil application. In order to manage animal production and industrial production's wastes. Examples: brown coal, sewage sludge [19, 20, 23].

The Aim of the Research

The aim the research is to estimate the influence of granulated organic-mineral fertilizers formed from spent mushroom substrate on the common cabbage crop.

Methodology

The influence of granulated organic-mineral fertilizers on common cabbage crop is investigated in microplot experiment conditions. Microplots were constituted by ground vases \varnothing 40 cm, situated 120 cm depths and filled grey-brown podsolic soil profile up, carried with soil profiles stratified system conservation from experimental untreated field (without fertilization) [18]. The soil profile is following: A-horizon 30 cm soil thickness granulometric composition of a soilheavy loamy sand, E-horizon (30–45 cm) light loamy sand, B-horizon below 45 cm—light loam. Organic-mineral fertilizers investigated in experiment formed from composted spent mushroom substrate (Fig. 1), which supplemented various components (sewage sludge, mineral fertilizers: urea, ammonium salpeter, ammonium sulphate, potassium salt, powdery superphosphate) and that mixtures prepared became pelleted by using PELECIARKA (Fig. 2) [11]. In this experiment used the following manurial combinations: control devoid of fertilization, manure, ammonium salpeter and granulated organic-mineral fertilizers formed from composted spent



Fig. 1. Composted spent mushroom substrate.

mushroom substrate (Fig. 3): granulated organic-mineral fertilizer with supplement urea, potassium salt and powdery superphosphate, granulated organic-mineral fertilizer with supplement ammonium salpeter, potassium salt and powdery superphosphate, granulated organic-mineral fertilizer with supplement ammonium sulphate, potassium salt and powdery superphosphate, granulated organic-mineral fertilizer with supplement ammonium salpeter, granulated organic-mineral fertilizer with supplement sewage sludge, granulated organic-mineral fertilizer with supplement sewage sludge and ammonium sulphate, composted spent mushroom substrate. Fertilizers obtained from composted spent mushroom substrate and composted spent mushroom substrate are using on two doses on account of applicationed nitrogen content, these doses are 100 and 200 kg N ha⁻¹. Manure and ammonium salpeter are using only one dose on applicationed nitrogen content — 100 kg N·ha⁻¹. In experiment 10 fertilizers combinations on four replications are used. The test plant was common cabbage, which was planting out on 2009.06.08, harvested on 2009.11.05. Yield of green matter and dry matter yield were estimated after harvest. Statgraphics 4.0 programme was using to statistic data processing of the results.



Fig. 2. Peleciarka — machine to organic-mineral fertilizers production.



Fig. 3. The granuled organic-mineral fertilizer formed from spent mushroom substrate.

Results

Dry matter yield of cabbage was intrinsically dependent of the kind of fertilizer applied in the experiment and the doses. Independently of applied the dose the greatest yields are obtained from objects fertilized by granuled fertilizer formed from spent mushroom substrate with supplement of urea, potassium salt and powdery

superphosphate (combination 2), and granuled fertilizer formed from spent mushroom substrate with supplement ammonium salpeter (combination 5). Also Other organic-mineral fertilizers (combination 2, 4, 6, and 7) also influenced on the increase of cabbage yield in comparison to control object. However, the yield effect is similar. The poorer yield of cabbage occurred on object, where only the compost formed from only spent mushroom substrate applied. The yields from, in that case, these objects were comparable to yield obtained from control object. Independently of manurial combination, indeed, greater yields were obtained after a bigger dose of investigated fertilizers (suit of application $200 \text{ kg N}\cdot\text{ha}^{-1}$) were applied.

Fertilizers formed from spent mushroom substrate with supplement sewage sludge (combination 6 and 7) are typical of high macronutrients content (Table 1) and a very small account of heavy metals content (Table 2). Because granuled organic-mineral fertilizers proved fundamental influence on the enlargement of cabbage yields, production of these fertilizers it might be a good idea to combine spent mushroom substrate with organic wastes, and in this way recycle two by-products.



Fig. 4. The cabbage fertilized by granuled organic-mineral fertilizer formed from spent mushroom substrate with urea, potassium salt and powdery superphosphate.



Fig. 5. The cabbage from object without fertilization.

Table 1. The chemical composition of spent mushroom substrate. The content of macronutrients [24].

	s.m. [g · kg ⁻¹]	Corg. [g · kg ⁻¹]	Nog. [g · kg ⁻¹]	P [g · kg ⁻¹]	K [g · kg ⁻¹]	Ca [g · kg ⁻¹]	Mg [g · kg ⁻¹]	C/N
min.	300,0	206,2	16,9	3,1	8,4	14,8	1,8	12,2
max.	450,0	298,2	25,2	14,8	22,9	106,0	5,9	11,8
śred.	350,0	260,0	20,4	11,2	15,8	75,3	3,8	12,7

Table 2. The chemical composition of spent mushroom substrate. The content of trace elements [24].

	Cd	Cr	Cu	Ni [mg · kg ⁻¹]	Pb	Zn	Fe	Mn
min.	0,2	27,5	14,9	16,3	2,1	99,7	800	102,5
max.	0,8	45,7	45,6	26,3	7,7	511,5	3400	407,3
śred.	0,4	37,8	24,1	21,3	4,4	319,1	1700	258,1
norma	20,0	500,0	1000,0	300,0	750,0	2500,0	—	—

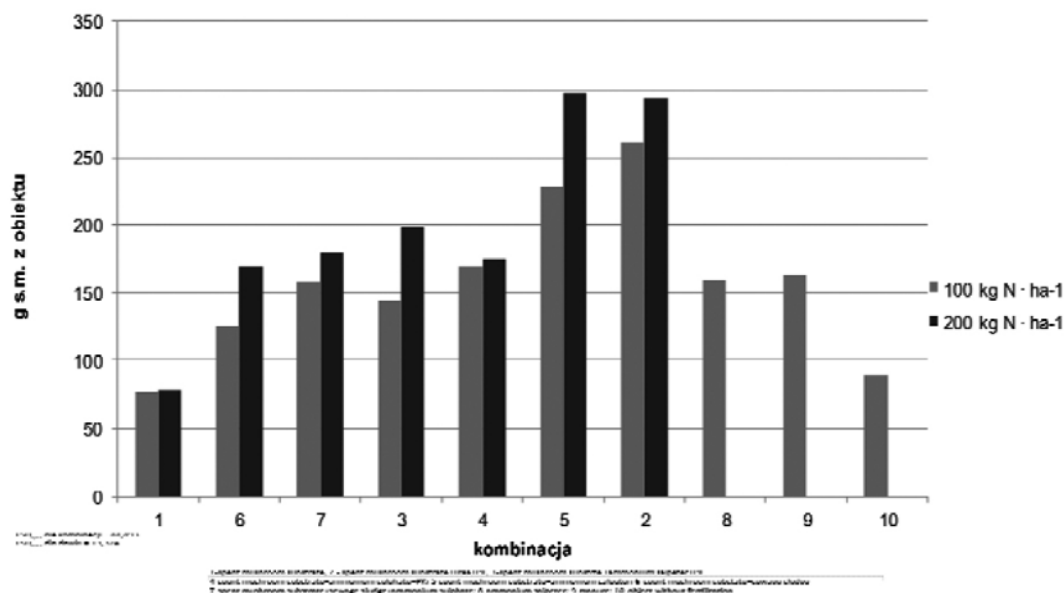


Fig. 6. The influence of fertilizer organic-mineral fertilizers on yield of cabbage.

Conclusions

- 1) Dry matter cabbage yield was depended on the kind and dose of fertilizers applied in the experiment.
- 2) The greatest yields were obtained from object manured by fertilizer formed from spent mushroom substrate with supplement urea and powdery superphosphate and potassium salt, also fertilizer formed from spent mushroom substrate with supplement ammonium salpeter.
- 3) Other granulated organic-mineral fertilizers have a strong influence on increasing cabbage yield in comparison to control object, but nevertheless, their yield effect was similar.
- 4) The poorest cabbage yield was produced when object were fertilized with compost from SMS only, but the results were better in comparison with yield from control object where no fertilizers were used.
- 5) Independently of the fertilizer combination greater cabbage yields were obtained when a bigger dose of investigated fertilizers (suit of application 200 kg N·ha⁻¹) was applied.
- 6) Fertilizers formed from spent mushroom substrate with supplement sewage sludge were characteristic of high macronutrients content and little heavy metal content. They also influence on the increase of cabbage yields, so it is possible to conclude that the production of these fertilizers should be a good idea to simultaneously manage both organic wastes.

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