Ukrainian Journal of Ecology

Ukrainian Journal of Ecology, 2021, 11(5), 72-76, doi: 10.15421/2021_211

ORIGINAL ARTICLE

The agrochemical properties of organogenic wastes and the possibility of preparing composts

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Received: 28.06.2021. Accepted: 09.07.2021.

The article presents data on the chemical composition of solid household waste, manure, straw, and silt, as well as the possibility of disposal of solid household waste of the city of Samarkand by composting them with cattle manure, straw of winter wheat, and silt of freshwater of Hishrau Lake of Samarkand. At the same time, an assessment was made of these components' chemical composition and agrochemical property in terms of their compatibility for composting, maturation, and nutritional value of composts. The municipal solid waste (MSW) city of Samarkand has a high content of organic substances, organic carbon, ash content, and therefore, as a source of humus, is of great importance in composting composts. Manure has all the nutrients for plant nutrition and low carbon to nitrogen ratio, enhancing the decomposition of MSW and straw during composting. The studied the composition and properties of MSW, and other organic wastes are essential factors for modern global municipal solid waste management policies.

Keywords: Municipal solid waste, silt, straw, manure, soil, compost.

Abbreviations: MSW -Municipal Solid Waste, NPK-Total Nitrogen, Phosphorus, Potassium.

Introduction

Currently in the world is accumulated about 1.3 billion tons of municipal solid waste in the year and will reach 2.2 billion tons in 2025 (Hoornweg et al., 2012); if urgent measures are not taken, waste will grow by 70 percent by 2050, and waste generation will increase to 3,40 billion metric tons (Kaza et al., 2018).

This represents a significant increase in the rate of per capita waste. In Uzbekistan, the output of various wastes is also increasing in total and per capita. This creates a threat to the ecology of the environment; they accumulate and pollute the soil, air, water, and other objects, creating dangerous conditions for living organisms and humans. In many countries, including Uzbekistan, municipal solid waste is stored open surface spice, which pollutes the environment physically and creates conditions for the formation of greenhouse gases (Peavy et al., 1985; Desjardins, 2002; Rasapoor, 2009; Kholikulov, 2015). Therefore, the disposal of these wastes and their subsequent use is of great importance. Municipal solid waste is an organogenic waste. Therefore, recycling can be used as organic fertilizer. For proper disposal of municipal solid waste in the form of composts, it will be necessary to study their qualitative and quantitative composition over the year's seasons. When preparing composts, the agrochemical composition of these wastes, the content of organic matter, nutrients, and heavy metals, is of great importance. The composting process, the duration of these processes, and the ripening period depend on this (Wolkowski, 2003; Kholikulov et al., 2016).

The mineralization of organic nitrogen depends on many processes during composting: the ratio of carbon to nitrogen (C:N), the conditions of composting, the maturity of composts (Hargreaves, 2008; Annabi, 2007). The composting process is essential, as well as the components of the compost. Composts prepared from the same components, but according to different technologies, are very different quality compost (He et al., 1992). Composts of optimal composition are obtained at 55 °C, the humidity of 60%, the airflow of 10 l/kg*hour (Abu Qdais, 2004). Composting municipal solid waste improves the agrochemical properties of the soil, the nutrition of crops, and their involvement in the biological circulation of substances (Otten, 2001; Achiba et al., 2009). Therefore, studying the agrochemical properties of urban solid waste and the possibility of making composts from them is relevant.

A considerable quantity of municipal solid waste accumulates in the cities of Uzbekistan, which accumulate more than 14 million tons/year; the recycling rate of this waste is low (less than 10%). Therefore, their full utilization is an environmental necessity. Mass fraction of organic carbon in municipal solid waste (MSW) is about 33%, calculated on the dry matter.

The worldwide annually is generated municipal solid waste is only 10% of the waste recycled (incinerated, composted, and separated), that 95% of solid waste is stored at landfills every year. Consequently, with an average moisture content of 50%, 82 to 98 million tons of organic carbon are being dumped annually; carbon in landfills is 0.28% bioproduction of the biosphere (Vitkovskaya, 2012).

The use of recycled MSW to improve soil fertility can be considered as one of the ways to return organic carbon to the biological circulation of substances. In this regard, the disposal of organogenic solid municipal waste of cities and agriculture with organic fertilizers is of great importance.

A study conducted by many authors shows that composting organic waste and manure is a valuable and efficient process, and the resulting composts are better than non-composted waste. Composting has reduced the volume, mass, vector of attraction, the content of pathogenic microorganisms and weed seeds, and their viability compared with non-composted waste. These benefits significantly increase the value of compost as an organic fertilizer. Composting organic waste allows decomposing organic materials into a more compact form for management (Epstein, E., 1997, Tognetti C., 2011).

Despite the effectiveness of the use of composts from various wastes in different regions, in the conditions of Uzbekistan, there were practically no studies to study the possibility of using these wastes, with a considerable supply of organic matter, by preparing composts as fertilizer, especially on soils with low humus content.

However, the modern technology for preparing composts from municipal solid waste has not yet been developed in Uzbekistan. The development of composting technology from these wastes would give agriculture the required amount of organic fertilizers. This leads to an improvement in the environmental situation of environment and waste management. Without the disposal of these wastes, they accumulate to an impossible limit, a dangerous source of pollution. One way to dispose of this waste is to make compost from it. Composting this waste has led to the production of suitable quality materials that can be used as soil amendments and sources of plant nutrients. Large quantities of N and K are usually generated and are very effective in crop production. When compost was added, the leaching of nutrients was less than that of mineral fertilizers. It has been found that composting municipal solid waste is the best option for open disposal. For this, it is necessary to conduct special studies and find the optimal ratio of compost components that would contribute to the production of high-quality composts. The urgency of the problem lies in the fact that when disposing of solid waste by composting, the environment improves, the supply of organic fertilizers and soil fertility increase, as a result of which the crop yield increases.

Thus, exploring the possibility of composting municipal waste, the environmental and economic benefits of which are apparent, plays an essential role in managing municipal solid waste. In this research, we studied the possibility of efficient utilization of municipal solid waste by preparing composts for them in a mix with manure, wheat straw, and silt, studying this component's chemical composition.

Materials and Methods

Materials

The studied the chemical composition and agrochemical properties of municipal solid waste of the city of Samarkand of the Republic of Uzbekistan, cattle manure, and winter wheat straw, the silt of Lake Hishrau outside the city of Samarkand, and the possibility of their utilization by preparing composts with different ratios of components.

Observations and analyzes of municipal solid waste (MSW) were conducted seasonally throughout the year at the sites for sanitary storage and disinfection of these wastes. The samples were taken from city waste landfills from 10 places to 20-25 kg, then all samples were mixed, and 10-15 kg of an average sample was taken by an envelope method (Stroiizdat, M., 1970). To determine the morphological composition of the waste, they were passed through a metal sieve with a diameter of 15 mm. The wastes which remained on the sieve were divided into separate components and weighed separately. The material was dried at room temperature for a couple of days and then cut, milled, and screened. Thus, the proportions of each component of the waste were determined. Then an average sample was prepared from this waste, taking into account their share in this waste.

Analytical Methods

The chemical composition and agrochemical properties of the individual components and their mixed average sample were determined according to generally accepted methods (Stroiizdat, M., 1970). Potentiometric methods determined the reaction of the medium components and the mixed medium sample, dry matter at a temperature of 105°C in a drying cabinet, ash content by burning samples in a muffle furnace (650°C), Total NPK forms by burning a sample in a mixture of concentrated acids: sulfuric and perchloric acids in a ratio of 10:1. Total nitrogen content was determined by the Kjeldahl digestion, using a 2020 Kjeltec Digester and a 2400 Kjeltec Analyzer unit. Total phosphorus at the Photoelectric Colorimeter method and total potassium at the flame photometer. The carbon content was determined by the method of Tyurin. The ratio of carbon to nitrogen is calculated.

Statistical Analysis

All experiments in this study were carried out in triplicates. All error bars and intervals reported represent 95% confidence intervals.

Results and Discussion

Alexandrova, L.N., 1980, notes that the main parameters of organic fertilizers as humus formers are dry matter, nitrogen, ash content, and chemical composition of the organic part.

Chemical analysis of MSW shows that the dry matter content in municipal solid waste of the city of Samarkand is 43.8%, ash content 7.9%, organic carbon is 14.91%, total nitrogen, phosphorus, and phosphorus potassium is respectively 0.55; 0.24 and 0.75%, pH=7.2. Thus, the MSW city of Samarkand has a high content of organic substances, organic carbon, and therefore, as a source of humus, are of great importance in composting composts. In developing countries, the composition of solid waste is more

than 60 to 90% organic, and this is ideal for composting (Yuan S.W., 2000, Getaneh G., 2006, Manju Rawat, AL. 2013). Research studies show that valuable organic fertilizer can be obtained from organic waste, which, when used in agricultural production, improves soil properties and regimes, reduces erosion, increases crop yields, and improves crop quality (Adhikari et al., 2010; Bedada, 2015; Perrot et al., 2018). This is especially important in agriculture in Uzbekistan, where there is a substantial lack of organic fertilizers and a low humus content in the soil.

At the same time, in Samarkand MSW there is a high nutrient content-total nitrogen, phosphorus, and potassium. Significantly, the nitrogen content is several times more than its amount in serozem soils. This indicates the high fertilizing properties of MSW of Samarkand since, in the soils of Uzbekistan, the biggest problem is the low content of humus and nitrogen. The reaction of MSW environment corresponds to the indicators of the soil, which will not lead to unpredictable consequences. The ratio of carbon to nitrogen (C:N) in MSW 27:1 contributes to the enhancement of the process of humification in the soil.

The chemical composition of cattle manure differs from the chemical composition of MSW in the city of Samarkand, with a lower content of dry matter, ash, total potassium, and a large content of carbon, total nitrogen. So, in cattle manure the dry matter content was 34.7%, ash content 4.6%, carbon content 12.5%, total nitrogen is 0.57%, total phosphorus 0.25%, total potassium 0.61%. The manure is pH 7.4, the carbon to nitrogen ratio C:N 22:1 contributes to the increased decomposition of organic waste during composting (Fig. 1 and 2).

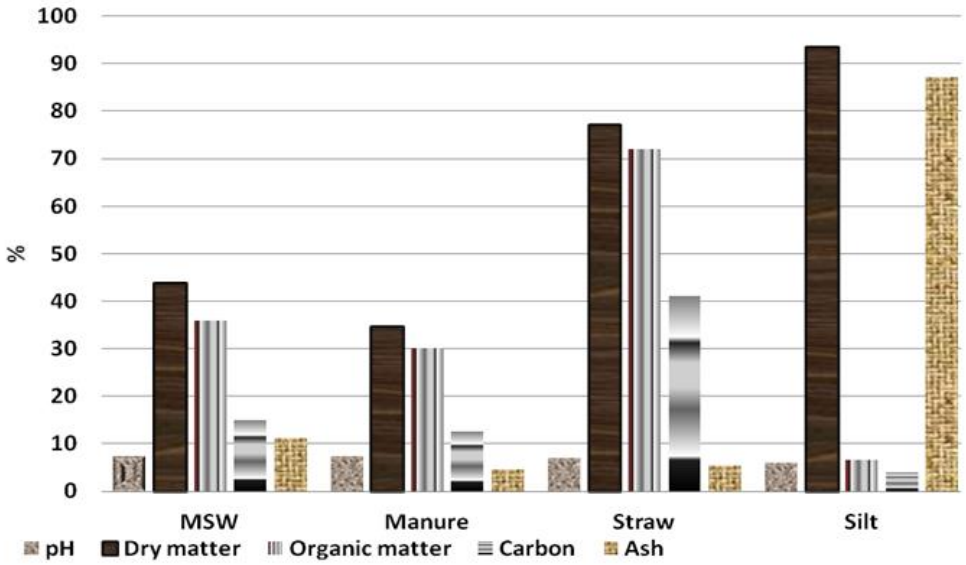

Fig. 1. Chemical contents of organic wastes**,** %, dry weight basis**.** MSW-municipal solid waste; Manure-cattle manure; straw- winter wheat straw; silt- freshwater sediments.

The dry matter content in the straw was 77.1%, total nitrogen 0.5%, and phosphorus 0.25%, potassium 0.8%, carbon 41%. The ratio of carbon to nitrogen 82:1. Such a C:N ratio contributes to the absorption of mineral nitrogen of other compost components as it matures, which prevents the loss of nitrogen from the compost. The straw having high fiber content enhances the vital activity of cellulose decomposing microorganisms, which positively affects the maturation and quality of the prepared composts. Plant residues contain a significant amount of nutrients, which allows them to be used effectively as a fertilizer and in the composting process. For example, according to the Belgorod State National Research University research results, it was revealed that straw is a significant reserve for increasing the amount of organic matter in the soil.

With a grain yield of 50 centners per ha, about 60 centners of straw remain on the field, which is equivalent to 30 tons of manure. On average, 1 ton of straw contains 5 kg of nitrogen, 2.5 kg of phosphorus, 8 kg of potassium oxide, 360-400 kg of carbon in the form of various organic compounds. When straw is introduced, there is an improvement in the water resistance of the soil structure, the physicochemical properties of the soil, an increase in productive moisture, and a decrease in nitrogen losses, which generally optimizes the nutritional conditions of plants (Krisanov D.P., 2013).

Silt has high dry matter content, along with low carbon content. Therefore, the ash content of silt is significantly higher. The content of total nitrogen and phosphorus is low, but the total potassium is high. At the same time, the ratio of carbon to nitrogen is low 30:1, which enhances the composting process and accelerates its maturation. In addition, silt having non-degradable particles in the composting process absorbs all the beneficial substances that are formed during composting and thereby prevents their loss.

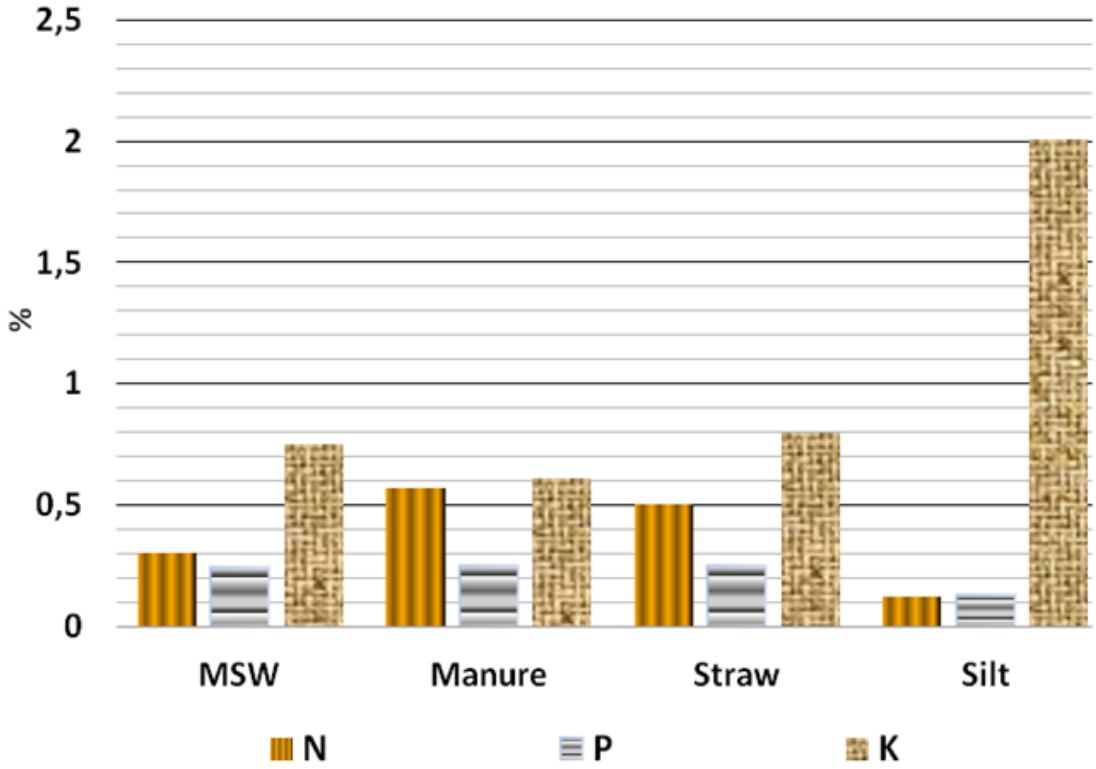

Fig. 2. Agrochemical content of organic wastes, % dry weight basis. MSW-municipal solid waste; Manure-cattle manure; straw-winter wheat straw; silt- freshwater sediments. N -nitrogen (total N); P-phosphorus (P_2O_5); K-Potassium (K_2O).

Conclusion

Thus, different wastes have a peculiar chemical composition, which differs from other components. Municipal solid waste has high ash content, a relatively high C: N ratio. Manure has all the nutrients for plant nutrition and low carbon to nitrogen ratio, enhancing the decomposition of MSW and straw during composting. Straw and silt contribute to a high yield of compost; prevent the loss of nitrogen and other volatile substances, absorbing them during maturation of composts. Straw converts mineral nitrogen formed in the process of maturation of composts into organic, enhancing their immobilization. The composition of MSW most contained organic materials, and these give us revision as recyclable materials by creating compost preparation technology. The studied the composition and properties of MSW, and other organic wastes are essential factors for modern global municipal solid waste management policies.

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Citation:
Pardaev, S., Kholikulov, Sh.T., Ortikov, T.K. (2021). The agrochemical properties of organogenic wastes and the possibility of preparing composts. Ukrainian Journal of Ecology, 11 (5), 72-76.