XXIII INTERNATIONAL ECO-CONFERENCE® 2019
XIII ENVIRONMENTAL PROTECTION OF URBAN AND SUBURBAN SETTLEMENTS

25th–27th SEPTEMBER 2019

NOVI SAD, SERBIA

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THE ECOLOGICAL MOVEMENT OF THE CITY OF NOVI SAD: AN IMPORTANT DECISION OF ITS PROGRAMME COUNCIL

Since 1995, the Ecological Movement of the City of Novi Sad organizes „Eco-Conference® on Environmental Protection of Urban and Suburban Areas", with international participation.

Twelve biennial conferences have been held so far (in 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013, 2015 and 2017). Their programs included the following environmental topics:

Session 1: Environmental spheres: a) air, b) water, c) soil, d) biosphere
Session 2: Technical and technological aspects of environmental protection
Session 3: Sociological, health, cultural, educational and recreational aspects of environmental protection
Session 4: Economic aspects of environmental protection
Session 5: Legal aspects of environmental protection
Session 6: Ecological system projecting (informatics and computer applications in the field of integrated protection)
Session 7: Sustainable development of urban and suburban settlements–ecological aspects

Conference participants have commended the scientific and organizational levels of the conferences. Conference evaluations have indicated that some aspects are missing in the conference program. In addition, since a team of conference organizers was completed, each even year between the conferences started to be viewed as an unnecessary lag in activity.

Eco-Conference® on Safe Food

With the above deliberations in mind, a decision was made that the Ecological Movement of the City of Novi Sad should embark on another project – the organization of Eco-Conferences® on Safe Food. These Conferences were planned to take place in each even year. Preparations for the first Eco-Conferences® on safe food started after the successful completion of the Eco-Conference® '99.

So far ten Eco-Conferences® have been held (in 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016 and 2018.) focusing this general theme.

Theme of the Eco-Conference®

By organizing the Eco-Conference® on Safe Food, the organizer wishes to cover all factors that affect the quality of human living. Exchange of opinions and practical experiences should help in identifying and resolving the various problems associated with the production of safe food.

Since 2007 Eco-Conference gained five times in a row, a sponsorship from UN and their sectorial organizations (UNESCO and UN-FAO) and became purely scientific Conference.

Objectives of the Eco-Conference®

– To acquaint participants with current problems in the production of safe food.

– To make realistic assessments of the causes of ecological imbalance in the conventional agricultural production and the impact of various pollution sources on the current agricultural production.

– Based on an exchange of opinions and available research data, to make long-term strategic programs of developing an industrialized, controlled, integral, alternative and sustainable agriculture capable of supplying sufficient quantities of quality food, free of negative side effects on human health and the environment.

Basic Topics of the Eco-Conference®

Basic topics should cover all relevant aspects of the production of safe food. When defining the basic topics, the intention was itemize the segments of the

production of safe food as well as the related factors that may affect or that already have already been identified as detrimental for food safety and quality.

The topics include ecological factors of safe food production, correct choice of seed (genetic) material, status and preparation of soil as the basic substrate for the production of food and feed, use of fertilizers and pesticides in integrated plant protection, use of biologicals, food processing technology, economic aspects, marketing and packaging of safe food.

To paraphrase, the envisaged topics cover the production of safe food on the whole, individual aspects of the production and their mutual relations, and impact on food quality and safety.

Sessions of the Eco-Conference®

1. Climate and production of safe food.
2. Soil and water as the basis of agricultural production.
3. Genetics, genetic resources, breeding and genetic engineering in the function of producing safe food.

4. Fertilizers and fertilization practice in the function of producing safe food.
5. Integrated pest management and use of biologicals.
6. Agricultural production in view of sustainable development
7. Production of field and vegetable crops.
8. Production of fruits and grapes.
9. Livestock husbandry form the aspect of safe food production.
10. Processing of agricultural products in the framework of safe food production.
11. Economic aspects and marketing as segments of the production of safe food.
12. Food storage, transportation and packaging.
13. Nutritional food value and quality nutrition.
14. Legal aspects of protecting brand names of safe food.
15. Ecological models and software in production of safe food.

Attempts will be made to make the above conference program permanent. In this way will the conference become recognizable in form, topics and quality, which should help it find its place among similar conferences on organized elsewhere in the world.

By alternately organizing conferences on environmental protection of urban and suburban areas in odd years and conferences on safe food in even years, the Ecological Movement of the City of Novi Sad is completing its contribution to a higher quality of living of the population. Already in the 19th century, Novi Sad was a regional centre of social progress and broad-mindedness. Today, owing first of all to its being a university centre, Novi Sad is in the vanguard of ecological thought in this part of Europe.

It is our duty to work on the furtherance of the ecological programs of action and, by doing so, to make our contribution to the protection of the natural environment and spiritual heritage with the ultimate goal of helping the population attain e higher level of consciousness and a higher quality of living.

Director of the Ecological Movement
of Novi Sad
Nikola Aleksic

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COMPOSTING AS A ALTERNATIVE TREATMENT OF BIODEGRADABLE WASTE FROM VEGETABLE PRODUCTION IN HOME GARDENS AND YARDS

Abstract

A large amount of organic matter is formed during vegetable production. A part of the created organic matter is in the form of plant parts that are used in human consumption. Most often, those are the fruits of tomato, pepper, cucumber, leaves of lettuce and spinach, or root of radishes and beets, etc. The organic residue in vegetable production implies the biomass residues of annual and perennial vegetables species, stems, leaves, roots of vegetable species, stems of other crops, grass clippings, leaves, husks, as well as unused feed remains of farm animals, and manure. Therefore, our goal is to show the importance of composting organic garden residues from vegetable production, as a possibility of restoring a part of organic matter in garden soil.

Key words: *vegetables, compost, garden, organic matter*

INTRODUCTION

Selection of a specific production method – open field or greenhouse with mandatory irrigation, well-chosen and organized time of work and necessary inputs, precondition the intensive vegetable production (Červenski et al., 2013).

This organization of vegetable production includes growing a preceding crop, main crop and additional crop on one area during a year, with an aim of including as many vegetable species as possible. The success rate of this kind of production implies maximum and organized use of available land and resources (Červenski et al., 2016).

The results of the abovementioned authors suggested vegetable production in gardens and protected spaces without heat, organized according to principle of growing preceding, main and additional crops. Depending on the method of production and vegetable species, yields of preceding crops (peas, radish, kohlrabi, spinach, lettuce) on open field ranged from 0.6 to 4.0 kg/m^2, yields of main crops (cabbage, peppers, tomatoes, beets, kale) ranged from 3.3 to 12.5 kg/m^2, and yields of additional crops (autumn garlic, spring onion, lettuce, spinach) ranged from 2.0 to 7.2 kg/m^2. Yields of preceding crop (peas, radish, kohlrabi, spinach, lettuce) in the greenhouse without heat ranged from 0.6 to 4.0 kg/m^2, yields of main crops (pepper, tomato, cucumber) ranged from 4.0 to 15.0 kg/m^2, and yields of additional crops (autumn garlic, spring onion, lettuce, spinach) ranged from 2.0 to 5.0 kg/m^2. Study of CoDyre et al. (2015) stated that vegetable producers averagely produce 1.43 kg/m^2 of vegetables in their gardens, with variance from 0.08 to 5.18 kg/m^2. Studies of Duchemin et al. (2009) showed that vegetable production in gardens varied between 0.3 kg/m^2 and 5.4 kg/m^2. Eigenbrod & Gruda (2015) indicated the possibility of annual potential yields in vegetable production up to 50 kg/m^2 and more. Besides, annual agricultural production of Vojvodina generates large amount of biomass, which is contributed by a large number of small farmsteads (Odavić et al., 2017).

More than 95% of vegetable production in Serbia takes place at the open field, while only 5% is carried out in greenhouses. In addition, garden production is significant as well. It takes up about 20% of vegetable production in the Republic of Serbia (Červenski et al., 2015).

These results indicate a large amount of organic matter, which is created and used from vegetable production. The part of formed organic matter is outtaken from cultivated area in the form of yield, while other "no less interesting" part of vegetable production makes "organic residue". Organic residues (garden or green waste, residues from preparation of vegetables and food) can make 30–64% of total waste that is collected in agricultural farmstead or household (Ilić-Krstić et al., 2017; Mihaljević 2016). Organic residues include biomass residues of annual and perennial types of vegetables and fruit, straw, corn stover, stems of other crops, husks, residues from pruning fruit trees, as well as unused residues of farm animals feed, and manure.

Results of Chang et al. (2006) stated that vegetable waste includes parts that have been discarded during collection, handling, transport and processing of various vegetable species. Furthermore, they suggest that it is sufficient to have composter of 0.6–6 m^3 volume to process 100–1000 kg of these residues.

The aim of this paper was to point out the importance and the possibility of composting the organic garden residues or bio-waste from vegetable production.

Composting organic garden residues

Composting is defined as controlled biological aerobic translation of organic matter from waste into more stable material, during which the organic waste is converted into humus by the activity of organisms living in the soil (bacteria, fungi, nematodes, actinomycetes, small animals, etc.) with the presence of oxygen and water.

According to the Law on Waste Management, composting is defined as a treatment of biodegradable waste under the influence of microorganisms in order to create compost, in the presence of oxygen and under controlled conditions. End composting products are carbon dioxide, water, minerals and stabilized organic matter, which do not affect the environment adversely (Mihajlović, 2015). According to Estevez-Schwarz et al. (2012), composting represents the best solution for recycling organic garden residues.

It is becoming more common practice to use organic residues from farmsteads for the purpose of obtaining compost. Residue suitable for composting consists of leaves, branches, dry and wilted flowers, dry and fresh grass. Global initiative indicates the need for using residues from agricultural production as a material for composting (Grabić et al., 2018).

Production of quality compost is the most beneficial if organic waste is processed at the site of its origin (garden, backyard farm, and farmstead).

Garden residues from intensive vegetable production used for making quality compost can be classified into:

- Bio-waste rich in carbon (it is slowly degraded and ensures the ventilation of the compost mass): grass clippings, leaves, wilted flowers, weeds, chipped branches, charcoal ash, etc.
- Bio-waste rich in nitrogen (it is more quickly degraded and ensures the moisture of the compost mass): crude vegetable residues, potato crust, fruit residues, coffee residues, tea residues, egg shell, etc.

A significant contribution to quality composting is the real possibility of using manure. Manure in soil increases the humus percentage, regulates the presence of microorganisms, improves soil structure, pH value, allows the soil to regulate better the shortage and excess water (Červenski i Medić-Pap, 2018). Manure, as the source of microorganisms, should be well mixed with compost mass. Converting manure into compost and its use in the vegetable production have positive effect on yield and economical profitability of a farmstead (Lončarić et al., 2012).

The following should not be used for making compost: fertilized weed, walnut leaves, bark of conifer trees, infested and diseased plants and plant residues, waste of cooked dishes (they attract rodents), meat, bones, large quantities of newsprint paper, colour magazines, tobacco residues, the contents of bags from a vacuum cleaner, coal ash, etc.

Due to slow and severe degradation, it is not recommended to compost cork plugs, walnut shell. Waste containing chemicals, such as old medicines, various oils, plastic containers, painted or lacquered wood, polystyrene, pesticide residues or pesticide packaging should not be put in the compost pile under any circumstances.

Forming compost pile

Site of composting in backyard farms or gardens should be located in the half-shade to protect the compost from excessive drying out during extreme heat or heavy rainfall in the rainy season. The ground of compost site should be flat, not inclined, so the water would not accumulate. It is not suitable to place the compost site near wells or on a slope because of the water flow (Marjanović et al., 2008).

Compost pile should be in direct contact with the soil, so that microorganisms would have undisturbed access to the compost material. Therefore, compost site is not made on stone, concrete or other impermeable surface. In addition, it is not recommended to put the material for composting in a hole made in the land, because lack of oxygen and possible excess moisture from surface water flow will lead to decay and creation of unpleasant odours. At the beginning of compost pile formation, branches, straw, wood chips and other materials rich in carbon are put at the bottom of the pile. Then, "green" materials are added, after which "ligneous" and herbal components are added alternately. Organic waste initial C/N ratio of about 20–30:1 is necessary for quick composting. Quality compost should have optimum ratio of carbon (C), as a source of energy, and nitrogen (N), as a basic element of plant nutrition (Lazić et al., 2013).

Grass clippings on a farmstead are also an organic residue suitable for composting. They should be placed on the compost pile in a very thin layer due to the possibility of decay. It is recommended to leave the cut grass to dry beforehand. Organic waste from garden, such as leaves, cut grass and plant parts are placed at the bottom of the compost pile in a layer from 20 to 25 cm. Material rich in nitrogen should be placed above this layer. Compost pile should be covered on top by a layer of soil or mature compost. Main reason for adding this final layer is the inoculation of the pile by microorganisms, which decompose the organic material. Microorganisms from surface layer develop rapidly if conditions for composting are created (Marjanović et al., 2008).

Heat develops due to the activity of microorganisms during the decomposition of organic material. Microbial activity in the composting process leads to the temperatures up to 60°C (Agarski et al., 2006). High temperatures lead to destruction of weed seeds, causal agents of plant diseases, pests, and pathogenic organisms causing diseases in plants and humans (*Salmonella spp.* and *Echerichia coli*). On the other hand, moderate temperatures enable the development of aerobic bacteria, which are the most efficient decomposers. Many decomposers in the compost are destroyed at temperatures of about 60°C (Marjanović et al., 2008).

In order to create the optimum conditions for composting, attention should be paid to the size of organic matter in the compost pile. Crumbling large material to a size of 5–6 cm increases the composting speed. During the formation of compost, equal volumes of green and dry garden waste should be mixed, due to the availability of oxygen, as well as the ratio of C/N. Any deposited layer of compost pile can be sprinkled with garden soil or mature compost. It will accelerate the process of compost material degradation.

Optimum external air temperature for the composting process is 20–25°C. Higher temperatures lead to drying up of the material, while lower (winter) temperatures slow down the biological processes in the compost pile. Living organisms (bacteria) in compost are less active during cold weather. Also, it is necessary to pay attention to the presence of moisture in the compost pile. Too dry material slows down the process of composting, or does not start it at all. Too much moisture can create thick and sticky mass, which decreases the oxygen flow and stops the aerobic process of organic waste degradation. Optimum quantity of moisture is between 40% and 60%, which can be determined by touch. Moisture content can be tested by squeezing a piece of moistened material in a hand (Marjanović et al., 2008). Since microorganisms consume oxygen during their activity in the compost pile, the concentration of carbon dioxide is increased. To prevent this, it is necessary to tumble the compost pile periodically, and add a structure material, such as dry leaves, straw, hay or twigs.

The importance of compost

Using compost in a vegetable production is very significant. On the one hand, it is used in the production of substrate for cultivation of seedlings of different vegetable and flower species. On the other hand, the application of compost positively affects a number of significant physical and chemical properties of the soil. Introduction of compost in the soil increases its total porosity, decreases specific soil density, which contributes to the better structure, less compaction of the soil and easier penetration of vegetables roots. Also, compost affects the increase of water and thermal capacity of the soil. Use of compost leads to the increase of organic matter and total nitrogen in the soil (Lončarić and Karalić, 2015).

The end products of composting are carbon dioxide, water, minerals and stabilized organic matter, that is, stable product similar to humus with characteristic scent of soil, finely crumble structure – highly quality compost, which does not harm the environment.

Due to high content of organic matter, compost has favourable melioration effect on improvement of water, air, thermal and biological regime. It can be used for the "revival" of devastated and improvement of degraded areas' production ability, as well as the mean of soil structure improvement, and as substrate in the production of various plant species (Ćurčić et al., 2008; Ilić-Krstić et al., 2017).

Preservation of soil fertility, its physical and chemical properties, with the stimulation of the microbiological activity of the soil, is one of organic production's aims as well, while respecting the principles of environmental protection (Tabaković et al., 2017).

Study of Živanov et al. (2019) showed the significance of organic residues from household (grass clippings, leaves, residues from horticultural production) as a source of organic matter suitable for composting, but also the need for testing the chemical composition of compost before its use.

Depending on a method, technology, used organic residues, and composting conditions, fully mature compost ready for use can be created within 2 to 20 months (Lazić et al., 2013; Mihajlović, 2015; Mihaljević 2016; Ilić-Krstić et al., 2017).

Gardens and backyard farms for vegetable production in the Republic of Serbia occupy small areas, but these areas are globally significant. Analysis of soil samples collected from a total of 96 individual plots under vegetable crops (56 from the town gardens and backyard farms at the territory of the City of Novi Sad and 40 from field production from suburban areas) determined the average content of organic matter in the soil of 3.16% (from minimum 1.32% up to maximum of 4.97%) (Ninkov et al., 2018).

Insufficient use of organic fertilizers due to harvest residues burning, their removal, inadequate land cultivation, etc. results in decrease of organic matter content in arable land. Stamenov et al. (2018) showed that microbial biomass of the soil up to 30 cm depth is a sensitive indicator of changes in soil organic matter, which is responsible for maintaining and increasing the quality and fertility of the land. Soil microorganisms, such as bacteria and fungi, control the ecosystem through decomposition and nutrient cycle, and can be the indicators of ecosystem health and changes in soil use.

Diversity of waste origin intended for compost defines the structure of microbial flora in the compost. For this reason, the intensity of fungi or bacteria development in organic matter of the compost provides important information on the final composting phase (Villar et al., 2016).

By adding mature compost to the soil, nutrients needed for growth and development of vegetables are also added. It improves microbiological activity and soil structure, and serves as a good mean for maintaining and improving the quality and fertility of the soil, since a certain percentage of organic matter is retained in the soil itself (Mihaljević, 2016).

Vegetable species have different demands toward the quantity of introduced compost in the soil. During the production of cabbage, cauliflower, broccoli, pepper, potato and pumpkin, it is necessary to introduce from 4.0 to 6.0 kg/m^2 of compost. Celery, garlic, leek, watermelon, tomato, and melon demand from 2.0 to 4.0 kg/m^2 of compost, while onion, carrot, beet, spinach, cucumber, radish, and kohlrabi demand from 1.5 to 2.5 kg/m^2 of compost (Lazić et al., 2013).The value of composting is reflected also from an aspect of protecting the environment. Composting in gardening is a way for managing organic waste, but with comparative monitoring of its effect on the environment (Andersen et al., 2012).

Human health is immeasurably endangered and watercourses polluted by uncontrolled waste dumping in the environment. Therefore, there is no reason for burning dry organic bio-waste, such as leaves, grass clippings, chipped branches and other by-products of gardening. Burning "kills" the top soil layer, destroys useful organisms, and above all, increases the air pollution.

Considering the EU Landfill Directive and prohibition of disposing biodegradable waste to landfills, composting becomes significant as an alternative treatment of biodegradable waste. Composting planning reduces the need for disposal onto landfills or burning waste, which creates the ecological benefit of future generations for the prosperous time to come. Following these activities we are approaching the trends of world cities in environmental protection (Agarski et al., 2006).

CONCLUSIONS

The benefits of composting biodegradable residues from vegetable production are multiple, and it is necessary to introduce gradually the composting process into each individual farmstead dealing with intensive vegetable production. Introducing compost in the soil rationally preserves and renews the content of organic matter and humus, thus establishing the natural cycle of matter in nature. If organic residues from vegetable production are composted regularly, it is necessary to perform chemical analysis of mature compost before use every second or third year, in order to obtain the precise data on its composition, content, and functionality, thus contributing to the ecological sustainability of vegetable production.

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КОМПОСТИРАЊЕ КАО АЛТЕРНАТИВНИ ТРЕТМАН БИОДЕГРАДАБИЛНОГ ОТПАДА ИЗ ПРОИЗВОДЊЕ ПОВРЋА У БАШТАМА И ОКУЋНИЦАМА

Апстракт

У производњи поврћа ствара се велика количине органске материје. Део створене органске материје се износи у облику делова биљака који се користе у људској исхрани најчешће су то плодови: лишће, или корен. Други ″не мање интересантан″ део повртарске производње чини "органски остатак". То су остаци биомасе једногодишњих и вишегодишњих врста поврћа, стабла, лишће, корење повртарских биљака, стабљике других биљака, покошена трава, лишће, љуске, неискоришћени остаци хране домаћих животиња, али и стајњак. Циљ нам је да укажемо на значај компостирања баштенског органског остатка из производње поврћа, као могућност обнављања или враћања дела органске материје у земљиште баште.

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