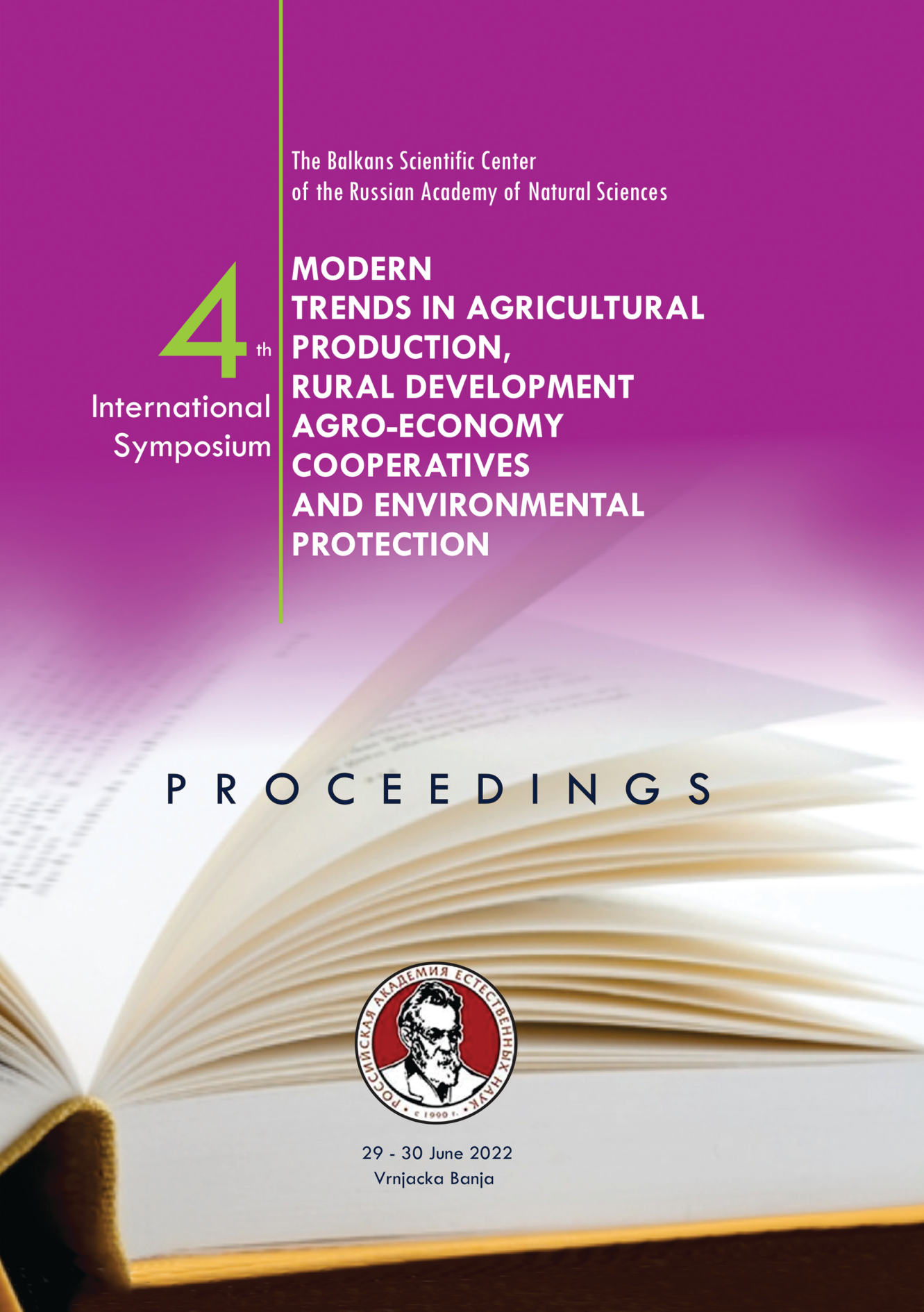
The Balkans Scientific Center
of the Russian Academy of Natural Sciences

4th International Symposium

MODERN TRENDS IN AGRICULTURAL PRODUCTION, RURAL DEVELOPMENT AGRO-ECONOMY COOPERATIVES AND ENVIRONMENTAL PROTECTION



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PROTECTION OF BIOLOGICAL RESOURCES - LEADING CHALLENGE IN ENVIRONMENTAL PROTECTION

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Abstract: *The term biodiversity includes the overall diversity of living organisms within the biosphere. In order for natural processes in ecosystems to take place, it is necessary to preserve all components of biodiversity. The cycles of the circulation of matter and the flow of energy are the basis for the maintenance of life on the planet, and take place in ecosystems thanks to the activity of plants, animals and microorganisms. In addition to enabling the maintenance of all life on the planet, biological resources, that is, living organisms, have an exceptional practical value for humans. Therefore, the protection and conservation of biological resources should be included in the implementation of activities related to environmental protection. In this paper, the importance of preserving the diversity of biological resources, as a group of the most important natural resources on the planet, is considered.*

Keywords: *biodiversity, biological resources, plants, animals, microorganisms.*

1. INTRODUCTION

The term biodiversity encompasses the overall diversity of living organisms within the biosphere. Given that each biological species has a unique role in the life cycle on the planet, it is necessary to preserve biodiversity, ie ecosystem, genetic and species diversity as the main components (Stevanović and Vasić, 1995; Popović, 2015; Šarčević-Todosijević et al., 2018a; Šarčević-Todosijević and Popović, 2019).

Without biodiversity there are no biogeochemical cycles and oxygen production, no ecosystem functioning, no photosynthesis, no decomposition of organic matter. Preserved biodiversity contributes to climate regulation, reduces the effect of greenhouse gases, maintains air and water quality (Popović, 2015; Šarčević-Todosijević et al., 2018a). In order for natural processes in ecosystems to take place, it is necessary to preserve the integrity of all components of the living community, that is, phyto, zoo- and microbiocenosis.

Plants, as the primary producers of organic matter, form the basis of the food chains of all ecosystems on the planet, but then animal organisms are also included in the food chain, so the importance of zoocenoses in the functioning of ecosystems is indisputable. Further stages of the cycle of matter circulation and energy flow take place in ecosystems thanks to soil microorganisms, which play a primary role in these processes. Through the enzymes they release into the environment, they are involved in almost all biochemical reactions of the soil related to cycles of C, N, P, S and microelements, in which the formation and degradation of soil organic matter occurs, and nutrients become available to plants again. Decomposition of organic compounds of carbon and nitrogen, dissolution of phosphates, oxidation of H_2S, nitrification, denitrification and nitrogen fixation, transformation of microelements and heavy metals, are just some of the processes that continuously occur in the soil by metabolic activity of microorganisms and enzymes that release (Jemcev and Đukić, 2000; Stevanović and Janković, 2001; Đukić and Đorđević, 2004; Šarčević, 2011; Šarčević-Todosijević et al., 2020). Therefore, microorganisms and other heterotrophic organisms, through their metabolic activity, enable the decomposition of organic compounds of carbon and nitrogen and make them re-available to plants for organic synthesis, which closes the life cycle on the planet. In addition to enabling the maintenance of life on the planet, biological resources, that is, living organisms, have exceptional practical value for humans. In food production at the planetary level, the primary role belongs to plant production, and flowering plants (Magnoliophyta) are of the greatest importance. Flowering plants (Magnoliophyta) include species that are intensively used in pharmacy, medicine

and other areas of human activity (Jančić, 2004; Šarčević-Todosijević et al., 2018a). Providing food for over seven billion people on the planet can only be achieved through agricultural production based on scientific principles. The beginning of the development of agriculture as a human activity, within which living organisms are used to obtain appropriate products, can be considered the beginning of biotechnology. Principles of biotechnology, such as breeding of plants and domestic animals, application of microorganisms and other organisms in the production of food and biologically active substances, genetic engineering, today have enabled the remarkable development of various fields of agriculture, forestry, molecular biology, pharmacy and medicine (Arnold, 2005; Popović, 2010; Popović, 2015; Thieman and Palladino, 2008). Modern development of biotechnology has also opened the possibility of applying biological systems, ie living organisms, in monitoring and bioindication, pollution prevention and bioremediation of polluted ecosystems and the environment (Đukić et al., 2013).

Therefore, it is indisputable that the protection and conservation of biological resources should be included in the implementation of activities related to environmental protection. In this paper, the importance of preserving the diversity of biological resources, as a group of the most important natural resources on the planet, is considered.

2. SIGNIFICANCE, APPLICATION AND PROTECTION OF BIOLOGICAL RESOURCES

Plant genetic resources, as biological resources, represent the entire plant material in the world and are of exceptional value to humans (Popović, 2015). Man first used plants that originated from wild flora, and then about 10,000 years ago he began to grow plants. During the history of agriculture, people have cultivated about 7,000 to 10,000 different plant species, and cultivated plants make up only 3-4% of the described plant species (Prodanović et al., 2015). Today, there are about 1300 registered institutions in the world that collect genetic resources, while the state of agrobiodiversity is indicated by the number of newly created varieties and local populations. On the national variety list, there are about 5000 varieties and about 200 plant species, which are grouped into the following groups: small grains and corn, industrial plants, fodder plants, vegetables and fruits and vines, aromatic and medicinal plants (Popović, 2015; Šarčević-Todosijević et al., 2018a). Živanović and Popović (2016) point out the data of the Statistical Office of the Republic of Serbia (2014) that in 2013, field and vegetable production in the Republic of Serbia took place on an area of 3.3 million hectares. The areas under wheat covered 563 000 hectares, and about 2.69 million tons

were produced. Corn, as the most important agricultural product, is sown on an area of about 1.19 million hectares, with an average production of about 5.8 million tons, while industrial plants were grown on an area of about 350 thousand hectares. Površine pod žitima zauzimale su 1,9 miliona hektara. The Republic of Serbia is among the largest producers of oilseeds in Europe, with the production of sunflowers, soybeans and oilseed rape dominating. Successful plant production of soybeans is achieved by choosing high-yielding varieties and appropriate production technology. In the Institute of Field and Vegetable Crops in Novi Sad, a total of 1500 varieties were created and registered, and over 150 NS varieties of soybeans. More than half of the varieties are recognized abroad, and a significant number are on the EU list. Soybean produced in the Republic of Serbia are not genetically modified, which ensures the security of exports to the world market (Živanović and Popović, 2016).

Biological diversity can best be recognized by studying the division Magnoliophyta (flowering plants), one of the most numerous groups within the plant kingdom. Flowering plants include the species on which the diet of all mankind is based, and they represent a significant resource of compounds with healing properties, which is why they are intensively used in pharmacy and medicine (Šarčević-Todosijević et al., 2018a). Numerous scientific studies indicate that the area of the Balkan (Sabovljević, 2003; Radojković et al., 2017; Huseinović et al., 2017; Šarčević-Todosijević et al., 2019; Popović et al., 2019) is extremely rich in medicinal herbs. Šarčević-Todosijević et al. (2018a), at the locality Košutnjak, collected and determined 32 plant species within 24 families of flowering plants: Rosaceae, Brassicaceae, Tiliaceae, Primulaceae, Salicaceae, Aristolochiacae, Violaceae, Liliaceae, Poaceae, Asteraceae, Geraniaceae, Apiaceae, Araliaceae, Hippocastanaceae, Cornaceae, Fabaceae, Fagaceae, Corylaceae, Betulaceae, Papaveraceae, Ranunculaceae, Sambucaceae, Plantaginaceae, Urticaceae. Determined plant species belonged to the mesophytes, the largest ecological group of terrestrial plants, which grow in temperate climates. Based on the conducted research, Šarčević-Todosijević et al. (2018a) conclude that a significant number of plant species with medicinal properties are present at the Košutnjak locality. The range of therapeutic effects of collected plant species is very wide, including antibacterial, antiviral, anti-inflammatory, antioxidant, anticancer, cytotoxic, antispasmodic, diuretic, sedative and many other effects, based on which the collected plant species are used in traditional and official phytotherapy (Šarčević-Todosijević et al., 2018a). to jest They possess exceptional value as plant genetic resources. Numerous plant species are of great importance in medicine. *Urtica dioica* is a plant whose effectiveness in the treatment of diabetes mellitus has been confirmed by numerous scientific studies (Figure 1).

Figure 1. *Urtica dioica*

(*source: https://www.sorianatural.com/plants/green-nettle-or-stinging-nettle-i-urtica-dioica-i-l*)

Figure 2. *Fagopyrum esculentum*

From the same aspect, it is important to note that the Balkan is a natural habitat of plant species, which are traditionally used in the treatment of diabetes mellitus, and whose effectiveness has been confirmed by numerous scientific studies: *Fagopyrum esculentum*, *Linum usitatissimum*, *Vaccinium myrtillus*, *Urtica dioica*, *Taraxacum officinale*, *Allium ampeloprasum* etc. (Matvejev, 1973; Dročić et al., 2020).

Šarčević-Todosijević and Popović (2019) point out that biological diversity can be best known by studying Insect, one of the oldest classes of the animal kingdom, which belongs to the phylum Arthropoda and includes nearly a million species, which have diverse morphology and way of life. Insects are the most numerous and successful group of Arthropoda on land, and since they process huge amounts of plant matter into their own proteins, which are then used through food chains by a number of consumers, they play a significant role in the biosphere. Ephemeroptera represents an ancient order of the class Insecta. The scientific name of Ephemeroptera is due to the short (ephemeral) life of the adults. After swarming and laying eggs, adult individuals fall to the water surface, where they

float like flowers (Janković et al., 1973; Krunić, 1994; Brittain and Sartori, 2003). They are extremely sensitive to changes in the quality of the environment, which occur due to pollution, so they have a significant role in bioindication. According to the key for determining saprobic zones by the percentage share of the most important groups of macrozoobenthos, waters in which the share of Ephemeroptera is higher than the share of larvae of other groups of insects, belong to the oligosaprobic zone, with predominant oxidative processes. The decrease in the number of Ephemeroptera, indicates the transition to the mesosaprobic zone, which is dominated by reduction processes, extremely unfavorable for a given ecosystem and all its cenobionts (Natchev, 1985; Cvijan, 2000).

Table 1. Overview and number of Ephemeroptera and other taxonomic groups in the studied localities of the river Ukrina in the municipality of Derventa (Republika Srpska, BiH) (Šarčević-Todosijević and Popović, 2019)

Taxonomic groups	**Localities**				
	L1	**L2**	**L3**	**L4**	**Average number (ind./m^2)**
Mollusca	7	1	14	2	**6**
Ephemeroptera	578	1109	3254	821	**1440**
a) Subordo Schistonota					
Familia Baetidae					
Baetis sp.	+		+	+	
Familia Ephemeridae					
Ephemera sp.	+	+	+	+	
Familia Heptageniidae					
Ecdyonurus sp.	+	+		+	
Epeorus assimilis Eaton	+	+	+		

Rhithrogena semicolorata Curt.					
Heptagenia sp.	+	+	+		
Familia Leptophlebiidae					
Paraleptophlebia sp.	+	+	+	+	
Familia Oligoneuriidae					
Oligoneuriella rhenana Imhoff.	+	+	+	+	
b) Subordo Pannota					
Familia Ephemerellidae					
Ephemerella ignita Poda	+	+		+	
Familia Caenidae					
Caenis macrura Stephens	+	+	+		
Caenis luctuosa Burmeister	+	+		+	
Plecoptera	34	82	/	27	**47**
Coleoptera	199	205	31	/	**145**
Diptera	111	83	79	9	**70**
Trichoptera	223	402	301	127	**263**

Šarčević-Todosijević and Popović (2019) studied the diversity and possibilities of protection of the Ephemeroptera of the river Ukrina, in the part of the flow that passes through the territory of the municipality of Derventa (Republika Srpska, Bosnia and Herzegovina). They determined a significant taxonomic diversity of the order Ephemeroptera, as well as the number of individuals/m^2. In the examined localities, Ephemeroptera dominate with an average number of 1440 individuals/m^2. In addition to Ephemeroptera, in a significantly smaller percentage, Mollusca, Plecoptera, Coleoptera, Diptera and Trichoptera are present. Mollusca with 6 individuals/m^2 has the lowest average number at the

examined localities, followed by Plecoptera with 47 individuals/m^2, Diptera with 70 individuals/m^2, Coleoptera with 145 individuals/m^2 and Trichoptera with 263 individuals/m^2 (Table 1). In the territory of the municipality of Derventa, Ephemeroptera significantly contribute to the biological diversity of the ecosystem of the river Ukrina. In food chains, in river ecosystems, larvae are of great importance because they represent food for cenobionts (especially fish). The Ukrina River is characterized by an rich ichthyofauna (Table 2). Fish species from the family Cyprinidae are the most numerous in the river. Most species feed on bottom organisms, most often eggs and larvae of aquatic insects, including representatives of the order Ephemeroptera.

Table 2. Overview of fish species in the river Ukrina (Šarčević-Todosijević and Popović, 2019)

Redni broj	Vrste
1.	*Acipenser ruthenus*
2.	*Ctenopharyngodon idella*
3.	*Acerina cernua*
4.	*Acerina schraetser*
5.	*Rutilus rutilus*
6.	*Noemacheilus barbatulus*
7.	*Chalcalburnus chalcoides*
8.	*Misgurnus fossilis*
9.	*Leuciscus cephalus*
10.	*Abramis brama*
11.	*Tinca tinca*
12.	*Cottus gobio*
13.	*Barbus meridionalis*

In addition to all the above roles, which they have in the ecosystem, the appearance of Ephemeroptera in the summer period of the year is a true natural rarity. However, in order to protect this group of insects, it is necessary to take into account measures to prevent pollution and habitat destruction (Šarčević-Todosijević and Popović, 2019; Šarčević-Todosijević et al., 2021).

Similarly, Šarčević-Todosijević et al. (2017; 2018b) examined the aquatic river invertebrate community, which is necessary for biological and ecological assessment of river water quality. At five localities of the Banjska river (in the area of Vranjska Banja), macrozoobenthos samples were taken seasonally for biological and ecological analysis. The aim of the study was to assess the saprobity index, biological indicator of water status and intensity of organic matter decomposition, ie the level of organic load of the river, based on the community of aquatic invertebrates as bioindicator organisms. The value of the saprobic index in all localities and in all seasons was within the limits of β-mesosaprobic waters or waters (II) class, which corresponds to moderate organic load. The inflow of wastewater significantly affects the composition of the macroinvertebrate community, based on which it is concluded that it is necessary to reduce the load of the river with organic matter and nutrients (Šarčević-Todosijević et al., 2017; 2018b).

In addition to plants and animals, there is no doubt that, given the role they play in ecosystems, microorganisms are their most important component and biological resource that needs to be protected. Different groups of microorganisms live in the soil, whose abundance, microbiological biomass and enzymatic activity are the most important indicators of soil fertility (Jarak et al., 2005; Đukić et al., 2007). Microorganisms involved in the cycle of matter in the soil, mainly include aerobic, anaerobic and facultatively anaerobic bacteria and fungi (Simić, 1989; Đukić and Đorđević, 2004; Đukić et al., 2007).

Determining the number of actinomycetes can serve as an indicator of soil fertility. Phylogenetically, actinomycetes belong to the group of Gram-positive bacteria. Most organisms in this group have common properties; they are rod-shaped, aerobic organotrophs and mostly immobile in the vegetative phase (Madigan et al., 1997). These are soil microorganisms, adapted to grow in relatively dry conditions, with pronounced hydrolysis activity against various polymers, and especially chitinolytic activity on fungal substrate (Đukić and Đorđević, 2004).

In addition to the important role they play in the biogeochemical cycles in the biosphere (Odum, 1972), actinomycetes are the object of intensive research in biotechnology due to the ability to synthesize antibiotics. This ability undoubtedly provides this group of organisms greater competitiveness in nature (Đukić and Đorđević, 2004). Šarčević-Todosijević et al. (2020) studied the influence of ecological factors and nitrogen fertilizers on the number of actinomycetes of chernozem soil, in the climatic conditions of eastern Srem, in different physiological phases of maize development. It was determined that the phenophase of the plant significantly influenced the number of actinomycetes during the research period. The number of actinomycetes was more pronounced

in the phenophase of plant maturation compared to the phenophase of flowering. Although actinomycetes belong to the group of drought-resistant microorganisms, higher precipitation and the availability of water in the soil in the phenophase of plant maturation have conditioned the proliferation of actinomycetes. The number of actinomycetes ranged from 4.0-21.0 x $10^4 g^{-1}$. The number of actinomycetes was significantly influenced by the applied fertilizers and mainly increased the number of this group of microorganisms. A similar trend was observed in the phenophase of flowering and in the phenophase of plant maturation. In the phenophase of maize flowering, the highest number of actinomycetes was observed in the variant in which was applied N_{120} kg ha^{-1}, both on "ugar" (14.6 x $10^4 g^{-1}$) and under plant crops (13.5 x $10^4 g^{-1}$). The amount of nitrogen of N_{180} kg ha^{-1} significantly reduced the number of this group of microorganisms (Šarčević-Todosijević et al., 2020). This research also showed that soils under cultivated plants are very rich in microorganisms, that microorganisms play a key role in improving soil fertility, increasing crop yields, and that they are very sensitive to environmental factors, especially anthropogenic, in ecosystems.

Mineral fertilizers increase the biological productivity of agroecosystems and the yield of cultivated plants, but their increased use causes environmental pollution, eutrophication and groundwater pollution, accumulation of nitrates and heavy metals in soil and plants and the formation of carcinogenic nitrosamines. Therefore, the rational use of mineral fertilizers is a priority in agricultural production, with the aim of preventing environmental pollution (Jemcev and Đukić, 2000; Živanović et al., 2018; Kolarić et al., 2021).

There are a large number of microbial biopreparations, that is, microbiological fertilizers. Microbiological fertilizers contain live microorganisms, which, when introduced into the rhizosphere, increase the availability of nutrients and promote plant growth. These preparations do not contain chemical additives, but live microorganisms, which have a positive effect on both the soil and the plant; increase the availability of nutrients and promote plant growth, synthesize and decompose humus, ensure the circulation of nutrients, produce a variety of biologically active substances, which positively affect the yield of cultivated plants and control the number of phytopathogenic organisms. The microorganisms in the composition of these preparations are isolated from the ecosystem. They include different ecophysiological groups of microorganisms (Jemcev i Đukić, 2000; Mirecki et al., 2011). Heterotrophic bacteria break down organic compounds of nitrogen and phosphorus and translate them into a form accessible to plants. *Azotobacter* sp. belongs to the group of nitrogen-fixing bacteria. It is a group of microorganisms that absorb elemental nitrogen and reduce it to ammonia, while bacteria of the genera *Rhizobium* and

Bradyrhizobium are used to stimulate the formation of nodules and increase symbiotic nitrogen fixation in legumes. All these groups of bacteria in the composition of microbiological biopreparations, intensify the processes of matter circulation in agroecosystems, increase the biological productivity of agroecosystems and the yield of cultivated plants, and have no negative effects on the environment (Đukić et al., 2007).

There is no doubt that the increased and uncontrolled use of pesticides, causes environmental pollution, their accumulation in food chains, and the manifestation of toxic, mutagenic and carcinogenic effects on members of bicenosis. Biopesticides are biological preparations for protection of plants from pests, plant pathogens and weeds, do not have a negative impact on the environment and are intensively used in organic production (Đukić et al., 2007). Modern plant protection technologies include the creation of unfavorable conditions for the development of plant diseases through the application of agrotechnical measures, the use of antagonistic organisms and their biological products, superparasites or predators, the introduction of competitive species individually or together, the use of less harmful chemical pesticides (Grgić, 2009). The use of biopreparations encourages mechanisms of environmentally safe protection of plants from pests. Unlike chemical pesticides, which are the group of the most important causes of environmental pollution, biopesticides act only on target organisms, phytophages, phytopathogens and weeds and, through natural processes of regulation, suppress their abundance (Đukić et al., 2007).

3. CONCLUSION

Cycles of matter and energy flow are the basis for maintaining life on the planet, and take place in ecosystems thanks to the activity of plants, as primary producers of organic matter, but also the activity of heterotrophic organisms, which decompose organic compounds and make them available to plants for organic synthesis. In addition to enabling the maintenance of all life on the planet through their activities, biological resources, that is, living organisms, have an exceptional practical value for humans. Plant species enable the nutrition of all mankind, but they are also intensively used in medicine, pharmacy and other areas of human activity. The principles of modern biotechnology have ensured the intensive development of agriculture, forestry, molecular biology, medicine and pharmacy, as well as the application of living organisms in the production of food, biologically active substances and environmental protection. Based on that, the leading goals in environmental protection should include the conservation of

natural resources, among which the most important place belongs to the plants, animals and microorganisms.

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4. LITERATURE

Arnold, J.P. (2005). Origin And History of Beer And Brewing From Prehistoric Times to the Beginning of Brewing Science And Technology, Cleveland, Ohio: BeerBooks.

Brittain, J.E., Sartori, M. (2003). Ephemeroptera (Myflies), In: Resh, V.H., Carde, R.T. (eds) Encyclopedia of Insects, Academic Press, California, USA.

Cvijan, M. (2000). Ekologija zagađenih sredina, bioindikatori i monitoring sistem, Univerzitet u Beogradu, Biološki fakultet.

Dročić, M., Šarčević-Todosijević, Lj., Petrović, B., Vukomanović, P., Đorđević, S., Đorđević, N., Popović, V., Živanović, Lj. (2020). Mogućnost primene biljaka u prevenciji i lečenju dijabetesa, XXV Savetovanje o biotehnologiji sa međunarodnim učešćem, Univerzitet u Kragujevcu, Agronomski fakultet u Čačku, Zbornik radova, 1, 105-110.

Đukić, D., Đorđević, S. (2004). Prirodoslovna mikrobiologija, Stylos, Novi Sad.

Đukić, D., Jemcev, V., Kuzmanova, J. (2007). Biotehnologija zemljišta. Budućnost. Novi Sad.

Đukić, D., Trifunović, B., Đorđević, S., Mandić, L., Marković, G., Brković, D., Tanasković, S., Mašković, P. (2013). Bioindikacija i biotestiranje zagađenosti životne sredine, "Budućnost" DOO, Novi Sad.

Grgić, A. (2009). Biološki fungicidi i insekticidi u paleti Stockton-a, Zbornik sažetaka 53. seminara biljne zaštite – Glasilo biljne zaštite, 1/2: 54-55.

Huseinović, S., Bektić, S., Čivić, S. (2017). Inventarizacija ljekovitog bilja u tradicionalnoj fitoterapiji. XII savetovanje o biotehnologiji, Zbornik radova, Knjiga 2, 661-666, Agronomski fakultet u Čačku.

Jančić, R., Botanika farmaceutika (2004). Službeni list SCG, Beograd.

Janković, M., Blečić, V., Glišić, LJ., Marinković, D., Marinović, R., Mikulić, F., Nešković, M., Pantić, V., Petrović, V., Pljakić, M., Tešić, Ž. (1973). Enciklopedijski leksikon-biologija, Novinsko-izdavačka ustanova "Interpres", Beograd.

Jarak, M., Milošević, N., Mrkovski, N., Đurić, S., Marinković, J. (2005). Mikrobiološka aktivnost - pokazatelj plodnosti i degradacije zemljišta, Ekonomika poljoprivrede,Vol. 52, br. 4, str. 483-493.

Jemcev, V., Đukić, D. (2000). Mikrobiologija, Vojnoizdavački zavod, Vojna knjiga, Beograd.

Kolarić, L., Popović, V., Živanović, L., Ljubičić, N., Stevanović, P., Šarčević-Todosijević, L., Simić, D., Ikanović, J. (2021). Buckwheat Yield Traits Response as Influenced by Row Spacing, Nitrogen, Phosphorus, and Potassium Management, Agronomy 2021, 11, 2371. Manuscript ID: agronomy-1471521; doi: 10.3390/agronomy11122371. Basel, Switzerland.

Krunić, M. (1994). Zoologija invertebrata, Zavod za udžbenike i nastavna sredstva, Beograd.

Madigan, M., Martinko, J., Parker, J. (1997). Biology of Microorganisms, Eighth Edition, Prentice Hall. International, Inc. New Yersey.

Marišovà, E., Milovanović, J., Đorđević, S., Jerekovà, Z., Dražić, G., Hauptvogl, M., Prčik M., Mariš, M., Kortla, M., Fandel, P., Ilkova, Z., Gaduš, J., Popović, V., Ikanović, J., Živanović, Lj., Radojević, U., Kovàčik, M., Mandalovà, K. (2016). Agro-energy for sustainable agriculture and rural development. Good practices from Slovakia-Serbia bilateral cooperation. Agentúra na podporu vỳskumu a vỳvoja and Ministarstvo prosvete, nauke i tehnološkog razvoja, Vlada Republike Srbije - Futura, Singidunum University, Belgrade. Monograph. CD Rom Copy, 300. 1-291.

Matvejev, S. D. (1973). Predeli Jugoslavije i njihov živi svet, Naučna knjiga, Beograd.

Mirecki, N., Wehinger, T., Repič, P., Jaklič, M., Stanišić, V., Bubanja, S., Zuber, D., Ćetković, D., Babović, G., Baćović, S., Bijelić, S., Petrović, S. (2011). Priručnik za organsku proizvodnju - za poljoprivredne proizvođače, Biotehnički fakultet, Podgorica.

Natchev, N. (1985). Interrelation between Non-Specific Categories of Benthic Macrofauna as Criterion for Saprobic Zone Determination of Blagoevgradska Bistritza River, Hydrobiology 24, 23-31.

Odum, E.P. (1972). Fundamentals of Ecology, Third Edition, W.B. Philadelphia: W.B. Saunders Company.

Popović, V. (2010). Agrotehnički i agroekološki uticaji na proizvodnju semena pšenice, kukuruza i soje. Doktorska disertacija. Univerzitet u Beogradu, Poljoprivredni fakultet Zemun, 1-145.

Popović, V. (2015). Pojam, podela i značaj bioloških resursa u poljoprivredi, Ured. Milovanovic, J., Đorđević, S.: Očuvanje i unapređenje bioloških resursa u službi ekoremedijacije, Monografija, Beograd, ISBN 978-86-86859-41-9; 1-407. 29-51.

Popović, V., Marjanović Jeromela, A., Jovović, Z., Filipović, V., Ugrenović,V., Kolarić, Lj., Šarčević-Todosijević, Lj. (2019). Linseed (*Linum usitatissimum* L.) Production Trends in the World and in Serbia. Ed. Janev. I. Chapter in Book ISBN: 978-1-53614-897-8, Book Title: Serbia: Current Issues and Challenges in the Areas of Natural Resources, Agriculture and Environment. NOVA Science Publishers, Inc., NEW YORK, USA, 123 - 147.

Prodanović, S., Momirović-Šurlan, G., Rakonjac, V., Petrović, D. (2015). Genetički resursi biljaka, Univerzitet u Beogradu, Poljoprivredni fakultet.

Radojković, M., Mašković, P., Đurović, S., Filipović, V., Filipović, J., Vujanović, M., Nićetin, M. (2017). Tehnološki potencijal lekovitog bilja Balkana. XII savetovanje o biotehnologiji, Zbornik radova, Knjiga 2, 479-483. Agronomski fakultet u Čačku.

RZS - Strategija poljoprivrede i ruralnog razvoja Republike Srbije za period 2014-2024. godine ("Sl. glasnik RS", br. 85/2014).

Sabovljević, M. (2003). Geobotanička studija brioflore Vojvodine, Magistarska teza, Univerzitet u Beogradu, Biološki fakultet.

Simić, D. (1989). Mikrobiologija, Univerzitet u Beogradu, Prirodno-matematički fakultet.

Stevanović, V., Vasić, V. (1995). Biodiverzitet Jugoslavije sa pregledom vrsta od međunarodnog značaja, Ecolibri, Univerzitet u Beogradu, Biološki fakultet, Beograd.

Stevanović, B., Janković, M. M. (2001). Ekologija biljaka sa osnovama fiziološke ekologije biljaka, NNK, Beograd.

Šarčević, Lj. (2011). Uticaj količine azotnog đubriva na mikrobiološku aktivnost zemljišta pod usjevom kukuruza, Magistarska teza, Univerzitet u Beogradu, Poljoprivredni fakultet.

Šarčević-Todosijević, Lj., Marinović, B., Dražić, G., Popović, V., Živanović, Lj. (2017). Saprobiological Analysis of Water Quality in the Banska River based on Indicators of Clear and Polluted Water, XXI International ECO-CONFERENCE® 2017, XII Environmental Protection of Urban and Suburban Settlements, Novi Sad, 89-96.

Šarčević-Todosijević, Lj., Petrović, B., Marinković, T., Živanović, Lj., Popović, V. (2018a). Pregled lekovitih biljnih taksona razdela Magnoliophyta na lokalitetu Košutnjak, XXIII savetovanje o biotehnologiji sa međunarodnim učešćem, 339-345.

Šarčević-Todosijević, Lj., Popović, V., Marinović, B., Živanović, Lj., Ikanović, J., Simić, D., Šašić – Zorić, Lj. (2018b). A Locality Influence on Biological and Ecological Quality of the River Water, XXII International Eco-Conference, X Safe Food, Novi Sad, 66-74.

Šarčević-Todosijević, Lj., Popović, V. (2019). Diverzitet reke Ukrine s posebnim osvrtom na Ephemeroptera, 6. međunarodna naučna agrobiznis konferencija MAK-2019 "Evropski put - put uspeha", Kopaonik, Zbornik radova, 193-209, ISBN 978-86-80510-05-7.

Šarčević-Todosijević, Lj., Popović, V., Živanović, Lj, Popović, S. (2019). The Possible Use of Allelopathic Relationships in Plant Growing. Ed. Janev. I. Chapter in Book ISBN: 978-1-53614-897-8, Book Title: Serbia: Current Issues and Challenges in the Areas of Natural Resources, Agriculture and Environment. NOVA Science Publishers, Inc., NEW YORK, USA, 105-121.

Šarčević-Todosijević, Lj., Popović, V., Đorđević, S., Živanović, Lj., Filipović, V., Đorđević, N., Golijan, J. (2020). Influence of Some Ecological Factors on the Number of Soil Actinomycetes in Different Physiological Phases of Development of Maize, International GEA (Geo Eco-Eco Agro) Conference, University of Montenegro, 28-31 May 2020, Book of Proceedings, 176-180, Podgorica.

Šarčević-Todosijević, Lj., Popović, V., Đorđević, S., Perić, M., Živanović, Lj., Đorđević, N., Stevanović, A. (2021). Endangerment of the biological minimum and eutrophication – factors of disturbance of ecological balance and sustainability of the Ukrina river ecosystem, XXV International ECO-CONFERENCE® 2021 XIV Environmental protection of urban and suburban settlements, 22th–24th September, 2021, Novi Sad, Serbia. Book of Proceedings, p. 77-84.

Thieman, W. J., Palladino, M. A. (2008). Introduction to Biotechnology, ISBN 978-0-321-49145-9.

Živanović, Lj., Popović, Lj. (2016). Proizvodnja soje (*Glycine max*) u svetu i kod nas, XXI Savetovanje o biotehnologiji sa međunarodnim učešćem, Univerzitet u Kragujevcu, Agronomski fakultet u Čačku, Zbornik radova, Vol. 21.(23), 129-135.

Živanović, Lj., Golijan, J., Šarčević-Todosijević, Lj., Popović, V., Ikanović, J. (2018). Uticaj tipa zemljišta, količine azota i hibrida na sadržaj ukupnih proteina u zrnu kukuruza, Održiva primarna poljoprivredna proizvodnja u Srbiji - stanje, mogućnosti, ograničenja i šanse, Fakultet za Biofarming, Bačka Topola, Zbornik radova, 158-165.

Urtica dioica: https://www.sorianatural.com/plants/green-nettle-or-stinging-nettle-i-urtica-dioica-i-l

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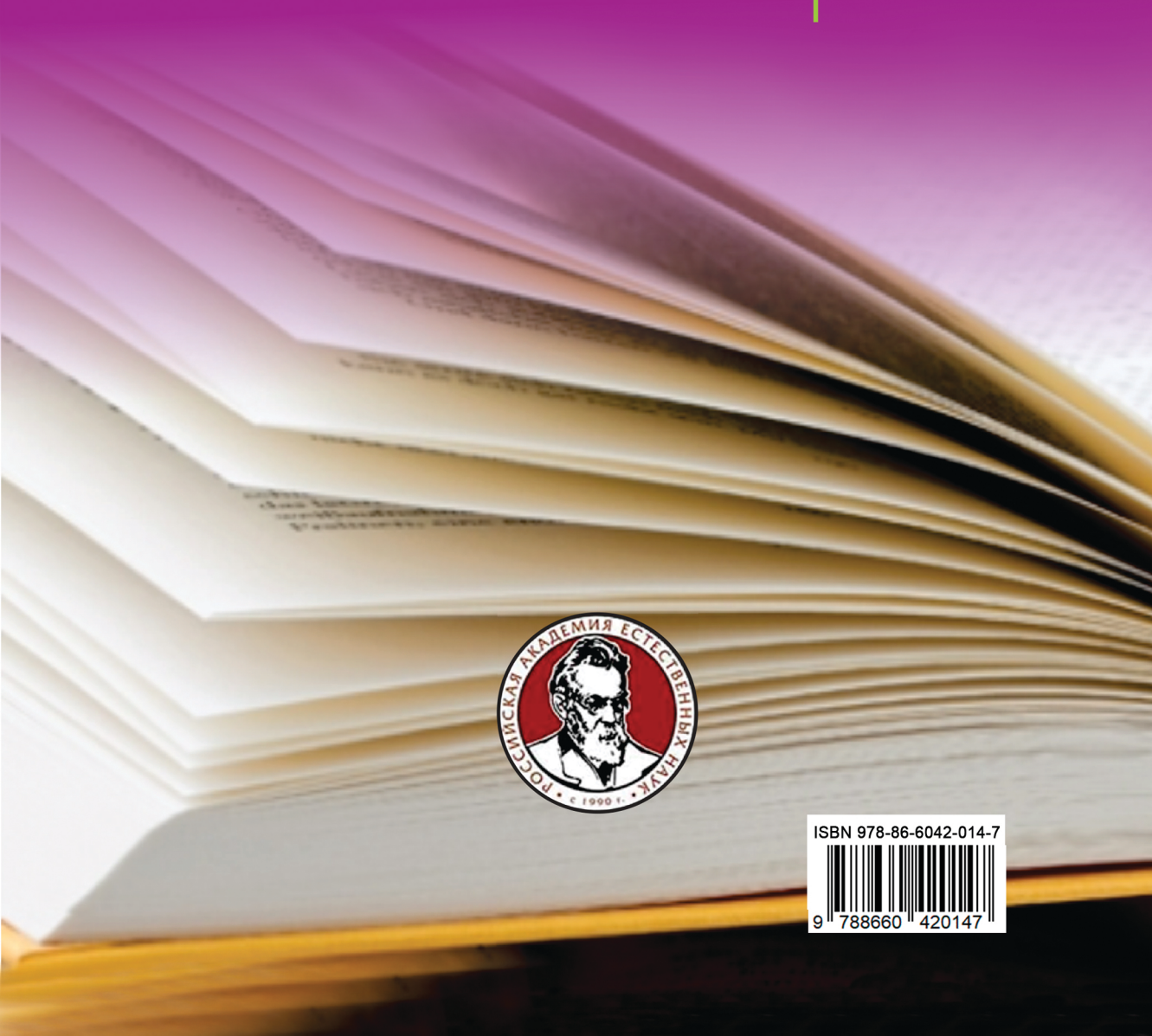

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