XXIV INTERNATIONAL
ECO-CONFERENCE® 2020
23–25th SEPTEMBER

# XI SAFE FOOD


PROCEEDINGS

NOVI SAD, SERBIA

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**XI SAFE FOOD**
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PROCEEDINGS
2020.

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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. Seven biennial conferences have been held so far (in 1995, 1997, 1999, 2001, 2003, 2005, 2007, 2009, 2011, 2013 and 2015.). 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 four Eco-Conferences® have been held (in 2000, 2002, 2004, 2006, 2008, 2010, 2012 and 2014.) 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 patronship from UNESCO 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. Lifestock 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 center of social progress and broad-mindedness. Today, owing first of all to its being a university center, 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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## ECOLOGICAL MODELS AND SOFTWARE IN SAFE FOOD PRODUCTION

ECO-CONFERENCE® 2020
ECOLOGICAL MOVEMENT OF NOVI SAD

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# SIGNIFICANCE OF VEGETABLE CROPS ROTATION IN GARDEN PLOTS FROM THE PERSPECTIVE OF PRODUCING HEALTH-SAFE FOOD

**Abstract**

Vegetable crops production should represent the source of healthy and safe food, which is the basis for human development and health. It allows intensive use of soil and earns a high income per unit area, certainly with greater investment and a lot of human labour. Production of health-safe and biologically valuable vegetables with known composition and quality in controlled conditions is becoming increasingly interesting to consumers. Therefore, land resources should be used as rationally as possible and with proper vegetable crop rotation, reducing the possible occurrence of harmful organisms and obtaining health-safe products. In vegetable production, crop rotation is the most often neglected basic preventive measure.

**Key words:** *vegetable species, crop rotation, food, quality*

## INTRODUCTION

Vegetable production is a significant and traditional economic activity in the Republic of Serbia. Vegetable crops production allows intensive use of soil and irrigation systems through rotation of two to three crops during a year on the fields, greenhouses and gardens. The specificity of a large number of vegetable species also enables the production of food in climatically and edaphically unfavourable conditions, using different production methods and systems (Vlahović et al., 2010).

Over 95% of vegetable production in Serbia takes place in the open field, and only a small part, up to 5%, is conducted in a protected area. The production of vegetables in gardens and backyards is also important. It occupies about 20% of vegetable production in the Republic of Serbia (Červenski et al., 2015; Gvozdanović-Varga et al., 2016).

Červenski et al., (2019) pointed out that gardens and backyards for vegetable production in the Republic of Serbia occupy small, but globally important areas.

According to the data of the Republic Statistical Office in the Republic of Serbia, in the last four years (2016-2019) the following vegetable species are mostly grown: potatoes, peppers, beans, tomatoes, cabbage and kale, peas, melons and watermelons, cucumbers, carrots and garlic (www.stat.gov.rs) (Tab. 1).

Vegetable production is one of the most intensive branches of plant production, which is expressed by yield per unit area, income, net income and human labour participation. The total production of vegetables is closely related to the development of processing capacities (Vlahović et al., 2016).

For these reasons, the aim of this paper is to point out the importance of vegetable crop rotation in garden plots, as a basic preventive measure in the production of health-safe food.

*Table 1. Areas under certain vegetable species in the Republic of Serbia in the period 2016-2019*

| Family | Vegetable species | Year | | | |
|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 |
| | | Area (ha) | | | |
| Nightshades (Solananceae) | potato | 40,105 | 38,472 | 28,232 | 34,110 |
| | pepper | 16,977 | 17,386 | 12,016 | 10,097 |
| | tomato | 10,065 | 10,917 | 8,629 | 7,888 |
| Leguminosae (Fabaceae) | beans | 12,404 | 13,181 | 9,112 | 9,091 |
| | peas | 7,502 | 8,097 | 6,736 | 6,282 |
| Mustards (Brasicaceae) | Cabbage and kale | 10,804 | 10,213 | 8,251 | 7,957 |
| Gourds (Cucurbitaceae) | melons and watermelons | 6,314 | 8,372 | 6,814 | 5,709 |
| | cucumber | 3,843 | 4,271 | 3,220 | 3,020 |
| Onions (Alliaceae) | onion | 4,772 | 4,145 | 3,618 | 3,349 |
| | garlic | 1,581 | 1,820 | 1,441 | 1,145 |
| Umbellifers (Apiaceae) | carrot | 2,465 | 1,932 | 1,385 | 1,915 |
| Total | (with potato) | 116,832 | 118,806 | 89,454 | 90,563 |
| | (without potato) | 76,727 | 80,334 | 61,222 | 56,453 |

(www.stat.gov.rs)

## Organization of crop rotation in intensive vegetable production on garden plots

Vegetable production is a source of quality and health-safe food that is the basis for human development and health. Besides that, it allows intensive use of soil and earns

a high income per unit area, certainly with greater investment and a lot of human labour. One of the conditions for successful vegetable production in gardens is intensive crop rotation or crop rotation in time and space. Crop rotation requires rotation of crops during year, as well as the simultaneous cultivation of different species, i.e. diverse vegetable production during the year, maximum use of available resources (land and labour), and high profitability.

Studies of Medić-Pap et al., (2019) concluded that the producers usually want to produce fresh and health-safe food. Of course, with well-organized and precisely timed (adjusted) vegetable production, we create the condition for continuous production throughout the year. By using a larger number of vegetable species in production as well as crop rotation, we provide a certain security of production. At the same time, in intensive vegetable production, it is necessary to conduct a systematic control of soil fertility and the use of fertilizers, which is monitoring the soil quality on each production plot and protected area.

In the last 50 years, crop rotation has been greatly simplified due to the reduction of the number of species in the crop rotation and the increase in the share of land under monoculture. The reason is the appearance and widespread use of synthetic fertilizers, pesticides and separation of crop and livestock production. Agricultural producers use different crop rotations to control the balance of nutrients, water, weed, pests, diseases, and the needs of people and livestock for food. Modern farms have simplified the "ways" of land use (Barbieri et al., 2017).

Often the same vegetable species are grown in gardens, such as peppers, tomato, cucumbers, cabbage, etc. Intensive cultivation practices are applied in the production of these vegetable species. Cultivation of one vegetable species at the same spot during several years creates conditions for intensive appearance of harmful organisms (diseases, pests and weeds). Therefore, the open garden can be divided into several smaller units to include larger number of vegetable species into the production, which will contribute the high yields in the shortest possible time. Mandatory rotation of two to three vegetable species is of utmost importance. This organization also increases the economy of intensive vegetable production. Intensive vegetable crop rotation can be based on the principle of three-field vegetable crop rotation. During one season or year, several types of vegetables are grown on the same land consecutively or simultaneously. This means that immediately after removing one species, another is sown or planted. This is possible due to the different length of vegetable seasons, differences in heat requirements, resistance of some species to low temperatures and different space requirements. The crop rotation plan is made on the basis of the main crop, i.e. the crop that has the longest vegetative season or the highest yield. In intensive crop rotation, there are: preceding crop (usually some early spring or winter varieties such as: lettuce, spinach, kohlrabi, radishes, peas, chard, early potatoes, spring onions); main crop (pepper, tomato, green beans, cabbage, onion, zucchini) and stubble crop – grown after the main crop (autumn garlic, silverskin onion, lettuce, spinach) (Lazić et al., 2013).

An example of a four-year vegetable crop rotation was studied by Medić-Pap et al., (2017). In the first year, they suggested planting young potatoes as a preceding crop for cabbage. After removing the potatoes, late cabbage should be planted on the same

plot in the same year. With this kind of arrangement, we make maximum use of the production area, and we also get two harvests a year. In the second year, they recommended producing pepper or tomato, and in the third year, onions or autumn garlic. Peas or beans are a good crop for the fourth year of vegetable cultivation. After harvesting peas or beans, 50-60 t of manure per hectare should be applied by deep autumn ploughing. The mentioned four-year crop rotation represents one of the possibilities for the organization of vegetable production in the crop rotation. With this formation, we also reduce the possibility of the appearance of a potential inoculum causing plant diseases.

It is not easy to compile a good vegetable crop rotation with all the elements, such as land rotation, crop rotation and shifting cultivation, because one needs to choose the species, cultivar, tillage, sowing and planting deadlines, fertilization, protection from harmful organisms and ripening time. Crop rotation should provide optimal development to plants in terms of soil structure and availability of nutrients and water. When planning crop rotation, it is important to take into account the change of species with different root depths, and to rotate the species with different needs for water and nutrients. For example, species that consume a lot of water, such as peppers, tomatoes, cucumbers and cabbages, should be replaced with species that have moderate water needs (root vegetables, onions and legumes).

The team of authors of Červenski et al., (2016) included in their research the well-organised and timed production of fourteen vegetable species in the optimal time: kohlrabi, radishes, lettuce, spinach, peas, peppers, cabbage, tomatoes, kale, beets, garlic, cucumber, onion, chard. Among first preceding crops sown on the open field were: peas, radishes, kohlrabi, spinach and lettuce. After the harvest, the main crops were transplanted: cabbage, tomato, peppers, beets, and kale. After harvesting the main crops, stubble crops were planted: silverskin onion, garlic, lettuce, spinach. Appropriate crop rotation should enable continuous cultivation of plant species that are economically important for a given region, without compromising soil fertility (Curl, 1963).

Medić-Pap et al., (2017) emphasized the role of crop rotation in preventing the appearance of harmful organisms due to the possible presence of pathogens, but insects and weeds as well. Growing vegetable crops in monoculture on the same area creates opportunities for the accumulation of plant pathogens in the soil, as well as increasing the number of pests and weeds, while nutrients from the soil are consumed unilaterally and irregularly. The same authors further pointed out that the system of crop rotation organization is often affected by the needs of the farm itself, their total land area and the fragmentation of plots. It is also important how much manpower a particular market-oriented farm has at its disposal in a critical period (e.g. requirements in planting, harvesting, sorting, packaging, etc.). Therefore, land resources should be used as rationally as possible, and with the correct crop rotation the possibility of the harmful organisms' appearance should be reduced, aiming to obtain health-safe products. More intensive occurrence of diseases caused by phytopathogenic microorganisms, which are maintained in the soil, are often a consequence of a poor crop rotation. Proper crop rotation can be a significant preventive measure that reduces weed number and controls the population of phytopathogenic organisms, improves soil fertility and increases yields (Sumner 1982; Brust & Stinner 1991, Medić-Pap et al., 2017).

An important condition for successful intensive vegetable production is the introduction of crop rotation, i.e. crop rotation in time and space, primarily due to the possible occurrence of common diseases, weeds and pests in species from the same family. This also refers to the different requirements of certain vegetable species for nutrients, with regular chemical analyses of the soil in order to monitor and improve the qualitative indicators of soil fertility (Lazić et al., 2003; Shafique et al., 2016; Popsimonova, et al., 2017).

Bokan et al., (2016) and Červenski et al., (2017), emphasized the importance of legumes in the vegetable crop rotation as one of the most desirable preceding crops, which leaves the soil in a favourable biophysical condition with a high content of accumulated nitrogen in a natural way. Today, vegetable production is becoming more and more market-oriented. It is associated with the cultivation of only a few significant vegetable species (peppers, tomatoes, cucumbers, potatoes, cabbage, onions), and often through a system of monoculture (Červenski et al., 2016).

One of the reasons for the underutilization of crop diversity lies in the close connection of cultivation practices and the environment with the economic and social issues, such as employment, work organization and the provision of markets for the placement and sale of these products. Most vegetables are sold on the market in the fresh form. The variety and availability of vegetables for the market directly depends on the degree of diversification and the way of production on the farm. Crop diversification even calls into question the organization of the farmhouse work (Castilla et al., 2004; Navarretea et al., 2015).

The importance of rotating two to three types of vegetables during one year is also stated by Ilin et al., (2009). The rotation of vegetable species conditions successful production in a longer period of time, with respect to intensive cultivation practices, whether it is a production in the protected spaces or in the open field.

The choice of a certain production method in the open field with mandatory irrigation, well-chosen and organized time of works and the necessary investments creates the conditions for intensive vegetable production, which Červenski et al., (2013) also stated.

Each vegetable production in garden plots has its own specifics depending on the species, region and cultivation method (indoor or outdoor space). Therefore, in the production of vegetables, there are number of preventive measures that need to be applied in order for the final product to be what vegetables are supposed to be, and that is the source of health-safe food.

## CONCLUSIONS

The monoculture way of growing vegetable species in gardens and backyards leads to the accumulation of plant pathogens in the soil, as well as to an increase in the number of pests and weeds. When planning crop rotation, it is important to rotate vegetable species with different root depths, different water needs and nutrients, along the vegetation season. It is not easy to compile a good crop rotation with all the elements such as land rotation, crop rotation and shifting cultivation, because one needs

to choose the species, cultivar, tillage, sowing and planting deadlines, fertilization, protection measures, as well as ripening time. Agricultural producers should monitor, supplement and enrich their knowledge of vegetable production through regular education and training, so that this production can be realized according to health and safety principles.

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# ZNAČAJ SMENE POVRTARSKIH USEVA U BAŠTAMA SA STANOVIŠTA PROIZVODNJE ZDRAVSTVENO BEZBEDNE HRANE

**Sažetak**

Povrtarska proizvodnja treba da predstavlja izvor zdravstveno bezbedne hrane, koja je osnov za razvoj i zdravlje čoveka. Ona omogućava intenzivno korišćenje zemljišta i ostvaruje visok dohodak po jedinici površine, svakako uz veća ulaganja i dosta ljudskog rada. Proizvodnja zdravstveno bezbednog i biološki vrednog povrća sa poznatim sastavom i kvalitetom u kontrolisanim uslovima postaje sve interesantnija potrošačima. Zbog toga treba što racionalnije koristiti zemljišne resurse i pravilnom smenom povrtarskih biljaka, smanjiti moguću pojavu štetnih organizama te dobijanja zdravstveno bezbednih proizvoda. U proizvodnji povrća plodored predstavlja najčešće zapostavljenu osnovnu preventivnu meru.

**Ključne reči:** *povrtarske vrste, plodored, hrana, kvalitet*

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