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THE ROLE OF ORGANIC AGRICULTURE IN THE CONSERVATION OF GENETIC RESOURCES AND INCREASING AGRODIVERSITY

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Abstract

Organic agriculture is an ecological form of production that promotes natural processes and biological diversity, legally regulated and is subject to inspection, which guarantees quality and health safety of food produced. Except producing healthy and quality food, the adoption of organic agriculture in recent decades has been indirectly established for saving species and varieties of cultivated plants which is due to lack of use threat disappearance.This paper analyzes the state of the global and national soil area under organic agriculture, as well as state of soil under organic production of grain crops as crucial for the food security of almost all countries in the world.Furthermore, paper work presents the state of genetic resources of cereals and show importance that organic agriculture has in process of preservation agro-diversity.

***Key words*:** *agrodiversity, genetic resources, grains, organic agriculture*

INTRODUCTION

Safety in the food supply, quality and health safety of food products vary around the world which makes achieving these three objectives a major challenge for the near future. The survival of industrialized agriculture is increasingly called into question since the contamination of the global food chain and water residues of persistent pesticide, nitrates, and all inferior organoleptic and nutritional properties of food is taking place. Organic farming excludes the use of synthetic inputs and largely relies on the respect of crop rotation, selection of varieties adapted to local conditions, the use of biological agents for crop protection, and use of organic and natural fertilizers. Prohibited use of chemical pesticides in organic agriculture is a very important standard in terms of land, water, biodiversity and health of both producers and consumers of food. Test conducted in Italy in the period 2002-2005 at the 3,500 samples of food of plant origin, found that the majority (97.4 %) of organic agricultural products do not contain detectable pesticide residues (Tasiopoluou et al., 2007).

In the past, agriculture has played an important role in maintaining genetic diversity. However, due to the resulting economic and environmental changes replacing a large number of species with a small number of superior performance of high and uniform varieties and hybrids, has caused a significant loss of agro-diversity. More than 40 % of the land is used for agriculture, making it a great responsibility to protect biodiversity. Many species and varieties that have played an important role in human nutrition practically disappeared over the past century. Rahmann (2011) states that during the twentieth century, a lost about 75 % of plant genetic diversity is recorded mainly by farmers and many local varieties replacing a few genetically uniform hybrids.

MATERIALS AND METHODS

The paper points out the role of organic agriculture in the biodiversity preservation. The paper is structured into three parts. The first part provides an overview of the state of the area under organic agriculture at the global level, the level of the European Union and the Republic of Serbia in the period 2007-2011.The second part gives an overview of the state of genetic resources of cereals as crops that have a key role in the diet of most of the global population, while in the third part of the paper on the role of organic agriculture in the preservation of biodiversity and genetic resources, the increasing diversity on farms "on farm "conservation. The paper use data from Research Institute of Organic Agriculture FiBL and the International Federation of Organic Agriculture Movements IFOAM, which are then processed and presented in graphical and tabular

form, and then analyzed. Besides the statistical data used are relevant domestic and foreign literature sources.

RESULTS AND DISCUSSIONS

Area under organic production globally and in the Republic of Serbia

Since the beginning of the twentieth century, organic farming has grown rapidly worldwide, so the area under the land management significantly increased. According to the data available from the 2011.the organic production is performed in over thirty seven million hectares worldwide, which represents 0.9 % of global agricultural areas (Tables 1 and 2).In relation to the data from 2007,areas under organic production have increased by almost 30 %. Studies have shown that more than one-quarter of the global area under organic farming is in developing countries. These are mainly countries with under-developed industry in which agricultural production is characterized by low investment and high levels of natural resource use. Low consumption of chemicals and fertilizers has contributed to the preservation of the main natural media resources on which is possible to grow organic food.

About 37 % of the global area under organic production is in Australia. Based on the data in Table 1 it can be observed that the continent has the largest share of organic in the total of agricultural area. On the European continent,28.6 % of the world area is under organic production, and the share of the total agricultural land in the European level was 2.2 %. Most land under organic production on the European continent have Germany (1 million hectares) and Italy (1 million hectares), while the largest share of total agricultural land are in Liechtenstein (29.3%), Austria (19.7%) and Estonia (14.8 %).

Compared with developed countries, organic production in Serbia has been applied recently, and from areas covered by this way the food is not coming in a big amounts. According to the 2011 data, under organic production in Serbia was 6,238 ha, which represents only 0.1 % of total agricultural land. If we bear in mind that the total agricultural area covers 5,096,267 ha , of which 64 % are arable land, it is clear that the current scope of practice of organic farming is much smaller than the real potential.

Table 1. Share of area under organic farming in total agricultural land in the period 2007-2011., in %

	2011	2010	2009	2008	2007
Africa	0.1	0.1	0.1	0.1	0.1
Asia	0.3	0.2	0.3	0.2	0.2
Europe	2.2	2.1	1.9	1.7	1.6
South America	1.1	1.2	1.2	1.1	0.9
NorthAmerica	0.7	0.7	0.7	0.7	0.6
Oceania	2.9	2.9	2.8	2.8	2.7
World	0.9	0.8	0.8	0.8	0.7

Source: http://www.organic-world.net/statistics-data-sources.html

Business associations and national non-governmental organizations in the sector of organic production, and the support of the relevant ministry and increase awareness of producers and consumers of environmental protection have contributed to the spread of the idea of organic food production in Serbia. Comparing to 2007, an area dedicated to organic production in 2011has been increased by seven times (Table 2).

Table 2. Share of total agricultural land

	2011	2010	2009	2008	2007
WORLD	0.9	0.8	0.8	0.8	0.7
EUROPE	2.2	2.1	1.9	1.7	1.6
REPUBLIC OF SERBIA	0.1	0.2	0.2	0.1	0.0

Source: http://www.organic-world.net/statistics-data-sources.html

Agro - biodiversity is an important part of global biodiversity, but people use in their nutrition a very small number of species. Agricultural areas in the world were planted with 12 species of grain, 23 species of field and vegetable crops, and about 35 kinds of fruit, which is to say that about 1440 million hectares are planted with no more than 70 species (Altieri, 1999). Not more than 30 varieties of plants produces 95 % of the calories of plant origin at the global level, with only three species (rice, wheat and maize) constituting 50 % of the total amount (Rahmann, 2011). Wheat, real ones andmillet, are an important factor of food security of almost all countries of the world. According to estimates, the annual consumption of grain per capita globally is about 150 kg. Although the production of these crops during the period 1961/63 to 2005/2007 have increased to 1,225

million tons, it is expected to increase to 940 million, and even before the 2050it will be around three billion tones (Alexandratos and Bruinsma, 2012). According to the World Bank statistics and predictions for the period 2010-2012 the grains are covering 703,114.5 hectares, with only 0.4 % of the surface of the grain grown in the principles of organic agriculture. This participation at the European level is much higher and amounts to 1.4%, which was expected since in Europe about 70 % of the world area is under organic production of cereals (Table 3). Because of the importance of grain in the diet of the global population, increasing the volume of production of these crops on the principles of organic agriculture would greatly contribute to improving the quality of nutrition of the global population.

The importance of grain in the daily diet of the population of Serbia is the fact that the consumption of bread per capita is more than 100 pounds during the year, which is three times higher than in Western developed countries. The major part of agricultural production is the production of grain covering the largest part of the arable land, grown on 1,911,166 ha, or 58 % of arable land, dominated by the cultivation of corn (66 %) and wheat (26 %), and considerably less barley (4 %), triticale (2%) and oats (1.7%). However, organic crop production is practiced on only 737 ha of concentrated mainly in the northern parts of the country.

Table 3.Share of the total area under cereals

	2011	2010	2009	2008	2007
WORLD	0.4	0.4	0.3	0.3	0.3
EUROPA	1.4	1.4	1.3	1.1	1.0
REPUBLIC OF SERBIA	0.0	0.0	0.0	0.0	0.0

Source: http://www.organic-world.net/statistics-data-sources.html

In recent years there has been a loss of diversity of cultivated plants, thus the grain, due to the increase in world population and the creation of new high-yielding and intensive varieties, but also because of the associated economic and environmental changes. For this reason, throughout the world numerous gene - banks of germplasm collections of various crops were formed, so genetic resources will be preserved and made available for future generations. As in all countries of the world, the Republic of Serbia is working intensively to preserve resources of genetic most important agricultural plants, the involvement of a large number of Institution - the collection, storage, copying, distribution, and evaluation of germplasm, but also the creation of new varieties.

Genetic resources of grains in the world and the Republic of Serbia

Genetic diversity is a necessary basis for human life and for economic development, and therefore policies to preserve genetic resources, is a core component of the global economy (Roljević et al., 2011). In order to preserve the diversity of species that currently have great significance for nutrition and diversity of species that are always regarded to have an economic impact in the future, around the world it is formed a number of gene - banks in which the genetic material of different species are preserved and multiplied. Gen - bank, and ex situ conservation, are the most convenient way of storing germplasm of domesticated plants and their wild relatives, and the in situ conservation in their natural habitat on farms and their storage and use eases considerably. In the seventies of the 20th century the first ex situ collections by international organizations such as FAO, the International Board for Plant Genetic Resources (IBPGR) and International Institute for Plant Genetic Resources (IPGRI) were promoted. According to its purpose, collections are classified into several groups (the basic collection, the active collection, core collection, gene collection).

According to FAO more reports from 2010. at the global level, there are 1,750 gene -banks that preserve the genetic material of plants relevant to food and agriculture. It is estimated that the global ex situ maintain 7.4 million of plant genotypes, and samples. According to the nature of the material to be preserved, the local population (44 %)are mostly used, followed by inbred line (22 %), modern varieties (17 %), and wild and weed species (17 %). Analysis of genetic material, indicate that approximately 30 % of total plant genotypes different from each other (or 1,9-2,2 million samples), while the rest are the duplicates. The gene - banks, the most common are collections of grain and leguminous crops (Figure 1).

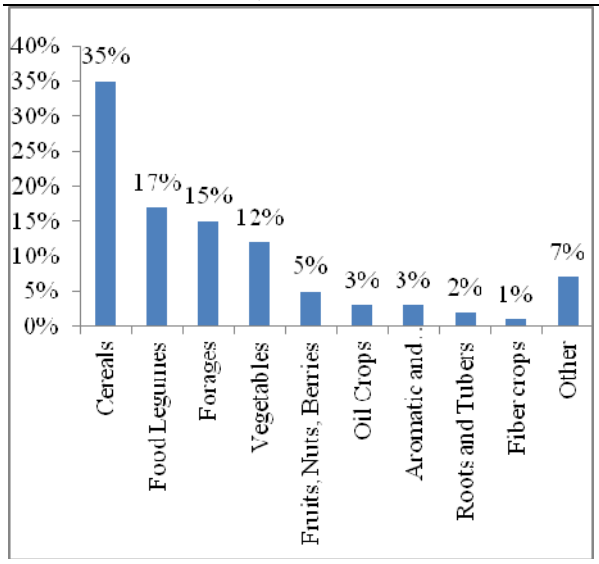

Figure 1. Percentage of different groups of plants in the total number of samples at the global level
Source: The Second Report on the State of the World's PGRFA, The state of ex situ conservation, Chapter 3, FAO, 2010

Collections have grain with 35 % of the total number of samples, whereby the largest number of wheat genotypes (856 168), rice (773 948), barley (466 531), and maize (327 932)are preserved. Genotypes oats (130 653), the genera Aegilops (40.926) and Triticosecale (37,440) are underrepresented in the collection of grain (FAO, 2010).

Institutions dealing with preservation of plant genetic resources at the national level, pay more attention to collection and preservation of neglected and under- cultivated crops. Neglected crops in the past were much more cultured and had a great importance in the diet of the population. However, replacement of major agricultural crops or the disappearance of the environments in which they are grown, brought us to the fact that these species began to disappear. In addition, there is a great concern for the survival of wild relatives of cultivated plants as their natural habitats are disappearing due to changes caused by man and climate. Great value of genetic resources of wild relatives is reflected in the possession of resistance or tolerance to biotic and abiotic stress and these properties are important for the adaptation of major crops to changing environment.

Cultivation of field crops on farms, in centers of origin, plays a key role in preserving genetic diversity. In this way it is allowed to express the genetic variability of the population to changing environmental conditions and the sustainability of agricultural production adapting.

In Serbia, the largest number of samples to be preserved in situ and ex situ collections is "wheat and corn" a total of 8,646. In situ, or breeding farms, held about 32% of genotype, while the remaining 68 % is kept in research institutions and gene - banks. In this collection, maize samples was highest (74 %), followed by wheat (17.5 %), barley (5.2%), oat (3 %), and rye (0.5 %).

According to the National Report of the Republic of Serbia (2010) In situ has preserved and cultivated 1,058 samples of cereals, with most samples of wheat, followed by barley, oats and rye. The largest number of genotypes grown in situ belongs to domestic varieties, while the local population and relatives of the main types of cereals can only be found on farms in marginal agricultural areas. Among the neglected species of grain crops in the country are classified as *Triticum durum* and *Triticumspelta*. The ex situ collections, most of the samples are old varieties and landraces, while the old commercial varieties are under-represented.

Table 4. Number of genotypes of small grains that are stored and grown in situ in the Republic of Serbia

	TYPE OF COLLECTION	WHEAT	BARLEY	OATS	RYE
INSTITUTS	CULTIVARS	200	70	10	1
	BREEDS	500	100	20	5
OTHERS	LANDRACES	50	10	5	5
	RELATIVES	50	20	10	2
TOTAL	1,058	800	200	45	13

Source: The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture was launched at FAO (SoWPGR-2), Country report on the state of plant genetic resources for food and agriculture country report, Republic of Serbia, Headquarters, Rome on 26 October, 2010

Collected genetic material is kept in the Institute "ZemunPolje" Plant Gene Bank and the Ministry of Agriculture, Forestry and Water Management.

According to estimates of the ex situ conservation includes 5,888 samples in the collection, "wheat and corn".

Table 5. Ex situ conservation of samples of grain crops in the Republic of Serbia

	TYPE OF COLLECTION	WHEAT	BARLEY	OATS	RYE
INSTITUTS	LANRACES AND TRADITIONAL CULTIVARS	70	30	15	10
	RELATIVES	200	100	20	5
GENBANK		439	117	180	18
TOTAL	1,204	709	247	215	33

Source: The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture was launched at FAO (SoWPGR-2), Country report on the state of plant genetic resources for food and agriculture country report, Republic of Serbia, Headquarters, Rome on 26 October, 2010

The total number of samples to be stored ex situ to 80 % are corn genotypes, while 20 % are small grains genotypes. In the collection there are 325 samples of relatives of small grains, which are an important source of genetic material for future breeding work.

Considering the great importance of wheat and other cereals in the diet of the population, the priority of institutions dealing with preservation of genetic resources in Serbia should be focused on collecting new samples, and evaluating old ones in existing collections. The system documentation also plays an important role in the management of genetic resources. Unfortunately, due to the poor economic situation in the country and research institutions engaged in germplasm collection, and cultivated plants, databases are maintained at a low level.

3.Role of organic agriculture in preservation of agrodiversity

According to the FAO/WHO organic agriculture is a holistic production management system which promotes and enhances agro - ecosystem health, including biodiversity, biological cycles and soil biological activity. Organic farming relies on creating and maintaining conditions that positively affect the health of ecosystems and encourage natural processes rather than the introduction of artificial inputs. The role of organic agriculture in the preservation of biodiversity and genetic resources, the increasing diversity on farms and "on farm" conservation is very important. This type of production to the number of species in nature does not reduce the production, and accordingly, is also known as sustainable. By integrating the advantages of biodiversity in agricultural practices to the genetic diversity of species and varieties adapted to local ecosystems limit the influence of biotic and abiotic stress factors on the yield and quality of crops. Therefore, breeding locally adapted varieties is not only one of the measures of sustainability and conservation of agro-diversity, but of the need for their use in organic agriculture because of all the agronomic characteristics they possess (Roljević and Grujić, 2013).

According to Oljača et al. (2002), almost all the methods that are used to increase agro-biodiversity (intensification of crop rotation, crop - pair polyculture, cover crops, establishing integrated ecological farms) are used in organic farming systems. The main goal of a well-planned crop rotation is to increase biodiversity in order to fill empty niches occupied by harmful organisms, and establishing community-like nature and interactions that exist in these communities. The effect of crop rotation as a complex measure is convenient to multiply: the structure of soil, water, air and heat mode, the biological activity of soil balance of organic matter, content and availability of mineral matter, the creation and maintenance of a favorable structure and soil protection from erosion which all contribute to creating a favorable microclimate for the development of crops and increase the competitive ability of crops. The introduction of intercrops achieved improvement of crop rotation and rational use of land resources.

Growing crops after harvesting small grains with rides causes stress (irrigation) in the warmest part of the year, and can greatly influence the overall productivity of agricultural land with far less investment. Pairing crops is mode of growing two or more crops at the same time in the same place. Increased diversity in cultivated plant communities contributes to a better redistribution and use of natural resources, increasing production of biomass and yield, reduces damage from the attack of weeds, pests and diseases and provide socio - economic benefits (greater system stability, secure income, better and more varied diet). However, many difficulties in the wider application of this system of cultivation in large areas can be found in the fact that the means of high technology (agro - chemicals, varieties, machinery) adapted the system of growing a single plant species.

With the application of the above mentioned and many other measures that are consistent with the preservation of natural resources, in the system of organic farming to the conservation of agro-biodiversity and genetic resources, encouraging natural processes and relationships in ecosystems is available.

CONCLUSIONS

Organic farming represents a system of safe food in accordance with environmental protection, maintaining soil fertility, ecosystem and human health. Because of the role it plays in the preservation of natural resources, organic farming as an alternative to conventional one, is gaining in importance. The adoption of organic farming in recent decades has been established indirectly saving species and varieties which is due to lack of use obese disappearance. On the other hand, the genetic diversity of cultivated plants in organic agriculture contributes to easier stability of production and yields establishing, which emphasizes the dependence of organic agriculture and biodiversity.

Cereals are the main source of food globally, both for direct consumption in the human diet and as input in livestock production. Organic grain production in the world is still very poorly represented since this area covers 0.4 % of the total area under cereals. The annual consumption of wheat globally per capita is 150 k, which indicates the importance of increasing the production of these crops to the principles of organic farming practices in order to increase the quality of the food of the global population.

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REFERENCES

[1]Alexandratos, N., Bruinsma, J., 2012, World agriculture towards 2030/2050, The 2012 Revision, Global Perspective Studies Team, ESA Working Paper No. 12-03, Agricultural Development Economics Division, Food and Agriculture Organization of the United Nations

[2]Altieri, A., M., 1999, The ecological role of biodiversity in agroecosystems, Agriculture, Ecosystems & Environment, Volume 74, Issues 1–3, pp. 19–31

[3]Oljača Snežana, Kovačević, D., Dolijanović, Ž., 2002, Agrobiodiverzitet u organskoj poljoprivredi. Zbornik radova sa savetovanja „Organska proizvodnja – zakonska regulativa" Subotica, septembar 2002., Savezno ministarstvo privrede i unutrašnje trgovine SR Jugoslavije, Beograd, 83-92

[4]Rahmann, G., 2011, Biodiversity and organic farming: what do we know?, Agriculture and Forestry research, vol. 3, pp. 189-208

[5]Roljević Svetlana, Cvijanović, D., Sarić, R., 2011, Genetički resursi pšenice u svetu i Srbiji, Zbornik naučnih radova Instituta PKB Agroekonomik, vol. 17, br. 1-2, str. 27-33

[6]Roljević Svetlana, Grujić Biljana, 2013, Productivity of old type and grains of genetic resources preservation, Thematic proceedings of International Scientific Conference „Sustainable agriculture and rural development in terms of the Republic of Serbia strategic goals realization within the Danube region" - achieving regional competitiveness, December, 5-7th 2013, Topola, Institute of agricultural economics Belgrade, pp. 1230-1247

[7]Tasiopoulou, S., Chiodini, A.M., Vellere, F., Visentin, S., 2007, Results of the monitoring program of pesticide residues in organic food of plant origin in Lombardy (Italy), J. Environ. Sci. Health B 42, 835-841

[8]The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture was launched at FAO (SoWPGR-2) (2010): Country report on the state of plant genetic resources for food and agriculture country report, Republic of Serbia, Headquarters, Rome on 26 October, 2010;

[9]The Second Report on the State of the World's PGRFA, The state of ex situ conservation, Chapter 3, FAO, 2010

[10]http://www.organic-world.net/statistics-data-sources.html