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НОВЫЕ МЕТОДЫ И РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ ЛАНДШАФТОВ В ЕВРОПЕ, ЦЕНТРАЛЬНОЙ АЗИИ И СИБИРИ

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This monograph shall inform you about up to date methodologies and recent results in landscape research. It is intended as a guide for researchers, teachers, students, decision makers, stakeholders interested in the topic of landscape science and related disciplines. It provides information basis for decision makers at various levels, from local up to international decision bodies, representing the top level of landscape science in a very short form.

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Chapter IV/43: EFFECTS OF LONG-TERM COMPOST TREATMENT ON PHYSICAL PROPERTIES OF SANDY SOILS


goal of our study was to determine the effects of the sewage sludge compost application on the physical properties of sandy soil. The soil type of the experiment was Arenosol (Dystric Lamellic Arenosol). The compost is applied from 2003 every 3rd year in 0, 9, 18 and 27 t ha\(^{-1}\) doses. The applied compost contained sewage sludge of 40%, straw of 25%, bentonite of 5% and rhyolite of 30%. Based on the results (2013-2015), the bulk density of soil decreased one year after compost treatment, but in the second and third years the positive effects of compost application were observed only in the highest compost dose treatment. In accordance with the decrease in bulk density, the air permeability of soil significantly increased. According to the results, the sewage sludge compost seems to be a suitable soil improving material of acidic sandy soils. However, the beneficial effect of application takes a short period because of the quick degradation processes.

**ABSTRACT.** The large part of sandy soils in Hungary is not suitable for intensive agricultural production because of their low fertility and unfavourable physical properties. The sewage sludge compost, due to its high organic matter content is a potentially usable material for improving the structure and increasing the fertility of these soils. The aim of our study was to determine the effects of the sewage sludge compost application on the physical properties of sandy soil. The soil type of the experiment was Arenosol (Dystric Lamellic Arenosol). The compost is applied from 2003 every 3rd year in 0, 9, 18 and 27 t ha\(^{-1}\) doses. The applied compost contained sewage sludge of 40%, straw of 25%, bentonite of 5% and rhyolite of 30%. Based on the results (2013-2015), the bulk density of soil decreased one year after compost treatment, but in the second and third years the positive effects of compost application were observed only in the highest compost dose treatment. In accordance with the decrease in bulk density, the air permeability of soil significantly increased. According to the results, the sewage sludge compost seems to be a suitable soil improving material of acidic sandy soils. However, the beneficial effect of application takes a short period because of the quick degradation processes.

**KEYWORDS:** sewage sludge compost, sandy soil, bulk density, air permeability

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**Резюме.** Большая часть песчаных почв в Венгрии непригодна для интенсивного сельскохозяйственного производства вследствие низкого плодородия и неблагоприятных физических свойств. Компост осадка сточных вод, благодаря высокому содержанию органического вещества, потенциально может использоваться для улучшения структуры и повышения плодородия этих почв. Наше исследование ставило целью определить эффекты применения компоста осадка сточных вод на физические свойства песчаной почвы. Почва опытного участка — Arenosol (Dystric Lamellic Arenosol). Компост применяется с 2003 г. один раз в три года в нормах 0, 9, 18 и 27 т га\(^{-1}\). Применяемый компост содержал осадок сточных вод (40%), солому (25%), бентонит (5%) и риолит (30%). Как показали результаты (2013-2015 гг.), объемная масса почвы через один год после применения компоста была ниже, но во второй и третий годы положительный эффект применения компоста наблюдался только в варианте с максимальной нормой. Снижение объемной массы приводило к существенному увеличению воздухопроницаемости почвы. Согласно результатам, компост осадка сточных вод, по-видимому, является подходящим почвоулучшающим материалом для кислых песчаных почв. Однако положительный эффект применения охватывает короткий период вследствие быстрых процессов разложения.
INTRODUCTION
Soil physical properties such as bulk density and air permeability are the important indicators of soil quality, and their changes can reflect the sustainability of soil [1]. In Hungary, the large part of agricultural area is covered with sandy soils. The fertility of these soils is limited by their low mineral and organic colloids content, therefore they have unfavourable physical properties [2]. The not aggregated sandy soils are prone to compaction, which results in a decrease in the pore space and inhibiting the flow of water and air in the soil. The root growth of cultivated plants is limited, which can lead to crop loss [3]. For increasing the suitable crop safety it is required the improving of structure and physical properties of sandy soils.
Nowadays, in the agriculture the utilization of the by-products and industrial wastes is preferred for improving the physical, chemical and biological properties of soils [4, 5]. Soil amendment with sewage sludge compost was found to improve the unfavourable properties of sandy soils by its high organic matter content. In addition, the organic matter treatment has a positive impact on the soil structure, reducing the soil compaction level and improving the air management of soil [6, 7]. The examination of different soil management in long-term experiment is also very important, because the physical changes in soil are related to long-term process. Therefore, our aim was to study the effect of regular sewage sludge compost application in a long-term experiment to evaluate the long-term changes in soil physical properties.

MATERIALS AND METHODS
Study area. The sewage sludge compost experiment is conducted at the University of Debrecen, Research Institute of Nyíregyháza in Hungary. The main goal of the experiment is to determine the effect of long-term application of composted sewage sludge on physical, chemical, biological properties of soil and on test plants. The experiment was established in 2003 on Dystric Lamellic Arenosol (87.69% sand, 2.67% silt, 9.64% clay). Figure 1 shows the experimental design of the field experiment.
The applied compost contained sewage sludge (40%, mass), straw (25%, mass), bentonite (5%, mass) and rhyolite (30%, mass). Every 3rd year the same rates are applied on the same plots and controls are received any compost addition. Test plants [triticale (**x** Triticosecale Wittmack), maize (**Zea mays** L.) and green pea (**Pisum sativum** L.)] were sown in a crop rotation.

Soil sampling and analysis. For measurements undisturbed soil samples of about 100 cm$^3$ in volume were collected from the soil layer of 5-10 cm in five replicates at the end of growing season. The bulk densities of undisturbed soil samples were measured after drying at 105 °C. The air permeability of soil was measured by the Eijkelkamp type air permeability apparatus (Figure 2), that measures the
permeability of an undisturbed soil sample at a defined air pressure difference of 1 cm watercolumn=0.1 kPa. The air permeability uniformly was determined at the moisture content of pF 2.3.

RESULTS AND DISCUSSION
Bulk density and air permeability are important indicators of soil compaction and their values depend on land use practices, such as tillage, fertilization and irrigation [1]. According our results, one year (in 2013) after the third compost treatment (in 2012) the compost application had a beneficial effect on soil compaction level in the 5-10 cm soil layer (Figure 3). All compost doses significantly decreased the soil bulk density in comparison with the control plots. In the second year (2014) after compost application, the bulk density of soil decreased only in the plots applied with the highest compost dose. Studies have shown that organic materials have an impact on formation of soil structure, which results in reduced bulk density [8]. However, the reduced soil compaction observed during the experiment was limited only to a short period of time, and was connected with rapid mineralization processes [9, 10].

![Figure 2 - Air permeameter apparatus](image)

![Figure 3 - Changes in the bulk density of soil in treatments with increasing doses of compost. a-c indexes mean different groups of means according to the Tukey’s test at the significance level of p<0.05, mean ± Standard Deviation (SD)](image)
Air permeability is an important indicator of other soil properties, such as soil aeration status, soil compaction level, hydraulic conductivity or structural stability [11, 12, 13]. According to our results, the effect of compost treatment on air permeability was stronger in the first year after compost application. The air permeability of soil samples increased as well by the increased total porosity and rate of macropores [14]. However, in the second year after compost application only the highest compost dose decreased the rate of air permeability. In the 3rd year any significant effect of compost treatment was found.

The air permeability is strongly related to the bulk density of soil ($R^2 = -0.6$), so the decrease in bulk density caused an increase in air permeability. The changes in bulk density affect approx. 25-30% increase or decrease in air permeability. This relationship indicates that the soil compaction level can significantly affect the air management of soil.

CONCLUSIONS
1. Long-term application of sewage sludge compost strongly impacted the physical characteristics of sandy soil. Addition of compost reduced soil bulk density and increased air permeability significantly. However, the beneficial effect of application takes a short period because of the quick degradation processes.
2. According to the results, the sewage sludge compost seems to be a suitable soil improving material of acidic sandy soils and it can be utilized in agriculture in an environmentally-sound way.

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REFERENCES


Основная глава 12.4 Борьба сорняками и с вредителями

Main Chapter 12.4 Weed and Pest Control

CHAPTER IV/44: PRINCIPLES AND METHODS OF INTEGRATED WEED MANAGEMENT IN CROPPING SYSTEMS

Глава IV/44: Принципы и методы интегрированного защиты от сорных растений в системах земледелия

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ABSTRACT. During the last decades weeds in field crops have been predominantly controlled by herbicides, at least in developed countries. However, the weak diversity in cropping systems in combination with one-sided use of herbicides created problems like herbicide-resistant weeds. This worldwide increasing threat is still impaired by the continuous loss of registered herbicides. Consequently there is a strong need for more integrated weed management (IWM) focusing on preventive weed control. IWM is considered as a complex long-term approach by reducing weed emergence and reproduction. The key element of successful IWM is a diverse crop rotation, supported by site-specific primary soil tillage and stubble tillage. However, IWM is not fully accepted by farmers, mainly because the efficacy as well as the costs are hard to predict. Thus, more research and guidance are needed on decision support, weed thresholds and prediction models.

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