Influence of compost composition on its agrochemical parameters

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Abstract. The article presents the results of studying the agrochemical characteristics of composts made on the basis of animal husbandry waste (manure) and woodworking enterprises (bark). A favorable effect of the bark on the mineralization of the composted substrate was revealed: an increase in the amount of bark contributes to an increase in the content of mobile forms of nitrogen and phosphorus.

1 Introduction

The biologization of agriculture implies the maximum use of biological factors to increase soil fertility, reduce anthropogenic pressure and produce environmentally friendly crop products. Under the conditions of agricultural stability, the expanded reproduction of soil fertility is one of the main tasks of the fertilizer system, the most important constituent elements of which are the liming of acidic and alkaline soils, the use of organic fertilizers, as well as green manure, which contribute to the maximum involvement in the biological nitrogen cycle [1].

On the one hand, manure is the most important raw material for the production of organic fertilizers, and on the other hand, it is a hazardous waste containing eggs and larvae of helminths, pathogenic microflora and a huge amount of germinating weed seeds. Irrational use of this fertilizer can lead to pollution of both agricultural land and adjacent territories. The largest volume of organic waste comes from keeping cattle.

Currently, many livestock enterprises do not have systems for the accumulation and processing of manure that meet regulatory indicators, which poses a danger to the environment. The resulting wastes require special places for their disposal, where as a result of decomposition greenhouse gases are released, spontaneous combustion centers appear, and groundwater is polluted [2].

This method of manure disposal leads to the loss of organogenic elements. The most effective for reducing the toxicity of biodegradable organic matter is the biological processing of waste by anaerobic fermentation and composting [3-5]. In the process of composting, the toxicity of components decreases, which is associated with the processes of degradation of organic pollutants and mineralization of the substrate, as well as reactions that limit their availability, for example, the formation of insoluble compounds [6-9]. It is

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not possible to describe these transformations of substances in the form of simple chemical reactions, since the compost mixture may contain more than 500 different organic compounds [10].

It is effective to use peat, bark and other components as a component of composts. A promising raw material is the remains of a woodworking industry. Waste in the form of tree bark can be an important source for the formation of humic substances; it contains a variety of labile organic substances and mineral compounds necessary for plant nutrition. This makes it possible to return the organic part withdrawn from it into the biological cycle of nature and restore the optimal functioning of the soil-biotic complex.

The most rational way to use wood waste is the production of organic and organomineral fertilizers. The use of compost causes qualitative changes in the features of accumulation, water resistance and bioavailability of the main nutrients that are able to adsorb on the surface of soil particles, as well as form complex compounds with organic substances. An analysis of the literature data showed a positive effect from the use of compost in the form of a decrease in plant disease infestation [11]. There is information about the inhibitory effect of pine bark composts on late blight pathogens, and the effectiveness was comparable to the effect of chemical and biological fungicides, which makes it possible to reduce the amount of pesticides when growing plants [12]. Hoitink and Fahy (1986) also reported that composts from agricultural, forestry and household wastes suppress soil plant pathogens, in particular those belonging to the genera Rhizoctonia, Pythium, Fusarium and Phytophthora. These authors [13] note the positive role of composts in increasing crop yields, increasing soil fertility, enriching it with nutrients, enhancing plant growth processes, and reducing the degree of damage by diseases caused by soil pathogenic microorganisms.

The purpose of this work is to give an agrochemical characterization of composts based on coniferous bark and cattle manure for use as an organic fertilizer.

Research on the use of tree bark in composts holds practical significance. It allows us to determine the potential for effectively utilizing this material to enhance compost quality and its impact on plant growth and development.

2 Materials and methods

To conduct our research, we collected the bark of coniferous trees. The bark has been carefully removed to minimize damage to the trees. It was then crushed into small pieces to simplify the composting process.

For research in laboratory conditions, fresh cattle manure was mixed with moistened crushed bark (fraction 1 mm) of conifers in various ratios:

Cattle manure (1000 g) - control.
Cattle manure (700 g) + bark (300 g).
Cattle manure (500 g) + bark (500 g).
Cattle manure (300 g) + bark (700 g).

The resulting substrates were placed in tight plastic bags to prevent nitrogen loss. The contents were regularly mixed, the composting process was carried out for 6 months at an average temperature of 22 °C.

Upon completion of composting, agrochemical indicators were determined according to generally accepted methods: exchange acidity (pHsalt) potentiometrically, hydrolytic acidity according to Kappen, the content of mobile forms of phosphorus according to GOST 26207-91 "Soils. Determination of mobile compounds of phosphorus and potassium

according to the Kirsanov method in the modification of TsINAO", ammonium nitrogen with Nessler's reagent.

3 Results

Our findings revealed that composts containing tree bark exhibited several positive characteristics. The presence of bark improved the overall structure of the compost, enhancing its ability to retain water and prevent excess moisture build-up. Additionally, the bark's high air permeability improved soil aeration, benefiting root development and promoting healthy plant growth.

At the initial stage, the bark was a crumbly, dry brown substrate; manure was characterized by a uniform brown color with a greenish tint. After six months of composting, the manure acquired a dark brown, close to black color, the substrates had a homogeneous mass with the smell of forest soil.

Table 1. Agrochemical characteristics of composts.

Option	Acidity		The content of nutrients, mg / 1000 g of soil	
	exchange, $pH_{sol.}$	hydrolytic, mmol / 100 g of soil	P_2O_5	NH_4
Cattle manure (1000 g) - control	4.2	9.3	0.8	0.8
Cattle manure (700 g) + bark (300 g)	4.4	7.8	2.2	1.9
Cattle manure (500 g) + bark (500 g)	4.4	7.9	2.6	3.2
Cattle manure (300 g) + bark (700 g)	4.2	8.3	4.3	3.2

The obtained agrochemical indicators are presented in table 1.

Studies have shown that composting bark with manure significantly changes the agrochemical parameters of the resulting compost in comparison with the control.

4 Discussion

The indicators of exchangeable and hydrolytic acidity of all studied variants indicate an acidic reaction of the medium. Therefore, when laying for composting, it is necessary to add lime fertilizers to these composts to reduce the acidity of the substrate.

It was revealed that the highest content of phosphorus available to plants is contained in the variants of bark composting mixed with cattle manure with the prevailing share of the bark. Its positive effect on the compost was also established by the content of ammonium nitrogen. The process of absorption and retention of volatile ammonium nitrogen by the crustal substrate not only enriches the organic fertilizer, but also is a powerful barrier against atmospheric air pollution by compounds of this series. In this case, an important role belongs to the weight amount of the bark: the more of this component in the compost (700 g), the more actively the mineralization of the mixture occurs, which enriches the resulting compost with mobile phosphorus and ammonium nitrogen.

Studies show that the use of compost with tree bark can lead to a significant improvement in soil structure. Due to its high air permeability, tree bark helps to prevent waterlogging of the soil and improve its drainage properties. This is especially important for lands with poor drainage or prone to waterlogging.

Tree bark is also a rich source of organic material, which is an integral part of fertile soil. They contain important trace elements such as potassium, calcium and magnesium, which promote healthy plant growth. In addition, the bark of trees contains phytohormones that can stimulate root growth and increase plant resistance to stressful conditions.

However, despite all the potential benefits, the use of compost with tree bark requires additional research. It is important to study the influence of different types of trees and their processing methods on the quality of compost. It is also necessary to determine the optimal with.

5 Conclusion

Thus, as a result of the study, the possibility of expanding the range of bioorganic fertilizers at the expense of composts produced on the basis of waste from agricultural enterprises (manure) and woodworking industries (bark) has been shown. An increase in the share of bark in compost with cattle manure contributes to its better mineralization and increase in the availability of nitrogen and phosphorus compounds for plants.

In conclusion, our study demonstrates the potential benefits of using composts with tree bark. The bark's unique properties contribute to improved soil structure, enhanced nutrient content, and healthier plant growth. These findings have practical implications for agricultural and gardening practices, offering sustainable and effective methods for soil improvement and increased crop productivity.

Further research is necessary to explore the optimal types of tree bark and compost ratios for specific plant species and environmental conditions. By continually investigating the applications of tree bark in composting, we can unlock its full potential and contribute to sustainable agriculture and environmental stewardship.

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