

SUSTAINABLE UTILISATION OF PLANT GENETIC RESOURCES FOR AGRICULTURE AND FOOD

BOOK OF ABSTRACTS

**International
scientific
conference
18 – 20 October 2016
Piešťany
Slovak Republic**



**NATIONAL AGRICULTURAL
AND FOOD CENTRE
RESEARCH INSTITUTE OF
PLANT PRODUCTION**

National Agricultural and Food Centre - Research Institute of Plant Production

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CONTENT

Content-----	3
Organizers and programme-----	7
Abstracts of oral presentation	
Nersisyan, A.: FAO activities and contribution in the field of plant genetic resources in the region-----	15
Session 1 Conservation and utilisation of Plant Genetic Resources	
Hauptvogel, P.; Benediková, D.; Benková, M. et al.: The contribution of plant genetic resources to sustainable agricultural development in Slovakia-----	18
Grausgruber, H.; Hochhauser, F.; Naderer, L. et al.: Utilisation of plant genetic resources for food and feed: case studies of spelt wheat and barley-----	19
Holubec, V.: <i>Aegilops</i> distribution revision in the Czech and Slovak Republics, collection and enotyping-----	20
Kamenetsky Goldstein, R.: The effective use of <i>Allium</i> genetic resources: benefits and pitfalls in the development of new horticultural crops -----	21
Session 2 Molecular characterisation and data processing Plant Genetic Resources	
Barazani, O.; Westberg, E.; Dag, A. et al.: Genetic variations in old olive trees open a window into the history of olive cultivation in the southeast Mediterranean-----	25
Muñoz Organero, G.; Cabello, F.; Gaforio, L. et al.: Recovery of minor old grape varieties in Spain-----	26
Štefúňová, V.; Žiarovská, J.; Bežo, M.; Kysel', M.: <i>BARE-1</i> - horizontal profiling of cereal genomes-----	28
Mendel, L.; Hauptvogel, P.; Benková, M. et al.: GRISS - Documentation system of plant genetic resources of Slovakia-----	29
Brindza, J.; Gažo, J., Miko, M.: Conservation and utilization of plant genetic resources in the research and educational programme of the Slovak University of Agriculture in Nitra-----	30
Session 3 Evaluation of Plant Genetic Resources	
Topçu, T.; Karik, Ü.: Some morphological and quality characteristics of Anatolian Sage (<i>Salvia fruticosa</i> Mill.) populations in Aegean and West Mediterranean Region-----	33
Kacharava, T.: Medicinal, aromatic and spice plants' genetic resources, protection in Georgia	34
Fejér, J.; Gruľová, D.; Gajdošová, A.: Study of medicinal plants genetic resources at the Prešov University-----	35
Sivicka, I.: Activities on genetic resources of medicinal and aromatic plants at Latvia University of Agriculture-----	36
Čičová, I.: Status of medicinal and aromatic plants in Slovakia-----	37

Karik, Ü.; Topçu, T.: Domestication, selection and, breeding of golden thistle (<i>Scolymus hispanicus</i> L.)-----	38
Ziffer-Berger, J.: Phylogeny of the genus <i>Raphanus</i> -----	39
Hozlár, P.; Matúšková, K.; Čemanová, D.; Havrlentová, M.: Assessment of <i>Avena</i> genetic resources in the Slovak <i>Avena</i> L. collection-----	40
Benková, M.; Mendel, L.; Havrlentová, M.: The potential of Slovakia barley germplasm-----	41
Chojnowski, M.; Fu-Dostatny, D.; Małuszyńska, E. et al.: Quality of seeds of tomato accessions collected in the framework of National Programme of Genetic Resources Conservation in Poland-----	42
Matys, I.; Markvich, I.; Melnikova, T.: The National Bank of Plant Genetic Resources of Belarus-----	43
Černecký, J.: Monitoring of Animals, Plants and Habitats of Community interests in the Slovak Republic-----	44
Békefi, Z.; Ujfalušsyné Őrsi, D.; Horváth-Kupi, T.: Value of the Hungarian almond Gene bank collection - history, fruit characteristics, frost resistance and incompatibility studies-----	45
Benediková, D.; Benková, M.; Čičová, I.: The old cherry genotypes in Slovakia - very interesting source for conservation and breeding-----	46
Zetochová, E.; Benediková, D.; Benková, M.: Frost damages of apricot and peach collections during spring 2016-----	47
Porvaz, P.; Tóth, Š.: Use of energy and the introduction kinds of plants grown in Slovakia--	48
Havrlentová, M.; Hozlár, P.; Benková, M.: Cereal beta-D-glucan as a possible tool of plant protection-----	49

Session 4 Climatic change, biotic and abiotic stresses

Djalovic, I.; Kulina, M.; Majstorović, Ž.: Climate changes in Bosnia and Herzegovina and potential adaptation measures: case studies of crop production and biodiversity-----	53
Iraqi, D.; Senhaji, Ch.; Hanane, A. et al.: Integration of drought tolerance genes in Moroccan durum and bread wheat varieties-----	54
Matušíková, I.; Horník, M.: Crop responses to toxic elements under different fertilization regime	55

Abstracts of poster presentation

Avagyan, A.: GAP analysis in nation <i>ex situ</i> collections to assist the planning of seed collection mission-----	59
Bradová, J.; Dvořáček, V.: Polymorphism of storage protein in selected non-traditional wheat species-----	60
Melyan, G.; Gabrielyan, I.; Sahakyan, A.; Kik, Ch.: An <i>Asparagus</i> collecting expedition in Armenia-----	61
Muchová, D.; Brezinová, B.; Deáková, L. et al.: Identification of Slovak local landraces of poppy (<i>Papaver somniferum</i> L.)-----	62

Djalovic, I.; Bekavac, G.; Šeremešič, S.; Macák, M., Tyr, Š.: Effects of nitrogen and phosphorus fertilizers on yield and yield components of maize (<i>Zea mays</i> L.) in temperate semiarid region-----	63
Gubišová, M.; Gubiš, J.; Žofajová, A.: Multiplication of <i>Miscanthus x giganteus</i> and <i>Arundo donax</i> in tissue culture and its impact on biomass production-----	64
Danilovič, M.; Hnát, A.: Sweet flag (<i>Acorus calamus</i> L.) <i>in situ</i> conservation-----	65
Hauptvogel, P.; Jezerská, Z.: Slovak capacity building to <i>on-farm</i> conservation and utilization of rice landraces in Kyrgystan-----	66
Hovhannisyan, H.: Armenian landraces of apple and pear-----	67
Ivanova, R.; Gasian, I.; Gasian, A.: Secondary metabolites accumulation in safflower of fall and spring sowing in the Republic of Moldova-----	68
Kanianska, R.; Kizeková, M.; Tian, D.; Zhang, X.: Agricultural biomass input data for material flow analysis in Slovakia and China-----	69
Kanianska, R.; Kizeková, M.; Jaďud'ová, J.; Makovníková, J.: Comparison of plant and animal diversity at two mesophile pasture biotopes-----	70
Kizeková, M.; Martincová, J.; Čunderlík, J.; Jančová, M.; Mihovski, T.: Monitoring and collection of genetic material of forage crops of local origin in Slovakia and Bulgaria-----	71
Kristó, A.: Cultivation possibilities of <i>Physalis</i> sp. with focus on the ecological needs as new crops in the hungarian agrobiodiversity-----	72
Kruczyńska, D.E.; Rutkowski, K.P.; Matulska, A.; Chojnowski, M.: Fruit quality of some local apple cultivars, derived from Gene Bank of Research Institute of Horticulture, Poland-----	73
Landau, N.; Ogran, A.; Barazani, O.: Differences in defense against herbivores between wild populations of <i>Eruca sativa</i> in Israel-----	74
Martincová, J.; Kizeková, M.; Vargová, V.; Michalec, M.: Revitalization of areas damaged by motorway construction through native species-rich plant communities-----	75
Matějová, E.; Dvořáček, V.: Variability content of arabinoxylans in selected modern and ancient wheat species-----	76
Motyleva, S.; Kulikov, I.; Medvedev, S.; Marchenko, L.: The evaluation of sweet cherry genotypes resistance to <i>Coccomyces</i> blight according to the leaf biochemical characteristics	77
Nečas, T.; Nečasová, J.; Kiss, T.; Ondrášek, I.: Evaluation of phytoplasma ESFY in genetic resources of apricot and peach in south Moravia-----	78
Nôžková, J.; Novysedláková, E.; Hauptvogel, P.: Morphometric analysis of grains selected varieties of <i>Triticum aestivum</i> L.-----	79
Oláh, G.; Dikasz, E.; Kristó, A.: Collecting plant genetic resources in Veľká Fatra and in Baranya county within the framework on Hungarian-Slovakian bilateral cooperation-----	80
Olas-Sochacka, M.: Cryobank of garlic (<i>Allium sativum</i> L.) genetic resources in Poland-----	81
Ondrášek, I., Nečas, T.: Pomological evaluation of some peach and nectarine cultivars from geene pool collection in horticulture faculty in Lednice-----	82
Pastirčák, M.: Diversity of microscopic fungi associated with St. John's wort plants in Slovakia-----	83

Romanciuc, G.: Current status of genetic resources documentation in Republic of Moldova	84
Szilagyi, S.; Ujfalussyne Orsi, D.; Bekefi, Z.: Morphological and phenological characterisation of hungarian sweet cherry landrace accessions-----	85
Šveistytė, L.; Radušienė, J.; Lakokas, J. et al.: Medicinal and aromatic plant genetic resources conservation in Lithuania-----	86
Ujfalussyne Orsi, D.; Horváth-Kupi, T.; Békefi, Z.: Fruit quality and s-allele analysis of some almond accessions selected from the Hungarian genebank collection-----	87
Yeraminovich, A.: Regional cooperation and investment into plant-based bioeconomy as a stimulus for growth in Eastern Europe-----	88
Žofajová, A.; Rückschloss, L.; Havrlentová, M.; Gavurníková, S.: Winter wheat gene resources with different grain colour-----	89
List of participants-----	91
Crop cultivars development at the NAFC-RIPP-----	95
Note	

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Zurawicz Edward, Poland

Žofajová Alžbeta, Slovakia

TIME TABLE

Tuesday, 18 October 2016

11:00-13:30	Registration
13:30-14:30	Opening ceremony
14:30-16:10	Session 1
16:10-16:40	Coffee break
16:40-18:20	Session 2
18:20-19:20	Poster session

Wednesday, 19 October 2016

9:00-11:00	Session 3
11:00-11:40	Coffee break
11:40-13:20	Session 3 continue
13:20-14:20	Lunch
14:20-18:00	Excursion
19:00-22:00	Social dinner

Thursday, 20 October 2016

9:00-11:00	Session 3 continue
11:00-11:30	Coffee break
11:30-12:30	Session 4
12:30-13:00	Closing ceremony
13:00-14:00	Lunch

PROGRAMME

Tuesday, 18 October 2016

Registration, *Welcome coffee*

Opening ceremony: Representative of Ministry of Agriculture and Rural Development of SR and National Agricultural and Food Centre

Avetik Nersisyan

FAO Regional Office for Europe and Central Asia
FAO activities and contribution in the field of Plant Genetic Resources in the Region

Session 1 – Conservation and utilisation of Plant Genetic Resources

Pavol Hauptvogel

The contribution of plant genetic resources to sustainable agricultural development in Slovakia

Heinrich Grausgruber

Utilisation of plant genetic resources for food and feed: case studies of spelt wheat and barley

Vojtech Holubec

Aegilops distribution revision in the Czech and Slovak Republics, collection and phenotyping

Rina Kamenetsky Goldstein

The effective use of *Allium* genetic resources: benefits and pitfalls in the development of new horticultural crops

Coffee break

Session 2 – Molecular characterisation and data processing of Plant Genetic Resources

Oz Barazani

Genetic variations in old olive trees open a window into the history of olive cultivation in the southeast Mediterranean

Gregorio Muñoz Organero

Recovery of minor old grape varieties in Spain

Žiarovská Jana

BARE-1 - Horizontal profiling of cereal genomes

Ľubomír Mendel, Matej Smieško

GRISS - Documentation system of plant genetic resources of Slovakia

Gažo Ján

Conservation and utilization of plant genetic resources in the research and educational programme of the Slovak University of Agriculture in Nitra

Poster Session

Wednesday, 19 October 2016

Session 3 – Evaluation of Plant Genetic Resources

Tamer Topçu

Some morphological and quality characteristics of Anatolian Sage (*Salvia fruticosa* Mill.) populations in Aegean and West Mediterranean Region

Tamar Kacharava

Medicinal, aromatic and spice plants` genetic resources, protection in Georgia

Jozef Fejér

Study of medicinal plants genetic resources at the Prešov University

Irina Sivicka

Activities on genetic resources of medicinal and aromatic plants at Latvia University of Agriculture

Iveta Čičová

Status of medicinal and aromatic plants in Slovakia

Ünal Karik

Domestication, selection and, breeding of golden thistle (*Scolymus hispanicus* L.)

Coffee break

Session 3 – Continue

Jotham Ziffer-Berger

Phylogeny of the genus *Raphanus*

Peter Hozlár

Assessment of *Avena* genetic resources in the Slovak *Avena* L. collection

Michaela Benková

The potential of Slovakia barley germplasm

Mariusz Chojnowski

Quality of seeds of tomato accessions collected in the framework of National Programme of Genetic Resources Conservation in Poland

Lunch

Excursion: Firm Plantex Ltd Veselé, Gene bank of SR Piešťany

Social dinner in Hotel Park and vine degustation with sommelier

Thursday, 20 October 2016

Session 3 – Continue

Černecký Ján

Monitoring of Animals, Plants and Habitats of Community interests in the Slovak

Zsuzsana Békefi

Value of the Hungarian almond Gene bank collection - history, fruit characteristics, frost resistance and incompatibility studies

Daniela Benediková

The old cherry genotypes in Slovakia - very interesting source for conservation and breeding

Erika Zetochová

Frost damages of apricot and peach collections during spring 2016

Pavol Porvaz

Use of energy and the introduction kinds of plants grown in Slovakia

Michaela Havrlentová

Cereal beta-D-glucan as a possible tool of plant protection

Coffee break

Session 4 – Climatic change, biotic and abiotic stresses

Ivica Djalovic

Climate changes in Bosnia and Herzegovina and potential adaptation measures: case studies of crop production and biodiversity

Driss Iraqi

Integration of drought tolerance genes in Moroccan durum and bread wheat varieties

Ildikó Matušiková

Crop responses to toxic elements under different fertilization regimes

Closing ceremony

Lunch

Abstracts of oral presentation

FAO ACTIVITIES AND CONTRIBUTION IN THE FIELD OF PLANT GENETIC RESOURCES IN THE REGION

Avetik Nersisyan

Agricultural Officer, FAO Regional Office for Europe and Central Asia, Budapest, Hungary

The natural resource base and ecosystems services are the foundation of all food and agricultural systems, and their protection is a guiding principle in their use.

Finding the appropriate balance between increasing production and natural resources utilization is critical. Therefore, the objective is to increase the contributions of agriculture, forestry and fisheries to economic development, while generating income and employment and providing livelihood opportunities for family farms and more generally the population in rural areas. Production systems must meet this challenge through innovations that increase agricultural productivity and efficiency in a context of a sustainable use of natural resources, and adaptation to climatic change, as well as the delivery of environmental services etc.

The FAO with its regional and country offices is playing a lead role in strengthening countries capacity in sustainable use and conservation of genetic resources for food and agriculture. This is to ensure the FAO vision achieving a world free from hunger and malnutrition where food and agriculture contribute to improving the living standards of all, especially the poorest, in an economically, socially and environmentally sustainable manner. Thus, for example the Regional office for Europe and Central Asia (FAO REU) is implementing, among the others, several projects in area of plant genetic resources. These projects will support the development of a National Programmes in countries to conserve and use plant genetic resources for food and agriculture, and is expected to have a beneficiary impact on national development, food security, sustainable agriculture and the preservation of agricultural biodiversity, by improving the effective use of national plant genetic resources in plant breeding and the seed sector.

Key words: food, agriculture, conservation biodiversity, plant genetic resources

Session 1.

Conservation and Utilisation of Plant Genetic Resources

THE CONTRIBUTION OF PLANT GENETIC RESOURCES TO SUSTAINABLE AGRICULTURAL DEVELOPMENT IN SLOVAKIA

Pavol Hauptvogel, Daniela Benediková, Michaela Benková, Iveta Čičová,
Ľubomír Mendel and Erika Zetochová

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Today, the production of knowledge in the experimental agriculture relies crucially on the use of data collections and their accessions, such as plant genetic resources. These collections of plant genetic resources, in both their creation and their current use, are embedded in the research and breeding tradition in the Slovak Republic and former Czechoslovakia. This contribution focuses on the issues concerning the establishment of the Gene Bank of the Slovak Republic in 1996 and National Programme on Plant Genetic Resources for food and agriculture started already in 1994.

The National Agricultural and Food Centre - Research Institute of Plant Production (NAFC-RIPP) in Piešťany has overall responsibility for coordinating the Programme, stores numerous accessions in the Gene Bank and runs the Genetic Resources Information System of Slovakia (GRISS). All of the accessions are fully documented with passport data and continual evaluation and characterization data sets. Since 1994 users have been provided with 7,084 accessions for breeding purposes, 13,654 accessions for research and 1,758 for education other activities. Further 3,643 accessions have been provided for research and breeding purposes abroad. By the end of 2016 there were 22,260 accessions of crops deposited in the gene bank and these accessions are accessible for research, breeding and other uses in food and agriculture. Passport data are registered in the information system for 26,679 accessions, of which 17,043 accessions are registered in EURISCO.

The collecting missions within Slovak and outland (foreign countries) territory, including the conservation and monitoring of valuable resources *in situ*, contribute to the conservation of valuable autochthonic resources. International collaborations operate on global, regional and bilateral levels and guaranty of the international exchange of genetic resources is a fundamental policy. Researchers of NAFC-RIPP and programme partners dealing with plant genetic resources are involved in the European Cooperative Programme on Plant Genetic Resources (ECPGR). The achieved results of the conservation and utilization have been used in the breeding process, but also in frames of various research activities with outputs in professional and scientific journals.

Key words: crop diversity, plant genetic resources, research, breeding, Gene Bank

Acknowledgement: This work was supported by the Slovak Research and Development Agency under the contract No. APVV- 15-0721, APVV-15-0156, APVV-0197-10 and APVV-0661-10.

UTILISATION OF PLANT GENETIC RESOURCES FOR FOOD AND FEED: CASE STUDIES OF SPELT WHEAT AND BARLEY

Heinrich Grausgruber¹, Florian Hochhauser¹, Lukas Naderer¹, Catherine Cuendet², Franca Dell'Avo², Reine Koppel³, Stefan Kutschka¹, Ljupcho Jankuloski⁴, Dagmar Janovska⁵

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Plant genetic resources stored in *ex situ* collections can help to face today's challenges of food and feed security and safety. On the one hand, climate change impacts both crop and livestock production, on the other hand, food allergies and intolerances are on the rise, especially in the West.

To cope with the negative effect of drought on pasture quantity and quality and the globally increasing demand for meat, forage production has to become more effective. Barley is a crop of high adaptability and a valuable feedstuff as grain, hay or silage. To use barley efficiently for hay and silage production mutant genetic stocks offer some potential. Awnless, hooded and orange lemma mutants are the most promising sources. Awnless and hooded barley can be feed after heading when the crop is highly productive as the absence of awns poses no risk for livestock. Orange lemma mutants increase the digestibility of fodder due to reduced lignin content of grains and straw.

The number of people who suffer from allergic reactions after eating common wheat is increasing. Often these people do not react to spelt wheat as long as they aren't afflicted with coeliac disease or gluten intolerance. Consequently, acreage and research activities of spelt wheat increased significantly in recent years. However, several spelt wheat programs in the second half of the 20th century crossed spelt with common wheat to introgress the genetics for high baking quality, high productivity and the semi-dwarf character to improve lodging tolerance. In the face of consumerism, modern spelt wheat varieties with common wheat hybridization are refused by some manufacturers to avoid unsettledness of consumers.

Results from two ongoing projects on the use of barley and spelt wheat *ex situ* collections to improve fodder and food quality of barley and spelt wheat, respectively, are presented.

Key words: Feed, food safety, forage, *Hordeum vulgare*, *Triticum spelta*

Acknowledgements: The spelt wheat research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 613609 (*An integrated approach to diversify the genetic base, improve stress resistance, agronomic management and nutritional/processing quality of minor cereal crops for human nutrition in Europe*). The barley research has received funding from the IAEA Coordinated Research Programme D23030 (*Integrated Utilization of Cereal Mutant Varieties in Crop/Livestock Production Systems for Climate Smart Agriculture*).

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AEGILOPS DISTRIBUTION REVISION IN THE CZECH AND SLOVAK REPUBLICS, COLLECTION AND PHENOTYPING

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Aegilops distribution was revised on localities in the territory of the Czech Republic and the former Czechoslovakia, based on herbarium data, literature and floristic databases. The only species *Ae. cylindrica* reaches the target territory forming the northern limit of distribution in the Danube basin, in the foothills of Burda (Kováčovské hills). The other sites are considered secondary and both permanent and temporary sites were revised. Two sites in the Czech Republic and three sites in Slovakia seem to be stabilized. *In situ* conservation was proposed for 2 Czech sites where *Aegilops* cylindrical became naturalized in local vegetation. *Ex situ* gene bank collection has been maintained in the Gene Bank Prague since 1985 and includes 21 species and 1,100 accessions. The collection was phenotyped and evaluated on resistance to biotic stresses: resistance to leaf diseases, cereal aphids, viral diseases and qualitative parameters. Recently the collection was retested for the present races of leaf and stem rust including new introductions from Kazakhstan. Six different leaf rust races and five different stem rust races collected from the Czech Republic were applied in the older tests, and three races from each rust species in the recent tests. The highest number of accessions resistant both to wheat leaf rust and wheat stem rust and powdery mildew was found in *Ae. speltoides* (90%). Spontaneous hybridization of *Aegilops* accessions occurred with wheat cultivar as isolation. The resulting hybrids were phenotyped and compared with parents.

Goatgrass occurs in 6 localities in Slovakia (Dunajská Streda, Sered', Chľaba, Kamenica nad Hronom, Čierna nad Tisou, Dobrá). These localities were localized by geographical position system and accessions were collected and evaluated by descriptors for wheat and *Aegilops*. These accessions were analysed to storage protein and we revealed polymorphism in the number of gliadin bands. Collected accessions of *Aegilops* species are interesting for improvement programme.

Key words: *Aegilops*, distribution, *ex situ*, phenotyping, evaluation, *in situ*, conservation

Acknowledgement: The research leading to these results has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 613609 and was supported by the Slovak Research and Development Agency under the Contracts No. APVV-0197-10 and No. APVV-15-0721

THE EFFECTIVE USE OF *ALLIUM* GENETIC RESOURCES: BENEFITS AND PITFALLS IN THE DEVELOPMENT OF NEW HORTICULTURAL CROPS

Rina Kamenetsky Goldstein

Institute of Plant Sciences, The Volcani Center, ARO, Rishon LeZion, ISRAEL

The genus *Allium* L. includes a large number of agricultural plants that are used as food (onion, garlic, leek, shallot, chives), ornamentals, and sources of natural therapeutic products. *Allium* domestication started millennia ago, and many of the direct ancestors of the cultivated crops have either been lost or changed beyond recognition. Genetic shifts and drastic, unbalanced selection pressure by growers and breeders, resulted in the loss of many traits important for modern agriculture, and therefore the genes of potentially useful characteristics are not readily available for crop improvement. Since the 1970s, collection and conservation activities of land races and wild relatives of the cultivated species have been initiated by various agencies, gene-banks and researches. This genepool is of the greatest importance for the introduction of useful genes to the current cultivated alliums, as well as for immediate, intermediate and long-term domestication of new cultivated crops. Introduction of species with ornamental potential depends on the knowledge of their physiological responses to the environment; new species can be domesticated as condiment vegetables and spices, and many species and local landraces can serve as resources for quality traits, such as dry matter content, pungency, colors, yield, resistance to pests and/or to environmental stresses, and for sources for the pharmaceutical and nutraceutical industries.

However, the way from initial assessment to commercialization of the new crop is complex and consists of several main steps: (1) scientific and horticultural study of the species, including reproductive physiology, genetic regulation, biochemical traits and environmental effects; (2) development of propagation, growth, storage, and transportation technologies; (3) marketing and business aspects. In reality, however, these strategies interact, and more scientific or technological development is usually required when the crop is already released to the market. In such a case, the research aims are directed by the market analysis and sales program. The main pitfall of the process is usually an imbalance between technology and business teams. Therefore, for successful crop development, collaboration between public and private parties is beneficial.

A few examples of the introduction and development of new *Allium* crops (e.g., *A. ursinum*, *A. tricoccum*, *A. tuncelianum*, *A. aschersonianum*) from natural populations or genebank collections to the market will be discussed.

Key words: *Allium* L., introduction, genetic resources, crop development

Session 2.

Molecular Characterisation and Data Processing of Plant Genetic Resources

GENETIC VARIATION IN OLD OLIVE TREES OPEN A WINDOW INTO THE HISTORY OF OLIVE CULTIVATION IN THE SOUTHEAST MEDITERRANEAN

Oz Barazani¹, Erik Westberg², Arnon Dag³, Zohar Kerem⁴, Yizhar Tugendhaft^{3,4}, Mohammed Hamid⁵, Thameen Hijawi⁵, and Joachim W. Kadereit²

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⁵Association for Integrated Rural Development, Ramallah, The Palestinian Authority

The Simple Sequence Repeat (SSR) marker technique was used to study genetic diversity of old olive trees in the southeast Mediterranean. Leaf samples were collected from tree canopies (scions) and shoots growing from the trunk base (suckers). A total of 310 trees were sampled in 32 groves and analyzed with 14 SSR markers. Multi-locus lineages (MLLs) analysis provided evidence that the majority of olive trees (82.7%) are grafted, and that 90% of the scions belong to a single ancient cultivar. For the majority of the grafted trees it seems likely that saplings were used as rootstocks. But one MLL was specific to rootstocks, which was found in 22.6% of the samples. Results of AIC model selection procedure suggest that farmers in the past may have chosen to cultivate olives as grafted trees using the specific rootstocks in order to enhance olive oil quality.

Key words: Grafting, domestication, microsatellites, propagation

RECOVERY OF MINOR OLD GRAPE VARIETIES IN SPAIN

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The varietal grapevine heritage in Spain, as in the rest of Europe, has suffered a significant erosion process and change over the last hundred years by different phytopathological, commercial and legislative reasons. However, in the last decade, minor varieties have gained interest thanks to studies and knowledge on their agronomic and oenological potential. Recent works by experts in viticulture and oenology in Spain under the same project, in collaboration with the Spanish Plant Variety Office and the Plant Genetic Resources Center, have allowed the identification of old vine genotypes in relictic areas. Molecular and ampelographic methods have been used to identify the plant material, combining 8 microsatellites with high discriminant power and 67 morphological traits including those required by the Community Plant Variety

Office. The analysis of 2.175 samples have allowed the identification and recovering of varieties cited in ancient literature, many of them considered minor varieties, and simultaneously found in plots sometimes located in distant regions. It is really ancient plant material, although sometimes without a name. A total of 94 Spanish commercial varieties have been identified, as well as 77 foreign varieties, 48 minor varieties, 34 table grape varieties, 48 hybrids or rootstocks, 220 unknown genotypes and y 91 new minor autochthonous varieties. Recovery of this invaluable heritage would enable to bring a diversity of products to market in the near future, contributing to enhance the added value to producers and quality to consumers.

Key words: conservation, grapevine, identification, autochthonous

BARE 1 – HORIZONTAL PROFILING OF CEREAL GENOMES

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BARE-1 retrotransposon was firstly described in the genome of barley but the sequences similar to those of *BARE-1* are supposed to be a part of all cereals. *BARE-1* is one of the active retrotransposons in the plant genomes and that is why it can be used as a very effective marker for the analysis of cereal genetic resources. Here, a data mining approach was chosen to design and test the IRAP marker for the concurrent assessment of wheat and barley genetic resources. This will provide a platform for the comparative studies of the *BARE-1* retrotransposon distribution in the genomes of wheat and barley. BLAST algorithm was applied to find the high similar sequences of *BARE-1* retrotransposon to those of wheat. The sequence compliance was found between the nucleotides 375-401 of *Hordeum vulgare* DNA for *BARE-1* copia-like retroelement (NCBI accession Z17327) and nucleotides 219-244 of *Triticum aestivum* transposon (NCBI accession AJ303051). A nonspecific primer was subsequently designed in this area and tested for its effectivity for different barley and wheat genotypes. This approach was proved as to be successful as for both of species a positive amplification of *BARE-1* length polymorphism was achieved. Comparing the results, approximately 30% more DNA fragments were amplified for the barley varieties. For both of the species, the amplified length polymorphism of *BARE-1* insertions was in the whole range of the PCR when using standard polymerases, very concrete in the range of 50 bp up to the 2000 kbp when 4% PAGE was used to separate them.

Key words: molecular markers, Bare1, cereals, IRAP

Acknowledgement: This study has been supported by the project Genomic selection of cereals for drought tolerance (APVV-15-0156).

GRISS - DOCUMENTATION SYSTEM OF PLANT GENETIC RESOURCES OF SLOVAKIA

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From 2015 it was given to use of the new information system for plant genetic resources of Slovakia, who is on-line web portal solution for comprehensive information management in research of plant genetic resources for food and agriculture and to support processes associated with complex management of *ex situ* samples of plant genetic resources stored in National Agricultural and Food Centre, Research Institute of Plant Production, Gene Bank of Slovak Republic in accordance with the „National Programme of Conservation of Plant Genetic Resources for Food and Agriculture in Slovak Republic“. He was named as GRISS - Genetic Resources Information System of Slovakia. GRISS web portal is available at URL address <http://griss.vurv.sk>. Information system GRISS allows curators of collections of plant genetic resources of automated support for all activities related to the creation and management passport and evaluation data. GRISS is designed as a web application that provides a sophisticated web interface for entering data via the Internet. Mainly serves curators of the preparation, management and archiving of exchanger protocols, preparation and editing passport and evaluation data for samples. It enables effective management of the collection. GRISS at every moment provides an overview of the appointment or unfinished samples of all collections, lists of samples to effectively filter by any criteria, manage the regeneration process, control and review applications and issue individual items. It provides mechanisms for access to stored data and their individual analysis and export-controlled data. GRISS was built as an open system and modular scalable. The modular system architecture allows its future expansion with additional subsystems such as barcode, image analysis and geographic information systems (GIS). The concept of a comprehensive information system solutions, including interface based on the use of open standards and platforms, ensuring low-cost ratio for future growth.

Key words: GRISS, documentation system, information system, web portal, plant genetic resources

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CONSERVATION AND UTILIZATION OF PLANT GENETIC RESOURCES IN THE RESEARCH AND EDUCATIONAL PROGRAMME OF THE SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA

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The team at the Institute of Biodiversity Conservation and Biosafety and the Department of Genetics and Plant Breeding, Faculty of Agrobiology and Food Resources at the Slovak University of Agriculture provides for 25 years significant research and educational activities. In the frame of 11 research projects at national and international level were collected over a thousand genotypes mostly landraces and old varieties that were planted in 7 established clone repositories. These collections of species *Malus* spp.; *Prunus* spp.; *Cerasus* spp.; *Vitis* spp.; *Morus nigra*; *Sorbus domestica*; *Pseudocydonia japonica*; *Cucurbita* spp.; *Pisum sativum*; *Capsicum annuum*; *Sambucus nigra*; *Cornus mas*; *Castanea sativa*; *Cydonia oblonga*; *Ziziphus jujube*; *Diospyros kaki*; with determined economic value of genotypes. As part of the scientific school covering economic value assessment of genetic resources and their practical utilization 22 graduates from Slovakia and 3 from abroad successfully completed their doctoral studies. The study of the genepool was applied in preparation 42 bachelor thesis and 76 diploma works of the full-time and part-time students. Extensive results of the research were presented by the research team on the organized scientific events: Perspectives of genetics, breeding and seed production (3); Natural and cultural heritage of Slovakia (6); Opportunities and risks of the use of genetically modified organisms (7); Tokay Viticulture and Enology (5). The collective has organized four international conferences and as a co-organizer was involved in organizing 15 international conferences. In the framework of international cooperation attended our institution more than 100 PhD students and researchers each in the duration from 1 to 10 months. Within the publishing activities provides research team edition of 36 proceedings, 7 yearbooks, 111 textbooks, 6 monographs and more than 700 scientific publications in national and international scientific journals. More than 25 years are provided courses in "Protection of plant genetic resources" and "Food genetic resources" in the various study programs. In the Lifelong Learning Programme entitled "*Education for everyone and for all*" were implemented 4 specialized accredited courses oriented to the preservation and use of agricultural biodiversity, the revitalization of traditional agro-ecosystems, rural development, support to the implementation of food security, breeding, seed production and development of beekeeping, which was completed by more than 1,600 participants.

Key words: Plant genetic resources; clone repositories, research; education; utilization

Acknowledgement: The publication was prepared with the active participation of researchers involved in the international network AgroBioNet in an international program of "Agrobiodiversity to improve nutrition, health and quality of life" TRIVE (ITMS 26110230085) and within the project ITEBIO (ITMS 26220220115).

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Session 3.

Evaluation of Plant Genetic Resources

SOME MORPHOLOGICAL AND QUALITY CHARACTERISTICS OF ANATOLIAN SAGE (*SALVIA FRUTICOSA* MILL.) POPULATIONS IN AEGEAN AND WEST MEDITERRANEAN REGION

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This study was conducted in order to determine some morphological and quality characteristics of Anatolian sage (*Salvia fruticosa* Mill.) populations distribution in Aegean and West Mediterranean Region in 2014. 17 plant sample belong to populations collected from Antalya (7), Muğla (6), Aydın (2) and İzmir (2) province in this study. Plant height vary to 98.4-140.7 cm, branch number 6.0-9.3, leaf length 6.2-9.3 cm, leaf width 1.6-3.5 diameter 118.3-170.0 cm, fresh herb yield 2545.5-4234.7 g/plant, drug herb yield 732-1423.2 g/plant and drug folia yield 257-565.5 g/plant between populations in the flora. While essential oil yield vary to 2.6-4.3% between populations, main components and rates the essential oil were determined 1.8-cineole (20.7-46.9%), β -pinene (5.3-11.3%) and camphor (3.8-12.3%) respectively.

Key words: Anatolian sage, population, Aegean, West Mediterranean, morphology, quality

MEDICINAL, AROMATIC AND SPICE PLANTS GENETIC RESOURCES PROTECTION IN GEORGIA

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Biodiversity plays an important key role in sustainable development of Georgia, where huge quantities of species of medicinal, aromatic and spice plants represents as a "bank of biodiversity under the sky". Recent years global world climate changes had significant influence on plants collections of Georgia.

We have elaborated recommendations on historically traditional priority - growth and production technology of ecologically sound standard raw materials and products of medicinal, aromatic and spice plants for Georgia such as: forms of *Valeriana officinalis* L., including endemic forms *Valeriana colchica* Utk.; *Calendula officinalis* L.; *Melissa officinalis* L.; *Carum carvi* L.; *Chelidonium majus officinalis* L. and others. Highly productive model for diagnostics has been created in the block of earth- environment- plant-fertilization-harvest, and impact of ecosystems on productivity, quality of raw materials and production has been differentiated.

Successful on-going activities include:

1. Survey of unique biodiversity and natural resources, natural habitats and varieties of populations;
2. Impact of ecosystems on genetic resources and their protection;
3. Impact of ecosystem, sorts and forms on productivity and quality of medicinal, aromatic and spice plants;
4. Determination of general chemical composition;
5. Searching for new medicinal, aromatic and spice plants as well as pharmacologically active substances.

Key words: biodiversity, medicinal, aromatic, spice plants

STUDY OF THE MEDICINAL PLANT GENETIC RESOURCES AT THE PREŠOV UNIVERSITY

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Evaluation and storage of the plant genetic resources represents the elementary basis for the selection of desired genotypes as the initial material for creation of new varieties. These can be consequently introduced into agricultural production system and by this way contribute to agrobiodiversity enlarging. The University of Presov in Presov is involved in the National Programme on Protection of Plant Genetic Resources for Food and Agriculture from 2010. In framework of this activity, the collection of more than 50 the most significant species of medicinal, aromatic and spice plants was gathered. Among the species, the most extensive are the collections of chamomile (*Matricaria recutita* L.) and opium poppy (*Papaver somniferum* L.). The evaluation of genetic resources and plant breeding material brought success in form of the new medicinal and special plant variety registration. In 2013, two varieties of medicinal plants were registered. Chamomile (*Matricaria recutita* L.) with high content of α -bisabolol in essential oil (55.1%) named 'Lianka' and mint (*Mentha \times piperita* L.) with high content of menthol in essential oil (69.3%) named 'Kristinka'. In collaboration with Institute of Plant Genetics and Biotechnology, SAS in Nitra, red amaranth (*Amaranthus cruentus* L.) with high weight of thousand seeds (0.9617 g) named 'Pribina' was registered in 2013. Another amaranth mutant line evaluated by State Variety Testing the third year will be registered under name 'Zobor' soon. As an implementation output of the APVV 0248-10 project "Poppy plants producing seeds with enhanced properties for food processing", the selection of opium poppy (*Papaver somniferum* L.) was evaluated by State Variety Testing in 2016. This selection reached above-average seed and capsule yield in comparison with reference varieties.

Key words: agrobiodiversity, essential oil, gene pool, variety, weight of 1000 seeds, yield

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ACTIVITIES ON GENETIC RESOURCES OF MEDICINAL AND AROMATIC PLANTS AT LATVIA UNIVERSITY OF AGRICULTURE

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The use of medicinal and aromatic plants (MAPs) has a long history in Latvia. Despite this, the research of genetic resources of MAPs is still innovative in our country. Activities on MAPs at Latvia University of Agriculture (LLU) started in the 1960s. In this time, the first collection was created with a purpose to acquaint the students with diversity of MAPs. Since 1994, this collection was purposefully supplemented with genetic resources of MAPs. After 2000s, when the research of plant genetic resources became the priority of our government, this *ex situ* collection became a fundamental in Latvia. It is attached to the Institute of Agrobiotechnology, Faculty of Agriculture, LLU and it is located in Jelgava, Strazdu iela 1. It's GPS coordinates are N 56° 39' 47"; E 23° 45' 13".

It includes 14 species of MAPs: *Allium ursinum* L., *Artemisia abrothananum* L., *Artemisia dracunculus* L., *Carum carvi* L., *Hyssopus officinalis* L., *Lavandula angustifolia* L., *Levisticum officinale* L., *Melissa officinalis* L., *Mentha x piperita* L., *Mentha spicata* L., *Nepeta cataria* L., *Origanum vulgare* L., *Thymus serpyllum* L., *Thymus pulegioides* L. The number of accessions per each species differs from 1 (*Lavandula angustifolia* L.) to 44 (*Origanum vulgare* L.). Totally, there are 129 accessions of MAPs. The collection visually shows the morphological diversity of accessions.

During the past 20 years, the information about winterhardiness, frosthardeness, phenological stages, fresh and air-dry biomass of accessions as well as the influence of meteorological conditions, propagation methods, cutting methods, drying and storage conditions on yield and quality of MAPs has been collected. The conservation of accessions and the evaluation of their agronomical behavior are the priorities of the scientific work conducted with this collection. Thanks to participation in different projects, the chemical composition of several species was issued.

Key words: *ex situ* collection, accessions, characterization

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STATUS OF MEDICINAL AND AROMATIC PLANTS IN SLOVAKIA

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The genetic resources of medicinal and aromatic plants are observed in the Gene Bank in Piešťany. MAP obtaining is realised through collecting expeditions, establishment of international exchanges with botanical gardens, research institutes, Index seminum and commercial companies. The aim of the collecting expeditions is monitoring, collection and documentation of plant genetic resources used for food and agriculture.

The Slovak Republic actively finds genetic resources of cultivated plants for research purposes, as well as the preservation of genetic resources with important properties. The *ex situ* MAP collection consists of 321 accessions medicinal plants, which representing 101 genus and 141 species. The highest diversity is in families *Lamiaceae* (18 genus, 40 species) and *Asteraceae* (15 genus, 23 species). Among the introduced cultivated medicinal plants are genus e.g. *Ocimum basilicum*, *Satureja hortensis*, *Majorana hortensis*, *Matricaria recutita*. A rich species are in wild collecting species (65 genus) e.g. *Carum carvi*, *Achillea millefolium*, *Centaureum erythraea*, *Hypericum perforatum*, *Origanum vulgare*.

The collected medicinal plants are evaluated, multiplied and conserved. The evaluation of medicinal plants includes a basic morphological description, biological and economic characteristics are made by the international descriptors. We make the special evaluation (chemical analyses - content and composition of essential oil), with cooperation of Department of Pharmacognosy and Botany of Comenius University in Bratislava.

Our microscope Carl Zeiss Discovery V20 allows detailed morphological analysis (AxioVision imaging system is a modular system for processing and image analysis). The all medicinal and aromatic plants are grown in field in Piešťany. Every year approximately 10 - 20 accession are regenerated in field condition from active collection of Gene Bank of Slovakia. The medicinal and aromatic plants are also used for educational purposes e.g. creating herb gardens in primary schools; planting beekeeping path in the village Kálnica; material for Bachelor and Master Work degree in university system.

Key words: medicinal plants, aromatic plants, evaluation

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DOMESTICATION AND SELECTION BREEDING OF GOLDEN THISTLE (*SCOLYMUS HISPANICUS* L.)

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Golden thistle (*Scolymus hispanicus* L.), from Asteraceae, is used both as a medicinal plant and a vegetable. Although it grows in the wild, there is a need for cultivation. This study was conducted to improve a population via selection and to assess the agronomic characters of the thistle. The seeds of the thistle were collected from Ege, South Marmara and West Karadeniz regions of Turkey. Thistle was distributed from sea level to 753 m above sea level. A selection nursery was established with around 3,000 plants from 15 populations. Roots of the plants in the nursery were dugged up just before stalk erection. Plants having weak, little or branched roots were eliminated immediately and the rest were transplanted after lower 1/3rd parts of the roots cut and kept for observations and analysis. Then, another selection was conducted according to evaluated characters, especially for root cortex yield. The number of the selected plants after the first and the second selections were 360 and 170, respectively. The thickness of the cortex increased from 3.98 mm to 4.26 mm while weight of cortex increased from 5.44 g to 6.28 g for fresh and from 0.49 g to 0.55 g for dried samples after selection. Two third of the root diameter was consist of the cortex. The rate of the cortex in the fresh root of the thistle was 80% while dried cortex was 8% of the fresh root base. Active substance taraxasteryl acetate was not formed at the rosette stage of the thistle. The ranges of the active compounds taraxasterol and taraxasteryl acetate in the cortex were between 0.001%-0.0043%; and between 0.001%-0.015%, respectively.

Key words: Golden thistle, *Scolymus hispanicus* L., cortex, taraxasterol, taraxasteryl acetate

THE TAXONOMIC POSITION OF *BRASSICA*-RELATED *RAPHANUS* SECT. *HESPERIDOPSIS*

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An evaluation of the two sections of *Raphanus* (Brassicaceae) sensu O.E. Schulz, as given in Engler's *Pflanzenreich*, on the basis of multi-species morphological and ITS data supported that *Raphanus* is a polyphyletic group embedded in the *Oleracea* lineage of the tribe Brassiceae. Section *Raphanis*, which includes *Raphanus raphanistrum*, *R. pugioniformis* and *R. sativus*, is a strongly supported monophyletic lineage. Section *Hesperidopsis* is embedded in a different lineage together with *Brassica deflexa* and *B. aucheri*. We propose to reinstate the genus *Quidproquo* in place of *Raphanus* sect. *Hesperidopsis*, to reflect the polyphyletic origins of the genus *Raphanus* sensu O.E. Schulz.

Key words: taxonomy, *Raphanus sensu*, evaluation

ASSESSMENT OF AVENA GENETIC RESOURCES IN THE SLOVAK AVENA L. COLLECTION

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Biodiversity of the genus *Avena* L. in the Slovak Republic is concentrated in the Slovak *Avena* collection. Responsible for the evaluation of the *Avena* L. collection is the NAFC – RIPP - RBS Víglaš-Pstruša. At present, the Slovak *Avena* L. collection consists of 1,261 *Avena* genotypes. A species of *Avena sativa* constitutes a decisive share with 1,242 genotypes. *Avena byzantina* is represented by 10 genotypes, *Avena strigosa* 5 genotypes, *Avena fatua* 2 genotypes, and both, *Avena abyssinica* and *Avena brevis* by 1 genotype. The specific morphological and biological marks were recorded according to the descriptor "*Avena*" (IBPGR, 1985). 44 data-processing and 27 descriptive marks were recorded totally.

Statistica Programme have been used to evaluate means of all specific descriptive characters in the *Avena* collection. Histograms of specific characters and density function of a common distribution of these marks have been also carried out. The height variability of the collection was found out of the following economically important characters: yield, plant height, 1,000 seeds weight, volume weight, percentiles of husk, protein content, quotient of grains over 2 mm sieve, and crude fibre content. Proportion of husks is made on a peeling machine. Volume weight of seeds is determined using cylinders intended for this purpose. Steineker sieves are used to strain the largest grain. A seed calculator is used for the next characteristic, TKW (thousand kernel weight). Nitrogen is analyzed by the Dumas method using the analyser CNS 2000 (LECO Corp. (USA) and calculation to proteins is used. Dry basis content is determined by the automated moisture analyzer ME 30 (Sartorius). Crude fiber is determined using the method of Henneberg and Stohmann. On the basis of these analyses, genotypes with extreme characteristics have been selected as materials for breeding and/or research purposes.

Key words: *Avena* collection, genetic resources, variability, histogram

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POTENTIAL OF SLOVAK BARLEY GERMPLASM

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A set of 43 genotypes of Slovak spring barley, created from 1938 to the 2009 on the selected agro-morphological characteristics and quality parameters during three atypical years were evaluated. The selected characteristics and parameters such as plant height, spike length, 1,000 grain weight, and number of spikes per m², grain weight per spike, number of grains per spike, grain uniformity, grain yield, protein content and total starch in the seeds were analysed. Based on the analysis of variance, we found a highly significant effect of genotype ($P < 0.01$) for all the investigated characteristics, except a weight of the grains per spike. Statistically significant influence of year ($P < 0.01$) was recorded in characters grain yield, grain uniformity, the number of spikes per m², length of the spike, the protein content and the total starch in the grain. Grain yield was significantly positively associated with the starch ($r = 0.74^{**}$), contrary the protein content with grain yield was in significant negative relationship ($r = -0.65^{**}$). Cluster analysis divided the set into two major clusters, where the first cluster consisted of older genotypes (1938–1965), including landraces, and the second cluster was formed of the genotypes produced from 1967 until 2009. Differences in groups showed increases yield components during breeding process at later varieties, but also the quality of indigenous barley landraces and populations.

Key words: barley, variability, agro-morphological traits, analysis of variance, starch, protein

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QUALITY OF SEEDS OF TOMATO ACCESSIONS COLLECTED IN THE FRAMEWORK OF NATIONAL PROGRAMME OF GENETIC RESOURCES CONSERVATION IN POLAND

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Testing of seed quality in genebanks is one of the most time and labour consuming operations. However, it is key operation for proper management of seed collections. Evaluation of germinability and vigour of seeds on the basis of germination *sensu stricto* is relatively fast and easy. Additionally, it is possible to conduct this test manually or by automated image analysis.

Germination of seeds over 900 tomato accessions collected in the framework of National Programme of Genetic Resources Conservation in Poland and stored under conditions of medium-term storage (tightly closed glass jars in a chilling room at a temperature 0°C) was investigated. Dynamics of germination *sensu stricto* was determined by radicle emergence counts. Seeds of 803 accessions (88.8%) germinated in 100%, seeds of 44 accessions (4.9%) had germination still acceptable, it means between 85% and 100%, while seeds of 57 accessions (6.3%) had germinability ranging from 0% to 84%. The mean germination time (MGT) of seeds, with 100% germination varied from 1.62 to 6.96 days. That shows big differences in seed vigour of accessions with the highest germinability. For accessions, which seeds had lowered germination percentage, both, final germination and MGT were dependent on seed age. However, effect of harvest year and origin of seeds was also observed.

Key words: tomato, germplasm, seed, germination, storage

Acknowledgement: This work was performed in the frame of multiannual programme, financed by the Polish Ministry of Agriculture and Rural Development.

THE NATIONAL BANK OF PLANT GENETIC RESOURCES OF BELARUS

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The paper presents the basic results of the scientific research on the creation of the bank of genetic resources of agricultural and forest crops of the Republic of Belarus which contains 64,000 accessions. Reflected are the scientific and practical results for 2000-2016 on mobilization, conservation and rational use of plant genetic resources in the breeding and economy of the republic to ensure its food and biological security. The collections of genetic resources of field crops, fruit and berry crops, nut crops and vine, collections of fungus strains, and collections of DNA plants have been declared the national treasure and included in the National Register of Scientific Objects of the Republic of Belarus.

The National program "Genepool" worked out in 2000 is a basis for mobilization and preservation of plant genetic resources in Belarus. The National Genepool of Belarus includes working collections of 11 research organizations of the National Academy of Sciences of Belarus and the collections of 2 higher educational establishments. The Genepool is maintained under regulated conditions. The head organization which exercises control over the Genepool study and preservation is the Research and Practical Center of the National Academy of Sciences of Belarus for Arable Farming where favourable conditions for long term conservation of plant genetic resources have been created. The basic collections of vegetative propagated crops are preserved in the Research and Practical Center of the National Academy of Sciences of Belarus for Potato Growing, Fruit and Vegetable Growing. The vegetative maintenance of the collection here is conducted via *in vitro* culture and in the field. The monitoring of the seed material preserved under regulated conditions is carried out.

The National Genebank of Plant Genetic Resources of Belarus accounts for 64,100 accessions. Among the CIS countries the Bank ranks fifth in respect of the number of accessions, and it ranks third in respect of species diversity and includes 1,680 crops and their relatives. Basic, active, core collections, genetic DNA collections of plants have been created for the first time in Belarus. The Genepool database which is annually filled with new data has been developed. The Republic of Belarus collaborates with 42 internationally renowned breeding centers and gene banks in the field of study, collection, conservation, evaluation, and use of plant genetic resources. The collections of cereals, leguminous, fodder crops, oil crops, collections of sugar beet and flax, collections of fruit and berry crops, nut crops and vine, collections of fungus strains, collections of DNA plants and herbarium together with the herbarium of introduced plants of the world flora have been declared the national treasure and included in the National Register of Scientific Objects of the Republic of Belarus.

Using plant genetic resources 980 varieties of crops were created in the Republic of Belarus in 2000-2015. These new varieties cover the area of more than 2 million hectares. Preserved are 52 rare wild species of plants included in the Red List of the Republic of Belarus.

Key words: plant genetic resources, collections, accessions, mobilization, food and biological security

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MONITORING OF ANIMALS, PLANTS AND HABITATS OF COMMUNITY INTEREST IN THE SLOVAK REPUBLIC

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Monitoring of species and habitats of European importance provides an important data source for nature conservation in all member states of the European Union at national and international level and represents the basis for decision-making, reasoning and professional preparation of nature protection documentation for as well as for the evaluation of the conservation objectives achieved. The basic principle of monitoring consists of repeated collection of data on the state of individual species and habitats in the field using standardized methods on precisely defined areas, so-called permanent monitoring localities (PMLs). With these principles the monitoring differs from the conventional field mapping.

Field data collection and assessment of conservation status of habitats and species of community interest was one of the key objectives of the project "Preparation and implementation of monitoring of habitats and species and to improve the disclosure of information to the public", realized by SNC SR and financially supported by Operational Program Environment in the years 2009-2015.

Basic outputs of the project are:

- Targeted monitoring of species and habitats of European interest on developed permanent monitoring plot network. Systematic monitoring of 195 species and 66 habitats. Total number of realized field visits is 18,439.
- Informing the public about the current conservation status of selected species and habitats.
- Support of additional collection of data for all species and habitats occurring in the territory of Slovak Republic.

Additional benefits of the project are:

- Improvement of public awareness and provision of the information to amateur conservationist, as well as professional experts in the field of nature conservancy on the presence and status of species and habitats of European importance, protected species and habitats as well as gathering distribution data concerning all other unprotected species and habitats.

As support tool for the purpose of collection, processing, evaluation and publication of data from field monitoring a Comprehensive Information and Monitoring System (KIMS) of SNC SR was developed, which includes electronic forms for filling in data in accordance with the methodology of monitoring. KIMS is designed for storing, selecting and publishing of open data to the public and for increasing of efficiency of professional staff of SNC SR through an easy access to data on the provide information on presence and status of protected species or habitats.

Originality of the KIMS solution:

- Centralization and regular updating of spatial data, linked to the collection of data on species and habitats.
- Mobile data collection directly from the field.
- Automatic generation of the conservation status of species and habitats

Who and how uses the data from systematic monitoring and distribution data:

- General Public - information about the species and habitats in general in Slovakia, information about the conservation status of selected protected species and habitats.
- Professional public - advanced information about the status of protected areas and the state of systematic monitoring and outputs via the Web, as well as public map portal.
- SNC SR Employees - targeted monitoring of species and habitats, evaluating the conservation status of species and habitats in Slovakia and support of the reporting to the European Commission.

Key words: monitoring, habitats, species, conservation

VALUE OF THE HUNGARIAN ALMOND GENE BANK COLLECTION - HISTORY, FRUIT CHARACTERISTICS, FROST RESISTANCE AND INCOMPATIBILITY STUDIES

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Hungary is located at the northern border of almond growing regions, safe almond production is possible only at protected areas.

In the 1960's yearly production of shelled fruits in Hungary was 3,200 tons that decreased to 320 tons until recently. Conscious almond growing started in the 1800's when phylloxera caused serious damages in vineyards and grape was replaced partially by almond trees. In early times Italian and French cultivars were planted (e.g. 'Princess', 'Bruantine'), then their seedling populations were selected.

From 1950's almond cultivars for commercial production were selected by Sándor Brózik, a Hungarian pomologist (landrace and seedling selection), his cultivars still determine Hungarian growing ('Tétényi' and 'Budatétényi' series), all of them are self-incompatible.

Our almond genebank in Érd contains around 220 accessions and consist of landraces, foreign cultivars and seedling populations. In our work we evaluated fruit morphological characters of seven accessions that preliminary showed high fruit quality compared to two Hungarian cultivars ('Tétényi bőtermő', 'Tétényi keményhájú') in 2013 and 2014, according to ECPGR *Prunus*-specific descriptors (1981). Overall, 'Fournat de Brezenaud' stood out from the others regarding fruit size and 5/15 had the largest kernel.

In another work frost hardiness of four Hungarian almond cultivars ('Tétényi bőtermő', 'T. kedvenc', 'T. rekord', 'T. keményhájú') and nine genebank accessions deriving from the collection of NARIC Fruit Research Institute were tested by artificial and natural (*in vivo*) freezing of flowering shoots in 2016, in closed bud, ball (balloon) and opened flower stages.

According to our results artificial freezing at -2°C did not damaged the flowers. At -4°C commercial cultivars seemed to be frost resistant, however, appr. 25% of the flowers of the accessions 'Érdi édes' and 'Sóskút 66/3' were frozen. Regarding cultivars, *in vivo* conditions (-6°C frost during night) no frost damage of 'Tétényi keményhájú' cultivar occurred, the most susceptible cultivar was 'Tétényi bőtermő'. Among genebank accessions the most frost resistant were 'Sóskút 16/7', '5/15' and 'Fournat de Brezenaud'. Additionally, our observations reconfirm correlation between frost hardiness of almond cultivars and their flowering time.

We also studied the presence of the self-compatibility allele S_f in 7 accessions, one local variety of them obtaining special interest, since its name means „Self-compatible of Badacsony” („Badacsonyi öntermékeny”). The cultivar 'Belona' carrying the self-compatibility allele S_f was used as a reference. According to our results none of the 7 accessions carry the allele S_p , so the Badacsonyi öntermékeny variety cannot be assumed true-to-name self-compatible.

Key words: almond, descriptors, fruit quality, frost resistance, incompatibility

THE OLD CHERRY GENOTYPES IN SLOVAKIA — VERY INTERESTING SOURCE FOR CONSERVATION AND BREEDING

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Cherries belong to the attractive fruit crops suitable for direct consumption or industrial processing, and were traditional fruit plants for a long time. The project studies are performed in selected regions of Slovakia and running for four years (2014–2017). Research objectives are focused on the evaluation morphological and pomological characteristic of several indigenous old cherry trees (*Prunus avium* L.) grown in the Slovak Republic. Additionally is studied - occurrence of economically important and emerging viruses of red stone-fruits and development of molecular techniques for sensitive and specific detection.

The trees were also studied and evaluated for morphological characteristics. The following characteristics were investigated: period of flowering and ripening, morphological characteristics of the flowers, fruit size, fruit weight, and description of quality characteristics of the fruits. Descriptor list of genus *Cerasus* Mill. was used for description.

Fourteen localities were monitored in 2014 and 2016 in different regions of Slovakia. In total 170 samples from old trees were obtained and evaluated. The results have shown high variation of attributes levels among evaluated genotypes. From the monitored localities, the most valuable genotypes were found in the locality Horná Streda, Čachtice, Krakovany, Nitra and Brdárka.

The best 42 cherries genotypes have been propagated on the registered rootstocks ('GISELA5', *Prunus mahaleb* L. and *Prunus avium* L.). Trees will be used for the establishment of experimental genetic resources orchards. Some of selected cherry genotypes can be used for commercial growing after tests, while some of them can be used only for collection of genetic resources. All obtained samples have been analysed in term of health status, mainly for the presence of viruses.

Key words: biodiversity, fruit species, genetic resources, *Prunus avium* L. monitoring, evaluation

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FROST DAMAGES OF APRICOT AND PEACHES COLLECTIONS DURING SPRING 2016

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Apricots and peaches (*Prunus species*) belong to the temperate fruit species. Optimal growing conditions for these species occur mainly in the Mediterranean countries and also in southern Europe. In these countries started breeding programs especially for apricots respecting requirements not only for farmers but also for consumers. Whereas climatic conditions of the Slovak Republic are marginal for growing apricots and peaches frost resistance was one of the main breeding objectives, particularly in the apricot breeding program. For growing temperate stone fruits (apricots, peaches and almonds) are suitable regions with an average annual temperature over 9°C. South of Slovakia is the most convenient for these species.

Most of Slovak apricot varieties are resistant against winter frost (Veharda, Vemina and others) and against spring frost (Vegama, Vesna and Vesprima). The Gene bank of Slovak Republic maintained in field collections 102 genotypes of apricots, 118 peaches and 4 almonds. The paper is documenting extreme frost damage of fruits apricots and peaches in the spring 2016. Development of weather during the spring 2016 caused significant damage stone fruits. Suddenly cooling with the occurrence of ground frost (-3°C and -6°C) at the end of April 2016 damaged apricot fruits in the ranged from 60 to 80% expected harvest. Minimum temperature during night (-9°C) on 26 April 2016 caused the fatal destruction of young apricot fruits. Some of peach genotypes to show as frost resistant and produce minimal expected harvest. The occurrence of such extreme frost is not usual in this region. These extreme frosts are once every 10 years observed. These extreme climatic conditions caused damage harvest of fruit growers in south Slovakia region.

Key words: *Prunus*, apricot, peaches, genetic resources, frost damages, evaluation

Acknowledgement: This work was supported by the project no. APVV-0174-12 from the Slovak Research and Development Agency and by COST FA1104 project.

USE OF ENERGY AND THE INTRODUCTION KINDS OF PLANTS GROWN IN SLOVAKIA

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Biofuels produced from biomass are currently the only real direct substitute for fossil fuels in transport, which are incorporated into the fuel supply infrastructure.

Directive 2003/30 / EC on the promotion of the use of biofuels or other renewable fuels and adjusted in 2007 for the EU member countries determined the use of biofuels in the total energy consumption of motor fuels for 2020 to 10% as a minimum binding target to be a cost-efficient manner.

Such an objective is likely to be achieved only with the use of second-generation biofuels.

Recent studies have called life cycle analysis (life-cycle analysis, ASSESS - LCA) indicates that compared to the use of traditional crops such as cereals or sugar crops, can be a significant economic and environmental benefits bring cellulosic plant materials (grasses and woody crops). Use of perennial grasses and woody crops reduced when compared with field crops application of fertilizers and pesticides.

In the production of bioethanol in Slovakia is the basic raw material for silage maize, which annually consumes about 300,000 tons. In the world, including Slovakia, in the production of bioethanol start to apply non-traditional crops such as *Miscanthus x giganteus*, *Sida hermaphrodita*, *Arundo donax*, every one with high structural fiber.

Key words: biofuels, *Miscanthus x giganteus*, *sida hermafrodita*, *Arundo donax*, perennial grasses

CEREAL BETA-D-GLUCAN AS A POSSIBLE TOOL OF PLANT PROTECTION

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Plants have evolved to live in environments where they are often exposed to different stress factors. Biotic and abiotic forms of stress as well as permanently changing climatic conditions can negatively affect the life cycle of crops resulting in loss in yield and seeds quality. Being sessile, plants have developed specific mechanisms that allow them to detect precise environmental changes and respond to complex stress conditions, minimizing damage while conserving valuable resources for growth and reproduction. One of such tools, effective in plant protection, is the beta-D-glucan. In some cereals, especially seeds of oat and barley, (1-3)(1-4)-beta-D-glucan is located in cell walls. Higher amounts of this polysaccharide have been detected in naked seeds compared to hulled, so there is an assumption of protecting role of the polysaccharide in the cell to resist the effect of stress factor to the intracellular space (especially the DNA). In heat stress, higher amounts of beta-D-glucan have been accumulated in the seeds of oat as a regulator of humidity in the plant, again, with the assumption of protecting role in heat stress conditions. In oat, plants with higher amount of beta-D-glucan were more resistant to biotic stresses caused by pathogens such as *Fusarium* or leaf-rust. Beta-D-glucan was observed only in some cereals, plants growing in broad-spectrum of regions, very often of extreme inhospitable conditions. The potential of beta-D-glucan, cell wall polysaccharide in cereals, as a natural tool of plant protection and its adaptation is discussed in the contribution.

Key words: beta-D-glucan, plant protection, cereals, stress, oat

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Session 4.

Climatic change, biotic and abiotic stresses

CLIMATE CHANGES IN BOSNIA AND HERZEGOVINA AND POTENTIAL ADAPTATION MEASURES: CASE STUDIES OF CROP PRODUCTION AND BIODIVERSITY

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Global climate change has a major impact on the crop production, biodiversity and sustainable development. Increasing temperatures, changing rainfall patterns and increases in frequency of weather extreme, such as droughts, storms and floods, will present important challenges to agricultural and food systems. The impact of climate change on crop productivity and land suitability depends not only on global climate trends but also on a range of local factors, such as soil characteristics, crop management, as well as specific adaptation measures taken by farmers. Bosnia and Herzegovina (B&H) has a rich biodiversity, with a high level of biotope diversity and a large number of endemic flora (30% of the total endemic flora of the Balkans). The strategy on biodiversity defines those areas of B&H that are most vulnerable to climate change: high mountainous systems (above 1,600 m); mountain ecosystems (900–1,600 m); sub-Mediterranean ecosystems (300–800 m); highlands (600–900 m), ecosystems of the Peripannonian area (200–600 m) and Pannonia ecosystems (up to 200 m). Studies of temperature change for the period 1961–2010 indicate that temperatures have increased in all areas of the B&H. During 1981-2010, the largest increases in average temperature during the summer months were observed in Herzegovina (Mostar, 1.2°C) and in central areas (Sarajevo, 0.8°C), while the largest increase in spring and winter temperatures was in north-central areas (Banja Luka, 0.7°C). The adaptation to climate change has in particular to be factored in as part of the ongoing technological development in agriculture, including plant breeding (growing of more tolerant genotypes, application molecular techniques, etc.), irrigation management, application of information and communication technology, etc. This paper presents the results of a research of possible climate fluctuations in B&H and their potential impact on of crop production, biodiversity and genetic resources. The study presents the current progress of this approach using several case studies and involving identify risks related to climate change and the main effects on the production of important crops and its potential to adapt and eventually mitigate climate change.

Key words: climate changes, crop production, biodiversity, adaptation

INTEGRATION OF DROUGHT TOLERANCE GENES IN MOROCCAN DURUM AND BREAD WHEAT VARIETIES

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Drought is the most important environmental stress affecting the wheat crop in Morocco, causing a severe decrease in performance. Moreover, the transfer of resistance drought, using traditional approaches is limited because of the complexity of the characteristics of tolerance. However, genetic transformation can help in improving this trait, while overcoming the difficulties of classical improvement. Therefore, this study was formulated with the objectives of genetic transformation of bread wheat and durum wheat with genes known to be involved in drought tolerance and molecular characterization of transgenic plants, and testing of the wheat transgenic plants for tolerance to drought under controlled environments. The collected embryogenic calli were bombarded with 1µm gold particles coated with plasmid DNA. After shooting, the induction of embryogenic tissue in the absence of selective agent "basta" was successful for all varieties studied. However, during the selection (on basta), the percentage of survival reduced drastically as there were subcultured on the selective media. Finally putative transgenic plants were obtained for durum wheat and bread wheat. In the other hand, an *Agrobacterium*-based transformation protocol using mature embryos, have been developed. The experiment was focused on acetosyringone concentrations, genotypes and different explants source for transformation studies.

Key words: environmental stress, drought tolerance, wheat, genetic transformation

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CROP RESPONSES TO TOXIC ELEMENTS UNDER DIFFERENT FERTILIZATION REGIMES

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Non-optimal fertilization has negative impact on plant production but also defense potential against environmental stresses. Nitrogen (N) availability provides energy for defense responses, at the same time, extreme concentrations can result in plant stress, too. Unfortunately, the underlying plant mechanisms under a broad scale of available N have rarely been studied, and knowledge on molecular level is still fragmentary. Our results showed that the growth, photosynthesis and the profiles of defense enzymes are significantly affected by the nutrition regime, in nonlinear manner. Moreover, these appear as strongly affected in presence of abiotic stress, namely ions of arsenic. The data indicate that the linearity of nitrate as well as metalloid uptake and transport in plants have to be re-evaluated within wider ranges of N concentration to conclude on efficient fertilization and plant protection strategies.

Key words: nutrition regime

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Abstracts of poster presentation

GAP ANALYSIS IN NATIONAL *EX SITU* COLLECTIONS TO ASSIST THE PLANNING OF SEED COLLECTION MISSION

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Armenia is famous for the indigenous diversity of numerous species of cereals, vegetables, oil-bearing plants and fruit crops. The rich gene pool of crop wild relatives serves as an essential source of variation in plant breeding, contribute to food security and is a part of national heritage. The wild species of cereals (three wild species of wheat, eight species of wild barley and two species of wild rye) growing in the country are distinguished by high level of intraspecific polymorphism and are of a great significance for both phylogenetic studies and breeding purposes. For broadening the genetic base of cultivars to keep the genes useful for pest resistance, to adaptation to climate change and to sustain crop improvement it is essential to conserve *ex situ* entire gene pools of the crop wild relatives. At present national *ex situ* collections do not include all intraspecific diversity and do not cover all geographical regions/areas the species are growing in. The European catalogue - EURISCO, the European Wheat Data Base, the European Barley Data Base, as well as on-line accessible national inventories of a number of European region countries have been assessed in terms of availability of intraspecific diversity and geographical coverage, to detect missing samples and assist in developing seed collection strategies. The data on habitats of the target species presented in research papers, national Red data book, management plants of protected areas have been compared with passport data of accessions stored in different *ex situ* collections. Revealed gaps in *ex situ* collections concerning insufficiently representation with regard to the full range of variation in their native distributions and incomplete geographical coverage will serve as a basis for planning and undertaking targeted collecting from the wild.

Key words: wild cereals, intraspecific and geographical coverage

POLYMORPHISM OF STORAGE PROTEIN IN SELECTED NON-TRADITIONAL WHEAT SPECIES

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The research of genetic diversity in wheat collections is a permanent task important for targeted wheat breeding. Wheat storage proteins gliadins and glutenins are still suitable breeding markers owing to their relatively high level of polymorphisms and close relations to baking parameters. The study focused on the assessment of a glutenin composition in selected non-traditional species of genus *Triticum* saved in the Gene Bank of the Czech Republic and the evaluation of some properties of quality. A model set included 12 winter genotypes of wheat species belonging to hexaploid species: *T. compactum*, *T. macha*, *T. vavilovii*, *T. palmovae*; tetraploid species: *T. turgidum*, *T. karamyshevii* and diploid sp. *T. urartu*.

Genotypes were cultivated at the Crop Research Institute in Prague (CRI). The treatment of experimental plots was carried out according to standard agronomical procedures suitable for genetic resources.

Sodium dodecyl sulphate polyacrylamide-gel electrophoresis (SDS PAGE) was used to detect the different alleles of high molecular weight glutenin subunits (HMW-GS) encoded at 3 glutenin loci. Three, seven, and three alleles were observed at the *Glu-A1*, *Glu-B1*, and *Glu-D1* loci respectively. Tetraploid species showed unique HMW-GS composition compared to hexaploid species. Alleles, especially found at *Glu-1B*, differed completely in both species.

Starch and crude protein content was predicted using near-infrared spectroscopy with Fourier transformation (FT-NIR). Relatively low variability was detected for the both characters. Coefficient of variation (CV) for protein content was 6.7% with the highest value 14.36% found for *T. compactum* (local name Kubb, origin United Kingdom). CV of starch content was 1.7%. The highest value 66.44% was found for *T. macha* (*T. macha* Gatersleben), origin Switzerland.

Key words: glutenin composition, electrophoresis, genotypes, wheat species

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AN ASPARAGUS COLLECTING EXPEDITION IN ARMENIA

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Plant Genetic Resources (PGR) plays an important role in the breeding of cultivars with improved agronomic traits. In this context crop wild relatives next to landraces represent important gene reservoirs. The flora and vegetation of Armenia is surprisingly rich and diverse. In the international minor leafy vegetables database (<http://documents.plant.wur.nl/cgn/pgr/LVintro/>) 231 accessions of *Asparagus officinalis* (garden asparagus) and 132 accessions of its wild relatives are reported to be present in gene banks worldwide. Checking the availability of these accessions CGN observed that only 168 accessions were available: 144 *A. officinalis* and 24 wild relatives. As the number of the accessions is considered to be low, the Centre for Genetic Resources, the Netherlands (CGN) and Scientific Center of Agrobiotechnology, Armenia carried out a joint collecting expedition in Armenia, in 2012. There were two major expedition aims namely: to broaden the *Asparagus* collection of CGN by collecting *Asparagus* and its wild relatives for breeding and research purposes and to contribute to the international need for the conservation of PGR. A field collecting form based upon a modified multi-crop passport descriptor list (MCPD) was used to document the passport data of the accessions sampled. The *A. officinalis* collected in Armenia was mostly cultivated. Most gardeners in Armenia mentioned that the *Asparagus* they cultivate was collected one or more decades ago in the region from the wild. In total 31 cultivated *Asparagus* accessions were collected: 23 accessions of *A. officinalis*, five accessions of *A. persicus* and three of *A. officinalis/persicus* (the accessions which gave identification problems were assigned as *officinalis/persicus*). In total 11 *Asparagus* accessions were collected in the wild: 8 accessions of *A. officinalis*, one *A. persicus* and two *A. verticillatus*. Grazing of *Asparagus* species by cattle, sheep and goats is widespread in Armenia and limits considerably the number of *Asparagus* populations from which berries could be harvested. Therefore, the three *Asparagus* species that were sampled occur mostly in areas where no/few grazing is taking place and in locations where grazing is difficult like in bramble bushes and basalt outcrops.

A. officinalis was reported in literature to occur from 0–2000 m altitude, *A. persicus* from 0–1400 m and *A. verticillatus* from 0–2500 m. In this expedition we found that *A. officinalis* grew up to 1929 m, *A. verticillatus* up to 1000 m and *A. persicus* up to 1261 m. Only *A. officinalis* was found on the higher altitudes in environmentally exposed (wind, temperature) conditions.

Key words: *Asparagus*, genetic resources, collecting expedition, evaluation, breeding

IDENTIFICATION OF SLOVAK LOCAL LANDRACES OF POPPY (*PAPAVER SOMNIFERUM* L.)

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Poppy landraces could be valuable sources to broaden the genetic base of cultivated poppy. Slovakia has a long tradition in cultivation and utilising poppy, which is related to considerable occurrence of landraces. At present, it is still possible to find some landraces which are cultivated in gardens or on small plots across the country. Several local landraces were collected from the eastern regions of Slovakia three years ago. Out of them eight accessions along with two checks were evaluated during 2014-2015 in locality Malý Šariš. The main agro-morphological and qualitative traits were recorded. The examined accessions were characterized by a great variation of morphological traits, like stem length, stem hairiness, flower bud – anthocyanin coloration, capsule – waxiness, anthocyanin coloration, shape, length, diameter and stigmatic disc shape. Analysis of variance manifested significant differences among the genotypes for seed yield, dried capsule yield and 1,000-seed weight. Seed yield ranged from 1.47 to 2.14 t/ha and capsule yield varied from 0.86 to 1.26 t/ha. Two accessions, ZB-22 and ZB-28, showed superior yield performance of seeds as well as dried capsules. They also had significant higher 1,000-seed weight (0.58 g) over the best check Major. Mean values revealed that the genotypes were have nonsignificant differences for oil content and its physicochemical characteristics. Oil content fluctuated between 44.8% and 46.7%. The highest oil content contained the accessions ZB-27 and ZB-22.

Key words: genetic resources, poppy, seed, capsule, oil

EFFECTS OF NITROGEN AND PHOSPHORUS FERTILIZERS ON YIELD AND YIELD COMPONENTS OF MAIZE (*ZEAMAYS* L.) IN TEMPERATE SEMIARID REGION

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Maize (*Zea mays* L.) is most important cereal crops in Serbia. The cropping technology of maize is generally based on a growing hybrids with genetic potential, mouldboard tillage and application of high rate of the mineral fertilizers. Optimum rate of nutrients for maize depends on numerous variable factors such as environmental conditions, management selection and genotypes requirements. A three years field experiments was conducted at the research experimental station of Institute of Field and Vegetable Crops, Novi Sad, Serbia (N 45°19', E 19°50') to investigate effects of nitrogen and phosphorus fertilizers on yield and yield components of maize and to determine optimum levels of N and P for recommendation in agroecological conditions of South Pannonian basin. The trial was established on a chernozem soil (subtype: chernozem on loess and loess-like sediments; variety: slightly calcareous). Factorial combinations of six levels of nitrogen (0, 30, 60, 90, 120 and 180 kg/N/ha) and three levels of phosphorus (0, 50 and 80 kg/P/ha) were laid out in a randomized complete block design (RCBD) with four replications. Highly significant effects ($P < 0.01$) were observed on almost all agronomic parameters studied due to the pronounced effects of N and P and their interaction. Grain yield was significantly affected by year, fertilization and year \times fertilization interaction. The highest grain yield (10.850 kg/ha) were obtained with the high rate of N (120 kg/N/ha) and P (80 kg/P/ha). Likewise, application of N and P significantly ($P < 0.01$) influenced 1,000 kernel weight, harvest index, leaf area index and plant height. Nitrogen concentrations in grain tended to increase with increase in N rates. Combined with genetic improvement, fertilization has been a powerful tool for increasing yield, especially for maize.

Key words: maize, fertilization, nitrogen, phosphorus, temperate semiarid region, yield.

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MULTIPLICATION OF *MISCANTHUS* × *GIGANTEUS* AND *ARUNDO DONAX* IN TISSUE CULTURE AND ITS IMPACT ON BIOMASS PRODUCTION

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Miscanthus × *giganteus* Greef et Deu. (miscanthus grass) and *Arundo donax* L. (giant reed) are introduced rhizomatous grasses of *Poaceae* family. Plants are characterized by the production of a huge amount of biomass that can reach up to 40 t/ha for miscanthus grass and 78 t/ha for giant reed. Both species do not produce viable seeds and are multiplied by the vegetative ways only. Miscanthus grass is usually multiplied by rhizome segments; in giant reed, multiplication by stem segments is preferred. *In vitro* propagation via plant tissue culture is an alternative method to produce a large amount of plantlets in a short time. Plant tissue culture methods can also be used for breeding and medium-term storage of plant material.

Culture of giant reed was initiated from stem segments with axillary bud and emerged shoots were then multiplied by the method of *in vitro* tillering. Optimised media for giant reed multiplication were based on MS medium supplemented with cytokinin BAP (6-benzylaminopurine) or TDZ (thidiazuron) and solidified with Gelrite. For rooting of shoots, BAP combined with NAA (α -naphthaleneacetic acid) was used. Tissue culture of miscanthus grass was initiated from immature inflorescences. Regeneration started via callus phase which took place 3 months on MS medium supplemented with 2,4-D (2,4-dichlorophenoxyacetic acid) and L-cystein HCl as an anti-browning agent. Regenerants were then multiplied by *in vitro* tillering using nutrient medium supplemented with cytokinin BAP and rooted in the medium with NAA. *Ex vitro* acclimatized plants were transplanted to the field together with plants multiplied by rhizomes (miscanthus grass) or stem segments (giant reed) and compared for biomass production during three growing seasons (2013-2015). While statistically significant differences between *in vitro* plants and rhizome-developed plants were not observed for miscanthus grass, for giant reed, a significantly lower production of biomass was observed for *in vitro* plants.

Key words: giant reed, miscanthus grass, *in vitro*, rhizomes, vegetative propagation

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SWEET FLAG (*ACORUS CALAMUS* L.) IN SITU CONSERVATION

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Acorus calamus, called as Sweet flag or Calamus is a tall perennial wetland monocot the *Acoraceae* family, in the genus *Acorus*. The scented leaves and more strongly scented rhizomes have traditionally been used medicinally and to make fragrances, and the dried and powdered rhizome has been used as a substitute for ginger, cinnamon and nutmeg. Natural populations of Calamus were markedly depleted in Slovakia, due to previously implemented hydro technical melioration. There is only one habitat of Sweet flag natural occurrence in Slovakia, which is located on an abandoned meander of the river Latorica in Rad residential area (Trebišov district) at an altitude of 110 m above sea level. Recent population of sweet flag is extensive and multiple – relatively hundreds of herbs. Monitoring of Calamus on this site in the years 2005-2010, 2016 focused mainly on climatic and soil characteristics of the site, assessing the extent and population size, creating a classifier for evaluation and description of morphological characters and sustaining the populations of Calamus. Selected biometric of Sweet flag, found using non-destructive methods in the period of maturity were as follows. Plant – plant height: very high (> 100 cm), tillering: very strong (> 4.0 tillers), tiller length: very long (> $\frac{3}{4}$ of the height of the plant). Stem – stems color: green. Leaf – length: long (76 – 100 cm) to very long (> 100 cm), width: very wide (> 2.0 cm), the number of leaves on the stem: high (4–6 leaves) to very high (> 6 leaves), leaf color: green. Inflorescence (spadix) – length: long (7.6–9.0 cm), width: wide (0.9–1.0 cm) to very wide (> 1.0 cm), height of inflorescence set: high (71– 80 cm) to moderate (81 – 100 cm). Rhizome – length: very long (> 50 cm), thickness: medium (2.1–3.0 cm), color: green brown. Abundance of population: medium (7.6–8.5 i/m²) to moderate high (8.6–9.5 i/m²).

Key words: sweet flag, conservation, in situ, biometrics

SLOVAK CAPACITY BUILDING TO *ON-FARM* CONSERVATION AND UTILIZATION OF RICE LANDRACE IN KYRGYZSTAN

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The changes in agricultural traditional system have brought many issues in social and economic areas of life in many countries. In the former countries of the Soviet bloc there was the collectivization of agricultural land in the last century and this change significantly decreased the traditional farming and crops in the country. Intensification of agriculture has led to increased use of fertilizers, pesticides and other agrochemicals. These processes contributed to significant genetic erosion of the gene pool of landraces.

The aim of the project was to reduce poverty of vulnerable groups - farmers in southern Kyrgyzstan by improving conditions in agricultural production, market participation and conservation of landrace "Uzgen rice", standard of living and health. We collected the original of rice landrace "Ak uruk" (Arpashali) and we conducted chemical analyses on rice samples for the content of qualitative characters. The protein content according to Kjeldahl in the samples of the landrace "Ak uruk" ranged from 7.59 to 9.45%. These values were higher by 2.33% comparing to the protein content declared in the database of the business network. Rice contains a relatively small amount of oil (500 mg/100g), however in the tested rice samples the fat content ranged from 0.97 to 2.74%. The amount of carbohydrates in the landrace "Ak uruk" ranged from 76.80 to 72.11 g, and the starch content averaged 70.29%. The landrace of the Uzgen rice "Ak uruk" was certified for autochtonity and quality for its use in agriculture and food. The traditional rice landrace "Ak uruk", have been rescued from the disappearance.

Key words: Uzgen rice, traditional farming, collectivization, genetic erosion, landraces, Kyrgyzstan

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ARMENIAN LANDRACES OF APPLE AND PEAR

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The history of horticulture in Armenia comes from ancient times. The territory of the country is the native land of such species as grape, apricot, pear, cherry, plum, sweet cherry, pomegranate, walnut and others. The rich gene pool of wild fruit species and forms and the presence of rich diversity of cultural valuable aborigine varieties in the country's forests as well as on some protected areas show that Armenia is one of the best centers of the formation of these species. Nowadays the fruit growing is the oldest and most profitable branch of the country's agriculture. Various fruit species are cultivated in the Republic – apricot, peach, plum, cherry, apple, pear, quince, nut, almond, fig, pomegranate, eastern persimmon and, recently, kiwi. The apple tree and the pear tree have their valuable place in horticulture. Local varieties of apple trees are specific in their vigorous growth, longevity, yielding, resistance to pests and diseases. Many varieties are drought and frost resistant. The brief description of the most valuable Armenian landraces of apple and pear is presented in the paper. In particular, dimensional characters of trees, color of trunk and skeleton branches, size and shape of leaves, fruits' size, color, sweetness, seed bags type and seeds number, as well as drought and frost resistance, sensibility to pest and diseases are described. Valuable characterizes of each variety such as maturity period, productivity, etc. are presented. The rich gene pool deserves an attention and conservation actions, especially in the form of collection orchards which will enable the breeding activities as well as contribute to utilization of their valuable genetic characteristics.

Key words: agrobiodiversity, landraces, apple, pear

SECONDARY METABOLITES ACCUMULATION IN SAFFLOWER OF FALL AND SPRING SOWING IN THE REPUBLIC OF MOLDOVA

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Safflower (*Carthamus tinctorius* L.) is a versatile crop, used as a source of edible oil, meal, whole seed for dairy cattle, birdseed, and as a biodiesel feedstock. Flowers and seeds are extensively applied in traditional herbal medicine in Asian countries (China, Korea, and Japan) for treating various ailments such as gynecological, cardiovascular and cerebrovascular diseases. Pharmacological effects of safflower are due to its ability to accumulate biologically active secondary metabolites, especially phenolic compounds. The aim of this study was to evaluate the differences in accumulation of phenolic compounds in leaves and flowers of safflower sown in fall (November 20, 2015) and spring (March 22, 2016). Field experiments were carried out at the research station of medicinal plant collection of IGPPP. The total phenolic content in extracts from leaves and flowers of safflower was determined by Folin-Ciocalteu method. Antioxidant activity of extracts was studied *in vitro* by potentiometric procedure using 2,2'-azobis(2-amidinopropane)-dihydrochloride as generator of reactive peroxy radicals. It is known that phenolic compounds such as luteolin, quercetin and their corresponding glycosides detected in safflower exhibit strong antioxidant activity. Because of that the flavonoid content, especially flavone and flavonol glycosides (expressed as luteolin-7-O-glucoside and quercetin-3-O-rutinoside, respectively) was evaluated by HPLC methods. The content of flavonoid glycosides in safflower leaves collected in intense growth phase of plants sown in spring and fall was similar. In flowering phase the total phenolic content as well as the flavonoid glycosides in leaves and flowers of spring sown safflower was 20-30% more than in leaves of fall sown plants. Antioxidant activity of extracts from leaves and flowers of spring sown safflower was more but not significantly than antioxidant activity of extracts from fall sown plants. The present study revealed that the greatest accumulation of secondary metabolites of phenolic structures was in safflower sown in spring.

Key words: safflower, leaf, flower, phenolic compound, antioxidant

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AGRICULTURAL BIOMASS INPUT DATA FOR MATERIAL FLOW ANALYSIS IN SLOVAKIA AND CHINA

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Agricultural production heavily relies on the balance of natural resources and human socio-economic activities that includes the high efficiency and sustainability of materials consumption and energy usage. Modern agriculture, which is characterized by the high input of fertilizer, pesticide and other production materials, has resulted in some obvious or potential environmental problems, such as emission of greenhouse gases, excessive consumption of energy, water pollution and fertility decline. Therefore, it is necessary to evaluate the efficiency of materials and energy use, and the sustainability of different production systems. Efforts to increase economic and environmental use efficiency of agricultural biomass needs assessment of the whole systems which must be conducted to assure that development do move towards sustainability and eco-friendliness. Energy and material flow analysis are effective tools for carrying out this type of evaluation. Input data including agricultural phytomass are key elements for both analysis. In this study we aim to select and evaluate input material flow analysis data gathered at national level in Slovakia and China. Data are used for calculation of material flow input and output indicators. Main input indicators are area of land use categories, fertiliser consumption, pesticide consumption, livestock numbers, water use, fuel consumption. As output indicators are used or calculated yields of main agricultural crops, used and unused harvest residues, root residues, emissions of greenhouse gases, ammonia emissions, waste production. Gathered data allow to carry out the material flow analysis that quantifies physical exchange between country economy, environment and foreign country economies using total mass of materials yearly flowing through boundaries of the economy. The analysis shows negative consequences of material use in economy on environment.

Key words: Biomass, material flow analysis, land use, agricultural yield, harvest residues, root residues

Acknowledgement: The work was supported by the Slovak Research and Development Agency under Grant No. APVV-SK-CN-2015-0004 Sustainability evaluation and optimization methods for agricultural production system: coupling energy and material flow theory

COMPARISON OF PLANT AND ANIMAL DIVERSITY AT TWO MESOPHILE PASTURE BIOTOPES

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Plant and animal diversity play very important role in ecosystem services. Estimating the value of the various ecosystem services and biodiversity may be done with a variety of valuation approaches. The concept of biotope defines specific biotic and abiotic conditions of some area which meet the requirements of specific plant and animal species. Methods for assessing of biotopes rely predominantly on the plant and animal communities. Biotope valuation method (BVM) has been developed for assessing the biodiversity damages and reasonable costs of ecological restorations. Each biotope type is valued using points according to eight ecological characteristics (matureness, naturalness, diversity of plant species, diversity of animal species, rareness of biotope, rareness of species, vulnerability, and threat to existence), each of them with a potential point value ranging from one to six points. In this study we aim to compare plant and animal diversity at two same biotope of mesophile pastures. The field work was carried out in the spring 2015 on permanent grasslands at 2 study sites (Tajov, Liptovská Teplička) located in different climatic and natural conditions. Plant and soil arthropod diversity was evaluated by Shannon-Weaver index (H'). The calculated values of both, plant and soil arthropod diversity were slightly higher at Tajov (H'_{plants} 2.57, $H'_{\text{soil arthropods}}$ 1.42) comparing to Liptovská Teplička (H'_{plants} 2.36, $H'_{\text{soil arthropods}}$ 1.25). The results indicate that plant diversity can influence soil arthropod abundance and diversity in terrestrial ecosystems.

Key words: plant diversity, soil arthropod diversity, biotope, ecosystem services, biotope valuation method

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MONITORING AND COLLECTION OF GENETIC MATERIAL OF FORAGE CROPS OF LOCAL ORIGIN IN SLOVAKIA AND BULGARIA

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Forage genetic resources play a very important role in food security and poverty alleviation. A diverse forage germplasm collection, description and evaluation is a key to any forage development. Natural and seminatural grasslands of Slovakia and Bulgaria are a huge reservoir of germplasm of forage species.

The bilateral project "Collection and Research of Genetic Material of Local Origin of Grass Forage Species for Need of Selection" provide research workers and breeders from Slovakia and Bulgaria opportunity to collect genetic materials of different grass species (*Festuca rubra* L., *Festuca arundinacea* Schreb., *Phleum pratense* L., *Dactylis glomerata* L.) and legume species (*Trifolium repens* L., *Trifolium pratense* L., *Trifolium hybridum* L., *Lotus corniculatus* L., *Medicago sativa* L., *Securigera varia* L.) in grasslands located under different environmental conditions.

Based on field research in July 2016, the first localities were selected at altitudes from 341 m a.s.l. (Pliešovská and Zvolenská basin) to 733 m a.s.l. (Kremnica hills and Starohorské hills). Grasslands habitats belong to "Lowland hay meadows" with *Arrhenatherion elatioris* Koch1926 alliance (Natura 2000 code: 6510), „Foxtail alluvial meadows“(NATURA 2000 code: H6440) with *Alopecurion pratensis* alliance and "Mesophilous pastures" with the *Anthoxantho-Agrostietum tenuis* Sillinger 1933 alliance (habitat of national importance). In September 2016, field research will continue at higher altitudes on seminatural grasslands in Low and High Tatra Mts., and Rhodope, Rila and Pirin Mountains in Bulgaria as well.

Key words: forage crops, genetic resources, collection expeditions

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CULTIVATION POSSIBILITIES OF *PHYSALIS* SP. WITH FOCUS ON THE ECOLOGICAL NEEDS AS NEW CROPS IN THE HUNGARIAN AGROBIODIVERSITY

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Nowadays, the increasing food requirements causing high pressure on the living environment and on the agro-ecosystem in our global society. Several issues remain to be solved as high priorities. One of them is the effects of the cultivated flora reaction to sudden changes of climatic and ecological situations. A number of useful plant species are absolutely not cultivated or not in wide range because we do not see the economic potential in them or simply we just ignore or underestimate their values. Therefore, we can ask ourself: how could we use the predicted climate change to grow economically valuable species far from their places of origin and using the advantage of the new climate conditions. For this reason we have to examine the new opportunities offered by the changing environment to find valuable species for our future horticultural structure. According to this aim, the genus *Physalis* from Solanaceae family has been chosen for further investigation. The genus contains many lesser-known species with edible or ornamental fruit. The selected species have economic value in some regions which could be increase after introduction of the species in new areas. The present study try to describe the climatic and ecological needs of six perspective species of the genus (*P. pruinosa* L., *P. peruviana* L., *P. pubescens* L., *P. ixocarpa* Brot., *P. philadelphica* Lam., *P. alkekengi* L.). The species examined on three different locations and on five different soil types between the years 2014-2016 in Hungary. The resulting morphological data and the level of homo- and heterogeneity of the populations with the relationship among local meteorological measurement data and soil analysis, using statistical methods, will clarify the exact cultivation possibilities of the valuable species. All measurement data and observations going to lead us to get a better picture of this genus in the new environment also open the possibilities for future breeding programs to develop new cultivars and make agrobiodiversity more colourful and not least could help to stabilize the uncertainty of food supply.

Keywords: *Physalis*, cultivation, introduction, agrobiodiversity, plant ecology

FRUIT QUALITY OF SOME LOCAL APPLE CULTIVARS, DERIVED FROM GENE BANK OF RESEARCH INSTITUTE OF HORTICULTURE, POLAND

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In 2015 at the Pomological Orchard (belongs to Research Institute of Horticulture in Skierniewice, Poland) apple fruits of 36 cultivars (13 summer and 23 autumn-winter), derived from gene bank of Research Institute of Horticulture were harvested. After harvest fruit weight, percentage of blush, internal ethylene concentration, starch index, total soluble solids content, titratable acidity and fruit firmness were measured. The quality parameters are cultivar depended and varied greatly.

Among summer cultivars the lowest titratable acidity (0.4%) was found for 'Korbasowki' and the highest (1.2%) for 'Oliwka Czerwona'. The total soluble solids content for those cultivars varied from 'Oliwka Zolta' (9.7%) to 'Profesor E. Jankowski' (13.9%). 'Kardynalskie Plomieniste' had the highest percentage of blush (ca 75%) and produced the biggest fruits (ca 250 g).

Among autumn-winter cultivars the lowest titratable acidity (0.4%) was found for 'Sztetyna' and the highest (1.4%) for 'Boiken'. Fruits of 'Matwilowka' cv characterized the lowest total soluble solids content (10.0%) in contrast to 'Kronselska' (15.0%). Fruit weight for those cultivars varied from ca 60 g ('Koksa Guzik') to more than 300 g for 'Sztetyna Zielona'.

Key words: *Malus*, fruit genetic resources, local cultivars, fruit quality

Acknowledgement. This work was performed in the frame of multiannual programme IHAR/IO (2015-2020), financed by the Polish Ministry of Agriculture and Rural Development.

DIFFERENCES IN DEFENSE AGAINST HERBIVORES BETWEEN WILD POPULATIONS OF *ERUCA SATIVA* IN ISRAEL

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Populations of the annual winter species *Eruca sativa* (rocket, *Brassicaceae*), originating from arid desert and Mediterranean habitats in Israel, differ in several morphological and phenological features, as well as in their resistance to generalist herbivores. A no-choice feeding experiment indicated that larvae of the generalist *Spodoptera littoralis* gained significantly less mass when feeding on methyl-jasmonate (MJ) defense-induced leaves of the desert population than these feeding on control ones. Differently, no difference was found between the weight of larvae feeding on control and defense-induced leaves of the Mediterranean population. Unexpectedly, measurement of defense metabolites revealed an increase in the accumulation of glucosinolates in defense induced leaves of the Mediterranean population, but not in leaves of the desert population. Analysis of the transcript level of *NSP2*, responsible for diverting glucosinolate breakdown products to simple-nitriles on the expense of toxic isothiocyanates was found higher in plants of the desert population than in the Mediterranean plants, both constitutently and in response to MJ, or herbivory. In the desert population however, divergence of glucosinolates breakdown products to less toxic nitriles is compromised by induced expression of proteinase inhibitor. Our results indicate that the divergence to two distinct defense strategies can be associated to differences in the abundance of the specialist moth *Plutella xylostella* in the two natural habitats.

Keywords: *Eruca sativa*, herbivores, glucosinolates, habitat, Mediterranean

REVITALIZATION OF AREAS DAMAGED BY MOTORWAY CONSTRUCTION THROUGH NATIVE SPECIES-RICH PLANT COMMUNITIES

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Currently, new non-invasive methods for grassland renovation are investigated. Latest knowledge aims at harvesting seeds from species-rich seminatural grassland sites. These wild seeds are utilized in restoration of areas with degraded arable land or sites damaged by infrastructural interventions, such as motorway constructions, landfills and mined land, or ski slopes. All such infrastructural changes require renovation with the objective to establish new areas with high value of the nature and the landscape. One of the method is presented here. A new sward may be established on the damaged recipient area by applying fresh-cut herbage from a grassland donor site containing a high proportion of ripe plant seeds. In 2013-2015, the method was used to revitalize protected habitats of national and European importance that were disturbed during the construction of motorway section R2 Vígľaš Pstruša - Kriváň. The fresh-cut herbage ("green hay") was spread on the motorway embankments and new sward was successfully established there. It is necessary to apply regular management to the newly established grassland in the following years, mainly to prevent the weed infestation. The research is continued at seven sites in 2016-2018. The research scope aims at more objectives, such as definitions of habitat character, suitable time for the green hay application or comparison to other revitalizing methods.

Key words: species diversity, grassland revitalization, motorway construction

VARIABILITY CONTENT OF ARABINOXYLANS IN SELECTED MODERN AND ANCIENT WHEAT SPECIES

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Arabinoxylans are non-starch polysaccharides with xylose backbone and arabinose side chains. They include nearly 70% of the non-starch polysaccharide in wheat bran and 90% in wheat endosperm. Arabinoxylans are the important physiologically functional component of dietary fiber varying in the range 40–50% of total dietary fiber (TDF). The healthy benefit of other components of dietary fiber such as cellulose or lignin has not been confirmed yet compared to arabinoxylans, resistant starch, β -glucans and fructans. Their inadequate intake is associated with an increased risk for cardiovascular disease, colon cancers and diabetes. Ancient wheat species such as spelt, emmer and einkorn are offered to customers as better sources of dietary fiber as well. This proclamation is often based on improper confirmation with refined white flour of common wheat. Thus, our study was aimed at objective comparison of content variability of wheat arabinoxylans in selected modern and ancient wheat species.

The set of tested spring wheats included 6 modern wheat cultivars (*T. aestivum* and *T. durum*) contrasting in their development (registration) time (2nd world war vs. 2004) and starch composition (normal vs. waxy) and 4 ancient wheat species (*T. monococcum*, *T. dicoccum*, *T. spelta* and *T. turanicum*). All genotypes were cultivated at the Crop Research Institute in Prague (CRI) in two years 2014 and 2015. The content of water extractable (WEAX) and total arabinoxylans (TAX) were detected using spectrometric method according to Douglas (1981). Starch and crude protein content was predicted using near-infrared spectroscopy with Fourier transformation (FT-NIR).

The results confirmed significantly higher content of TAX in modern wheats (by 0.7%) and comparable content WAEX (0.55%). It is evident that whole grain of modern wheats offer fully comparable or even a better source of arabinoxylans as ancient wheat species.

Key words: arabinoxylans, dietary fiber, wheat species

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THE EVALUATION OF SWEET CHERRY GENOTYPES RESISTANCE TO *COCCOMYCES* BLIGHT ACCORDING TO THE LEAF BIOCHEMICAL CHARACTERISTICS

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The experimental data of sweet cherry genotypes leaf apparatus studying according to biochemical characteristics (chlorogenic and ascorbic acids quantitative content) are given and the breed characteristics of the parameters under study are identified. The interconnection between ascorbic and chlorogenic acids in the sweet cherry leaves resistant to *Coccomyces* blight ($R = 0.99$) is determined that can be used for the development of diagnostic method to identify sweet cherry resistance to environmental biotic factors and for the formation of new approaches to selection process speed-up.

Keywords: sweet cherry, *Coccomyces* blight, ascorbic and chlorogenic acid

EVALUATION OF PHYTOPLASMA ESFY IN GENETIC RESOURCES OF APRICOT AND PEACH IN SOUTH MORAVIA

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In the course of research of the ESFY phytoplasma presence in genetic resources of apricot its symptoms and influences on phenology stages were recorded. Detection of phytoplasma ESFY was confirmed by nested PCR using specific primers within whole evaluation process. During the eight years of trees evaluation differences between periods of blooming and maturing between healthy and infected trees were described. Among most frequent symptoms in apricot were chlorotic leaf roll and the leaves yellowing with occurrence of 45.0%, early maturing in 31.8% of individuals, leaf roll 22.7% etc. For peach trees are most common symptoms such as leaf roll with occurrence of 90.0%, chlorotic leaf roll or redness of leaves 68.0%, growth depression 53.5%, preliminary leaf fall and little fruit. Usually the symptoms are blend together with each other, so it is difficult to visually quantify them. Infestation of apricot genetic resources were about 55.0% infected trees and 68.0% of infected peach trees in germplasm resources. The evaluation of phytoplasma ESFY presence in this extensive gene pool collection can provide significant reduction of time for finding resistant sources against this disease.

Key words: apricot diseases, stone fruit, health condition, PCR, symptoms

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MORPHOMETRIC ANALYSIS OF GRAINS SELECTED VARIETIES OF *TRITICUM AESTIVUM* L.

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The aim of the work was characterization of grain morphology on 15 selected varieties of winter wheat (*Triticum aestivum* L.) by morphometric analysis with use of image analysis tools. Detailed visual displays of wheat grains (6 visual displays = 300 images) we made using fully automated microscope Zeiss Discovery V20. Image analysis software Axio Vision 4.8.2 with module for automatic measurement was used. The grains were characterized in four quantitative traits, and that the height of the grain cross-section (mm), the width of the grain cross-section (mm), the length of the grain cross-section to the crease (mm), the length of the grain cross-section from the crease (mm), and also in four qualitative traits (the grain shape, the crease shape, the shape of the grain from side, the shape of the grain from dorsal side). By studying the variability of the varieties have been designed new descriptors for evaluation of qualitative traits - the shape of the grain from side, the shape of the grain from dorsal side. We found that when evaluating the character shape of the grain the elongated shape was prevailing shape type, and only variety Istra had ovoid shape of grains. When evaluating the character shape of crease, only variety Košútska was characterized with intermediate narrow crease shape. With ANOVA were confirmed statistically significant differences ($p < 0.05$) between varieties Bučianska červenoklasá and PS Lubica in all evaluated quantitative traits. The used tolls of morphometric and image analysis are still relevant in the evaluation and characterization of genetic resources of winter wheat.

Key words: wheat (*Triticum aestivum* L.), image analysis, grain morphology, genotype

Aknowledgement: This work was supported by the Operational Programme Research and Development of the European Regional Development Fund in the frame of the project „Support of technologies innovation for special bio-food products for human healthy nutrition“, ITMS 26220220115.

COLLECTING PLANT GENETIC RESOURCES IN VEĽKÁ FATRA AND IN BARANYA COUNTY WITHIN THE FRAMEWORK OF HUNGARIAN-SLOVAKIAN BILATERAL COOPERATION

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Staff from the Center for Plant Diversity and its partner institute in the Slovak Republic, Výskumný Ústav Rastlinnej Výroby have been organizing joint collecting missions in 2015-16 within the framework of international Bilateral Scientific and Technology cooperation. In both years we have searched for and collected valuable plant genetic resources, specially cultivated landraces and usable plants on one domestic trip and one trip abroad, respectively. In 2015 we collected 143 accessions of 45 taxa in Veľká Fatra, Slovakia and 121 accessions of 72 taxa in Baranya county, Hungary.

Keywords: medicinal plant, collecting mission, forage plant, landrace, wild species

CRYOBANK OF GARLIC (*ALLIUM SATIVUM* L.) GENETIC RESOURCES IN POLAND

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The Research Institute of Horticulture, Skierniewice, Poland maintains 539 garlic (*Allium sativum* L.) accessions in a field collection (296 bolting garlic accessions and 243 non-bolting garlic accessions). The collection has been maintained since 1986. The plant material was collected on expeditions in various parts of the world. Garlic accessions have been a source of many features needed in breeding, biotechnology and other research branches. To provide a long-term storage, protect from harmful biotic and abiotic factors, preserve the genetic stability and reduce costs of maintaining field collection safe duplicates of the field collection in liquid nitrogen were performed. Cryopreservation has become an alternative, safe and the most effective method for long-term conservation of vegetatively propagated germplasm. Garlic shoot tips isolated from bulbils and *in vitro* plantlets were cryopreserved by vitrification method. On April 1, 2011 the European Tripartite Cryobank was established. A Cryobank Network has been carried out by the three partners from: the Czech Republic, Germany and Poland. At present, 160 garlic accessions from European field collections are maintained in the cryobank, 75 accessions are from Polish collection.

Key words: cryobank, garlic, cryopreservation, genetic resources

Acknowledgement: This work was performed in the frame of multiannual programme on preservation of gene bank resources financed by the Polish Ministry of Agriculture and Rural Development: Task 1.3 "Collecting, preservation in *ex situ* collections, cryopreservation, evaluation, documentation and using of gene bank resources of horticultural crops".

POMOLOGICAL EVALUATION OF SOME PEACH AND NECTARINE CULTIVARS FROM GEENE POOL COLLECTION IN HORTICULTURE FACULTY IN LEDNICE

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In accordance with a long-term evaluation of peach and nectarine cultivars from the gene-pool collection in Lednice is composed the following evaluation. This paper presents some examples of prospective varieties, lists different pomological groups of prospective varieties, and classifies the varieties in terms of their resistance to plum pox virus (PPV) and late spring and winter frosts. Early-flowering cultivars include for example the varieties Nataly, Aline, Silvery and Anita. Catharina and Nectadiofik are late-flowering. According to the time of ripening, early cultivars are Maycrest, Starkcrest, Earlycrest and China 2. Late-ripening cultivars are Lucia, Orion, Venus and Sandra. From the point of view of frost hardiness of flower buds, hardy cultivars are Miss Italia, Flamingo, Fenix, Elegant Lady, Envoy, Harbelle and Maria Marta. Less frost-hardy are the varieties Armking, Rich Lady or Aurelia. On the basis of their flavour and growing requirements, it is possible to recommend the following examples of promising cultivars – Maycrest, Early Star, Royal Glory, Miss Italia, Symphonie, Crimson Gold, Harken, Orion and Venus.

Key words: phenology, PPV, pomology, varieties

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DIVERSITY OF MICROSCOPIC FUNGI ASSOCIATED WITH ST. JOHN'S WORT PLANTS IN SLOVAKIA

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St. John's wort, known botanically as *Hypericum perforatum*, is a sprawling, leafy herb that grows in open, disturbed areas throughout much of the world's temperate regions and has been considered a medicinally valuable plant for over 2000 years. St. John's wort is perhaps most commonly found in grasslands, pastures, meadows, and rangelands. Endophytic fungi isolates from stems of *Hypericum perforatum* were studied to determine the total diversity of endophytes inhabiting stems.

This paper presents data on fungi (pathogenic or endophytic) found on *Hypericum perforatum* plants in Slovakia during 2009-2014. The classical method of isolation and morphological analyses were used to identify fungal communities on symptomatic plants. In dead parts of stems, fungi were identified by microscopic analyses of fruit bodies *in situ*.

A total of 97 fungal isolates representing 24 genera were isolated along with dark septate and sterile fungi in 36 samples of *Hypericum perforatum* plants. These fungal isolates belonged to Ascomycota (49.5%), Coelomycetes (40.2%), and Hyphomycetes (10.3%). The symptoms of powdery mildew (effuse-to-dense white patches of mycelium, primarily on adaxial leaf surfaces) caused by fungus *Erysiphe hyperici* have been recorded very often. The most common fungi detected in necrotic lesions on stems were *Diploceras* (47.2%), *Septoria* (25%) and *Mycosphaerella* (17%). Other frequently isolated fungi included *Ascochyta*, *Botrytis*, *Coniothyrium*, *Colletotrichum*, *Clathrospora*, *Fusarium*, *Melanconium*, *Microdiplodia*, *Phaeosphaeria*, *Phoma*, *Phomopsis*, *Pleospora*, *Scopinella*, and *Trichometasphaeria*. Endophytic fungi are major contributors to fungal diversity and an important component of plant microbiota.

Keywords: *Hypericum perforatum*, biodiversity, fungi, Slovakia

CURRENT STATUS OF GENETIC RESOURCES DOCUMENTATION IN REPUBLIC OF MOLDOVA

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Proper and accessible documentation is vital for the future use of any stored gene bank material. A primary focus in the documentation of plant genetic resources (PGR) is development, implementation and utilization of information system.

The system for the documentation of PGR in Republic of Moldova – *ReGen*, has been developed in the Centre of Plant Genetic Resources (now is the Laboratory of Plant Genetic Resources), Institute of Genetics, Physiology and Plant Protection in 2002. It represents unified information system that includes three basic functional blocks: *ex situ* (seed collections), *in situ* - maintenance of plant genetic resources in natural habitats, and data on crops and crop varieties grown *on-farm*.

Information on collection maintained *ex situ* consists of two categories of data: passport data, and characterization/evaluation data. For the standardization of data are used common international descriptors, developed by the Bioversity International with the participation of FAO. In case of passport data are used the List of Multi-Crop Passport Descriptors (MCPD), and for evaluation and characterization – IPGRI Crop descriptors.

At present about 3,000 accessions are described in passport database. A set of data (1,213 accessions) on plant genetic resources from Moldova has been loaded to EURISCO web catalogue. A lot of information on characterization/evaluation is documented manually and only a small part of these data has been computerized.

The database for *in situ* conservation was established recently. For this reason was created a specific list of descriptors. This system includes aspects of species biology, ecology, conservation status, distribution, crop production, local community uses and existing conservation actions.

The data about the *on farm* conservation is structured in two parts: passport data and collecting data. The created list of descriptors include information of site environmental data, which are important for characterization, as well as socio-economic data, which are vital for continued maintenance of populations *on farm*.

Key words: plant genetic resources, documentation, information system, database, descriptors

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MORPHOLOGICAL AND PHENOLOGICAL CHARACTERISATION OF HUNGARIAN SWEET CHERRY LANDRACE ACCESSIONS

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The great adoption to a regions climate, the unique characteristics make landrace varieties remarkable, and their conservation is increasingly important. Since they represent great variability in many properties, and carry useful attributes, can be selected as great genetic resource in plant breeding programs, as well as supplementary specialty on local markets.

In our studies, sixteen hungarian sweet cherry landrace accessions that selected for EU.Cherry Programme, located in the gene bank of NARIC Fruitculture Research Institute, Research Station of Érd, were examined and described, based on one year's observation in 2016. For our study, we used primarily descriptors established by the International Union for the Protection of New Varieties of Plants (UPOV).

Phenotypic observations were carried out for a total 40 qualitative and quantitative characteristics of every accessions. The observed characteristics described growing habit, 1-year-old shoot, leaf size and nectaries, a comprehensive description of the cherry fruit including external and internal properties. The time of beginning of fruit ripening was recorded, along with productivity. For each accession, 10 leaf samples were collected and measured in summer. At the ripening time of each variety, 20 fruit samples were harvested randomly, measured and analysed.

With the measurements and qualitative observations, the comparsion of the accessions were carried out. Out of the 16 accessions, 12 had skin color of red, or a shade of red, one was blackish, and three had light yellow skin color. 'Kecskecsöcsű' had the largest fruits with an average 27.4 mm diameter, and the smallest cherries were harvested from 'Péceli cseresznye' trees at an average value of 11.9 mm. The earliest fruit ripening time was recorded of 'Famosi cseresznye' variety, and a very late beginning of fruit ripening time could be observed on 'Szeptember'.

Keywords: sweet cherry, landrace, *Prunus avium*, fruit characteristics

MEDICINAL AND AROMATIC PLANT GENETIC RESOURCES CONSERVATION IN LITHUANIA

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The existing system of conservation of medicinal and aromatic plants includes *ex situ* and *in situ* methods. The Lithuanian flora contains 1,334 plant species. About 1/3 of native plant species are being used in both modern and traditional medicine in Lithuania.

Generally, the conservation of MAP's and their resources is regulated by the the Law on Wild Vegetation, the Law on Protected Areas, Law on National Plant Genetic Resources and supplementary legal acts. The Law on National Plant Genetic Resources (2001) included MAP's and regulate the procedure for collecting, investigating, conserving and regenerating plant genetic resources. The Plant Gene Bank was established in 2004.

The genetic recourses of MAP's are stored, studied and constantly maintained in the field collections of the Institute of Botany the Nature Research Centre, Kaunas Botanical Garden of Vytautas Magnus University and the Aleksandras Stulginskis University. The field collection of the Institute of Botany includes over 500 accessions of medicinal and berry plants, about 90% of accesions are plants of wild origin native to Lithuania. The collection of medicinal plants in Kaunas Botanical Garden consists of 400 species, the indigenous species comprise 1/5 of the collection. The field collection of caraway, which vary in time of flowering, colour of inflorescence and the amount of essential oils are stored in Aleksandras Stulginskis University.

Today the 21 areas for *in situ* conservation of MAP's and small fruits as well crop wild relatives in Lithuania are selected. In most cases *in situ* conservation is more reliable within the already existing network of protected areas than outside them.

Presently seeds of 214 accessions representing 38 species of medicinal and aromatic plants are put in long-term storage in the Plant Gene Bank. The data about national genetic resources are stored in the Central Database of the Plant Gene Bank.

Key words: Medicinal aromatic plants, conservation, *ex situ*, *in situ*

FRUIT QUALITY AND S-ALLELE ANALYSIS OF SOME ALMOND ACCESSIONS SELECTED FROM THE HUNGARIAN GENE BANK COLLECTION

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Our almond genebank in Érd contains around 220 accessions. There are Hungarian and foreign landraces and local varieties, as well as genotypes from the old Hungarian breeding work.

In this work we evaluated fruit morphological characters of seven accessions that preliminary showed high fruit quality compared to two well-known Hungarian cultivars ('Tétényi bőtermő', 'Tétényi keményhéjú'). Two of the tested accessions are foreign varieties ('Eriane', 'Fournat de Brezenaud'), five of them originate from seedling populations ('Sóskút 66/3', 'Sóskút 96/5', 'Sóskút 16/7', 'Akali 57/2', '5/15'). We evaluated the selected accessions and the control varieties in 2013 and 2014, according to ECPGR *Prunus*-specific descriptors (1981), using samples of 10 fruits.

Our examinations have confirmed our preliminary observations. The width and length of the shelled fruits and the kernels of the genebank accessions (except 'Akali 57/2') were above the size of the control varieties in both years. As regards the thickness of the fruits, only 'Eriane' lagged behind the control varieties. Overall, 'Fournat de Brezenaud' stood out from the others regarding fruit size and 5/15 had the largest kernel. 'Tétényi bőtermő' had typically narrow, 'Akali 57/2' and '5/15' had rounded fruit shape. Light shelled fruits are popular on the market. 'Akali 57/2' had the lightest shell colour, 'Sóskút 96/5' and 'Sóskút 16/7' the darkest shell. Kernels of 'Sóskút 96/5' and 'Akali 57/2' were less hairy. All shells of the examined accessions (except 'Tétényi bőtermő') were hard as they could be broken only with hammer. With the taste of 'Tétényi bőtermő' only 'Akali 57/2' could took up the race, with its aromatic almond taste. Double kernels were found only by 'Sóskút 96/5' and 'Akali 57/2' in 2014.

We also studied the presence of the self-compatibility allele S_f in 7 accessions, one local variety of them obtaining special interest, since its name means „Self-compatible of Badacsony” ('Badacsonyi öntermékeny'). The cultivar 'Belona' carrying the self-compatibility allele S_f was used as a reference. According to our results none of the 7 accessions carry the allele S_f , so the 'Badacsonyi öntermékeny' variety cannot be assumed true-to-name self-compatible.

Key words: almond, descriptors, fruit quality

REGIONAL COOPERATION AND INVESTMENTS INTO PLANT-BASED BIOECONOMY AS A STIMULUS FOR GROWTH IN EASTERN EUROPE

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Plant-based bioeconomy, as one of the key industries of the post growth countries, features a biotechnological future of socio-economic developments. Whereas a number of European countries have already established bioeconomic regional clusters, managerial committees, and international consortiums to foster biotechnological transformation, many countries in the Eastern Europe only enter the discourse of sustainable utilization, energy production from biomass, and the associated logistics, research, and commercialization. Against the background of slowing global economic growth and euro area crisis, the intra-European investment and regional cooperation in the Eastern European countries have a set of clear economic, ecological, and geopolitical benefits. The primary target of cooperation is a consortium-like intra-regional intercourse which allows to attract substantial foreign investment and to foster a smooth communication within academia, agricultural firms, innovative SMEs, high-tech parks, and economic and investment zones.

Key words: plant-based bioeconomy, regional cooperation, investments, bioeconomic agents

WINTER WHEAT GENE RESOURCES WITH DIFFERENT GRAIN COLOUR

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In wheat breeding in addition to obligate traits (grain yield, quality, tolerance to biotic and abiotic stresses), new directions are aimed in increasing of health promoting substances. The anthocyanins represent a new goal for wheat genetic improvement. In colour wheat anthocyanins are located either in a purple pericarp, or in blue aleurone and carotenoids in the yellow endosperm. In the vegetative years 2012/13 and 2013/14 in terms of grain yield and its quality, seven genotypes with purple grain colour, five blue and four with yellow endosperm were evaluated in field experiments at the research institute in Piešťany. Six genotypes and one variety (PS Karkulka) came from the breeding program of colour wheat, which has been conducted at the Research and Breeding Station at Víglaš-Pstruša during several years. There were differences observed among genotype groups at the beginning of the ear emergence; the earliest were genotypes with yellow grains (May, 18 to 19, on average), a day later purple genotypes and approximately 5 days later genotypes with blue grains. The highest genotypes were blue and the lowest one with the yellow endosperm. The highest number and weight of grains per spike had genotypes with yellow endosperm and the lowest parameters were determined for blue grain genotypes. A valuable source of high grain weight per ear is the blue grain variety Skorpion (2.86 g), Citronova (2.39 g) with yellow endosperm and purple colour genotype K 3517 (2.31 g). The highest protein content possessed blue grain genotypes, as well as the gluten, due to positive relationship. Blue grains genotypes have good yield potential, as manifested by high 1,000 grain weight and good resistance to diseases, respectively. The main objective in breeding mainly in purple and blue winter wheat genotypes is still increasing grain yield. Growing of colour wheats will depend on the grain yield and agronomic characters, comparable to commercial wheat varieties.

Key words: winter wheat, purple pericarp, blue aleurone, yellow endosperm, breeding

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**CROP CULTIVARS DEVELOPED AT THE NATIONAL AGRICULTURAL AND FOOD
CENTRE – RESEARCH INSTITUTE OF PLANT PRODUCTION - RESEARCH AND
BREEDING STATIONS (RBS) AND CURRENTLY REGISTERED IN THE SLOVAK
NATIONAL LIST OF VARIETIES**

Variety name	Developed by RBS	Main advantages	Year of registration
Winter wheat			
Torysa	Malý Šariš	High yield potential, good N utilization, supplement baking quality.	1992
Malyska	Malý Šariš	Medium early, ecostable, high yield potential, very good frost resistance, lower leaf rust resistance.	2001
Vanda	Víglaš - Pstruša	Earliness, high yield potential, frost and diseases resistance.	2001
Pavĺína	Víglaš - Pstruša	Medium early to late, medium to expanded height, good yield, disease resistance.	2005
Veldava	Víglaš - Pstruša	Middle early, medium height, high yield potential, animal feed use, and disease resistance.	2005
Viglanka	Víglaš - Pstruša	Middle early, lower growth, resistant to lodging, high 1000-kernel weight, diseases resistance, high-yielded, high bread-making quality - very high volume weight and Zeleny test, high protein and gluten content.	2010
Madejka	Malý Šariš	High yield potential, baking quality A/B, good winter hardiness and resistance to lodging, middle to very good diseases resistance.	2011
PS - Pintta	Víglaš - Pstruša	Earliness, high yield potential, good diseases resistance and resistance to lodging, very good frost resistance, high drought resistance.	2011
Zaira	Víglaš - Pstruša	Late animal feed use variety, high yield potential, good frost resistance, good resistance to powdery mildew and leaf spot, middle leaf rust resistance.	2012
Stelarka	Malý Šariš	Late feed variety with high yield potential, resistant to lodging, good levels of resistance to Stagonospora glume blotch and Fusarium head blight.	2013

Variety name	Developed by RBS	Main advantages	Year of registration
Vladarka	Malý Šariš	Medium early to late with good yield potential, high bread-making quality, high volume weight, strong farinograph parameters, very high and stable falling number, moderate to good disease resistance.	2013
PS Sunanka	Víglaš - Pstruša	Middle early animal feed use variety, lower growth, resistant to lodging, good winter hardiness, middle 1000-kernel weight, high-yielded, very good diseases resistance - to Erisiphe graminis, leaf spot diseases, Septoria spp. on the ear and to Puccinia tritici, Fusarium in ears and root diseases.	2013
PS Elinor	Víglaš - Pstruša	Late variety with bread-making quality, high yielded, high protein content, high sedimentation index by Zeleny, good resistance to powdery mildew and leaf spot, medium resistance to leaf rust.	2014
PS Karkulka	Víglaš - Pstruša	The first Slovak variety with purpur colour of grain. Anthocyanin content is 20x higher in comparison to common wheat with red grain. Very high protein content and sedimentation index by Zeleny, high flour water absorption.	2014
MS Luneta	Malý Šariš	Medium early variety with bread making quality, good yield potential, high hectolitre weight, good protein content, good falling number value. The variety has middle to very good diseases resistance.	2014
PS Puqa	Víglaš - Pstruša	Early variety with high bread-making quality, high yielded. Variety has high volume weight, flour water absorption and farinograph value. Health condition is good, resistance to yellow rust is good.	2015
PS Jeldka	Víglaš - Pstruša	Medium early to late variety with feed quality, with high yield potential. Variety has very good resistance to yellow rust, good resistance to powdery mildew, leaf spot and leaf rust.	2015

Variety name	Developed by RBS	Main advantages	Year of registration
PS Amilka	Víglaš - Pstruša	Medium late variety, resistant to lodging, average 1000-kernel weight is 43 g, ear without owns. Grain yield is 109-119, 3 % in comparison to standard varieties. PS Amylka is predestined for fried canapes. It has lower protein content, low flour water absorption and high content of amylosa. Variety has good resistance to whole complex of leaf and ear diseases.	2016
PS Endka	Víglaš - Pstruša	Medium early variety, resistant to lodging, average 1000-kernel weight is 43 g, ear without owns. Grain yield is 105-107 % in comparison to standard varieties. Variety has bread-making quality B and middle to very good resistance to diseases.	2016
MS Januska	Malý Šariš	Medium early variety with feed quality, high yield potential. It is short-stem type, resistant to lodging, with very good resistance to yellow rust, good resistance to powdery mildew and leaf spot diseases and medium resistance to brown rust.	2016

Spring wheat

Slovenka	Víglaš - Pstruša	Very early variety, ear with owns, 1000-kernel weight is 44,7 g. Grain yield is 96,6-102,9 % in comparison to standard varieties. Variety has bread-making quality A/B and good resistance to whole complex of leaf and ear diseases.	2016
Viera	Víglaš - Pstruša	Early variety, resistant to lodging, ear without owns, 1000-kernel weight is 42,8 g. Grain yield is 106,8-114 % in comparison to standard varieties. Variety has bread-making quality A- and middle to very good resistance to diseases.	2016
Voskovka	Víglaš - Pstruša	Medium early variety, resistant to lodging, average 1000-kernel weight is 41,2 g, ear without owns. Grain yield is 105,7-120 % in comparison to standard varieties. Variety has bread-making quality A/B and good resistance to whole complex of leaf and ear diseases	2016

Variety name	Developed by RBS	Main advantages	Year of registration
Zelenka	Víglaš - Pstruša	Medium early variety, resistant to lodging, average 1000-kernel weight is 42,15 g, ear without awns. Grain yield is average 103,3 % in comparison to standard varieties. Variety has bread-making quality A/B and middle to very good resistance to diseases.	2016
<i>Triticum aestivum x Triticum spelta</i>			
PS Lubica	Víglaš - Pstruša	The first Slovak variety made by crossing of <i>Triticum aestivum</i> and <i>Triticum spelta</i> . Regarding nutritional quality variety retains spelt quality and achieve high grain yield. The grain is no need hulling.	2014
Common spring oat			
Zvolen	Víglaš - Pstruša	Earliness, ecostability, high ratio of grain, high yield potential, sale of seed at Croatia.	1997
Vendelin	Víglaš - Pstruša	Earliness, high 1000-kernel weight, high yield potential, ecostability.	2007
Valentin	Víglaš - Pstruša	The earliest and biggest 1000-kernel weight variety registered in Slovakia, low height, good resistance to lodging, high yield potential.	2008
Prokop	Víglaš - Pstruša	Huskiess oat with yellow colour of grain, high grain yield, good resistance to lodging, middle 1000-kernel weight, high volume weight, high ratio of grain, good diseases resistance.	2011
Viliam	Víglaš - Pstruša	Huskiess oat with yellow colour of grain, high grain yield, very good resistance to lodging, high 1000-kernel weight and volume weight, high ratio of grain, good diseases resistance.	2011
Václav	Víglaš - Pstruša	Huskiess oat with yellow colour of grain. Václav is early maturing of common oat variety with high weight of thousand grains (37-40 g), volume weight 50-51 kg.hl-1, low % of huskiess (26.0 %) and good resistance to lodging. Václav has highest β -glucan content of all common oats varieties registered in Slovakia.	2013

Variety name	Developed by RBS	Main advantages	Year of registration
Dunajec	Víglaš - Pstruša	Very early maturing of naked oat variety. The height stand is medium (1,00 m). Dunajec has medium of weight of thousand grains (24-25g), very high volume weight (67 kg.hl-1) and low % of husk grains (1-3 %). Resistance to lodging is very good.	2015
Winter triticale			
Pletomax	Víglaš - Pstruša	Very high yield potential especially in maize and beet growing regions, very good winter hardiness, very good health condition, resistance to lodging, medium early.	2008
Pingpong	Víglaš - Pstruša	Very high yield potential especially in maize and beet growing regions, very good winter hardiness, very good health condition, resistance to lodging, medium early, high TSW.	2010
PS Tecko	Víglaš - Pstruša	High grain yield potential, good winter hardiness, very good health condition, and medium resistance to lodging, medium early, high TSW.	2012
Mareto	Malý Šariš	Medium early to late variety, high yield potential, good winter hardiness and resistance to lodging, middle to very good diseases resistance.	2014
Poppy			
Gerlach	Malý Šariš	Medium early, ecostability, high yield potential, resistance to plant lodging and uprooting and seed shedding, good health condition, Helminthosporium resistance.	1990
Albín	Malý Šariš	White-seed early variety, resistance to plant lodging and uprooting, good capsule filling.	1991
Opál	Malý Šariš	Medium early, resistance to plant lodging and uprooting and seed shedding, high yield potential, stable yield, Helminthosporium and downy mildew of poppy resistance.	1995

Variety name	Developed by RBS	Main advantages	Year of registration
Bergam	Malý Šariš	Medium early, high and stable yield, very good equality of ripening, resistance to plant lodging and uprooting, adaptability.	1998
Maratón	Malý Šariš	Medium early, high yield potential, very good equality of ripening, resistance to plant lodging and uprooting and seed shedding, good health condition, Helminthosporium resistance, adaptability.	2000
Major	Malý Šariš	Medium early, high yield potential, resistance to plant lodging and uprooting and seed shedding, high yield of poppy straw, adaptability.	2002
Lucerne			
Lucia	Borovce	High forage quality, good seed yield, good regrowth ability, disease resistance.	1990
Vanda	Borovce	High forage quality, good seed yield, persistence, disease resistance.	1995
Vali	Borovce	Good health condition, good seed yield, persistence.	1995
Lubona	Borovce	High forage quality, good seed yield, suitable for dry areas.	2006
Red clover			
Viglana (2n)	Víglaš - Pstruša	Persistence, good health condition, high seed yield.	1992
Sigord (4n)	Malý Šariš	Stable high green matter and hay yield, high regrowth rate after cutting, very good winter survival ability, high fungi diseases resistance, high seed yield, suitable for mixtures.	1992
Pol'ana (2n)	Víglaš - Pstruša	Persistence, high seed yield, forage quality.	1996
Manuela (2n)	Malý Šariš	Stable high green matter and hay yield, high powdery mildew and stem rot resistance, high and stable seed yield.	1996
Margot (4n)	Malý Šariš	High production ability mainly in 2nd using year, rapid spring growth, very high regrowth rate after cutting, good diseases resistance, persistence.	1996

Variety name	Developed by RBS	Main advantages	Year of registration
Magura (4n)	Malý Šariš	High green matter and hay yield, high crude protein content, good fungi and viral diseases resistance, high regrowth rate after cutting, suitable for grass-clover mixtures.	2002
Marieta (2n)	Malý Šariš	High green matter and hay yield, high crude protein content, three cuts, adaptability, good winter survival ability, equable in forage and seed production, high clover scorch resistance.	2006
Podjavorina (2n)	Víglaš - Pstruša	High green and dry matter yield, good health condition, persistence, cold resistance.	2007
Slatina (2n)	Víglaš - Pstruša	Very high crude protein production, cold resistance, high green matter and seed yield, persistence.	2007
Mazurka (4n)	Malý Šariš	Medium early to early, equable in quality, forage and seed production, high green matter and hay yield, high crude protein content, three cuts, adaptability, very good winter survival ability and rapid spring growth, high powdery mildew and fusarium root resistance.	2009
Bird's-foot trefoil			
Polom	Víglaš - Pstruša	High seed yield, disease resistance.	1991
Buckwheat			
Špačinská 1	Borovce	High yield, good resistance to fungal diseases.	1998

Note

Note

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