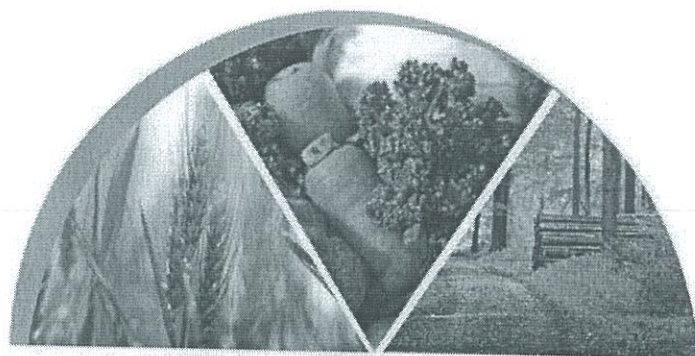


# BOOK OF PROCEEDINGS



*VII International Scientific Agriculture Symposium  
Jahorina, October 06-09, 2016*



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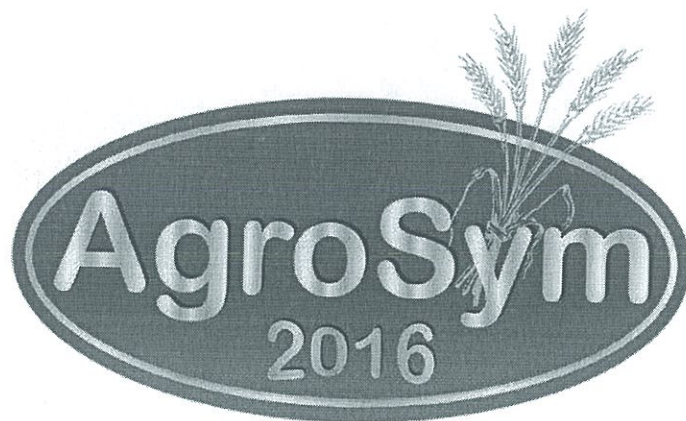
# **BOOK OF PROCEEDINGS**

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## THE REDUCTION OF NICOTINE CONTENT IN THE COMPOSTING PROCESS OF TOBACCO WASTE MIXING WITH SHEEP AND CHICKEN DROPPINGS

Gordana KULIĆ\*, Nemanja MANDIĆ, Vesna RADOJIČIĆ, Maja MALNAR

University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Belgrade-Zemun, Serbia

\*Corresponding author: [gkulic@agrif.bg.ac.rs](mailto:gkulic@agrif.bg.ac.rs)

### Abstract

Due to the rise of industrialization and urbanization, the amount of waste is gradually increasing as well, both in developed and developing countries. Tobacco waste generates in all processes it starts in the field and ends up with the production of cigarettes. The total global tobacco waste production in the year 2005 was more than 25.1 million tons. In our experiments we used Virginia tobacco waste (TW) after processing, as well as sheep and chicken drop pings. Two experimental samples were formed according to the following scheme: I 50% TW + 50% sheep drop pings, II 50% TW + 50% chicken drop pings. The comparison is made with the reference sample (100% TW). The experiment was conducted at the experimental farm of the Faculty of Agriculture, under natural conditions, in the open, during a three months period. The nicotine content in the samples was determined by a HPLC method. At the beginning of the experiment, the nicotine content in the tobacco waste was 17 363 mg/kg. By adding sheep and chicken droppings, nicotine content decreased by 66.5%. At the end of the research, nicotine content as dropped below 10mg/kg in both experimental samples. The results confirmed that the organic material, sheep and chicken manure, can be successfully used for composting of tobacco waste, primarily in order to reduce the nicotine content. Composting can be done in the open air and on the site where the waste is made, thereby it reduces energy costs, and what's the most important – the costs of the transport.

**Keywords:** *composting, tobacco waste, sheep droppings, chicken droppings, nicotine.*

### Introduction

The organic solid waste poses a serious threat to the environment. Biological technologies for treating waste materials, between where composting is also classified are considered clean and sustainable methods for organic waste management. Compost production has gained popularity, due to the fact that it is a method by which we can reduce pressure on landfills, extend their use, and minimize environmental pollution. It is the raise in environmental awareness among the society in recent years that caused the increase in people's interest in composting process, so as to prevent or reduce environmental pollution and establish sustainable management of the waste (Radojičić et al., 2009). Composting process can degrade various types of organic waste (Lim et al., 2016).

Composting is a biological decomposition of organic matter, caused by microorganisms in aerobic conditions. Composting process leads to stabilization of biodegradable waste (wet and solid organic matter, food waste, garden waste, paper, cardboard, etc.), and to the formation of a stable product, compost (Jovičić, 2006). This process can be conducted in controlled, partly controlled and uncontrolled environmental conditions. Composting is an acceptable solution, as it reduces the volume (mass) of the organic waste, whereas the material becomes a stable product at the end of the process, which can be used as an organic fertilizer. A substrate with optimal

physical and chemical characteristics for composting can be formed by mixing two or more types of biodegradable waste (Kopčić et al., 2013).

Agriculture production and industry generates large amounts of solid waste that may be suitable substrates for composting. The total global tobacco (*Nicotiana tabacum* L.) waste production in the year 2005 was more than 25.1 million metric tons (Radojičić et al., 2015). Tobacco waste, which is generated in all processes, from tobacco production in the fields to cigarettes manufacturing, accounts for a significant percentage of the agro-industrial and municipal waste in Serbia (Radojičić et al., 2009). According to the principle of extended responsibility, producers of tobacco products can be held responsible for the collection, transport, processing and safe disposal of tobacco products (Curtis et al., 2016). The main characteristics of the tobacco waste are high value of the total organic carbon (TOC), as well as high contents of nicotine, which is a toxic compound (Civilini et al., 1997).

According to Waste Catalogue issued by the Ministry of Environment and Spatial Planning and the Agency for Environmental Protection of the Republic of Serbia (Waste Catalogue, 2010), tobacco is categorized as nontoxic waste. While this waste is not classified as dangerous, neither as inert, it cannot therefore be disposed of to landfill without treatment (Radojičić et al., 2009).

According to EU Directive nicotine content above 500 ppm declares this waste into the category of hazardous waste (Radojičić et al., 2009). Also, due to the high solubility of nicotine in water, there is a serious risk that, when the waste material is kept, nicotine can be flushed out of the waste and get to the groundwater, which is a particular threat to the environment and human health. For these reasons tobacco waste cannot be disposed of together with urban waste (Pichtel, 2005), but must be destroyed under special conditions, which is an economic burden for tobacco producers and processors.

Previous research has found that the tobacco waste can be used as fertilizer because of its high content of organic matter and low content of toxic elements. But it first needs treatment, because in its original form (primarily due to its content of nicotine) it still toxic (Radojičić et al., 2009, Radojičić et al., 2008). As such it affects human health and the environment.

To release the tobacco waste from toxic elements, primarily nicotine, the composting process is the optimal solution. Clean scrap tobacco has a detrimental effect on the microbial activity in the soil, but compost can stimulate them, primarily due to a significant content of trace elements.

Radojicic et al. examined the possibility of growing mushrooms on compost prepared from tobacco refuse. They found that it is possible to perform microbiological degradation of nicotine in tobacco waste and turn it into such a relatively neutral plant material like any other plant waste. As such, it can be successfully used for producing compost for mushroom growing (Radojičić et al., 2008).

An experiment which was conducted in South Africa examined the changes that have taken place during the composting of solid waste tobacco, along with other types of organic waste (Adediran et al., 2006). By mixing tobacco waste with other organic waste and their dilution, nicotine content was reduced from 12180 mg/kg to 4872 mg/kg, while the composting process further reduced nicotine content to less than 160 mg/kg. The results of the experiment showed that the obtained compost is very suitable for use in horticulture.

In the experiment of Turkish scientists in Izmir in 2006, they treated the land on which one sort of lettuce was cultivated with compost derived from tobacco waste and manure, in different scales, in order to examine the impact of this kind of organic fertilizers on the biological properties of the soil and the growth of lettuce (Okur et al., 2008). Following mixtures were made: TWC 25% + 75% FYM; 50% + 50% TWC FYM; TWC 75% + 25% FYM and TWC 100% and 100% FYM (TWC - tobacco waste compost, and compost derived from tobacco waste

FYM - farmyard manure). Composting is carried out in the open, or under the roof. It has been found that the microbial biomass increased by using all the proportions of compost, and the results indicate that compost waste tobacco is a good alternative to recharge and improve soil characteristics (Okur et al., 2008).

The reasoning for this research was the problem of unused tobacco waste in the Republic of Serbia, expensive process of destruction under strictly controlled, legally prescribed conditions as well as the uncontrolled disposal, with the aim of revitalizing the waste in accordance with the requirements of environmental protection. The goal of this study was to examine the possibilities of reduction of nicotine content through the process of composting, waste mixing tobacco with sheep and chicken droppings.

### Materials and methods

Virginia tobacco leaves, which are declared as waste after redrying process, were used for the purposes of the experiment. Sheep and chicken droppings were used as components in experimental batches. Experiment was carried out during the period of three months: begin of March – end of May. The experiment was conducted at the experimental farm of the Faculty of Agriculture, University of Belgrade (Serbia).

*Preparation of experimental batches* - Tobacco wastewas stirred with sheep and chicken droppings. For the purposes of the experiment the following compost batches were formed:

Table 1. Compost batches ingredients (%)

Composting batch	TW	Sheep droppings	Chicken droppings
1	50	50	/
2	50	/	50
R	100	/	/

TW – tobacco waste

R–control sample

Composting is carried out in the open, under the roof. Aeration is provided by manual tumbling, and humidity is kept constant. The batches were covered with leaves to maintain moisture. The process was completed in three months, when the temperature of compost achieved the same value as the outdoor temperature.

*Analysis of nicotine content in samples experimental batches*- Nicotine content in the batches (at the begining and at the end of the ewperiment) was determined by High Performance Liquid Chromatography method (HPLC, Waters Breeze, USA).

The method applied in this analysis involves water extraction of the milled material followed by separation of the alkaloids on reverse-phase C18 column with a mobile phase of 40% methanol containing 0.2% phosphoric acid buffered to pH 7.25 with triethylamine. This procedure allows the quantitative analysis of four "major" alkaloids in tobacco and may it be partially automated as to handle a larger number of samples (Saunders and Blume, 1981).

## Results and discussion

Table 2 shows the results of the nicotine content in experimental batches.

Table 2. The nicotine content in experimental batches (mg/kg)

Composting batch	Initial value	Final value
R	17363.0	5132.0
1	5790.0	<10
2	5812.0	<10

The initial content of nicotine in tobacco waste was 17363 mg/kg. Already by mixing tobacco waste with other organic waste, the nicotine content decreased by 66.6% in the first batch of compost, and 66.5% in the second. This percentage decrease is even higher when compared with the literature data (Adediran et al., 2006). The experiment which was conducted in South Africa examined the reduction of nicotine in tobacco during composting of solid waste. Mixing tobacco waste with other organic waste reduced the nicotine content from 12180 mg/kg to 4872 mg/kg, with a single dilution (Adediran et al., 2006), which accounted for 60% reduction. At the end of the experiment, after three months, the nicotine content decreased below 10 mg/kg, in both experimental batches, which is far below the value specified by the European Directive (Radojičić et al., 2009). In a previous study conducted by authors from Serbia ((Radojičić et al., 2015). the process was carried out under partially controlled conditions, also lasted three months. Also, the results obtained in this study were far better than in previous studies, where the composting process decreased the nicotine content in the waste below 160 mg/kg (Adediran et al., 2006).

Our results confirm that the organic material, sheep and chicken droppings, can be successfully used for composting of tobacco waste, primarily in order to reduce the nicotine content. In experimental batches of compost in addition to reducing nicotine there was a loss of weight (Table 3).

Table 3. Loss of mass during the composting process

Composting batch	Initial mass (kg)	Final mass (kg)	Loss (%)
1	10	3,30	67
2	10	3,50	65

Based on these data we can see that the weight loss of the samples was approximately equal among all samples, or that it was slightly higher in the compost batch number 1. In the first batch the weight loss was 67%, while in the second one it was 65%.

## Conclusion

Given that tobacco waste accounts for a significant part of the total agro-industrial and municipal waste in Serbia it is necessary to examine the possibilities of its use. Tobacco waste, as a specific type of agro-industrial biodegradable waste, with the use of composting process can be converted in to a product that has practical agricultural value.

Based on these results, it can be concluded that, already by mixing tobacco waste with sheep and chicken droppings, nicotine content decreased by 66%. Nicotine content at the end of experiment

dropped below 10 mg/kg in both experimental compost batches, which is far below the 500 mg/kg - the value prescribed by the EU directive.

The results of the experiment showed that biodegradation of tobacco waste, by mixing it with chicken droppings and eyes and composting it, can be an effective method of removing nicotine.

That way the obtained organic material can be used without posing a risk to the environment.

The importance of this experiment lies in the fact that the process of biodegradation can be carried out in natural conditions. Regardless of the longer duration of the process, it does not require a high economic investment. Also, this experiment has proven the fact that the composting process can take place on the site where the waste is disposed, which can lead to saving on the transport costs.

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