International Network AgroBioNet activities on agrobiodiversity conservation in East Europe

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Abstract. The article describes the activities of the Institute of Biodiversity Conservation and Biosafety at the Slovak University of Agriculture in Nitra and the history of creation the International Network AgroBioNet. A chronology of research projects and international conferences is presented. Information on educational projects and adult education programmes is given. Publishing activities of the members of the international projects is analyzed. The Journal 'Agrobiodiversity for the Improvement of Nutrition, Health and Life Quality', which has been published since 2017, is an online platform where the results of collaborative research are accumulated.

1. Introduction

The Convention on Biological Diversity is one of the most important international conventions in the field of the environment and the conservation of Life on Earth. It was signed at the United Nations Conference on Environment and Development on 5 June 1992 in Rio de Janeiro. The Convention is a very noble and necessary aim for the conservation and development of contemporary civilization. But after 28 years, the situation has not changed for the better. The IPBES7 Biodiversity Conference in Paris on April 29th 2019 adopted the global 1800-pages report on the state of Earth's ecosystems. More than 150 experts reported: "Up to now, the importance of biodiversity is discussed, particularly from an environmental point of view. Unfortunately, immediate acceleration of species extinction is expected, and this will happen the next decades for many species" [1].

Biodiversity, and especially agrobiodiversity, forms the basis for the existence of civilization. At the level of agrobiodiversity, civilization can use more than 70 000 species, but in fact only about 7000 of these resources are used. And every year not only species but also cultivars are lost. The decline in agro-biodiversity is the result of the intensification of agricultural production, in which it is economically viable to produce homogeneous products over large areas.

Across the world, many of the plant species that are cultivated for food are neglected and underutilized while they play a crucial role in the food security, nutrition, and income generation of the rural poor [2]. While these crops continue to be maintained by cultural preferences and traditional practices, they remain inadequately characterised and neglected by research and conservation. Lack of
attention has meant that their potential value is underestimated and underexploited. It also places them in danger of continued genetic erosion and disappearance which would further restrict development options for the poor. Many neglected and underutilized crop species (NUCS) are nutritionally rich \cite{3-6} therefore, their erosion can have immediate consequences on the nutritional status and food security of the poor and their enhanced use can bring about better nutrition and fight hidden hunger.

It is now widely recognized that the dramatic increase in agricultural production and productivity has been accompanied by negative consequences, so serious that they have threatened the food security of the Earth. A paradigm shift has taken place. A common understanding has emerged that an ecosystem approach must underpin intensification of crop production. Sustainable crop production intensification is based on the following key points: 1) maintaining healthy soils to improve plant nutrition; 2) growing a wider range of plant species and varieties, using combinations, sequences and crop rotations; 3) using of well-adapted, high-yielding varieties and high-quality seeds; 4) integrated pest, disease and weed management; 5) rational use of water resources \cite{7}.

In Slovakia, the Program for conservation and use of agrobiodiversity began in 1974 at the Department of Genetics and Plant Breeding. In the first period, the focus was on studying the economic value and quality of the gene pool of registered varieties of summer wheat, peas, and potatoes. In 1991, the collective of Department of Genetics and Plant Breeding initiated a long-term research program called ‘Conservation of Endangered Gene Pool of Plant Species in Slovakia’. The establishment in 2005 of a specialized centre the Institute of Biodiversity Conservation and Biosafety has created the conditions for the realization of a research and training program for the biodiversity conservation, focusing on endangered plant species, agro-biodiversity and its sustainable exploitation in the plant breeding, seed production, agri-food, nutrition, rural development, biological and food safety and the conservation of natural and cultural heritage.

The purpose of this paper is to trace the stages of scientific research on agrobiodiversity conservation.

2. Materials and methods
Literary sources: reports from Institutes, scientific articles, collections of meetings held in 2005-2020 and conference abstracts were the materials of this study.

3. Results and discussion
3.1. International Network AgroBioNet
In 2013, the Institute of Biodiversity Conservation and Biosafety at the Slovak University of Agriculture in Nitra in cooperation with the Department of Fruit Plants Acclimatization of the M.M. Gryshko National Botanical Garden at the National Academy of Sciences of Ukraine in Kyiv initiated the establishment of International Network AgroBioNet. Targets of the international network are declared in the Memorandum of the international research, education and development program ‘Agrobiodiversity for the Improvement of Nutrition, Health, and Life Quality’. Networking activities are focused on the development of international cooperation in the use of traditional, forgotten, less-used and less-known plant species. Promoting of food security, expanding and using plant species for improving the human health, improving the socio-economic rural development, creating the conditions for the multiplication and cultivation of new plant species are the priorities of the program. More than 250 experts and over 30 studies from 21 countries have been officially registered in the International network, which has many activities (Table 1).
| Country          | Institutions                                                                 |
|------------------|------------------------------------------------------------------------------|
| Ukraine          | M.M. Gryshko National Botanical Garden of National Academy of Sciences, Kyiv |
|                  | Uzhgorod National University, Scientific-Research Institute of Phytotherapy, |
|                  | Uzhgorod                                                                     |
|                  | State Enterprise Experimental Farm “Novokakhovska”, Nova Kakhovka            |
|                  | National University of Life and Environmental Sciences of Ukraine, Kyiv       |
|                  | National Aviation University, Institute of Ecological Safety, Kyiv             |
|                  | Ukrainian Institute Ecology of Man, Kyiv                                      |
| Russia           | N.V. Tsitsin Main Botanical Garden of Russian Academy of Sciences, Moscow     |
|                  | Federal Horticultural Research Centre for Breeding, Agrotechnology and       |
|                  | Nursery, Moscow                                                              |
|                  | State University – Teaching, Research and Production Complex, Oryol          |
|                  | N.I. Vavilov Research Institute of Plant Industry, St. Petersburg            |
| Czech Republic   | Institute of Chemical Technology, Prague                                     |
| Armenia          | Armenian National Agrarian University, Yerevan                                |
| Republic of      | State Agrarian University of Moldova, Chisinau                               |
| Moldova          | Institute of Genetics, Physiology and Plant Protection, Academy of Sciences  |
|                  | of Moldova, Chisinau                                                         |

3.2. Educational projects and adult education program

Six educational projects have been realized these years – KEGA, AgrobiodiversityEduca, OrganicFarmingEduca, ApiEduka, FarmersEduca, BeeEduca by the preparing and reviewing of educational programs, lectures, and textbooks, organization, and evaluation of courses. The projects also included 6 specialized courses for beekeepers, teachers, farmers, managers, and other groups, which were attended by more than 500 participants in Slovakia, Serbia, Ukraine, Moldova, and Armenia.

3.3. International Conferences

Five International Scientific Conferences on conservation and utilising of non-traditional plant species have been held within the framework of the AgroBioNet: 'Non-Traditional, New and Forgotten Plant Species: Scientific and Practical Aspects of Cultivation' (2013 Kyiv, Ukraine); 'Agrobiodiversity for Improve the Nutrition, Health and Quality of Life' (2015 Nitra, Slovakia); 'Organic Agriculture for Agrobiodiversity Preservation' (2017 Novi Sad, Serbia); 'Agrobiodiversity for Improve the Nutrition, Health and Quality of Human and Bees Life' (2019 Nitra, Slovakia); 'Save Endangered Bees to Improve Nutrition, Health and Life Quality of Human' (2019 Nitra, Slovakia). The International Festival 'Cornelian Cherry' is held annually at the Arboretum in Bolestraszyce (Poland).

3.4. Research stays of PhD students and researchers

Annually, 15–30 scientists and PhD student graduate research stay from one week to 10 months at the Institute of Biodiversity Conservation and Biosafety and other workplaces. Research stays were financially supported by the SAIA Agencies, the International Visegrad Fund, Erasmus-World, and Bilateral Agreements between the Ministry of Education of the Slovak Republic and the Ministries of Education of Culture and Research of other countries (Table 2). The achieved results and findings from the research still contributed to the professional development of the participants.
Table 2. Research projects (2006–2019)

| Term solutions | Project |
|----------------|---------|
| 2006–2016      | MVT-SK-UA-06 Non-Traditional Plant Species and Their Products in Quality of Life |
| 2006–2016      | MVT-SK-RU-UA-07 Bee Pollen for Agri-Food and Phytotherapy |
| 2007–2009      | SAMRS 2007/01/42 Education and Support of Organic Farming and Production of Organic Food Products in the Báč Region, Republic of Serbia |
| 2009–2011      | KEGA 3/7448/09 Genetic Resources of Food in Support of the Development of Risk Capital Market |
| 2010–2014      | ITEBIO ITMS 26220220115, Supporting the Innovation of Technologies of Special Organic Food Products for Healthy Human Nutrition |
| 2013–2015      | KEGA 040SPU-4/2013 Diversification of Teaching the Subject of Plant Breeding for the Development of Business Skills Using Multimedia |
|                | TRIVE ITMS 25 110 320 104 Development of International Cooperation for the Purpose Transfer and Implementation of Research and Development Results into Educational Programs |
| 2014–2015      | ITMS 25 110 320 104 Innovation of Test Methods and Procedures for the Detection of Sources of Bioactive Substances for the Improvement of Health and Quality of Life |
| 2015–2016      | VF 11540020 Biodiversity Changes After the Chernobyl Disaster |
| 2015–2020      | MDa/SR/SPU1/15 MVTS Development of Bioregulators and Biopesticides |
| 2017–2018      | VF21640443 Visegrad Fund. FarmersEduca – Neglected and Underutilized Species in the Socio-Economic Rural Development |
| 2019–2020      | V4-21910411 Visegrad Fund. SaveEduca – Save Endangered Bees to Improve Nutrition, Health and Quality of Life |

3.5 Transition from classical traditional species to non-traditional species and their use

The research and educational program within the framework of international cooperation is implemented on three levels. In the first stage, attention is focused on the Conservation of Forgotten Regional and Ancient Cultivars of Plant Species, which form in each country of the world the part of natural resources and cultural heritage (Malus, spp., Pyrus spp., Cerasus spp., Legumes, cereals and other species). This valuable collection of genotypes presents irreplaceable genetic resources for plant breeding for their high tolerance to biotic and abiotic environmental factors [8-9].

In the second level, attention is paid to underutilized plant species, which are widespread throughout the country and regions, but the population used them only by harvesting fruits, seeds and other parts of plants for practical use in nutrition, health and quality of life (Cornus mas, Sorbus domestica, Morus nigra, Mespilus germanica, Rosa canina and others). This group is also referred to as "social plant species". The poorer people harvest significant parts of wild populations for sale in local markets to improve their financial situation. These plant species are vital to sustainable agriculture [10-14].

The third group is focused on less-known species. It is a group that has not been cultivated in the country so far, but current climate change allows their cultivation and spread (Cydonia oblonga Mill, Diospyros virginiana L., Elaeagnus multiflora Thunb., Hippophae rhamnoides L., Lycium spp., Pseudocydonia sinensis (Thouin) CK Schneid., Ziziphus jujuba Mill., etc. These lesser-known species can be practically used mainly by family and young farmers for their socio-economic development. Therefore, there is a special interest in their expansion and using [15-18].

3.6. Publishing activities

The knowledge obtained from research is relevant and the results of research projects are presented by cooperating teams in scientific publications. During the period of active cooperation with many
institutions from 14 countries, more than 200 publications have been published. Experts from contract institutions have prepared more than 90 e-lectures for specialized training courses.

The results of the project and research stay are presented by participants and experts every year in 20–50 scientific publications (Figure 1).

![Figure 1. Published research works in scientific journals and proceedings of conferences (2005–2020)](https://agrobiodiversity.uniag.sk/scientificpapers)

3.7. **Agrobiodiversity on-line Proceedings of scientific papers**

Proceedings of scientific papers entitled 'Agrobiodiversity for Improving of Nutrition, Health and Quality of Life' is issued annually by the Slovak University of Agriculture in Nitra and M. M. Gryshko National Botanical Garden of the National Academy of Sciences of Ukraine in Kyiv, within the jointly established international network AgroBioNet. The original scientific papers oriented on the conservation and sustainable use of genetic resources of the traditional, forgotten, underutilized and less-known plant species are presented in the Proceedings to support the increase of food safety, food security, biosafety, plant breeding and expansion, use of plant species for the improvement population health, ensuring the remediation of the natural resources and environment, improving the socio-economic rural development and creating the conditions for the development of regional economy and supporting the development of small and medium-sized farms. Every year, more than 40 scientific publications are presented in the Proceedings ([https://agrobiodiversity.uniag.sk/scientificpapers](https://agrobiodiversity.uniag.sk/scientificpapers)). The scientific series is indexed by bibliographic databases CABI.

4. **Conclusion**

In the two decades since the Institute of Biodiversity Conservation and Biosafety was founded in Slovakia, the agro-biodiversity conservation programme has evolved from a patchwork of isolated studies to a powerful international organization. The international network AgroBioNet currently consists of more than 250 experts and over 30 researchers from 21 countries. Five scientific conferences have resulted in a list of underutilized species and cultivars that are promising for wide introduction to improve nutrition, health and quality of life.

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