UDC: 631.147(497.11)
502.131.1:63(497.11)
COBISS.SR-ID: 227892748
Original research paper
Acta Agriculturae Serbica, Vol. XXI, 41 (2016); 65-85

Significant resources of sustainable agriculture and organic food production system in Serbia

Jelena Bošković[1], Zdravko Hojka[*2], Veselinka Zečević[2], Radivoj Prodanović[1] and Milica Vukić[3]

[1]Faculty of economics and engineering management in Novi Sad, Serbia
[*]KWS Serbia
[2]Faculty of Biofarming Backa Topola, Serbia
[3]Faculty of Science, The Department for Chemistry, Biochemistry and Environmental Protection in Novi Sad, Serbia

Abstract: This paper presents the conditions and possibilities significant resources of sustainable agriculture and the organic food production system in Serbia. The concept of organic agriculture was considered in the function of the organic food production. The principal characteristics of adjustment of cropping practices and procedures of establishing and realisation of the organic food production are pointed out. Furthermore, biological control in the realisation of the organic agricultural production is indicated. Fundamental procedures of biological control in organic agriculture are related to providing quality of soil, water resources and feed. Moreover, the alternative forms of crop protection products are indicated. Specificities of alternative programmes are studied with the aim to produce organic food. The necessity to adjust the education of producers and experts to perform the organic food production is also indicated.
Key words: Sustainable agriculture, Organic production, Organic food, Agroecology, Biological control, Organic manure.

Received: 20. 09. 2016. Accepted: 24.10.2016.

Introduction

The development of sustainable agriculture and thereby of the organic production are determined by ecological and economic conditions (Holt and Reed, 2006; Horlings and Marsden, 2011; Harlberg and Muller, 2013). On the basis of harmonisation of these two factors the possibilities to produce organic food are established (Bošković *et al*., 2003; Koohafan et al., 2011; Leifeld, 2012)). Greater requirements of consumers, especially during the last ten years have resulted in a significant increase and development of organic agriculture all over the world (Seufert *et al*., 2012). Although organic agriculture covered only 3% of total arable areas in the EU countries in 2000, it should not be forgotten that it is the most dynamic sector of agriculture in those countries (Tuomisito *et al*., 2012). Organic food is basically the oldest form of agriculture on the planet (Rosset and Martinez-Torres, 2012). The agricultural production without chemicals, based on oil (chemical fertilisers and pesticides) was the only option after the World War II. However, the technological advancement that followed resulted in significant economic advantages, but also in pollution and degradation of the environment (Schmidhuber, 2003; Harpinder *et al*., 2010).

Effects of the conventional agriculture

Monocultures spread all over the world leading to soil use for growing one crop species several years in a row (Azadi *et al*., 2011). Available data suggest that crop diversity per unit of arable areas significantly decreases (Lamine and Bellon, 2009). There exist political and economic forces that encourage gaining of higher profit from transformation of production on huge agriculture areas into monoculture, simultaneously implying that such production fits into the world market (Nemes, 2009). Technologies that allowed shift toward monocultures are mechanization, improvement of different varieties and hybrids of crops and development of certain chemicals for fertilization and weed and pathogen control (Altieri and Nicholls, 2008; De Ponti *et al*., 2012); Luttikholt, 2007; Piriou, 2002).

From ecological point of view, regional consequences of the monoculture specialization are many-folded:

1. Agricultural systems in which on huge areas are grown specialized crops lack former components of farms and are almost completely deficient in links or are entirely non-complementary in regard to crop production, soil, crops and animals.
2. Circling of nutrients, energy, water and waste materials does not exist any more and the circle, in regard to natural ecosystems remains open.
3. Part of instability and susceptibility toward diseases of the agroecosystem can be linked with the adoption of monoculture type of production on huge areas,

that enabled concentration of food source for specialized harmful herbivores and increased areas available for pest immigration.

4. Spread of certain crop species outside natural borders of spreading brings them into contact with potentially harmful pathogens.

5. Industrial type of agricultural production confronts with ever-lasting offer of new varieties and hybrids that should replace old ones due to the occurrence of biological stress, or changes on the market.

6. Need for maintenance of monoculture production type demands increased use of pesticides and fertilizers. However, effects of their use fall and yields of the majority of basic cultures reached the highest levels.

The concept of sustainable and organic agriculture

The World Commission on Environment and Development point out to the basic changes in the human population growth, the necessity for a strategy to maintain the production of safe food and the necessity to conserve natural resources (Ollivier and Bellon, 2013; Niggli *et al*., 2008). The definitions of sustainable agriculture are usually focused on the need for agricultural procedures that will be economically vital, meet requirements of people for organic food, but at the same time, that will positively affect the protection of the environment and the improvement of qualitative nutrition of people (Morgan and Murdoch 2000). Since these aims could be achieved by numerous different means, sustainable agriculture is not related to any special technological procedure (Rahmann *et al*., 2009). Also, sustainable agriculture is not entirely dependent on organic farming (Sangor and Abrol, 2004; Sandhu *et al*., 2010). The initial notion of sustainable agriculture was close to terms of its adaptability and flexibility to meet requirements of qualitative food (high and low). Its demands are orientated towards natural resources for production and possibilities to protect soil and other resources (Bellon *et al*., 2011a; 2011b; Bengtsson *et al*., 2005). This aim requires the efficient employment of technology in the most suitable way for sustainability (Messmer *et al*., 2012).

Organic agriculture is a holistic system that promotes and improves health of agroecosystm, including biodiversity, biological cycles and biological activity of the soil (Halberg, 2012; Altieri, 2002). It gives priority to the application of the production practices of tillage over the application of procedures outside agricultural areas (Blanchart *et al*., 2005; Bland and Bell, 2007). The crop rotation provides diversity in crops, feed and less utilised plants, and it improves the complete production and soil fertility, and also facilitates conservation of plant resources (Allard *et al*., 2000; Baars, 2011). The integration of the animal production into the sustainable agricultural system provides the additional income via organic meat, eggs and diary products, and also makes available the utilisation of animal draught (Hossein *et al*., 2011). Planted fruit trees and forests integrated into a wider ecological system provide not only food, yield, fuel and

wood, but also the protection against the sun and winds (Francis, 2009). There are also different aquatic plants that are integrated into diverse organic agricultural systems (Gabriel *et al*., 2010; Murphy et al., 2007).

The most important motifs for engaging into organic agriculture are economic ones, and then the production of organic food and the interest in the environmental protection (Tiemens-Hulscher *et al*., 2012). All organic farmers avoid the application of synthetic chemicals, although methods they employ differs from one another. The scope of organic farmers is very wide - there are farmers that absolutely avoid the application of any external agent and use exclusively sources obtained in the farm, such as compost, and stimulate insect actives via food conservation (Elzen *et al*., 2012). Also, there are farmers that increase soil fertility and control pests by external inputs. The philosophy of the latter ("input substitution") has been advertised much longer than organic agriculture (Drinkwater, 2009).

In the period of intensive development of commodity production in economy praxis and theory, existed comprehension on primacy of the principle of the social production efficiency (Goulet and Vinck, 2012; Lampkin *et al*., 2006). Such position and behavior of the economical subjects, commodity producers were based upon presumptions on unlimited economy resources. The starting point of these presumptions were that resources can be used intensively, without taking care on possibilities of their use in future and on need of reproduction and protection of restorable resources in such conditions in policy of development based upon principles of technical and technological accomplishments in the second half of the 20th century (Besson, 2009; Badgley and Perfecto, 2007). At the same time, with the achievement of the positive economic and production effects, processes of degradation and pollution of all ecological system were demonstrated (Dangour *et al*., 2010; Gliesman, 2007).

Emerged tendencies were especially obvious in the most developed capitalistic countries in the phase when intensive development and increase of material production is achieved under influence of merciless competition and elemental influence of commodity production laws (Blazy et al., 2009). Consequences of the aggressive behavior of the economy subjects toward nature in whole were economical and irrational spending of natural resources (Elzen and Wieczorek, 2005). In these processes, reproduction in nature, especially normal restoration of biological and ecological resources is noticeably disturbed. In last four decades of the 20th century developed knowledge on irrational and improper use of natural resources (Jovanović *et al*, 2003; Hojka *et al*., 2005).

In 1990, the concept of sustainable development was adopted by European Union, and two years later, the same was done by United Nations. In the period 3 – 14 June 1992 in Rio de Janeiro the Second Conference of United Nations on environment and development was held. On this meeting a significant declaration that legalized concept of the sustainable development was adopted. It became evident that environment can not be preserved and improved by partial politics

and measures, but that it is possible to achieve by use of the sustainable development concept.

In early years of the 20th century organic agriculture originated from theory and praxis, including diversity of alternative methods of agricultural production, mostly in northern Europe. There existed three main directions: biodynamic agriculture, that occurred in Germany and was defined by Rudolf Steiner; organic agriculture originated from England, based upon theory that was developed by Albert Howard in his Agricultural testimony (1940); Biological agriculture that was developed in Swiss by Hans-Peter and Rusch and Hans Muller.

Regardless on some differences in approach, mutual base of all these tendencies is accent on elementary connection between agriculture and nature and consideration of the rule of the natural equilibrium (Cabaret *et al*., 2003). Named directions of alternative methods development of agricultural production moved away from other approaches to agriculture (Hubert, 2002), that tended to maximize yield through use of various kinds of synthetic products.

In order to define the concept of the organic agriculture, it should point to definition by Codex Alimentarius, based upon contributions of experts from all over the world: "Organic agriculture is holistic system that promotes and improves health of the agro ecosystem, including biodiversity, biological cycles and biological soil activity. It gives priority to use of production praxis of soil cultivation in regard to application of procedures outside agricultural areas. This is maintained where it is possible by agronomic and biological methods, contrary to use of synthetic materials, in order to fulfill any specific function in the frame of the system". Codex of the organic agriculture system is directed toward: Increase of biological diversity in the frame of the system in whole; Increase of biological soil activity; Maintenance of longer period of soil fertility; Recycling of plant and animal origin waste, thus reducing use of unrestorable resources; Support of healthy soil, water and air use, as well as reduction of all forms of pollutants that emerge from agricultural procedures; Maintenance of agricultural products with the stress on the methods of the process in order to maintain organic integrity and vital product quality, and Stabilization of the existed farms over the conservation period, as well as it's length that is determined by external specific factors that refer to soil history, type of crops and animal products.

Biodiversity in sustainable agriculture

Agricultural biodiversity of all specii intended for human food is a significant part of biodiversity in general, highly considered in food market globalisation, intelectual property system and spreading unsustainable industrial food production (Hole *et al*., 2005). It is also known as agri-biodiversity or the genetic resourses for food and agriculture. It includes: harvested types of crops, selected animal specii, various fish specii, wild resources in the fields, forests and aquatic

ecosystems; not harvested specii within production ecosystems that support food supply, including soil micro-organisms, pollinators, etc.; not harvested specii in the broader field conditions that promote food production ecosystems (agricultural regions, forest and aquatic ecosystems).

However, the interaction between the environment and genetic resources management practice determines evolutionary processes (Bošković *et al*., 2011). These may include introgression from wild relatives, hybridization between cultivated plants (Wolf *et al*., 2008), mutation of natural and artificial selection, since the genetic material (variety of farm crops or domestic animals selected) is well adapted to local variations in biotic and abiotic external conditions (Sandhu *et al*., 2010).

Biodiversification of sustainable agroecosystem can be achieved through reviving functional biodiversity, thus initiating synergisms that provide environmental conditions, such as soil biology activation, nutrient cycle re-establishing, increasing favorable arthropods and antagonists (Bošković *et al*., 2003; Hooper *et al.,* 2012). Key actions are preventive, providing strengthening of agroecosystems' "immunity", through series of mechanisms (Doring, 2012).

Different strategies exercise following ecological principles:

1. Crop rotation. Occasional diversification provides crops feed and terminates life cycles of some insect pests, parasites and weeds.
2. Polyculture. The complex system of plant crops in which two or more crops are sown within sufficient spatial proximity, which results in competition or complementarity to increase yield.
3. Agro-forestal systems. Agricultural systems where the forest trees are grown together with annual crops and domestic animals, resulting in increased complementary relations between components with multiple use of agroecosystems.
4. Leguminous crops. The use of pure or mixed cultures of legumes or other annual plant species under fruit trees to increase soil fertility, while increasing the biological pest control with modification of orchards microclimate.
5. Integration of domestic animals into agroecosystems contributes increase in biomass production and optimal cycling of nutrients.

Biologic control witnin organic agriculture

Interests of the public and consumers of agricultural products in pesticide residues in food and serious impairment of the natural integrity of the environment led to the higher interest in control in agriculture (Bellon *et al*., 2010). There is a reliable proof that pesticides directly adversely affect human health, hence some countries introduced strict legal regulations on the application of certain types of pesticides in the plant production (Aeberdhard and Rist, 2009). It is obvious that a drastic reduction in the number of acceptable chemical

products, as well as, in the number of their users in agriculture will occur in the very near future (Lockie *et al*., 2006; Nunes *et al*., 2009).

Beside the food safety increase, and a reduced level of pesticides in the environment, the advantage of biological control lays in the fact that agricultural workers are less exposed to pesticide effects (Trkulja *et al*., 2015; 2016) Biological control, also, contributes to avoidance of harmful plants, provides the development of beneficial insects, and contributes to the mitigation of problems related to resistance of harmful insects to certain chemicals (Doring *et al*., 2012; Drobnjaković *et al*, 2016). Once established, biological control in agriculture is in fact relatively inexpensive. Biological control of citruses performed during the last 100 years resulted in great practical advantages. Annual saving in protection costs for only four insect species was estimated to 100 M dollars (Nunes *et al*., 2009). Contemporary studies relate to the development of plant varieties that can maintain or improve yields and quality, even under conditions of higher UV radiation caused by a rarefied ozone layer (Sivasakthivel and Siva Kumar Reddy, 2011; Arcas *et al.,* 2000). Managing water and soil resources for better conservation of available water, improvement of their quality and conservations encompasses the improvement of practical practices on a large scale, from soil conservation to plants with long roots that can use soil moisture and nutrients bellow the level reached by a common root system (Thieu *et al*., 2011).

The question of the improvement of the production of fibrous feeds and breeding of domestic animals is one of essential questions of biological control (Sørensen. *et al*., 2005). The point is to develop such fodder crops that will have the maximum gain of green matter during autumn. In such a way, the grazing season of ruminants can be significantly prolonged, and by this, costs of animal nutrition with expensive formula feed can be considerably reduced, with the simultaneous increase of feed consuming efficiency (Watson *et al*., 2008). The aim of animal breeding is to develop animals that will provide a higher meat and milk production per a kilo of consumed feed regardless of its origin.

Under conditions of the organic agricultural production that is developing today, biological control provides the base for control of various pests, but selective pesticides have often to be used (Trkulja *et al*., 2016). The aim is not to destroy pests, but to maintain their population under the level of economic losses. Since methods of biological control have been spreading, the reduced application of pesticides will result in greater damages in pests than via food alone (Butault *et al*., 2010).

Sound soil is the base for all systems of organic agriculture. Beside appropriate soil fertility, organic farmers have a tendency to biologically active soil with a rich population of micro-organisms necessary for the cycle of nutrients (Gliessman, 2010). The crop rotation is necessary for all types of nutrients, such as nitrogen in the case of leguminous crops, or biomass rich in carbon for the development of useful soil micro-organisms (Gosling and Shepherd, 2005). If necessary, limestone should be used to provide soil pH of 6-

7. Beside limestone, manure and composted manure are the best forms for the soil improvement in organic agriculture (Leifeld, 2012). In the case of field and vegetable crops, the use of immature manure is permitted three, i.e. four months, respectively, prior to harvest, in order to provide an adequate degradation or to avoid possible problems with bacterial contamination of products (Bošković *et al*., 2003). The application of immature (unfermented) manure on frozen or snow covered soil is not permitted. Composting is an advantageous method in manure stabilisation.

Spreading the information on organic agriculture and organic food in the function of the national diet improvement

At the end of the 60's and especially the 70's of the 20th century, the importance of organic agriculture in relation to the awareness of the necessity to protect the environment and to improve the national diet increased (Lampkin and Stolze, 2006; Lockie et al., 2006). New associations were established. These associations encompassed producers, consumers and other concerned about ecology and the style of living more harmonious with natural laws.However, since 1980 in the majority of European countries, and also in USA, Canada, Australia and Japan, organic agriculture has been improved significantly via the development of new methods in the production in accordance with the consumers' interests (Azadi *et al*., 2011).

The consumption of products of organic agriculture has been increasing all over the world. The greatest part of this increase can be explained by the requirements of consumers for agricultural products that did not contain genetically modified organisms (Bošković *et al*, 2013). Since the use of GMOs is not permitted in the organic production and processing, organic products are separately displayed in the markets (Bošković and Prodanović, 2016). Considering consumers in Europe, their greatest demands for products of organic agriculture show the highest increase in The Netherlands, Scandinavian countries and Germany.

In Italy for instance, about 4% of total agricultural areas are under organic production, while this percentage in Austria amounts to 10% with the increasing tendency. The Prince of Wales has established the farm for organic agriculture with a system by which the government supports farmers to start this form of the agricultural production. Large chains of supermarkets and restaurants in Europe offer a wide scope of such products.

Information on the ever increasing importance of nutrition quality in the function of health maintenance and improvement of the reproductive and creative abilities of the population has been spreading all over the world (Baars, 2011). Therefore, besides providing optimum quantities of agrarian products, demands for a greater supply and consumption of safe (organic) food have been more severely stated. A deficit in high quality and safe food has been appearing in the

food demand structure in the most developed countries. From the aspect of our market orientation one should bear in mind that in these countries the production, and surplus of supply of strategic products (cereals, sugar, meat, oil, etc.), which relatively decreases our export possibilities, on one hand, have been increasing, while on the other hand, the deficit of safe food is pronounced in the structure of the production and supply of agrarian products (Bošković *et al*., 2003; Halberg and Muuler, 2013).

Broaden information on the application of methods and technologies of the safe organic food production resulted in a new approach to the development of the organic production and better understanding of a positive relation between diet and human health, as well as, to a possibility to maintain and improve health of different population age groups (Dangour *et al*., 2010). The least and the most developed countries mutually approached better understanding of a great economic and human price of chronic malnutrition in countries that were not able to provide safe food or adequate nutrition of their population due to either economic and technological limits or to wars and natural catastrophes (Koohafkan *et al*., 2011). Factors related to the environment and the effects of chemical and microbiological pollutants on nutritive values and safeness of food are being discovered and considered. The development of a wide scope of new safe organic food products provides the improvement of the food nutritive value in favour of human health (Simić *et al*., 2004). Globally observed, a greater responsibility and expectancy of world institutions are required for increasing the production of safe food. The stress is put on the constructive role of international organisations such as FAO, which, often cooperating with other organisations and donors, establish a relation between a potential to improve human nutrition and quality of living with a struggle to eradicate famine, malnutrition and consumption of unhygienic food that jeopardise population health (Darnhofer *et al*., 2010; Guyomard, 2009; Halberg *et al*., 2006).

Development of sustainable and organic agriculture in Serbia

Available natural riches in Serbia play a key role in economic and especially agricultural development. This fact results from their diverse ecological structure and comparative possibilities of development. Common natural conditions have significant role for agriculture, for development of its diverse structure, as well as for application of the concept of sustainable development and environmental protection. This is also manifested by available orographic diversity and differential climatic conditions (Bošković *et al*., 2003; Boškovic *et al*., 2008; 2011). In establishment of the agriculture sustainable development, adequate measures for protection and improvement of the climate are necessary to be applied. With the aim of protection and management of the agricultural areas, the analysis and permanent adaptation of the production structure by ecological demands is necessary and important (Hojka *et al*., 2005).

In their structure and comparative characteristics natural potentials directly determine possibilities of agriculture development. Serbia possess with relatively convenient and diverse natural conditions that enable development of highly productive and quality agriculture production in a whole, and especially animal husbandry with suitable financial investments. The fact that animal husbandry in the structure of agriculture has a role of the key branch is indisputable, for conditions for more convenient economical valorization of the plant production, especially in regard to field crops is are carried out over it.

In development of agriculture in Serbia, animal husbandry fails to progress significantly, despite the fact that there exist convenient comparative advantages. Relative underdevelopment of the animal husbandry influences inconveniently to use of the available forage. Great portion of this food remains insufficiently used or even decays. This suggests examples of unused maize stalks in significant areas in which maize is grown. Similar situation refers also to other field crops such as sunflower stalks, hay and sugar beet top. In regard to the above stated, a fact that holding back of the animal husbandry in conveniently reflects to soil quality and fertility should also be taken into account (Jovanović *et al*. 2003). Broad development of the field production that influences on decrease in working productivity in animal husbandry is caused by extremely low availability of livestock in agricultural enterprises and cropping farms, in regard to hectare of agricultural land. At the other hand, insufficient technical and technological direction of field production is inconveniently reflected to the intensity level of the animal production. This tendency is even more expressed in agricultural enterprises of the former social sector in regard to the private one. However, facts clearly suggest that stimulation of animal production leads to creation of stimulating conditions for faster growth of field crop production. Manure production is enlarged with the increase in animal units. It means that assumptions for intensification of the production are created by increase of livestock, for increased use of manure, increase of active ingredients from organic fertilizers enables increase in volume of biologically high-quality commodity production in regard to hectare of arable land and per worker, raise working productivity and income, i.e. profit increase in agriculture in whole. This suggests that effects in field crop production are expressed by economical effects of animal products and their processed products (Hojka *et al*., 2006).

In agrarian sector, in development of agriculture and this sector in whole, livestock represents especially significant path of advancement and biological resource not only of animal husbandry, but of agriculture in whole. Depending upon livestock size and structure, emerge accomplishments and results in animal husbandry in this sector. This is especially achieved if reflection of commodity production, specialization and motivation of the economic subjects in agriculture, i.e. farmers is to use more rational other resources of development, such as working labor, natural riches, soil, economic objects and etc.

Cropping farms in conditions of market economy, under convenient economic position of animal husbandry have opportunity to increase ecological conditions and soil quality through animal production, growth rate, meat and other processed products simultaneously gaining positive results based on this. In these circumstances of increased livestock and maintenance of highly productive animal production, cropping farms achieve higher level of employment of the available working labor. This enables achievement of satisfactory level of valorization and other production factors (Simić *et al*., 2004). Maintenance of certain livestock level in agrarian sector is highly dependent upon existence of very convenient natural conditions for development of diverse and highly productive animal production in Serbia.

In the frame of the strategy of agriculture technological development, together with animal production, the aim is encouragement of more complete use of the available natural resources, which is highly significant for field crop and animal production development. In regard to accomplishment of this goal, the following is to be achieved:

(1) Providing of significantly higher consumption of organic fertilizers is needed in order to enable achievement of optimal technological and economical effects, improvement of biochemical soil properties and providing of ecological equilibrium with increase of economy and rent ability of animal production.

(2) For enhanced use of organic fertilizers, number of animal units is to be increased per hectare and quality manure collection and spread is to be provided. According to data for 1998 in our country there were only 32 animal units per 100 ha of agricultural land. In West European countries, according to data for 1995, there were 45 animal units per ha of arable land.

With the increase of livestock, significantly more convenient conditions are to be created for development of field crop production, above all through increase of green forage, especially leguminous fodder crops. Increased use of these cultures by production of silage would provide significantly cheaper animal production of higher biological quality.

In the period of intensive development of commodity production in economy praxis and theory, existed comprehension on primacy of the principle of the social production efficiency. Such position and behavior of the economical subjects, commodity producers were based upon presumptions on unlimited economy resources. The starting point of these presumptions were that resources can be used intensively, without taking care on possibilities of their use in future and on need of reproduction and protection of restorable resources in such conditions in policy of development based upon principles of technical and technological accomplishments in the second half of the 20^{th} century. At the same time, with the achievement of the positive economic and production effects, processes of degradation and pollution of environment and jeopardizing of all ecological system were demonstrated. Emerged tendencies were especially obvious in the most developed capitalistic countries in the phase when intensive

development and increase of material production is achieved under influence of merciless competition and elemental influence of commodity production laws. Consequences of the aggressive behavior of the economy subjects toward nature in whole were economical and irrational spending of natural resources. In these processes, reproduction in nature, especially normal restoration of biological and ecological resources is noticeably disturbed. In last four decades of the 20th century developed knowledge on irrational and improper use of natural resources (Bošković *et al*., 2008).

From ancient times humans recognized that use of organic fertilizers increases plant appearance and yields. In 19th to 20th century period various opinions among scientists existed in regard to the question if organic fertilizers are nutrients for plants or not. It is interesting that positive opinions in regard to this replaced negative ones, which resulted with more massive use of mineral fertilizers. It is a fact that only a small portion of organic fertilizers can be used as nutrients from plants directly. However, it is also true (and proved by the most recent studies) that mineralization process all down to the level of ion would be almost impossible without regular intake of organic material into soil. Not only this, organic matters intook into soil increase availability of nutrients to plant, i.e. enable photosynthesis.

In numerous studies it is determined that organic matters indirectly or directly influence to metabolism, i.e. to plant growth, development and productivity. Effect of organic matters to plants is not based to assimilate content. This makes their role in soil fertility maintenance irreplaceable by complete substitution of mineral fertilizers.

Organic matters of the soil enable uniform and harmonic plant nutrition. By its complex action it simultaneously increases plant resistance toward conditions of stress such as frost and drought. This is why lately it's wider ecological role, especially intensive plant production and healthy food production has been emphasized. Based upon presented facts, and with the aim of achievement of stable and high yields of higher biological value, use of organic fertilizers in future should be paid greater attention (Grubišić *et al*., 2011). Organic fertilizers are matters of human and animal origin. They are permanently produced and pollute environment. Prevention of environmental pollution is possible in two manners. One is destruction that demands significant quantity of consumed energy without any use. The second one is use in agriculture, that also demands energy, but in far less volume. This, second manner refers also to use of energies from originating matter. That is why we must gravitate toward use of organic fertilizers with the lowest possible loss of the matter.

There are many different studies on complex effect of organic fertilizers to soil (Hojka *et al.,* 2006). Numerous trials performed in the foreign countries suggest that comparisons of effects and studies of mutual effect of organic and mineral fertilizers require more decade period. Long-term trials prove positive effect of organic fertilizers. It is manifested in physical properties, microelement

content, biochemical processes and regulation of the soil chemical reaction. Organic matter in soil binds to incoherent soils, and makes heavy clay soil incoherent. Positive effect of organic fertilization of heavy clay soil is proved by experience of West European countries. According to trials in our country, use of organic matters proved useful in soil structure restoration. Use of organic fertilizers permanently increases capability of binding soils cultivation. Organic matter has significant role in providing soil by nutrients. Organic matters bind 96 to 99% of nitrogen, from 35 to 40% of phosphorus and 10 to 30% of sulfur in soil. Depending upon type, microelements also bind to organic matter in various proportions. Organic fertilization potentially enables control of biochemical processes that are responsible for mobilization, i.e. binding of nutrient matters.

Question of economic profitability of organic fertilizers use arises only on farms that do not have production of organic fertilizers. Question of economic feasibility must not be arisen for the places in which great quantities of environmental harmful organic matters are produced. Human and animal exudations, as well as waste of organic origin can be the most sufficiently neutralized in soils rich in humus matters. In such soils occurs acid and base material neutralization, and their biological activity is enhanced by organic fertilizer destroy pathogenic organisms. Organic waste application in soils resolve two problems, from one hand, placement of harmful matters without negative effects, and from the other hand increase in soil fertility. However, capability of soil detoxication is limited. Concentrated use of harmful matters in soil can contaminate it.

In the period of naturalized production, for soil fertility increase, matters available on farms, such as lime and waste of plant and animal origin were used. Priority was given to fertilizers of animal origin, whose positive effect to plant growth and development was noticed even by nomads. Up to 50th years of the 19 century in Europe in agricultural production for fertilization were used exclusively matters of organic origin, i.e. animal excrements predominantly. In the 19 century scientific researches were developed in regard to the problems of plant nutrition, knowledge of soil properties and making of different fertilization systems. Lei big studies contributed to creation of mineral fertilizers. However, their production did not remove need for organic fertilizers, especially for manure.

Parallel with the experience acquired by use of mineral fertilizers, enlarged also experiences and observations in regard to manure use and manipulation. Exudations of various kinds of animals in different age, as well as used bedding were analyzed in details. A large number of fertilizer fermentation systems were created. By the end of 19 century and the beginning of the 20th century, contrary to the increased use of mineral fertilizers, manure kept its dominant role. Intensive use of mineral fertilizers was the only way for fast soil supply by nutrient matters. Due to the significant increase of fertilization by mineral fertilizers, yields of field crops tripled.

In the course of the time, approach to use of organic fertilizers changed. Manure is a useful by-product that is predominantly used in field crop production for soil fertility increase (Rigby and Cáceres, 2001). Beside, this is the easiest manner for avoidance of pollution effect by manure. Agricultural use of manure is motivated by the nutrient matter content; however, its other effect should also be taken into consideration. By organic matter content it significantly improves water regime of sandy and clayey soils. Concentration of nutrient matters of plant origin is lower in manure in regard to mineral fertilizer, meaning that quantities of used manure must bi significantly higher. However, these kinds of nutrient matters for transport need only energy. It is well known that production of mineral fertilizers and especially nitrogen fertilizers requires high quantity of energy. Fertilizers with bedding in average per 1 t contains 5.0 kg N, 2.5 kg P_2O_5, 6.0 kg K_20 and 6.0 kg CaO, for which industrial production 511 MJ of energy is needed. One of the important indicators of industrial production is quantity of energy needed for production of single unit of a product. The best production system is one that in the given circumstances produces the lowest loss of row materials and energy. In the past, field crop and animal production complemented each other nicely. From the aspect of mutual use of by-products, in the future, these branches of agricultural production must be closely tied.

Cheap production of cattle and milk is possible only by fodder plants. Part of maize stalks and hay can be used in cattle feeding, and the obtained manure can be used for fodder plant production. In brief, close interconnection in regard to marketing of row crops and energy between filed crop and animal production is not only to be reduced, but organization level from this aspect is to be raised in every farm.

Conclusion

In several last years consumers growing demands toward healthy food led to significant increase and development of organic agriculture in the world. Simultaneously with expression of inconvenient tendencies, in increased number of inhabitants there rise a consciousness, especially in developed countries on necessity for adoption of a new value system in which important position belongs to the method of organic agricultural production and processing of agricultural products in safe manner. This method is affirmed as sustainable agriculture and as organic production, biofarming and eco-agriculture that produces healthy food. Biofarming obey the most contemporary ecological approach in food production. Sustainable agriculture as strategic base of organic production establishment enables increase in production volume of healthy and safe food. Gained experiences and developed consciousness on significance of organic agriculture for improvement of population nutrition in the world suggest that in our country also exist significant possibilities and perspectives.

In the frame of the strategy of agriculture technological development, together with animal production, the aim is encouragement of more complete use of the available natural resources, which is highly significant for field crop and animal production development. In regard to accomplishment of this goal, the following is to be achieved:

1) Providing of significantly higher consumption of organic fertilizers is needed in order to enable achievement of optimal technological and economical effects, improvement of biochemical soil properties and providing of ecological equilibrium with increase of economy and rent ability of animal production.

2) For enhanced use of organic fertilizers, number of animal units is to be increased per hectare and quality manure collection and spread is to be provided

Acknowledgements

This research was supported by the Ministry of education and science of the Republic of Serbia, as a part of the project TR31092, entitled "Study of the genetic basis of improving yield and quality of small grains in different environmental conditions".

References

Aeberhard A., Rist S. (2009): Transdisciplinary knowledge production in organic agriculture. *Agrarforschung,* **16:** 414–419.

Allard G., David C., Henning J.C. (2000): *L'agriculture biologique face à son développement: les enjeux futurs*. Les colloques, INRA, p. 396.

Altieri M. A. (2002): Agroecology: the science of natural resource management for poor farmers in marginal environments. *Agriculture, ecosystems & environment,* **93**: 1-24.

Altieri M. A., Nicholls C.I. (2008): Scaling up agroecological approaches for food sovereignty in Latin America. *Development,* **51:** 472–480.

Arcas M.C., Botía J.M., Ortuño A.M., Del Río J.A. (2000): UV irradiation alters the levels of flavonoids involved in the defence mechanism of Citrus aurantium fruits against Penicillium digitatum. *European Journal of Plant Pathology,* **106:** 617-622.

Azadi H., Schoonbeek S., Mahmoudi H., Derudder B., De Maeyer P., Witlox F. (2011): Organic agriculture and sustainable food production system: Main potentials. *Agriculture, ecosystems & environment,* **144:** 92–94.

Badgley C., Perfecto I. (2007): Can organic agriculture feed the world? *Renewable Agriculture and Food Systems,* **22:** 80–86.

Baars T. (2011): Experiential science; towards an integration of implicit and reflected practitioner-expert knowledge in the scientific development of organic farming. *Journal of agricultural and environmental ethics,* **24:** 601–628.

Bellon S., Desclaux D., Le Pichon V. (2010): Innovation and research in organic farming: A multi-level approach to facilitate cooperation among stakeholders. *9th European IFSA Symposium,* Vienna, Austria. p. 703–717.

Bellon S., Lamine C., Olivier G., De Abreu L.S. (2011a): The relationships between organic farming and agroecology, in: D. Neuhoff, et al. (Eds.), *Third Scientific Conference of ISOFAR, ISOFAR*, Namyangju, Republic of Korea. p. 235–238.

Bellon, S., Penvern, S., Ollivier, G., Debaeke, P., Cabaret, J. (2011b). Promouvoir des travaux sur l'AB dans un institut de recherche (INRA): enseignements d'un collectif interdisciplinaire. *Presented at Les transversalités de l'agriculture biologique, Strasbourg, FRA (2011-06-23-2011-06-24).* http://prodinra.inra.fr/record/43679, p. 21.

Bengtsson J., Ahnstrom J., Weibull A.C. (2005): The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Journal of applied ecology,* **42:** 261–269.

Besson Y. (2009): Une histoire d'exigences: philosophie et agrobiologie. L'actualité de la pensée des fondateurs de l'agriculture biologique pour son développement contemporain. *Innovations Agronomiques,* **4:** 329–362.

Blanchart E., Cabidoche Y-M., Gautronneau Y., Moreau R. (2005): Les aspects spatiaux et environnementaux de l'agriculture biologique, in: M. François, et al. (Eds.), *Agriculture biologique en Martinique: quelles perspectives de développement?,* IRD Editions, Paris (FRA), p. 325–379.

Bland W.L., Bell M.M. (2007): A holon approach to agroecology. *International Journal of agricultural sustainability,* **5:** 280–294.

Blazy J-M., Ozier-Lafontaine H., Doré T., Thomas A., Wery J. (2009): A methodological framework that accounts for farm diversity in the prototyping of crop management systems. Application to banana-based systems in Guadeloupe. *Agricultural systems,* **101:** 30–41.

Bošković J., Ivanc A., Hojka Z., Sarić R. (2003): *Osnovne determinante razvoja održive poljoprivrede*, u: Bošković J., Ivanc A., Simić, J. (Urednici), Održivi razvoj poljoprivrede i zaštita životne sredine-monografija. Megatrend univerzitet primenjenih nauka, Beograd, 65-100.

Bošković J.**,** Ivanc A., Hojka Z. (2008): Perspektiva održive i organske poljoprivrede u Srbiji. *Međunarodni naučni skup: Razvojne strategije preduzeća i privrede.* Zbornik radova. Beograd , 28. novembar 2008. Megatrend univerzitet Beograd, 59-71.

Boskovic J., Zecevic V., Galonja Coghill T., Ivanc A., Milenkovic S., Dozet G., Könyves T. (2011): Sustainable agriculture and enviromental protection. Review on Agriculture and Rural Development. "TRADITIONS, INNOVATION, SUSTAINABILITY". *X. Wellmann International Scientific Conferemnce. Hódmezővásárhely, 5th May, 2011.* Conference CD supplement. ISSN 1788-5345. p. 268-273.

Bošković J., Zečević V., Galonja Coghill T., Matković M., Trkulja N., Vukašinović D. (2013): Assessing ecological aspects of biosaffety of genetically modified crops to environment. *Acta Agriculturae Serbica.* **36:** 143-167.

Bošković, J., Prodanović, R. (2016): Methodology of risk assessment and cumulative impact of genetically modified plants on the environment. *The 6th Intenatnationala Congress Bomedicine and Geosciences-Influence of Environment on human Health.* 18-18. April 2016. Hotel Park, Belgrade. Invited lectures. p. 9-19.

Butault J.P., Dedryver C.A., Gary C., Guichard L., Jacquet F., Meynard J.M., Nicot P., Pitrat M., Reau R., Sauphanor B., Savini I., Volay T.

(2010): *Ecophyto R & D. Quelles voies pour réduire l'usage des pesticides? Synthèse du rapport d'étude.* INRA Editeur (France), p. 90.

Cabaret J., Bellon S., Gautronneau Y. (2003): Quelle recherche pour l'agriculture biologique. *Pour,* **178:** 116–126

Dangour A.D., Lock K., Hayter A., Aikenhead A., Allen E., Uauy R. (2010): Nutrition-related health effects of organic foods: a systematic review. *The American journal of clinical nutrition,* **92:** 203–210.

Darnhofer I., Lindenthal T., Bartel-Kratochvil R., Zollitsch W. (2010): Conventionalisation of organic farming practices: from structural criteria towards an assessment based on organic principles. A review. *Agronomy for sustainable development,* **30:** 67–81.

De Ponti T., Rijk B., Van Ittersum M.K. (2012): The crop yield gap between organic and conventional agriculture. *Agricultural Systems,* **108:** 1–9.

Doring T.F., Pautasso M.,Wolfe M.S.M., Finckh M.R. (2012): Pest and Disease Management in Organic Farming: Implications and Inspirations for Plant Breeding**.** In: Lammerts van Bueren, E.T., and Myers, J. R. (eds.). Wiley-Blackwell. *Organic Crop Breeding.* 39-60 pp.

Drinkwater L.E. (2009): Ecological knowledge: foundation for sustainable organic agriculture, in: C. Francis (ed.), Organic farming: the ecological system. American Society of Agronomy, Inc., *Crop Science Society of America*, Inc., *Soil Science Society of America,* Inc.: Madison. 19–47 pp.

Drobnjaković, T., Marčić D., Prijović M. Perić P., Milenković S., Bošković J. (2016): Life history traits and population growth of Encarsia Formosa Gahan (Hymenoptera: Aphelinidae) local population from Serbia. *Entomologia Generalis*. **4:** 281-295.

Elzen B., Barbier M., Cerf M., Grin J. (2012): Stimulating transitions towards sustainable farming systems, Farming Systems Research into the 21st century: *The new dynamic*, 431–455 pp.

Elzen B., Wieczorek A. (2005): Transitions towards sustainability through system innovation. *Technological forecasting and social change,* **72:** 651–661.

Francis C. ed. (2009): Organic Farming: the ecological system. American Society of Agronomy, Inc., *Crop Science Society of America*, Inc., *Soil Science Society of America*, Inc.: Madison. p. 353.

Gabriel D., Sait S.M., Hodgson J.A., Schmutz U., Kunin W.E., Benton T.G. (2010): Scale matters: the impact of organic farming on biodiversity at different spatial scales. *Ecology letters,* **13:** 858–869.

Gliessman S.R. Ed. (2007): *Agroecology: the ecology of sustainable food systems,* CRC Press, Taylor & Francis, New York, USA. p. 384.

Gliessman S. (2010): The framework for conversion. The conversion to sustainable agriculture. *CRC Press, Boca Raton.* p. 3–14.

Gosling P., Shepherd M. (2005): Long-term changes in soil fertility in organic arable farming systems in England, with particular reference to phosphorus and potassium. *Agriculture, ecosystems & environment,* **105:** 425–432.

Goulet F., Vinck D. (2012): L'innovation par retrait. Contribution à une sociologie du détachement. *Revue française de sociologie,* **53:** 195–224.

Grubišić, M., Hojka, Z., Stojanović, M., Milojković, J., Mihajlović, M. (2011): Organic matter, as indicator degradationds proces in soil. *19th International*

Scientific and Professional Meeting "ECOLOGICAL TRUTH" 01 – 04 June Bor 2011., 204-208.

Guyomard H. (2009): Politiques publiques et agriculture biologique. *Innovations Agronomiques*, **4:** 499–511.

Halberg N., Alroe H.F., Knudsen M.T., Kristensen E.S. (2006): *Global development of organic agriculture: challenges and prospects.* CABI Publishing, Wallingford. p. 391.

Halberg, N. (2012): Assessment of the environmental sustainability of organic farming: Definitions, indicators and the major challenges. *Canadian Journal of Plant Science,* **92**: 981–996.

Halberg N., Muller A. ed. (2013): *Organic agriculture for sustainable livelihoods*. Routledge, London and New York p. 296.

Harpinder S., Stephen D., Ross C. (2010): Organic agriculture and ecosystem services. *Environmental science & policy,* **13:** 1–7.

Hojka Z., Bošković J., Simić J., Vukosav M., Sarić R. (2005): Uslovi i mogućnosti razvoja održive poljoprivrede. *Journal for scientific agricultural research/Arhiv za poljoprivredne nauke,* 66 (237), **(7-258):** 233-240.

Hojka Z., Krmpotić T., Bošković J.**,** Simić J. (2006): *Organska đubriva-Osobine i primena u organskoj poljoprivredi*. Megatrend univerzitet Beograd. Monografija. Str. 210.

Hole D.G., Perkins A. J., Wilson J.**D**., Alexander I.H., Grice P.V., Evans A.D. (2005): Does organic farming benefit biodiversity? *Biological conservation,* **122:** 113–130.

Holt G.C., Reed M.J. (2006): Sociological perspectives of organic research: to policy and beyond, in: GCRM. Holt (ed.), Sociological perspectives of organic agriculture: from pioneer to policy, *Cabi, Wallingford*. 284–304 pp.

Hooper D.U., Adair E.C., Cardinale B.J., Byrnes J. E.K., Hungate B.A., Matulich K.L. (2012): A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature,* **486:** 105-108.

Horlings L. G., Marsden T.K. (2011); Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could 'feed the world'. *Global environmental change,* **21:** 441–452.

Hossein A., Sanne S., Hossein M., Ben D., Witloxa F., (2011): Organic agriculture and sustainable food production system: Main potentials, Agriculture, *Ecosystems and Environment,* **144:** 92–94.

Hubert B. (2002): Agricultures and sustainable development: The stakes of knowledge and research attitudes. Think forward and act now. *Dossiers de l'Environnement de l'INRA,* **22:** 41–56

Jovanović, R., Bošković, J., Pelagić-Radanović, V. (2003): *Organska poljoprivreda-veliki izazov i potreba budućnosti*, u: Bošković J., Ivanc A., Simić, J. (Urednici), Održivi razvoj poljoprivrede i zaštita životne sredine-monografija. Megatrend univerzitet primenjenih nauka Beograd,129-143.

Koohafkan P., Altieri M.A., Gimenez E.H. (2011): Green agriculture: foundations for bio-diverse, resilient and productive agricultural systems. *International Journal of Agricultural Sustainability,* **10:** 61–75.

Lamine C., Bellon S. (2009): Conversion to organic farming: a multidimensional research object at the crossroads of agricultural and social sciences. A review. *Agronomy for sustainable development,* **29:** 97–112.

Lampkin N., Stolze M. (2006): European action plan for organic food and farming. *Law, Science and Policy*, 3:59–73.

Lampkin N., Fowler S.M., Jackson A., Jeffreys I., Lobley M., Measures M., Padel S., Reed M., Roderick S., Woodward L. (2006): Sustainability assessment for organic farming-integrating financial, environmental, social and animal welfare benchmarking. *Aspects of applied biology*, **79:** 9–13.

Leifeld J. (2012): How sustainable is organic farming? *Agric Ecosys Environ.* **150:** 121–122.

Lichtfouse E., Navarrete M., Debaeke P., Souchere V., Alberola C., Menassieu J. (2009): Agronomy for sustainable agriculture. A review. *Agronomy for sustainable development,* **29:** 1–6.

Lockie S, Lyons K, Lawrence G, Halpin D. (2006): Going organic: mobilizing networks for environmentally responsible food production. *Cabi Publishing, Willingford.* p. 208.

Luttikholt L. W.M. (2007): Principles of organic agriculture as formulated by the International Federation of Organic Agriculture Movements. NJAS-Wageningen. *Journal of Life Sciences,* **54:** 347–360.

Messmer M., Hildermann I., Thorup-Kristensen K., Rengel Z. (2012): Nutrient Management in Organic Farming and Consequences for Direct and Indirect Selection Strategies. In: Lammerts van Bueren, E.T., and Myers, J.R. (eds.) Wiley-Blackwell. *Organic Crop Breeding,* 15-32 pp.

Morgan K., Murdoch J. (2000): Organic vs. conventional agriculture: Knowledge, power and innovation in the food chain. *Geoforum,* **31:** 159–173.

Murphy K.M., Campbell S.K., Lyon G.R., Jones S.S. (2007): Evidence of varietal adaptation to organic farming systems. *Field Crops Research,* **102:** 172-177.

Nemes N. (2009) Comparative Analysis of Organic and Non-Organic Farming Systems: A Critical Assessment of Farm Profitability. In: Natural Resources Management and Environment Department (Ed.) Department (Ed.), *FAO, Rome.* p. 33.

Niggli U., Slabe A., Schmid O., Halberg N., Schluter M. (2008): Vision for an Organic Food and Farming Research Agenda to 2025. *Published by IFOAM-EU and FiBL*, p. 48.

Nunes C.A., Teresa Manso T., Lima-Costa M.E. (2009): Postharvest Biological Control of Citrus Fruit Tree and Forestry Science and Biotechnology (Special Issue 2). *Global Science Books,* **3:** 116-126.

Ollivier G., Bellon S. (2013): Dynamiques paradigmatiques des agricultures écologisées dans les communautés scientifiques internationales. *Natures Sciences Sociétés,* **21:** 166–181.

Piriou S. (2002): L'institutionnalisation de l'agriculture biologique (1980-2000), École Nationale Supérieure Agronomique de Rennes. *Ph. D. Thesis.* p. 451.

Rahmann G., Oppermann R., Paulsen H.M., Weissmann F. (2009): Good, but not good enough? Research and development needs in Organic Farming. *Landbauforschung Volkenrode,* **59:** 29–40.

Rigby D., Cáceres D. (2001): Organic farming and the sustainability of agricultural systems. *Agricultural Systems*, **68:** 21–40.

Rosset P.M., Martínez-Torres M.E. (2012): Rural Social Movements and Agroecology: Context, Theory, and Process. *Ecology and Society,* **17** (3): 17.

Sandhu H. S., Wratten S. D., Cullen R. (2010): Organic agriculture and ecosystem services. *Environmental science & policy,* **13:** 1–7.

Sangor S., Abrol I.P. (2004): Conservation agriculture for transition to sustainable agriculture. *Current Science,* **88:** 686–687.

Schmidhuber J. (2003): "*Globalization in Food and Agriculture*", Chapter 10, pp.265-296 in Jelle Bruinsma, ed., World Agriculture: Towards 2015/ 2030, UNFAO (2003) Earthscan Publications, London, p.432.

Seufert V., Ramankutty N., Foley J.A. (2012): Comparing the yields of organic and conventional agriculture. *Nature,* **485:** 229–232.

Simić, J., Bošković, J., Hojka, Z., Krmpotić, T., Vukosav, M. (2004): Market and environmental determinants of safe food. *III International Eco-Conference "Safe food",* Novi Sad 22-25 September 2004. Proceedings 2, 225-230.

Sivasakthivel T., Siva Kumar Reddly K.K. (2011): Ozone layer depletion and its effects! *International Journal Science and Development*, **2:** 1-8.

Sørensen C.G., Madsen N.A, Jacobsen B.H. (2005): Organic farming scenarios: Operational analysis and costs of implementing innovative technologies. *Biosystems Engineering,* **91:** 127–137.

Sterk B., Van Ittersum M.K., Leeuwis C., Wijnands F.G. (2007): Prototyping and farm system modelling-Partners on the road towards more sustainable farm systems? *European Journal of Agronomy,* **26:** 401–409.

Thieu V., Billen G., Garnier J., Benoit M. (2011): Nitrogen cycling in a hypothetical scenario of generalised organic agriculture in the Seine, Somme and Scheldt watersheds. *Regional Environmental Change*, **11:** 359–370.

Tiemens-Hulscher, M., Lammerts van Bueren E.T., Hutten R.C.B. (2012): Potato: Perspectives for an Organic Crop Ideotype. In: Lammerts van Bueren, E.T., and Myers, J.R. (eds.) Wiley-Blackwell. *Organic Crop Breeding*, 227-238.

Trkulja N., Milosavljevic A., Stanisavljevic R., Mitrovic M., Jovic J., Tosevski I., Boskovic J. (2015): Occurrence of Cercospora beticola populations resistant to benzimidazoles and demethylation-inhibiting fungicides in Serbia and their impact on disease management. *Crop Protection,* **75:** 80—87.

Trkulja N., Pfaf-Dolovac E., A. Milosavljević A., Bošković J., Jović J., Mitrović M., Toševski I. (2016): First reporter of QoL resistance in Botrytis cinerea isolates causing gray mold strawberry fields in Serbia. *Plant Disease*, **1:** 221.

Tuomisto H. L., Hodge I. D., Riordan P., Macdonald D. W. (2012): Does organic farming reduce environmental impacts?-A meta-analysis of European research. *Journal of environmental management,* **112:** 309–320.

Watson C. A., Walker R. L., Stockdale E. A. (2008): Research in organic production systems-past, present and future. *The Journal of Agricultural Science,* **146:** 1–19.

Wolfe T.S., Baresel J. P., Desclaux D., Goldringer I., Hoad S., Kovacs, G., Löschenberger F., Miedaner T., Østergård, H., Lammerts Van Bueren E. T. (2008): Developments in breeding cereals for organic agriculture. *Euphytica,* **163:** 323-346.

ZNAČAJNI RESURSI ODRŽIVE POLJOPRIVREDE I SISTEMA ORGANSKE PROIZVODNJE HRANE U SRBIJI

Jelena Bošković[1], Zdravko Hojka[*2], Veselinka Zečević[2], Radivoj Prodanović[1], Milica Vukić[3]

[1]Fakultet za ekonomiju i inženejrski menadžment u Novom Sadu, Srbija
[*]KWS Srbija
[2]Fakulet za biofarming Bačka Topola
[3]Prirodnomatematički fakultet
Departman za Hemiju, Biohemiju i Zaštitu životne sredine u Novom Sadu, Srbija

Rezime

U radu se sagledavaju uslovi i mogućnosti značjani resursa održivog razvoja poljoprivrede i sistema organske proizvodnje hrane u Srbiji. Koncept organske poljoprivrede se izučava u funkciji proizvodnje zdravstveno bezbedne hrane. Ukazuje se na bitne karakteristike prilagođavanja agrotehnoloških postupaka i mera zasnivanja i ostvarivanja organske poljoprivrede i proizvodnje zdravstveno bezbedne hrane. Ističe se značaj biološke kontrole u ostvarivanju organske poljoprivredne proizvodnje. Osnovne mere biološke kontrole u organskoj poljoprivredi povezuju se obezbeđivanjem kvaliteta zemljišta, vodnih resursa i stočne hrane. Ukazuje se i na alternativne vidove primene sredstava za zaštitu bilja.

Ključne reči: održiva poljoprivreda, organska proizvodnja, zdravstveno bezbedna hrana, agroekologija, biološka kontrola, organsko đubrivo.