41st ANNUAL MEETING OF ESNA

(European Society for New Methods in Agricultural Research)

„***Advances in agrobiology research and their benefits to the future***“

co-organized with the International Workshop

Recent Advances in Plant Biotechnology

Book of abstracts

September 24– 28, 2012, Stará Lesná, High Tatras,
Slovak Republic

Approved by the Rector of SUA, Nitra on September 9, 2012 as „Book of Abstracts from International Scientific Conference ESNA“

ISBN 978-80-552-0855-8

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INVITED LECTURES

Crop yield prediction and *in situ* vitality monitoring of plants, grown under photovoltaic Nets, are actual and future topics in precision farming

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Today 7 billions of people on Earth have to get fed daily. In the year 2050 there will be over 9 billions and 10 billions of people are estimated for the year 2085. This challenge is out of the range of our agricultural potential today. Innovative thinking and unconventional approaches may reveal practical possibilities to use the naturally abundant resources, such as solar light and sea-water in a creative and usable way: Three domains of approaches are possible to increase the crop yield on Earth:

1) Increasing the agricultural area for planting: By using second class land and deserts.
2) Increasing the crop yield per plant: By selection, breading and genetic modifications.
3) Decreasing the impact of pests and weeds: By biological control and any kind of herbicides.

Testing the vitality of weeds means as well screening the efficiency of herbicides and brings therefore an important component to improve the crop yield. On the basis of the energy flux theory in bio-membranes (1) as a fast screening method, an opto-electronic approach, the **JIP-test** (2) has been developed to measure the plants activity, vitality, performance and structural and conformational parameters (3). **Early** symptoms' of stress in plants, **not visible** by eye, are recognized by the modified **fluorescence emission behavior** and allow early intervention by the farmer. Big agricultural areas will be screened by satellites with similar optical procedures, while green-house plantations and Under-Net-cultivations of vegetables and fruits of huge areas will be observed by fluorescence screenings for vitality testing and quality control. e.g. by using the JIP-test.

High productivity of food at remote and arid areas (e.g. deserts) needs electric energy, usually from a fossil fuel burning generator. Such systems however will never become sustainable. The only worldwide global and permanently available energy is **solar LIGHT.** Every sign of life on Earth is based on organic matter which has been synthesized directly or indirectly with Light as energy source.

More and more photovoltaic elements and wind-mills are used to supply the electricity for ventilation and water pumping. Photo-cells are usually flat, rigid and very expensive. Recently bendable photovoltaic sheets have been developed (4). This widens their potential applications enormously. Today we are waiting on **fully bendable** photocurrent producing fibers and strings or **Photocords**, which could be implemented into the big nets without any additional structures. They are transforming a regular net-installation into a **Photo-Net**, which supplies a photocurrent to pump water and which electrolyzes water to **Hydrogen** and Oxygen gases. Those can be stored as fuel. Further technologies will collect the clean water after the Hydrogen is burnt. Therefore the Photo-Net-System will be able to desalinate Sea water, so that it becomes usable for the biological plantations under the Photo-Nets. Economically it means that today low value desert land, close to the sea, can become sustainable areas for under-PhotoNet food production, as soon as bendable ribbons, strings or fibers as PhotoCords become available (5) and will be implemented in the conventional nets.

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Plant stress biology in maintaining sustainable development of coastal zone: disciplinary roles and relationship

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In the 21st century, the following issues are the concerns for human beings: Health of Human beings; Eco-environment; Sustainable Development; Food and Energy Supply. Although these challenges are linked with each other, the biggest is the last. For China, Agricultural Sustainable Development (including potential resources development such as coastal zone resources-plant resources, soil resources and sea water) and Eco-environmental Sustainable Development are the most important aspects. Along the Chinese coastal zone where more than 70% GDP is produced annually, this situation is quite similar in their parts of the globe.

On the basis of this tendency, we should reconsider coastal zone–related disciplinary system and relationship. We think that Soil Science (soil: the first protecting barrier for survival, not recognized), Ecology (scientific &efficient utilization for natural resources), Agricultural Sciences (safe and reliable food supply and guarantee), and Life Sciences (the core role for natural cycle, especially plant biology, providing the basic principles and measures) are the important disciplines. They are linked with one another, overlapped and inter-cooperated. In the sustainable development context, more attention should be paid to Advances in Life Sciences, in particular Plant Biology in the 21st century, which will provide an eventual platform for resolving the Issues mentioned above (Shao *et al*., 2007-2011) .The current presentation will discuss the roles of plant biology in maintaining sustainable development of coastal zone under global climate change on the basis of the recent work from my team group.

Acknowedgement: This work is jointly supported by the National Natural Science Foundation of China (41171216,41001137; 31100313), One Hundred-Talent Plan of the Chinese Academy of Sciences (CAS), the CAS/SAFEA International Partnership Program Double-hundred Talent Plan (XY-003-02). for Creative Research Teams, CAS VISITING PROFESSORSHIP (2012T1Z0010) and Yantai Double-hundred Talent Plan (XY-003-02).

Chlorophyll fluorescence: past, recent and future applications

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As per our knowledge, chlorophyll fluorescence phenomenon was observed by human being (naked eyes) for the first time almost 5 centuries ago. However, it started to be used as one of the main techniques/tools to study photosynthesis process in different living organisms which contain chlorophyll only almost 100 years ago. Up to the eighteens of the last century, this technique was used mainly to understand the photosynthesis process unconnectedly or along with CO_2 or/and O_2 measurements. It has helped to understand the light phase of photosynthesis, structure and bioenergetics of photosystems and electron transport process between the two photosystems: photosystem II (PSII) and photosystem I (PSI). After that period of time and up today, scientists and others specialists from other sectors (industry, commerce, astronomy and others) has started to exploit form the fact that, these measurements deliver reliable information about the physiological state of the studied samples in fast, noninvasive and cheap approach. Thus, this technique is being used in plant stress prediction, plant and animal vitality assessment, seeds and fruits quality estimation, yield prediction, climate change studies, flowers production, water quality studies, criminal investigations, desalination of sea water process, maintenance of sport objects, national alarm systems, and even to find a new life on other planets. In this work, the above mentioned topics and future trends related to the use of chlorophyll fluorescence signals as trustable bioindicator are discussed.

High-throughput phenotyping – a boost for genomics in the 21st century

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Due to the development of highly automated genetic analysis, plant genomics has immensely enlarged our understanding of the genetic structure of plants over the last two decades. The fast evolving need to identify interactions between genes and environmental factors (biotic and abiotic) that brings about a certain plant phenome made it necessary to develop quantitative, reproducible and highly automated plant phenotyping systems for large plant numbers. Phenotyping systems such as these have to integrate reproducible plant management (randomization, watering) and comprehensive imaging of root and shoot far beyond human vision (visible light, fluorescence, near infrared, infrared, hyper spectral, NMR, X-rays, THz) as well additional chemical analysis methods. Immediate and automated image analysis of the stored images and further data transformation using plant shape and plant growth models are the important intermediate steps before undertaking statistical data analysis of the phenotyping results to characterize plant phenotypes quantitatively. Such quantitative data contributes in a decisive way to the further analysis of gene functions (tilling, QTL etc.), especially under fluctuating or stress-induced environmental conditions with a special focus on complex traits like yield or drought tolerance. This presentation will provide a survey on phenotyping technology and the close interaction between phenotyping technologies, modelling approaches and the new opportunities of fast and automated high-throughput genomics.

Toward a sustainable agriculture

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The huge risk inherent in the over dependence on narrow base of species and genetic diversity is widely realized. Biodiversity and nutritional basis are fundamental for food and livelihood security but it is continuously reduced by pressure from Globalization and Poverty. The genetic diversity in the food basket is getting narrowed over time and policies on research, production, domestic distribution, processing and trade are promoting very few crops. This is forcing out many traditional crops and their diversity and also the cultural background that grew intimately linked, which in the past had played important role in local food and nutritional security as well as protection of biodiversity. In addition global changes such as land use changes, environmental degradation and climate change are reducing resilience of agricultural resources and its humanities. But effort and investment to enlarge this base in the food basket is not commensurate with the increasing risk and it is expected to increase many-fold under the growing change in climate.

Productivity is an important driver influencing policy on food production system but a large part of farming systems in Asia, Africa and Latin America are fragile. Here high adaptability of crops to provide a modest and sustainable harvest assumes importance over high productivity *without* sustainability. Many species of cereals, legumes, oilseeds, fruits and leafy and other vegetables adapted to the fragile conditions serve a substantial share in the local food and nutritional security.

The crops which are now neglected or under-utilized and better adapted to fragile environment offer opportunities under climate change They have genetic architecture conferring high resilience to climate change and hence adaptation. In general, it appears that all those crops, which are intensely bred for high yield had either lost or got their adaptive gene complexes rearrange and thus have substantially weakened adaptive capacity to CC.

We will discuss the importance for a sustainable agriculture of a program promoting dynamic conservation and adaptive management of globally significant agricultural biodiversity present in globally important agricultural heritage systems. Meeting the world's increased needs and expectations will require concerted effort and emerging field of research dealing with the interactions between natural and social systems, and *Science of Sustainability* could be the tool necessary to link science and practice. The new International Society of Sustainability Science (ISSS) born in 2012 could be a new instrument for ensuring the integration of different styles of knowledge creation in order to make a link between science, practice and politics.

Research techniques for improving crop and soil management

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This paper addresses some of the advances in research methods which have a two-fold effect in that they can have both an immediate effect on production agriculture and can be used to improve individual research programmes that can then have a further longer term beneficial impact. The core theme will be on enhancing soil management from which improved cropping systems can materialise; the paper will embrace:-

- a number of tools (soil electrical conductivity sensing, soil resistance measurement techniques, crop status and yield mapping) for site-specific agricultural management (commonly referred to as precision agriculture/farming);
- the use of global positioning systems in terms of vehicle movements (compaction tracking and its subsequent amelioration) and vehicle control (automatic guidance);
- strategies for good soil management from both the avoidance (improved vehicle ground drive systems and controlled traffic farming) and the targeted repair of soil compaction including the selection of soil amelioration equipment;

and

- improved water management from the maintenance/improvement in water infiltration which not only benefits crop growth and yield but also reduces run-off and soil erosion in times of climate change.

All of which should return improved crop growth and yield and with careful management reduce energy use.

The work sited will be principally based upon the work of the author, his students and associates in and from the UK, Slovakia and the Czech Republic. It will be integrated with the needs expressed in:-

- the Foresight Report 'The Future of Food and Farming: Challenges and choices for global sustainability' (www.bis.gov.uk/assets/foresight/..) where significant research is needed to sustain an ever increasing world population over the next four decades

and

- the response from the Institution of Agricultural Engineers – 'Agricultural Engineering: a key discipline for agriculture to deliver global food security' (http://www.iagre.org/)

to illustrate how engineering and physical sciences can make a significant and virtually immediate contribution through applied research and development.

Plant regeneration *in vitro*: from art to science

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In vitro plant regeneration is crucial for plant biotechnology as well as for the fundamental study of plant biology. Although regulation of *de novo* shoots and roots organogenesis has been described more than six decades ago, its molecular basis remains elusive. There is resurgence in the molecular genetics of *in vitro* plant regeneration, and our understanding of plant regeneration process has advanced considerably over the past five years. Recent studies have revealed new regulators, molecular connections, and have shown the importance of auxin and cytokinin responsive genes for the acquisition of organogenetic competence and for shoot and root induction. These studies include the identification of new *Arabidopsis* genes that regulate plant regeneration and time lapse imaging of living tissues has provided new insights and opportunities to redefine previous empirical models of plant regeneration. The emerging view is that the major regulatory events occur at early stages of callus/shoot/root formation and that there is never dedifferentiation or an embryonic state on the path to *in vitro* plant regeneration. During this symposium, we will describe the current state of the molecular dissection of complex *in vitro* plant regeneration system. In addition, we analyse the functions and interactions of genes that control key steps in two distinct developmental processes, i.e. *de novo* shoot organogenesis and lateral root formation. As a result of rapid recent advances in our understanding of plant regeneration, tissue culture should become less of an art and more of a true science. Thus, the identification of the common elements that provide various plant cells with their remarkable regeneration ability should finally help to optimize regeneration protocols for recalcitrant plant species, varieties or cultivars.

Genetic improvement of crops under the climate conditions by mutagenesis and biotechnology

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The basic requirement of plant breeding is the exploitation of natural and induced genetic diversity in developing plant varieties for sustainable food production. Plant breeders are handicapped due to lack of availability or non-existence of desired genotypes. However, they have successfully recombined the desired genes from the existed available gene pool, and successfully develop new cultivars; faced with new challenges such as climate change, human population growth, etc., which threaten to sustain food production worldwide. Some of the factors having great impact on climatic change, are gaseous pollution, depletion of atmospheric ozone, increase in UV-B radiation level, increased atmospheric CO_2, extreme variability of rainfall time and locations, irregular growing season lengths, intermittent dry spell, global warming, high temperatures, degradation of water and soil resources. Global warming may become disastrous to agriculture production especially by appearance of new insects and pests and diseases and some existing ones may disappear. The increase in atmospheric CO_2 levels and potential global climate change can alter growth rates, distribution of weeds and insect pests, and their impact on agricultural productivity. There are visible signs on the negative impact on world food production and rise in food price. The developing countries will have greater adverse impact of climate changes on food and fibre production, environmental services and rural livelihoods; faced with urgent needs to improve food security, and reduce the poverty. Moreover nearly 80% populations of poor countries depend on agriculture on their livelihoods and therefore are more vulnerable to climate changes.

The purpose of induced mutations is to enhance the mutation frequency rate in order to select appropriate variants for plant breeding. The mutation frequency rate of spontaneous mutations is rather very low and difficult to exploit by the plant breeders. Traditionally mutations are induced by physical, e.g. gamma radiation, and chemical, e.g. ethylmethane sulfonate (EMS), mutagen treatment of both seed and vegetative propagated crops. Plant breeders will look for new innovative tools, such as genetic engineering and *in vitro* culture techniques together with traditional breeding for sustaining food production to feed the world under the climate change. *In vitro* culture techniques have been effectively used for clonal propagation and *in vitro* selection and mutagenesis mostly in vegetative propagated crops. Doubled haploids and micropropagation have been effectively used in crop improvement. By induced mutations, over 3000 mutant varieties (www.iaea.org) have been released worldwide enabling sustainability in food production. The major advantage of mutagenesis is the selection of mutants with multiple traits-ideal for growing under the climate change. By transgenic approach, single gene trait transgenic plants have been produced. Moreover, consumers are not ready to accept genetically modified food (GM). In this presentation, the discussion will focus on mutant production with traits drought and salt tolerance, disease resistance in crops like banana, date palm, and tomato. To begin with some of the following recommendations could be followed to address food production under the climate change-

1. Collection of information on the existing available seeds of mutants, arrangements for multiplication and exchange/supply of mutant seeds and plant material.
2. Exploit local germplasm for developing new mutant varieties, basic research in gene discovery and functional genomics.

3. It is difficult to predict the impact of climate changes on global or regional or national agriculture and therefore new varieties must be developed and distributed regularly at the national and regional levels for sustainable crop production.

4. Develop new varieties that can be readily adapted in a short period on different locations with varying agro-climatic and growing conditions, and low available resources.

5. Study root architecture and root growth of plants to withstand abiotic and biotic stress conditions.

6. Mutation-based functional genomics to identify genes from induced mutants and study their functions either as a single or cluster of genes.

Green nanobiotechnology: phytosynthesis of metal nanoparticles and their applications

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Nanobiotechnology is a multidisciplinary science comprising of various aspects of research and technology at 1-100nm size. Green nanobiotechnology deals with the synthesis of nanomaterials and nanoproducts in eco-friendly way. This involves the principles of biology, green chemistry and green engineering. Since chemical and physical methods are energy intensive, employ toxic chemicals, and generate high temperature they are not eco-friendly and hence their use in biomedical applications is not beneficial. Synthesis of nanoparticles using the plant system is towards a greener approach and a low-cost technique.

There are many plants, which can synthesize nanoparticles. We studied both plants and fungi for the synthesis of silver nanoparticles. These include plants belonging to family *Apocynaceae* (*Thevetia peruviana, Carissa carandus, Nerium oleander, Rauwolfia serpentina, Catharanthus roseus* and *Holarrhena antidysenterica*), *Solanaceae* (*Lycopersicum esculentum, Solanum nigrum, Solanum xanthocarpum, Datura metel, Withania somnifera and Capsicum annum), and others (Murraya koenigii, Opuntia ficus-indica, Ocimum sanctum, Lawsonia inermis, Nymphaea nouchali, Hydrilla verticillata, Callus of Carica papaya).* A hypothetical mechanism of phytosynthesis of silver nanoparticles by *Datura alba* have also been proposed for the first time. This hypothesis explains that plastohydroquinones or quinol present in plants are responsible for reduction of silver ions into silver nanoparticles.

The biologically synthesized silver nanoparticles showed remarkable activity against pathogenic bacteria like *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, S. epidermidis, S. typhi,* etc. and fungi like *Fusarium semitectum, Candida albicans* and *Phoma sorghina,* etc. causing infections in plants as well as human beings. The nanoparticles also demonstrated synergistic activity against multi drug resistant (MDR) organisms when used in combination with Ampicillin, Streptomycin and Vancomycin, etc.

SESSION I

ECOLOGY AND CROP PRODUCTIVITY

Topic I

PLANT STRESS BIOLOGY AND CLIMATE CHANGE

Plant hormone dynamics during the cold stress responses of two wheat cultivars, winter Samanta and spring Sandra

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Phases of cold stress response were characterized in the leaves and crowns of winter wheat cv. Samanta and spring wheat cv. Sandra. Hormonal changes accompanying cold stress (4°C) response were related to the level of frost tolerance (FT; measured as LT50) and the content of dehydrins. The characteristic features of the early phase of cold response (alarm phase, within 1 day) were a rapid elevation of abscisic acid (ABA), associated with stabilization of water status, and an increase of protective proteins (especially dehydrin WCS120). The down-regulation of bioactive cytokinins and auxin, as well as enhanced deactivation of gibberellins, observed especially in winter wheat, indicated rapid suppression of growth. The ethylene precursor aminocyclopropane carboxylic acid was quickly up-regulated, unlike other stress hormones, salicylic acid and jasmonic acid, which exhibited mild decrease. After 3 - 7 days of cold exposure, plant adaptation to the low temperature was observed, coinciding with a decrease in ABA and elevation of growth-promoting hormones. The elevated cytokinin, auxin and gibberellin content, together with high level of protective proteins, resulted in re-establishment of growth under less favourable conditions. The content of salicylic acid and jasmonic acid also began to increase. After a prolonged cold exposure (21 days), maintenance phase occurred. Winter cultivar exhibited substantially enhanced FT, which was associated with a decline in bioactive cytokinins and auxin. The inability of spring cultivar to further increase its FT was correlated with maintenance of a relatively higher cytokinin and auxin content. The achieved results indicate that plant defence and acclimation to low temperatures is associated with highly dynamic changes of hormone content.

Stresses before and during cryopreservation of plant cultivated *in vitro*

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The aim of plant cryopreservation is a long-term storage of the plant germplasm at ultralow temperatures. The cryopreservation is a method due which plant biodiversity is possible to keep for future generations. This method is based on the vitrification state of the plant. The vitrification state is characterized by storage of plants without ice crystal formation. The prerequisite for vitrification is the high speed of cooling of plant parts. The shoot tips were mostly used for their small size and the highest regeneration ability. During extirpation of shoot tip meristematic part 1-2 mm of their final size the mechanical stress with oxidative stress together can occur. Avoiding mechanical injury the shoot tips are extirpated carefully dispelled the old leaves, young leaves and the cover scales. The meristematic part of the shoot tips should be extirpated under water to avoid oxidative stress. The second important demand for vitrification is to increase the viscosity of protoplasm. The optimal viscosity (the 10 to the power of 12 Pa s) characterized for vitreous state is. Water is removing from plant cells by dehydration with different dehydration solutions and/or by desiccation over silica gel or simply in the flow of sterile air in the flow box. The limit for deep dehydration is the water content at which the regrowth is stopped. The water content limit is in the range 0.1-0.6 g of water per g of dry weight. The lowest water content in this water content range the highest regeneration rate after ultralow temperature treatment but at certain low water content can diminish growth *per se*. It should be established an optimal water content of vitrification for specific species and tissue. The vitrification status is defined as the temperature at which glass transition occurred. The glass transition temperature of the meristematic tissue increases by lowering of the water content. In contrary freezing/melting temperature decreases by lowering of the water content. This opposite properties ensure the larger temperature interval at which vitrification state can occur in contrary to the smaller temperature range of dangerous ice crystal temperature range. Intracellular ice formation is mostly lethal stress for plant cells. Realizing and diminishing all of the possible stresses occurring before or during cryopreservation can increase the regeneration ratio of plants after their cryoconservation.

Acknowledgment: This work was partially supported by LD12041 grant of Ministry of Education, Youth and Sports.

The interaction of the heavy metals and radionuclides with the cell organelles in *Zea mays* L. leaves

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Numerous plant species present an important role in the phytoremediation process. As a result of the coal surface exploitations and Thermo Electric Power Plants (TEPP) nearby, in Middle Jiu river basin, are large areas with sterile and ash crops in the area is corn (*Zea mays* L.). In many papers is underlined the phytoremediatory role of the *Zea mays* plants, but there are very few information on the interaction between heavy metals and radionuclides with the cell organelles (Sharma & Dubey, 2005; Lone *et al*., 2008, Vaculik *et al*., 2012, a/o). In this paper are analyzed the ultrastructural modifications induced by air and soil pollution, in the considered area. The leaves samples were collected from fields situated nearby Turceni TEPP, sterile waste dump and a village 20 km away from the area (Control). The ultrastructural investigations were performed at the mature plants (at flowering). Leaf fragments, were prefixed in glutaraldehyde 2.7%, postfixed in a 1% Millonig solution, infiltrated and embebbed in EPON 812. Serriated sections, were contrasted with uranyl acetate and lead citrate. The examination was performed at a TEM 1010 JEOL–JEM from Electron Microscopic Center, *Babes-Bolyai* University. In comparison with the Control area, and the sterile waste dump, near the Turceni TEPP were recorded the highest values for almost all radionuclides (Th–234 [U–238], Ra–226, Pb–210, Bi–214, Pb–214, U–235, Pb–212, Be–7), as well as for the analyzed heavy metals (Cd, Pb, Cu, Zn, Ni, Cr and Co). **Control plants**. In cells are present exogenous particles of different shape (acicular, fibril, a/o). They penetrate the cuticle and cell wall and spread in the parenchyma tissue, at the desmosome level. The organelles presented a normal structure. **Plants collected from the field nearby Turceni TEPP**. In the cells the number of the exogenous particles is higher. In chloroplast are present or not starch grains, the thylakoids number from grana is lower and in nucleus is present a metabolic structure of NAB's type, as cell reaction to the presence of a stress factor in the environment. **Plants collected from field on the sterile waste dump.** In cells and intercellular spaces, as well as in endoplasmic reticulum and in mitochondria, are present numerous exogenous particles of acicular or granular shape. In chloroplast the starch grains are absent, and in mitochondria are present lyses' areas. Sometimes the tonoplast is broken and in nucleus is present a NAB's corpuscle.

Acknowledgement: These researches were financially supported by CNMP, Bucharest (Romania), 32150/2008, POLMEDJIU research grant (2008–2011).

Involvement of non-protein thiols in heavy metal tolerance of plants

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Contamination of soils by heavy metals has become a critical environmental concern due to their toxic effects. To minimize the detrimental effects of heavy metal exposure and heavy metal accumulation, plants have evolved different heavy metal detoxification mechanisms. Cysteine sulfhydryl is the primary site of metal binding in cysteine-containing peptides, namely glutathione (GSH), phytochelatins (PCs), and in low molecular weight cysteine rich proteins – metallothioneins. All these groups of chelators are responsible for heavy metal sequestration in plant cells.

Cysteine is a limiting substrate for glutathione synthesis. Glutathione is a tripeptide (L-gamma-glutamyl-L-cysteinylglycine) and occurs in both reduced and dimeric forms. Monomeric glutathione is known as reduced glutathione (GSH) and its dimer is referred to as oxidized glutathione (GSSG). The GSH/GSSG redox couple is involved in many physiological processes in plants under both optimal and environmental stress conditions. It has been previously demonstrated that GSH is an important thiol compound involved in plant cell protection against active oxygen species, including heavy metals. In response to heavy metal stress, the GSH/GSSG ratio decreases due to the oxidation of GSH during the detoxification of reactive oxygen species. Glutathione is constitutively active and inducible by oxidative stress. GSH synthesis is possible in chloroplasts and the cytosol, while its degradation and the degradation of the GS conjugates occurs in the vacuoles. For this reason a large GSH gradient exists within cells.

In the presence of some heavy metals (e.g. Cd, Hg, Cu, Zn, Pb and Ni), phytochelatin synthase (EC 2.3.2.15) catalyzes the synthesis of phytochelatins (PCs) using glutathione as a substrate. In higher plants, as well as in algae, PCs are inductively synthetized after heavy metal-exposure. They form complexes with heavy metals. It has been found that PCs demonstrate scavenging activity towards reactive oxygen species. Phytochelatins are low molecular weight thiol peptides. They possess a typical structure $(\gamma Glu\text{-}Cys)_n\text{-}Gly$, where n = 2-11.

Metallothioneins (MTs) are products of mRNA. They are low molecular weight (6-7 kDa), cysteine rich proteins. Thus far, their presence has been confirmed in plants, animals and fungi. Metallothioneins occur also in some prokaryotes. MTs can bind heavy metals and therefore can play important roles in heavy metal detoxification. The binding of metals is assigned through the thiol group of cysteine, similar to what was mentioned previously in the text. Cysteine in MTs represent nearly 30 % of all MT amino acid residues, however cysteine richness in MTs differs considerably between plants and animals.

Acknowledgments: This work was financially supported by Slovak Research and Development Agency (APVV) under contract APVV-0140-10 and Slovak Grant Agency (VEGA 1/1238/12).

The methodological approach for the study of associative microorganisms with plant

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The cultivation of crops must be based on the ecological safety technologies. Active strains of associative microorganisms are capable to provide the effectiveness of plant-microbial interaction of agrocenosis for getting of high-quality competitive products, preserving of the fertility of soil and environment.

The system approach for the selection and study of associative microorganisms with determinate plant species has been proposed. The determination factor in this method is the plant roots exudation.

Its have been isolating of the microorganisms, which were associative to the definite botanycal species (*Brassica capitata var. alba* Lizg., *Licopersicum esculentum* Mill., *Cucumis sativus* L.), studying of the morphological, physiology-biochemical properties of these isolations and the reaction of plants on the inoculation by them. It has been shown that the quantity of isolated isolations of associative microorganisms depended from the macroorganism species and from microorganisms of soil in which the plant was formed, and did not depend from quantity of microorganisms in the soil.

Intensity of LEDs illumination affects growth and nutritional quality of *Brassica* microgreens

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The objective of our studies was to evaluate the effect of light intensity produced by solid-state light-emitting diodes (LEDs) on the growth (hypocotyl length, height, leaf area, fresh and dry weight) and nutritional quality (ascorbic acid, anthocyanins, phenolic compounds, tocopherols, carotenoids, non-structural carbohydrates, chlorophylls, nitrates) of *Brassica* microgreens. Microgreens such as kohlrabi (*Brassica oleracea var. gongylodes*, 'Delicacy Purple') mustard (*Brassica juncea* L., 'Red Lion'), red pak choi (*Brassica rapa var. chinensis,* 'Rubi F_1'), tatsoi (*Brassica rapa var. rosularis*) were grown in phytotron chambers to harvest time (10 days) in a peat substrate. Day/night temperature 21/17°C, 16 h photoperiod and ~70% relative air humidity was maintained. A system of five high-power solid-state lighting modules with the main 455, 638, 665 and 731 nm LEDs were used in the experiments. Maximum photosynthetically active flux density (PPFD) of LEDs was 546.72 $\mu mol.m^{-2}.s^{-1}$. Other lighting options accounted for 80 % (437.376 $\mu mol.m^{-2}.s^{-1}$), 60 % (328.032 $\mu mol.m^{-2}.s^{-1}$), 40 % (218.688 $\mu mol.m^{-2}.s^{-1}$) and 20 % (109.344 $\mu mol.m^{-2}.s^{-1}$) of the maximum. Our results revealed that illumination intensity, which amounted 20 % of the maximum, was unfavorable for growth and nutritional quality of microgreens. Meanwhile, 40 % illumination increased some antioxidative compounds (total anthocyanins, total phenols and DPPH free-radical scavenging capacity) and leaf area, besides decreased nitrates content of microgreens. Depending on the species most suitable conditions for growth and nutritional quality of microgreens was under illumination, which amounted for 40-80 % of the maximum. The maximum illumination intensity compared with lowest one had no significant positive impact for many investigated parameters. Summarizing the results it can be stated that during cultivation of microgreens under LEDs optimal light intensity should be about 300 $\mu mol.m^{-2}.s^{-1}$.

Acknowledgements: This research was funded by a grant (No. SVE-03/2010) from the Research Council of Lithuania.

Influence of clonal rootstocks on the dry matter content in one year shoots of plum in two different growing regions

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The necessity to investigate the topic is roused by the problem that there is a lack of plum rootstocks suitable for North European (Latvia and Estonia) agro-climatic conditions. Changeful climate with sharp temperature fluctuations when severe frost changes with thaws during the winter is observed in Latvia and Estonia during last years. Rootstock and cultivar winter hardiness is very essential for tree survival in such conditions. The dynamic of dry matter content in the one year shoots during wintering period was observed as physiological parameter influencing wintering ability of trees in two growing regions with different meteorological conditions. Investigation was carried out during wintering periods of 2010/2011 and 2011/2012 in Pūre Horticultural Research Centre (Latvia) and Polli Horticultural Research Centre (Estonia) in the investigation orchards planted in 2001. Two plum cultivars used in the investigation – European plum `Victoria` (*P. domestica* L.) and hybrid plum `Kometa Kubanskaya` (*P. salicina* Lindl. x *P. cerasifera* Ehrh.) grafted on eight clonal rootstocks - `St. Julien A`, `Brompton`, `Ackermann`, `Pixy`, GF8/1, G5/22, GF655/2, and `Hamyra`. Trees are planted by spacing 5x3 m, in three replications, three trees per plot. Samples were taken five times during wintering period and dry matter content (mg g^{-1}) was detected in laboratory. The differences in dynamic of content of dry matter were observed in both wintering periods, and both growing places. Also, significant differences were found between cultivars and between rootstocks. The more sharp fluctuations of dry matter were observed for cultivar `Kometa Kubanskaya`. It indicates sensibility of the cultivar against temperature fluctuations. The dynamic of dry matter indicates about differences in physiological processes under different meteorological conditions, because these winters were different in terms of temperatures.

Histological study of graft union formation in plum by using light microscopy

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During grafting process, at the joining surface are produced oxidative compounds and cells oxidize producing a necrotic layer that isolates the cut surfaces. Callus cells formed from the xylem medullar ray and secondary shell cells destroy the necrotic layers on the cut surfaces. Then, the cavity between the rootstock and scion is filled and reestablish the connection between them. After this stage, the transport of water and nutrients through the grafting area occurs. For a successful grafting it is important to pursue the anatomical development between tissue of scion and rootstock after grafting. In this paper there was determined the anatomical structure of graft union in some combinations of plum varieties with *Prunus cerasifera* and find the implications that could explain graft compatibility-incompatibility between some varieties and rootstocks.The anatomical structure of graft unions was investigated in '*Stanley*', '*Centenar*', '*Tuleu gras*' and '*Pescarus*' plum varieties grafted on cherry plum (*Prunus cerasifera* Ehrh*)* seedlings. This research was aimed to determine the anatomical structure of graft union in some graft combinations of plum using chip-budding grafting technique. Tissue samples from graft unions were taken one year after grafting and fixed in formalin/glacial acetic acid/ethanol solution. Scattered brown necrotic layers were identified, as a result of enzymatic reactions in the junctional tissue. By analyzing the pattern of the development of vascular tissues we can estimate the compatibility of the graft combination and control the grafting process. The results are beneficial in nursery plant production for new rootstocks selections.

Differences in response of some Tunisian chickpea (*Cicer arietinum* L.) to drought

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Whether exposed to mild or severe drought conditions, plants exhibit a range of specific responses, aimed to reduce water loss and/or to optimize water uptake. In this work, a greenhouse experiment was conducted to assess the effects of drought stress on plant growth, water potential, water use efficiency, osmotic adjustment and relationship between all these parameters in three Tunisian chickpea (*Cicer arietinum* L.) genotypes (Amdoun, Kesseb and Chetoui) known by their different response to many abiotic stress. Culture was conducted on 1 kg pot filled with potting soil mix (pH: 6.0, N: 225 $mg.kg^{-1}$, P: 245 $mg.kg^{-1}$, K: 275 $mg.kg^{-1}$, EC: 0.7 $mS.cm^{-2}$). Treatments were imposed during 16 days. For control plants, pots were watered daily. For drought stressed plants, no water added.

Genotypic differences were expressed after one week of treatment. In comparison to Chetoui and Kesseb, Amdoun maintained the highest potentiality of plant growth and osmotic adjustment, maintained the most hydrated leaves and express an important ability to decrease its water potential. Water use efficiency and Sensitivity index discriminates clearly the studied genotypes.

Initiation of axillary bud outgrowth after decapitation in pea can be based on the canalization of auxin

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Bud outgrowth initiation in pea (*Pisum sativum* L.) after release from apical dominance by removal of the dominant apex is accompanied by directional auxin export by subcellular polarization of PIN1 auxin transporters. Application of auxin efflux inhibitor (NPA, TIBA) to the second axillary bud of decapitated plants reduces bud outgrowth. Inhibition of outgrowth of the second axillary bud in these plants caused outgrowth of the first bud. This competition between the second and first axillary buds as new potential sources of auxin after decapitation is associated with changes in expression profiles of *AUX1*, *PIN1* and *DRM1* genes. These results support the competitive canalization theory, by which canalization of auxin from the lateral auxin source is possible only if the primary source is removed or weakened. Length of the decapitated stem stump may affect timing of changes in expression of *AUX1*, *PIN1* and *DRM1* genes and hence the timing of initiation bud outgrowth after removal of the dominant apex. The signal for axillary bud outgrowth therefore could be the auxin decrease or depletion in the stem.

Acknowledgment: This work was supported by the project "CEITEC - Central European Institute of Technology" (CZ.1.05/1.1.00/02.0068).

Nitric oxide metabolism in senescing tobacco plants

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Leaf senescence is characterized by a cessation of photosynthesis, disintegration of organelle structures, intensive losses of chlorophyll and proteins and increases in lipid peroxidation and membrane leakiness. This developmental process is often associated with increased oxidative damage to cellular macromolecules by reactive oxygen species. However, very little is known about gaseous free radical nitric oxide (NO) and related molecules – reactive nitrogen species (RNS), e.g. peroxynitrite, S-nitrosothiols, S-nitrosoglutathione etc. Interesting is the relationship between NO and cytokinins (CKs), which are known to play an important role in senescence: increased CK production delayed leaf senescence and reduced endogenous CK level resulted in accelerated senescence. Similarly, the application of exogenous NO counteracts plant senescence. Hence, in the present study, we studied RNS metabolism of transgenic tobacco plants (SAG) with introduced gene encoding isopenthenyl transferase, an enzyme which catalyses the rate-limiting step in cytokinin synthesis, and we compared it with wild tobacco plants (WT).

Senescence in old leaves of SAG plants was significantly delayed as was shown by higher chlorophyll *a+b* content. Activity of nitrate reductase, one of NO producers, decreased with increasing leaf age both in SAG and WT plants. Nitrite reductase, another NO producer and the convertor of toxic nitrite, increased with leaf age in WT plants while it slightly decreased in SAG plants during ageing. Nitrosoglutathione reductase (GSNOR) can regulate the cellular level of S-nitrosothiols and therefore the nitrosoglutathione content via the NADH-dependent reduction of nitrosoglutathione to S-hydroxylaminoglutathione then producing oxidised glutathione and NH_3. GSNOR activity decreased with increasing age both in WT and SAG plants, but more prominently in WT plants. As GSNOR was proposed to protect cells from nitrosative stress, the lower content of nitrotyrosine, the marker of nitrosative stress, in old SAG leaves is in the accordance with higher GSNOR activity in these leaves compared to the corresponding WT leaves.

Our results show that old leaves of SAG plants showed the decrease of both NO producers followed. These leaves suffered from milder nitrosative stress compared to old leaves of WT plants.

Acknowledgement: This work was supported by the Grant Agency of the Czech Republic, grant No. P501/11/1239. The seeds were the kind gift of Professor R. Amasino, University of Wisconsin, USA.

Chickpea drought resistance (*Cicer arietinum* L.) under graduated water stress

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We are now at a time when you decide on the further development of the Earth. It is expected that with increase of temperature of the Earth, will increase the number of strong storms, devastating floods, fires and drought. Climate change will also affect the crop production and therefore must seek ways to reduce negative effects and improving positive effects on agriculture.

Soil, rainfall and temperature are major environmental factors for the cultivation of legumes. These crops reacts very sensitive on them. Heat and humidity have a greater impact on growth as the soil and measure of impact depends on the species and cultivar.

Chickpea is an important dryland pulse crop in many parts of the world, but in creating crops are also important habitat conditions. Adaptability to alternating conditions and integrity of the plants will probably play an important role in improving production and its stability. Productivity is often limited by periods of water deficit.

Therefore the aim study was to monitor the physiological parameters of four genetic resources (Alfa, Beta, Slovak, Irenka) of chickpea (*Cicer arietinum* L.). The cultivar „Irenka" originated in the Czech Republic. The origin of next to cultivars was of Slovakia (genotyp „Alfa", „Beta" and „Slovak"). These seeds were provided from Gene bank of the SR in Piešťany. Vegetation pot trials experiments were performed a year ago. These genotypes of chickpea were tested in conditions of water stress, because drought is in whole world the most important factor in reducing the yields of major crops.

The influence of drought conditions were tested on selected physiological parameters. Four parameters were used to characterize the water stress of the plant: stomatal closure, osmotic potencial, relative water content in leafs and free proline content. One of the most rapid reactions induced water stress was the stomatal closure. These tested cultivars differed in capacity for osmotic adjustment. Osmotic adjustment in plants refers to the net accumulation of solutes in the plant leading to a decrease in osmotic potencial and relative water content. The higher capacity for osmotic adjustment in the water stress showed cultivars „Alfa" (0,20 MPa) and „Irenka" (0,19 MPa).

Among tested pfysiological measuring the best parameters in tolerance to drought conditions achieved cultivar „Irenka" (Czech Republic), that could be used in the selection of genotypes suitable for growth conditions. Negative phenomena of climate changes can be mitigated by appropriate selection of plants, improving water management and irrigation systems. The solution can be also using the genotypes that in difficult circumstances will bring a reliable crop in good quality.

Impact of potassium on some physiological and biochemical traits of two common bean cultivars subjected to salinity

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Salinity is one of the major environmental stresses that limit plant growth and productivity. NaCl is the most abundant salt that contributes to soil salinity. So, pot experiments were conducted at the green house of National Research Centre, Cairo, Egypt, during two successive seasons 2010-2011 and 2011-2012 to evaluate the potential role of potassium fertilizer to counteract the deleterious effects of salinity on some physiological and biochemical traits of two common bean recombinant inbred lines (RILs). The results show that increasing salinity levels (40 mM and 80 mM NaCl as S1 and S2) caused marked decreases in number of pods/plants; fresh and dry weight of pods/plant; shoot dry weight/plant as well as photosynthetic pigments when compared with those irrigated with tap water (S0). It is worthy to mention that degree of reduction in the yield of two common bean RILs (RIL 147 and RIL115) due to salinity depends on cultivars and salt concentrations. On the other hand, K2 dose (100 mg potassium oxide; K_2O) per kg soil mitigates the harmful effect of salinity on common bean yield and photosynthetic pigments. Peroxidase and polyphenoloxidase activities were increased by salinity and /or K application. Both salinity levels and /or K2 dose caused significant increases in proline, free amino acids and soluble carbohydrate as compared to control. On the opposite side, the two RILs showed decreases in phenolic contents due to salinity and/or K-application as compared to control. K^+/Na^+ ratio decreased significantly as the salinity levels increased but it was increased by K2 application. It could be concluded that K-application mitigates the adverse effects of salinity through its role in the enhancement of photosynthetic pigments, antioxidant enzymes, osmoprotectants and K^+/Na^+ ratio that reflected in improvement of plant performance.

Effect of thermal stress conditions on plant photosynthetic efficiency of *Dactylis glomerata* and *Lolium perenne* varieties

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Increasing need for sustainable agricultural grassland requires the varieties such as *Dactylis glomerata* and *Lolium perenne* characterized by good winter survival to ensure sward longevity. Chlorophyll *a* fluorescence measurement is one of many physiological tools, which is exploited as reliable indicator in plant stress tolerance. In the present study, freezing tolerance of *Dactylis glomerata* and *Lolium perenne* varieties was investigated using plant photosynthetic efficiency as indictor to their tolerance to low and very low temperature. Forage varieties of *Dactylis glomerata* – "Amera", "Amila" and *Lolium perenne* – "Diament", "Gagat" were cultivated in pots and plants grew under controlled conditions (Phytotron). At emergence and tillering phases (22 and 43 days after sowing, respectively) plants were treated with two levels of low temperature: -5°C and -10°C for 24 hours. Chlorophyll *a* fluorescence was measured by Fluorescence Imaging System before (control) and after each low temperature treatment (directly and after 48 hours of stress application). After thermal stress application (-5 °C and -10 °C) a significant reduction in the maximal quantum efficiency of Photosystem II (Fv/Fm) was noted in all tested varieties during both emergence and tillering phases. However, during the emergence phase, and after 48 hours from freezing temperature of -5 °C, plants of all varieties showed recovery from thermal stress. "Amila" variety showed better photosynthetic efficiency (higher values of Fv/Fm) as compared with "Amera"; while "Diament" variety appeared to have better efficiency than "Gagat". No recovery was observed after -10 °C application for all studies varieties except in var. "Diament". There was no recovery from the applied thermal stress during the tillering phase. It seems to be that, each variety has its own tolerance threshold of low temperature at each growth stage.

Topic II

ECOLOGY OF CROP PRODUCTION

Competitive canalization of auxin stream controls axillary bud outgrowth initiation

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Polar auxin transport in stem is necessary for the control of bud outgrowth by a dominant apex. Following decapitation in pea (*Pisum sativum* L.) the axillary buds establish directional auxin export by subcellular polarization of PIN auxin transporters. Apical auxin application on the decapitated stem prevents this PIN polarization and canalization of laterally applied auxin. These results support a model in which the apical and lateral auxin sources compete for primary channels of auxin transport in the stem to control axillary bud outgrowth. Exogenous application of cytokinins, strigolacton or auxin transport inhibitors can stimulate or inhibit bud outgrowth and simultaneously polar auxin transport. Changes in polar auxin transport were followed by *PIN1* and *AUX1* gene expression and localization of PIN1 protein. The cytokinin induced stimulation of bud outgrowth even on intact plants was reflected by earlier elevation of gene expression and PIN1 polarization. Protein synthesis inhibitor cycloheximide prevented any observable outgrowth, but polarization of PIN1 proteins was similar as in outgrowing buds. Despite of NPA and strigolacton application to the buds of decapitated plants they started to grow and their outgrowth was partly inhibited in later stages. This is in accordance with the observed decrease of gene expression and PIN1 localization in longer time.

Acknowledgment: This work was supported by the project "CEITEC - Central European Institute of Technology" (CZ.1.05/1.1.00/02.0068).

Relationship between ion leakage and leaf anatomy of young barley plants under drought

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The physiological status of two barley (*Hordeum vulgare*, L.) cultivars subjected to soil dehydration was evaluated. Young plants were exposed to 7-days-long soil drying by withholding irrigation. Leaf water content and the levels of malondialdehyde and hydrogen peroxide were measured as indicative parameters corresponding to the degree of stress of treated plants. For characterization of cell membrane stability electrolyte leakage from leaf tissues of control and stressed plants was assess and Injury index was determined. It was confirmed that the previously established model system based on the kinetics of ion leakage was adequate for preliminary stress evaluation of contrasting genotypes. The two examined cultivars differed in their water content which corresponded to the extent of membrane injury caused by dehydration. Leaf thickness and total area of mesophyll cells decreased significantly after exposure to drought. The most apparent change in leaf anatomy was the disappearance of vacuoles of mesophyll cells which contributed to the leakage of the major part of electrolytes during the fast phase of the kinetics. The role of the cell wall and the vacuole in the processes of osmotic stress are discussed.

Influence of bacterization on the pigments of photosynthesis content and plants growth by the action of heavy metals

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One of widespread pollutants that inflict considerable harm to environment are heavy metals (HM). Almost 20% plough-land are polluted by HM in Ukraine (Medvedev V.V. *et al*., 1997). HM, included in nutrition chains, is able to change considerably an intensity of metabolic processes at plants (particular photosynthesis), it reduces their productivity and quality of harvest. Ihat's why searching methods which promoted to decline their negative effect on the plants productivity is actual. One of important elements of agriculture biologization is the application of preparations on the basis of bacteria, which improve the plants nutrition and promote to increase their productivity.

The aim of our researches was to definite the influence of bacterization (biopreparation Phosphoenterin) on photosynthesis pigments content in leafs of winter wheat (sort Fantasy Odeskaya) and barley (sort Taina) and their height and growth at the negative action of HM (Cr, Cu, Pb) in the conditions of vegetation experiments. Experimens was conducted in a green-house. The biopreparation Phosphoenterin was used for seeds inoculation. The control was with inoculation. The soil was southern chernozem carbonate.

The results of our researches showed, that content of chlorophyll pigments ($a+b$) in leafs of barley and winter wheat was decline by hм actions. It was showed, that bacterization promoted to increasing of pigments content in leafs of cereals on a background hм (on 4-7% against control).

The negative influence of hм was showed on the plants of barley and winter wheat. It was detaining the time of stairs appearance and was influenced on their height. The application of phosphoenterin had positively influence on a height and their plants development: the height of bacterization plants of barley and wheat increased on 11% and 5%, and general mass of plants - on 37% and 25% accordingly comparatively with control.

Thus, our results showed the positive influence of phosphoenterin on content of chlorophyll in barley and wheat winter leafs. It assisted to the best height and development of cereals in the conditions of hм polluted of southern chernozem.

High power microwaves and temperature influence on *Lycopersicon esculentum* physiological parameters

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Impact of microwave radiation to tomato seeds was investigated. To avoid the thermal seeds heating, short high power rare repetition microwave pulses were applied. Seeds of tomato variety 'Viltis' were exposed by microwaves at 9.3 GHz frequency for 10 minutes time, where pulse duration was 4 μs and pulse repetition – 25 Hz, electric field – 320 kV/m at the Centre for Physical Science and Technology. Plants were growth in growth chamber of controlled environment at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry. The plants were grown under ambient and elevated (T - +30/+22 °C, day/night) temperature conditions. Analyses were made after 14-days of plants germination and after 10-days of temperature exposition. Different combinations of investigated temperature and microwave radiation had a significant influence on tomatoes physiological indices. Plants under microwave radiation had significant higher growth parameters (dry matter, assimilating area, plant height) and higher amount of photosynthetic pigments (chlorophyll *a*, chlorophyll *b*) in compare with non-radiated plants. Different temperatures had no effect on amount of dry matter, but radiated plants had higher amount of dry matter in compare with non-radiated plants under both temperatures. Ambient (T - +21/+14 °C, day/night) temperature reduced assimilating area of radiated plants, but elevated (T - +30/+22 °C, day/night) temperature increased assimilating area of radiated tomatoes in compare with non-radiated.

Acknowledgement: This research was funded by a grant MIP-040/2011 from the Research Council of Lithuania.

Physiological, biochemical, and anatomical effects of proline soaking on faba bean (*Vicia faba* L.) plants grown under sea water management

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In arid regions, where water resources are limiting, poor quality waters are increasingly being used although such irrigated water is one of the major sources of salinity, which can result in crop yield reductions and soil degradation. Sea water mixed with fresh water may be used to irrigate a variety of plants. Faba bean (*Vicia faba* L.) is an important food crop in Egypt with good source of protein for human food and animal. The aim of this work was to study the effect of sea water management, (1:8 & 1:16 diluted sea water) and salinity stress on faba bean plants. Faba bean seeds were soaked for 12h at three concentrations of proline (0, 5, & 10µM) removed from the solutions, left to dry at room temperature, then sown in pots with 7 kg clay soil/pot, and grown using two concentrations of sea water (2000 & 4000 ppm), plus tap water which had 150 ppm, applied 10 days after sowing. Plant samples were taken after 65 days from sowing. Increasing sea water concentration decreased all growth parameters (plant height, number of leaves, and dry weights), photosynthetic pigments (chlorophyll *a*, chlorophyll *b*, and carotenoids contents) of faba bean leaves compared with control. While accumulation of total phenolics, free amino acids, total soluble sugars, and proline contents increased with increasing salinity levels, total carbohydrates were decreased in faba bean leaves with increasing salinity levels. Proline treatments resulted in clear increase in the growth parameters, photosynthetic pigments, total carbohydrates and total soluble sugars. Protein bands extracted from the variously treated faba bean leaves indicate a positive role of proline in the alleviation of the damage effects induced by sea water. It is clear that midvein thickness was decreased by 8.1% less than the control. Likewise, the dimensions of midvein bundle were decreased in length by 11.9% and in width by 3.5% below the control although an increase of 3.8% in number of vessels/midvein bundle was observed over the control and the mean vessel diameter was decreased below the control by 14.7%. At the same time thickness of lamina was increased by 9.6% over the control due mainly to the increase observed in thickness of palisade tissue by 23.2% and in thickness of spongy tissue by 7.9% over the control. This study suggested that proline soaking can reduce the harmful effect of salinity stress.

Tolerance of four mutant lines of barley (*Hordium vulgare* L.), wheat (*Triticum aestivum* L.) and garden cress (*Lipidium sativum* L.) to crude oil contaminated soil

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Phytoremediation shows promise as an alternative low-cost to most remediation methods. This study evaluated the germination of six crops, including four mutant lines of barley (*Hordium vulgare* L.) (1-9-3, 150-2-3, 1-1-200 and 150-1-5), Wheat (*Triticum aestivum* L.) and garden cress (*Lipidium sativum* L.). This experiment was conducted in laboratory at room temperature. Oil extracted from crude oil contaminated soil was added to sand used in different concentrations (0, 2, 4, 6, 8% and 10%). Ten seeds of each crop were sown in Petri dishes with different treatments separately. For each treatment four replicates were used in completely randomized design, germination percent was calculated, after one week, shoot and root length were measured. Data were statistically analyzed using MINTAB version 12. The results show that barley mutant line (150-2-3) was significantly different from other entries in germination percent, shoot and root length except mutant line 150-1-5 in germination percent. Results demonstrated that the mutant line 150-2-3 was promising to remediate crude oil contaminated soil.

Ecological aspects of *Bacillus thuringiensis* application in protection system of potato

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The share of the bioinsectisides on the basis of bacteria *Bacillus thuringiensis* in Ukrainian systems of plants protection is insignificant. After using of *B. thuringiensis*, vegetative cells and spores can remain as the component of natural microflora and join mutual relations with agrocenosis components. These relationships in the potato agrocenosis was the object of the research. The biopreparations in the base of strains *B. thuringiensis* 994 (BT 994) and 787 (BT 787) were investigated. The strain 994 can produce the parasporal crystals and exotoxin during sporification. The strain 787 can produce only the parasporal crystals. The bioinsecticide action was compared with the chemical insecticide Calypso.

It was established fact that the effectiveness of potato plants processing against potato beetle larvae with BT 994 and BT 787 during 10 days are respectively 87.4 and 89.7%. Calypso caused the insects destruction for 3 days.

Putting on practice the biopesticides didn't have negative influence on the potato beetle predators *Cocinella septempunctata* L. and *Forticula auricularia* L. (the destruction didn't exceed 6.7%). But under Calypso influence the lowering of insects quantity are accordingly by 14.8% and 18.4%.

Putting on practice the biopreparations caused the depression of soil fungal population in first 2 days. BT was shown to demonstrate the antagonism to phytopathogens *Fusarium oxysporum* and *Alternaria solani*.

Both biopesticides lead to insignificant and transitory increasing of the peroxidase activity (on 21.4 and 28.5%) and polyphenoloxidase activity (on 7.78 and 18.03%) in potato leaves during the whole experiment. It may be shown the plants ability of stabilizing the oxidization metabolism and provide the adaptation opportunities. Calypso caused decreasing the peroxidase activity (14.2%). It didn't influence on polyphenoloxidase activity.

The potato plant processing with biopesticides proved to insignificant decreasing of starch amount and starch grains dimensions in tubers. Calypso caused the decreasing of this rate on 4.5 and 51.6%. This changing is able to testify the aggravation in tuber's nutrient properties.

Thus conducted researches allowed to base ecological expediency of *B. thuringiensis* strains 994 and 787 putting on practice, like the preparation for plant protection bioagents from the potato beetle, as compared with Calypso arguments on facts.

Spectral dependence of pigments in vegetables

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Experiments were carried out to investigate the effect of light spectrum on the pigment content in vegetables. Red, yellow, blue colored and colorless (control) polyethylene plastic films were used. The transparency of films during vegetation period was detected at the wave length 400- 700 nm (photosynthetic active radiation). During vegetation period plastic film transparency and the ratio between red and blue spectrum was changed. Green and red basil, cucumbers, tomatoes and bell peppers were used for experiments. Plants were grown in vegetation pots placed in greenhouse covered with plastic film of different color. Chlorophylls and carotenoides content was determined spectrophotometricaly in the ethanol extract of plant leaves and fruits. Anthocyanin content in red basil leaves was detected spectrofotometricaly in the leaf extract in 1.5M HCl. Experiments showed the influence of plastic film color on pigment content in plant leaves. Chlorophyll content in plants depended on species, plant ontogenesis stage and light spectrum. The increase of carotenoides in cucumber leaves and tomatoes fruits under yellow plastic film was detected. Elevated anthocyanin content was observed in leaves of basil under red film.

Photosynthetic productivity and yielding of pear trees grown on different rootstocks and potassium fertilization levels

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The research described in this paper involves measurements of photosynthetic productivity, growth and yield of pear trees (cv. 'Conference') budded on different rootstocks and managed with different levels of potassium fertilization. The main aim is to determine the effect of five different potassium fertilization levels on the physiological state of pear trees and their yield, in order to improve relevant agrotechnical practices for a sustainable horticulture. Leaf gas exchange, photosynthetic efficiency, area index, and chlorophyll content were measured, as was tree yield. This study is a trail to clarify some physiological mechanisms influencing the productivity of pear trees growing on different rootstocks and with varied potassium fertilization levels.

Integrated effects of drought and temperature on physiological indices of field *Cucumis sativus* L.

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The aim of the study was to investigate the integrated impact of temperature and substrate moisture on physiological indices of *Cucumis sativus* L. The object of this study was two different varieties of cucumber (*Cucumis sativus L.*) 'Accord F_1' and 'Krukiai F_1'. Experiments were performed in growth chamber of controlled environment at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry. The plants were grown under ambient (T - +21/+14 °C, day/night) and elevated (T - +30/+22 °C, day/night) temperature in normal moisture (~40%) and drought (< 10 %) substrate. Analyses were made after 10-days of treatment. Different combinations of investigated factors had a significant influence on plant physiological indices. The moisture deficiency significantly reduced growth parameters (dry biomass, assimilating area, plant height) of both cucumber varieties. Water deficit in substrate significantly increased the content of photosynthetic pigments in 'Krukiai F_1' at ambient temperature, while in 'Accord F_1' at elevated temperature. Independently from temperature regime, drought significantly effected increase of total phenolic compounds in 'Krukiai F_1'. Whereas significant increase of phenolic compounds in 'Accord F_1' was observed at drought and elevated temperature. Higher amounts of ascorbic acid were detected under drought conditions at both temperature regimes in 'Accord F_1', whereas increase of ascorbic acid under drought and ambient temperature was noticed in 'Krukiai F_1'.

Acknowledgement: The work was carried out within the framework of the long-term research program "Horticulture: agro-biological basics and technologies" implemented by Lithuanian Research Centre for Agriculture and Forestry.

The changes of gas exchange parameters at the leaves of spring barley under water stress

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The objective of the study has been to describe some changes of gas exchange parameters at the leaves of spring barley under water stress. For experiments in greenhouse conditions, three spring barley genotypes *(Hordeum vulgare* L.) – Jersey, Malz and Valticky – were selected. Each genotype was cultivated as a sand culture in two treatments – stressed and control. The plants at the beginning of shooting (31.DC) were exposed to short-term (4 days), medium-term (10/15 days) water stress followed by rehydration (20 days), and long-term (30 days) water stress. During the water stress substrate moisture was maintained gravimetrically at 30 %, whereas for the control and rehydrated plants at 70 % of maximum capillary water capacity. Over the course of selected growth phases we determined the relative water content in the leaves (RWC), the photosynthesis (Pn) and transpiration (E) rates, stomatal conductance (g_s), intercellular CO_2 concentration (Ci), water use efficiency (WUE, WUEi) and the total weight of shoot dry matter. The experimental results have shown as well that the mild induced water stress influences only the stomatal limitation of photosynthesis in the leaves. It means that g_s decreases leading to the stomata closure that leads to the decrease in Pn and E. When the stomata close, the primary adaptation mechanisms on the physiological changes caused by water deficit start to function. Thus, the stomatal conductance has shown to be a good indicator for the evaluation of the water stress intensity. The stomatal limitation of Pn and E can be most notably seen at the beginning of dehydration, when WUEi increases. As the time of water stress is prolonged, gs decreases and Pn and E are therefore limited. There is no significant increase of WUE during the whole water stress period. After rehydration, gs and Pn increase, and particularly at the beginning of rehydration E increases also. When the time of rehydration is prolonged, WUEi decreases and WUE increases slightly.

Acknowledgment: This study was supported by „S grant of MSMT CR“.

Morphological, physiological and biochemical characteristics of entomopathogenic strain *Bacillus thuringiensis* 0371-1

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The tendency of biosphere saving from the pollution causes the interest for biological plant protection against pest insects. Most of entomopathogenic biopreparations in the world are producing in the base of *B. thuringiensis*. That's why the searching of the new active strains of it is important.

The strain 0371-1 was selected from the dead caterpillars of *Hyphantria cunea* Drury. It has a high entomopathogenic activity for the younger larvae *Leptinotarsa decemlineata* Say. The effectiveness of fluid was 100% within 5 days.

For identifying the new strain it's morphological and physiological and biochemical properties were studied. It was shown, that at bacterium cultivating on beef-extract agar formed round or the wrong form of a colony 5-12 mm in diameter in a 3 days.The relief of grayish-beige color colonies is flat, with matte surface. The optimum temperature for bacteria growth is 26-30 ºC. The color by Gram is positive. The spores and endotoxin crystals has a subterminal location. The capacity for β-exotoxins production was established. The physiological and biochemical properties of the selected strain 0371-1 were defined it as a bacteria *B. thuringiensis var. thuringiensis*.

It is shown that the strain has four classical phases during cultivation: Lag-phase, phase to accelerate growth, exponential and stationary phases. Lag-phase was observed for 0.5-1.5 hours, the phase of vegetative cells – was up to 10-12 hours. After 14-16 hours of cultivation the beginning of the active protein crystals and saprogenic zones formation were noted in vegetative cells. The entire cultivation period was during 45-48 hours and ended with full exemption spores from sporangium. The final titer was reached 2.0-2.7 billion spores in 1 ml.

Thus, the researches proved that the *B. thuringiensis* 0371-1 strain has entamopatogenic action. It is technological one and can be the basis for the biopreparation for plant protection against leaf-cutting pests.

Influence of meteorological conditions on the vegetative growth of apple trees

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The influence of meteorological conditions on the vegetative and generative productivity of trees is undeniable. The investigations on tree vegetative growth in different apple orchards systems have been carried out for 11 years in Pūre Horticultural Research Centre. Planting systems with tree density varying from 1250 to 3075 trees per ha planted in one-row, two-rows and three-rows systems have been compared. Analyze of yearly increase of trunk cross section area in some years shows deviations from total tendencies. It indicates about possible influence of meteorological conditions on this parameter. Hydrothermal coefficient for each month during vegetation period is used for characterization of meteorological conditions. The summary conclusions about influence of meteorological conditions on the vegetative productivity of apple trees are as follows: 1) meteorological conditions in July have the most influence on the changes of trunk cross section area; 2) the yearly increase of the tree height most significantly is influenced by meteorological conditions during May-June; 3) differences in influence of meteorological conditions on vegetative growth of trees were not stated between planting systems.

Progressive reduction of key *Brassica napus* L. volatile concentrations after pollination by a pollen-feeder, *Meligethes aeneus* F.

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There are qualitative and quantitative VOC differences among blooming flowering plants, which can be used by pollinators for floral attraction and orientation. Yet, some insects are pollinators as adults while larvae and/or adults are herbivorous on the pollinated plant. We studied *Brassica napus* L. (*Brassicaceae*, oilseed rape) whole plant VOC production for 3 days following pollination by a male-female pair of the pollen-feeding *Meligethes aeneus* F. (*Coleoptera: Nitidulidae*). We then assayed *M. aeneus* attraction to the three most abundantly produced terpenoid VOC (LA A, LA B, and VER) using y-tube tests. Of 11 constitutively emitted *B. napus* VOC, LA A, LA B, and VER were progressively suppressed with 30-40% reduction the day after pollinator introduction but 50-90% reduction by 3 days. A few other VOC had minor reductions, while LIN had brief 10 x induction only 2 days after pollinator introduction. Based on y-tube bioassay results, adult female and male *M. aeneus* had significant dose responses to LA A, LA B, and VER. Beetle adults were attracted at doses somewhat higher than constitutive plant emission, and showed avoidance only at doses much higher than individual plant emission levels with all three VOC. Although *B. napus* may have evolved VOC reduction after pollination simply to reduce unnecessary resource expenditure, *B. napus* may experience additional selective pressure to reduce future interactions with *M. aeneus*. Future studies will need to examine whether *B. napus* reduced VOC production is specific to *M. aeneus* pollination, and whether VOC reduction reduces *B. napus* floral attractiveness to *M. aeneus* adults.

Antioxidant properties and photosynthetic pigment content of *Thymus vulgaris* L. cultivated under elevated temperature and water deficit conditions

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Cultivation of medicinal plants under controlled environment conditions is a possibility to study the impact of abiotic factors on photosynthesis and bioactive compounds in herbal plant. The purpose of this study was to investigate the effect of elevated temperature and mild water stress on photosynthetic pigments, secondary metabolites and antioxidative capacity of thyme (*Thymus vulgaris* L.). The experiment was conducted in growth chambers of controlled environment. Until treatment, plants were grown in a greenhouse at an average temperature of 21-24 ºC under sunlight passing through the glass of the greenhouse. Plants at the initial flowering stage were placed for 10 days in one of the three environments: (1) reference – temperature day/night 21/14 ºC, and normal water level (~40%) substrate, (2) elevated temperature – 30/21 ºC and normal water level (~40%) substrate, (3) elevated temperature – 30/21 ºC and moderate water deficit (~20%) substrate. In growth chambers photoperiod was 16 h, high-pressure sodium lamps (SON-T Agro, Philips) were used for illumination. Substrate moisture content was measured with the "Delta-T Devices" soil moisture meter HH2 and plants were watered with a tap water according to the readings. It was found that interactive effect of elevated temperature and mild water deficit provided a significantly higher content of chlorophyll *a*, *b* and carotenoid in plant leaves as compared to reference one. The significant increase in DPPH· free-radical scavenging capacity was observed in thyme cultivated under elevated temperature or elevated temperature and water deficit. Total phenolic compounds and anthocyanin content in thyme herb were increased as a result of elevated temperature or elevated temperature and mild water stress. Thyme exposed to elevated temperature or experienced water deficit accumulated significantly lower content of ascorbic acid. In the leaf tissues of plants grown under higher temperature conditions essential oil content reduced whereas water shortage increased essential oil content in thyme herb. These results indicate that temperature and water availability are environmental factors which enable to induce secondary metabolite production in thyme and controlled environment technology with precise application of specific stresses might be used for induced secondary metabolite production in herbal plants.

Acknowledgement: *Postdoctoral fellowship is being funded by European Union Structural Funds project "Postdoctoral Fellowship Implementation in Lithuania".

The impact of LEDs spectrum on growth and nutritional quality of *Brassica* microgreens

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The objective of our studies was to optimize lighting spectrum for the growth (hypocotyl length, height, leaf area, fresh and dry weight) and nutritional quality (ascorbic acid, anthocyanins, phenolic compounds, tocopherols, carotenoids, non-structural carbohydrates, chlorophylls, nitrates) of *Brassica* microgreens under various combinations of light-emitting diodes (LEDs). Microgreens such as mustard (*Brassica juncea* L., 'Red Lion'), red pak choi (*Brassica rapa var. chinensis*, 'Rubi F_1'), tatsoi (*Brassica rapa var. rosularis*) were grown in phytotron chambers to harvest time (10 days) in a peat substrate. Day/night temperature 21/17°C, 16 h photoperiod and ~70% relative air humidity was maintained. A system of high-power solid-state lighting modules with the basal 455, 638, 665 and 731 nm LEDs were used in the experiments and supplemented by 520, 595, 622 nm LEDs. Photosynthetically active flux density (PPFD) level was maintained at 300 μmol m^{-2} s^{-1}. Our results showed that although studied plants were of the same family, but a different light spectrum had diverse effects on the growth and nutritional quality of microgreens. Supplemental 622 nm light have positive effect on all growth parameters of tatsoi and increased fresh and dry weight of mustard. Meanwhile, supplemental LEDs of different spectrum had no effect on red pak choi growth. Different supplemental light spectrum had a positive impact on different compounds of nutritional quality. For example, nitrates content in *Brassica* microgreens mostly decreased, when supplemental green 520 nm light was applied. Such illumination increased chlorophylls content in mustard and red pak choi. Supplemental orange 622 nm light increased content of anthocyanins in these plants and content of non-structural carbohydrates in mustard and tatsoi. Positive effects on total phenols and DPPH free-radical scavenging capacity in mustard and tatsoi had supplemental 595 nm light. Summarizing the results it can be stated that for such plants as microgreens, where external and internal quality is important, would be appropriate to design LEDs systems with few supplemental spectral components, but this requires further study.

Acknowledgement: This research was funded by a grant (No. SVE-03/2010) from the Research Council of Lithuania).

Assessment of the vegetation state of several under-exploited *Agrostis tenuis – Festuca rupicola* grasslands

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The purpose of this research is to assess the state of the biodiversity and pastoral value of four *Agrostis tenuis – Festuca rupicola* grasslands from the hill area. Also, there has been analysed the floristic composition and a series of ecological indexes, respectively humidity, soil reaction, temperature, light, and nitrogen.

Other aspects taken in account were the life-forms and geo-elements spectres. The analysed grasslands are placed on Bistrei Valey, in the perimeter of the locality Oțelul Roşu, Caraş-Severin County. The researches have been developed during 2010-2011 period. The average elevation level in the studied area is 268 square meters.

The soil from the studied area is brown type, with a pH comprised between 4.79 and 5.31. The rainfall amount is about 700 mm and the average temperature is 10 Celsius degrees. The management mode of these grasslands is extensive, the grazing period being 150 days per year.

The analysed surfaces are characterised by the lack of the maintenance works, there being present erosion phenomena. The method used for the vegetation analysis is the linear point quadrate method (Daget *et* Poissonet, 1971), the data being used for the calculation of different ecological indexes and pastoral value. According with the obtained results, the greatest contribution was registered in the case of the species from other botanical families. Also, the pastoral value of the species is low in all the analysed grasslands due to the great contribution o f the low economical values of the most of the species from the analysed grasslands.

The altitudinal gradient influence on the parameters of the mountain grasslands

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The great importance of the grasslands in the mountain region of Banat is given by the particularities of the area, where the permanent grasslands cover over 250,000 hectares.

The aim of the paper is to assess the influence of the altitudinal gradient on the quality and biodiversity of grasslands in the mountainous area Muntele Mic.

We studied various types of grasslands found at different altitudes as 613, 1342 and 1562 m. For each of them, we studied: the type of grassland, structure of vegetation, pastoral value (VP), Shanon-Weawer-Simpson biodiversity index, as well as autecological vegetation index. We determined the climatic factors through the average values of temperature and precipitations, and the edaphic characteristics of the substratum: pH value, clay content, humus content and phosphorus content. The main results indicate that the structural parameters of the ecosystems of mountain grasslands under study are strongly influenced by the altitudinal gradient. Studies such as this will allow of future modellation of the dynamics in the evolution of the quality and biodiversity in mountain grasslands in relation to the altitude. In its turn, this modellation will serve as an element of orientation for correct management of mountain grasslands.

Photosynthetic efficiency of maize in response to two-spotted spider mites (*Tetranychus urticae* Koch) feeding and/or soil drought conditions

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Crops suffer due various types of environmental stressors. Water deficit and arthropod herbivores including spider mites belong to those common abiotic and biotic stressors that cause a disturbance of photosynthetic apparatus functioning. Consequently, this leads to reduction of plants growth and yield. In the present study, the photosynthetic efficiency based on chlorophyll fluorescence measurements of 3 maize varieties grown under different stress conditions (mite feeding and/or drought) was examined at 3 terms of stress application (0, 4 and 6 days). Six-week-old maize plants (*Zea mays* L.) were divided into four groups: control plants (stress untreated); plants infested by the two spotted spider mite *Tetranychus urticae* Koch (Acari:Tetranychidae); plants subjected to soil drought evoked by water withholding; and plants subjected to both stresses simultaneously. Obtained results showed that, plants' reactions to all applied stressors were rather similar as regards to tested varieties except in the case of the maximal photosynthetic efficiency of photosystem II (PSII) parameter (Fv/Fm), which was surprisingly enhanced after 6-day of mite infestation. Drought stress (alone and together with mites feeding) decreased the pool size of PSII electron transport acceptors and electron transport rate per reaction center (ETo/RC), but caused an increase of absorption flux (ABS/RC) and trapping flux (TRo/RC). Our results showed considerable and specific changes in photosynthetic apparatus functioning of maize plants grown under abiotic and biotic stress conditions.

Effect of shading on the efficiency of photosynthetic apparatus of selected lawn varieties of perennial ryegrass (*Lolium perenne* L.)

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The main aim of the conducted researches was to determine the level of unfavorable condition of shading, which may produce significant impact on functioning and efficiency of photosynthetic apparatus of chosen lawn varieties such as perennial ryegrass (*Lolium perenne* L.). This species is native in Europe and northern Africa, but it is also widely cultivated and naturalized in other regions. A two-factor experimental micro-plot was conducted and three lawn varieties were chosen: "Henrietta", "Nira" and "Taya". Plots were arranged in three different shading variants (produced by white agro textile). Measurements were carried out three time during the period May-July, 2012. Chlorophyll *a* fluorescence measurements were provided and the main assessed parameters were: initial or minimal fluorescence (F_o), maximal fluorescence (F_m), variable fluorescence (F_v) and maximal photosynthetic efficiency of photosystem II (F_v/F_m). Our results showed that, there were significant differences between selected varieties in terms of their photosynthetic apparatus adaption to light conditions. During May, all varieties were characterized by a decrease in F_0 parameter under improved light radiation intensity. Similar reactions were found in the case of F_m and F_v parameters. The highest values of these parameters under complete shade conditions was noted for the variety "Taya". However, during July a declining trend of photosynthetic efficiency of this variety was observed. We also found some difference between our experimental variants in the other tested varieties, however there were not significant statistically. We assume that, each variety has special threshold and need for light intensity.

Reactions of photosynthetic apparatus of Endive plant to different culture media

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Endive (*Cichorium endivia* L.) is a leaf vegetable with high vitamins and nutritious values. Therefore, during the last years, an increase of its cultivation in Poland and other European countries is observed. Thus; commercial sector has been forcing scientists to learn more about this plant, especially its required growth conditions. The aim of the investigation was study the effect of different growth media on the photosynthetic efficiency of different cultivars and leaves of different ages. The experiment was conducted at the Department of Vegetable and Medicinal Plants in the Experimental greenhouse Centre of Warsaw University of Life Sciences (SGGW). Endive grown in three independent NFT cultivation systems (Nutrient Film Technique equipped with flowing gutters cultivation in closed circuit medium): a standard culture medium (control, A1), culture medium concentrated 3 fold (A2), and a concentrated 5 fold (A3). Four cultivars were used: 'Kethel', 'Barundi', 'Galanti', and 'Perceval'. Some physiological parameters, such as chlorophyll fluorescence was measured for each plant with three leaves of different ages: C1 - leaf old (external), C2 - leaf center, fully developed, and C3 - inner leaf (the youngest one). Our results showed that, the efficiency of photosynthetic apparatus of Endive plants was influenced by both, growth medium concentration and leaf's age. High medium concentrations affected plant photosynthesis negatively. However, the changes were variable between the tested cultivars. This work suggests that, chlorophyll fluorescence measurements can be recommended as bioindicator in endive production and cultivar selection.

The photosynthetic heat tolerance and acclimation assessed by fast chlorophyll *a* fluorescence kinetics in 30 wheat genotypes

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High temperature as a serious abiotic stress factor can be a reason of severe impairment of the photosynthetic apparatus. Chlorophyll *a* fluorescence techniques represent a good tool for monitoring effects of the heat as high temperature directly affects photosynthetic processes. In our experiment, the PSII thermostability was assessed during spring vegetation in 30 field grown wheat genotypes of different origin. The measurements of fast chlorophyll fluorescence kinetics before and after treatment by high temperature in darkness were realised. Along with decrease of variable fluorescence, we observed two major effects of dark heat treatment: steep increase of basal fluorescence F_0 as well as increase of relative variable fluorescence in time app. 300 μs (V_K/V_J). While the steep F_0 increase as a result of antenna disconnection and severe disintegration of PSII units occurred in our measurements at temperature 44°C and higher, we observed important increase of V_K/V_J even at 38°C; at 40°C appeared clearly evident K-step indicating loss of electron donor capacity of oxygen evolving complex in PSII. Observing seasonal changes in wheat PSII thermostability in field estimated by 40°C dark treatment, we identified two major periods valid for the majority of genotypes: the first period up to half of May was typical by pronounced K-step and obvious donor side limitation of PSII electron transport; in the latter period, the K-step partially or completely disappeared. This acclimation occurred immediately in the last decade of May. By the analysis of meteorological data it was evident that acclimation of PSII thermostability was induced by steep increase of daily air temperature over 30°C following a long period with moderate or rather low temperature. The acclimation effect persisted even after several cold and rainy days coming after hot period. Individual genotypes differed in acclimation level and we identified also small group of genotypes with very low or much slower acclimation, especially some of those originating from colder areas.

Acknowledgement: This work was supported by grant APVV-0197-10.

Analysis of the leaf photosynthetic performance and temperature response in wheat genotypes and *Aegilops*

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Wheat (*Triticum aestivum* L.) represents one of the oldest and the most intensively breded crops. Two major time periods in breeding can be recognized. The first phase represent thousands years of coincidental improvement from wild wheat ancestors to local landraces, well adapted, but generally low-yielding. The second period, "the Green Revolution" represent several decades of intensive systematic breeding resulting to recent high-yielding genotypes. The field grown plants of modern wheat variety 'Astella', the local landrace 'Diosecka' (both *Triticum aestivum* L.) and wild wheat relative species *Aegilops cylindrica* L. were analysed. We aimed at photosynthetic performance measured in optimum as well as in moderately increased and decreased temperatures. The analysis was based mostly on simultaneous measurements of gas exchange and chlorophyll fluorescence with analyses using photosynthesis models as well as on estimation of photosynthetic thermostability using rapid chlorophyll fluorescence induction. In modern wheat genotype we observed higher average net CO_2 assimilation rate compared to landrace and in both wheat cultivars substantially higher compared to *Aegilops*. Estimation of maximum carboxylation rate (V_{cmax}) showed the same trend; however maximum electron transport (J_{max}) was similar in both wheat genotypes but much lower in *Aegilops*. Estimation of CO_2 transfer conductance (g_i) showed significantly lower values in local landrace compared to modern genotype but also to *Aegilops;* that observations can be associated with a high specific leaf weight (SLW) of local landrace and very low SLW in *Aegilops*. We found also the highest carboxylation efficiency (k_c) in modern variety; however, the positive effect of higher carboxylation efficiency on net assimilation rate was partly diminished by substantially higher mitochondrial respiration. Observation of temperature effects on net assimilation shows the *Aegilops* being more sensitive to moderately increased temperature compared to both wheat genotypes. The analyses of the leaf thermostability brought similar results. Our results suggest that the process of breeding associated with increase of sink capacity led also to stimulation of source performance. Temperature response curve and thermostability test did not confirm expected decrease of heat tolerance in modern high yielding genotype.

Chlorophyll fluorescence- and assimilation pigments-based evaluation of heat tolerance in tetraploid wheats

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Ten genotypes of tetraploid wheat species (parental lines) of different origin were grown in growth chamber in pots as follows: RONCAL (*Triticum turgidum* subsp. *dicoccon*, TRI 17700, Spain); TRI 6158 (*Triticum turgidum* subsp. *dicoccon*, Iran) – donor of those two genotypes was IPK Gatersleben; ARM 7 (*Triticum timopheevii* subsp. *armeniacum*, PI 352265, Azerbaijan); CAR 1 (*Triticum turgidum* subsp. *carthlicum*, PI 61102, Georgia); DCS 9 (*Triticum turgidum* subsp. *dicoccoides*, PI 487262, Syria); ISP 6 (*Triticum ispahanicum*, PI 330548, Iran); PLN 8 (*Triticum turgidum* subsp. *polonicum*, PI 254215, Iraq); TIM 1 (*Triticum timopheevii* subsp. *timopheevii*, PI 119442, Turkey); TRG 7 (*Triticum turgidum* subsp. *turgidum*, PI 384230, Ethiopia); TRN 8 (*Triticum turgidum* subsp. *turanicum*, PI 624892, Iran) – donor of those eight genotypes was GRIN, Beltsville, USA (USDA, ARS, National Genetic Resources Program; Germplasm Resources Information Network - GRIN, Online database. The wheat species genotypes (lines) were tested for their heat susceptibility by exposure of whole plants to air temperature of 42^{o}C for the 6 hours in light and optimal water stage conditions (without water stress). The measurements of chlorophyll fluorescence kinetics and photosynthetic pigments content analyses were performed on mature plant leaves (age of 6 weeks) before and after applied heat stress. Majority of tested genotypes showed a decrease of total chlorophyll content under heat stress – mainly in TIM 1, CAR 1, RONCAL and TRN 8. Chlorophyll *a* to chlorophyll *b* ratio was generally almost unaffected, with exception of TRN 8, RONCAL and CAR 1, where a significant increase of the ratio was observed. The ratio of total chlorophylls to carotenoids decreased in all studied genotypes. The results of rapid chlorophyll *a* fluorescence kinetics measurements and CHF-derived parameters (photochemical quantum yield Φ_{Po}, quantum yield of non-photochemical dissipation Φ_{Do} , quantum yield for electron transport Φ_{Eo} , probability that dissipated electron moves to electron transport ψ_0) showed that genotypes CAR 1, TIM 1, ARM 7 and TRI 6158 were found as the most susceptible to heat stress at the level of photosynthetic apparatus; on the other hand, the best heat tolerance was observed in RONCAL, DCS 9 and TRG 7. Genotypes ISP 6, PLN 8 and TRN 8 showed medium or lower tolerance in high temperature conditions.

Acknowledgment: The work was supported by the Agency for Research and Development Support (APVV) through project no. APVV-0661-10.

Topic III

CROP IMPROVEMENT FOR MANAGED STRESS ENVIRONMENTS

Evaluation of some Romanian corn (*Zea mays* L.*)* landraces for tolerance to heavy metals (Cd, Pb, Ni)

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Plants landraces were developed in time under individual and distinctive environmental conditions. *Zea may* is one of the plants acquainted as a hiperaccumulator a lot of heavy metals from contaminated soils. The peculiarity goal of these researches is the estimation of heavy metals tolerance of three corn landraces collected from a polluted area, in order to select tolerant/resistant germplasm. The considered area is in proximity of surface charcoal exploitation and thermo electric power plants, consequently the soil is contaminated with heavy metals and radionuclides. The collected landraces were assessed for tolerance to heavy metals comparing with the inbred line Lv 113. Natural evolution of plantlets is subordinate on plants meristems, anywise studies in early stages of development, are of remarkable interest. The germinated seeds, with 10 mm length roots, were exposed to heavy metals in 10 variants: Control (tap water), Cd (0.0089, 0.0356, 0.0623 mM/L $CdSO_4$), Pb (0.1510, 0.3020, 0.6040 mM/L $PbNO_3$), Ni (0.1290, 0.6450, 1.2900 mM/L $NiSO_4$). The experiment was run in 3 repetitions. The plants were maintained for 21 days under the treatment conditions and after this period they were transferred in the field. After 7 days the most vigorous plantlets were transferred in pots, in soil. There were performed biometrical observations at 7, 14 and 21 days, concerning the development of the roots, stem, leaves, as well as determinations on heavy metals accumulation in the plant and some enzymes activity. The highest concentration in heavy metals inhibits secondary roots formation (25–35%), produce leaves tip necrosis in landraces and inhibited in over 50% of plants, the root development and plant growth, in Control. The treatment with $PbNO_3$ (low and medium concentration) determined a significant increase of Cd and Ni accumulation, in plants, while at the highest concentration decreased significantly the other metals accumulation. There was determined a significant increase of peroxidase and superoxide–dismutase (SOD) activity in Control (inbred line Lv 113), but no significant differences, were recorded for the landraces. An explanation for these results is the provenance of the landraces, which evolved for more than 20 years in soils with content in heavy metals over the normal limits, and so they are tolerant.

Acknowledgement: These researches were financially supported by CNMP, Bucharest (Romania), 32150/2008, POLMEDJIU research grant (2008–2011).

Development of valuable and high yielding amaranth through induced mutagenesis

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Over the next 20 years, the world's population is likely to increase by about 2.5 billion people. Consequently, food requirements are expected to double by 2025 (1). To cope with this issue, the genetic improvement, i*n vitro* and induced mutagenesis are used to develop so-called climate proofing crops, to overcome food insecurity and stabilize the crop yield and food production.

We focuse our research on the enhancement of the quality and quantity of amaranth grain by use of radiation mutagenesis and biotechnology approches. Two grain amaranth assessions were used for the irradiation treatment - *Amaranthus cruentus* genotype Ficha and hybrid K-433 (*A. hypochondriacus x A. hybridus)*. During the years 1998 – 2011, thirteen generations of putative mutants with their untreated counterparts were established. Finally, 4 putative mutant lines of *A. cruentus* and 3 lines of hybrid K-433 with a long-term significantly increased weight of thousand seeds were selected, with obvious tendency to stabilization of this trait compared to non-treated forms and to the samples of the previous generations (2).

The analyses of some biochemical traits in the grains of putative mutants showed comparable or improved nutritional quality over the control, non-irradiated varieties (3, 4). Some mutants were identified as variants with the significant, long-term lower soluble oxalate level over the controls. The overall oil content ranged in mutant seeds from 1.8 to 3.7% and squalene concentration, ranging from 7.4 to 11.4%, was recognized as uncommonly high compared with reviewed data. As for the protein analyses it is possible to slightly changed protein composition of amaranth seeds by irradiation. We can conclude that the climate, normally affecting yield and content of nutraceutical compounds, did not cause changes of analyzed parametres and these are only the consequence of mutagenesis.

Finally, our mutagenesis-generated lines are considered as valuable matrix for amaranth breeding programme. We have chosen putative mutant line with bigest impact of radiation on monitored traits to register as a new variety.

Acknowledgement: This contribution is the result of the projects implementation: VEGA no. 2/0109/09 and Centre of excellence for white-green biotechnology, ITMS 26220120054, supported by the Research & Development Operational Programme funded by the ERDF.

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Differences of endogenous phytohormone levels in dwarf and normal hop (*Humulus lupulus* L.) plants

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The cultivated hop (*Humulus lupulus* L.) is a short-day plant, normally grown in 5-8 m tall wirework to produce commercial yields of inflorescences known as cones. Relatively recently, dwarf hops have been developed in the United Kingdom, which have shorter internode lengths and are cultivated in low trellis systems. Phytohormones are organic substances, which regulate in small amounts plant growth and developmental processes including vegetative growth, internode elongation, flower induction, shoot formation, leaf senescence, chlorophyll production, etc. Endogenous levels of phytohormones are associated with environmental changes and various hop genotypes have different growth and flowering responses. Few years ago, endogenous hormonal status and changes associated with both vegetative and reproductive development in hop were characterized. The aim of our study was to investigate possible differences of phytohormone contents between normal and dwarf hop genotypes during development in field conditions. Samples were collected from female plants of three normal (Saazer, Sladek, Admiral) and three dwarf (First Gold, Herold, 5021) cultivars grown in experimental hopgardens of Hop Research Institute, Zatec, CR. Different tissue samples were immediately frozen by liquid nitrogen and stored at -80°C until analyses. Growth hormones (cytokinins, auxins, gibberellins) and stress hormones (abscisic acid, jasmonic acid and salicylic acid) were measured by LC-electrospray tandem-mass spectrometry in the Institute of Experimental Botany AS CR, Prague. Various plant tissues (apex buds, young leaves, old leaves, inflorescences) markedly differed in the phytohormone levels, independently on hop genotypes. Higher levels of auxins (IAA) and gibberellins (GA19, 20, 29) were detected in inflorescences suggesting these phytohormones might be involved in flowering, maturating and generative growth of plants. For cytokinins, statistically significant difference was revealed in *cis*-zeatin riboside-O-glucoside content between dwarf and normal hop plants. Higher levels of this cytokinin storage form were found in all tested tissues of dwarf cultivars. Slightly higher levels of abscisic acid were detected in apex buds of normal cultivars while considerably higher levels of salicylic acid occurred in apex buds and young leaves of dwarf cultivars.

Acknowledgement: This work was supported by the Ministry of Education, Youth and Sports of CR in EUREKA (LF11008) and the Czech Science Foundation (P506/11/0774).

Designing forest shelter belts to prevent soil erosion

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The most important risks that lead to reduce the agricultural crop yield, in Dobrogea area (Romania), are drought and soil erosion. It is known that soil erosion begins when the slope is greater than 3.5 meters height per 100 meters length. Practical realization of forest shelter belts on the elevation contour lines that have a difference of 3.5 meters between them is a difficult task. Thus, we chose the location of forest shelter belts on the elevation contour lines that have a difference of 10 meters height per 100 meters length between them. The theoretical model for the location of forest shelter belts on the elevation contour lines is the starting point in designing planting routes. Planting forest shelter belts on the elevation contour lines is a measure of long-term having good results because, in time, it will lead to land terracing and uniformizating soil properties. Using high-precision satellite images allows further vectorization and changing their routes based on existing ground conditions. After vectorization of these routes, planting lines will be available in compatible files with GPS devices. This will enable to plant forest shelter belts with an accuracy of few centimeters.

The resistance breeding to broomrape parasite and other stress conditions in sunflower

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Broomrape (*Orobanche cumana* Wallr.) is a weedy parasitic plant that damage and influence seriously sunflower production in Turkey as well as in other Eastern European countries and also in Spain. Broomrape attacks are frequently severe in those areas with resulting up to 100% yield reducing. Although Clearfield technology known as resistant hybrids with *Imidazolinone* (IMI) herbicides as post application which control both parasites and also key weeds is a promising method, genetic resistance is the most economical and efficient control way on broomrape in sunflower production. Because of higher variability and frequent breakdown of resistance, resistance breeding needs continuous process and new resistance sources commonly. Furthermore, extensive use of single race-specific dominant genes in only one parental line on breeding programs also leads to the appearance of new virulent races rapidly after the introduction of new resistant cultivars. On the other hand, both in Turkey and in other countries in the Black sea region which has 50% of world sunflower areas, sunflower grows mainly dry land areas, so sunflower hybrids are able to stand also to other stress conditions such as drought, higher temperatures during summer, etc. Therefore, sunflower breeding programs also should consider as the main breeding strategy for long-term period to intercooperate broomrape with other stress factors as well as seed yield and other important yield traits on developing new hybrids. Many hybrids have been developed recently and been selling commercially in Turkey as broomrape resistant and also drought tolerant too. Trakya Agricultural Research Institute (TARI), Edirne, Turkey conducts National Sunflower Project to develop sunflower hybrids tolerant to broomrape, downy mildew and other stress conditions. The study covered breeding process of developing these kind hybrids and inbred lines, yield trials and broomrape tests conducted by TARI in 2010-2011. To get resistance to broomrape, gamma radiation was applied TARI inbred lines in 2004 then that genetic materials were selfed in F_1 generation. In F_2 generation, resistant ones were determined in infested fields and they crossed with institute inbred lines. Phenotypic selection then after selfing was continued based on broomrape and other stress tolerance as well as desired characteristics in these genotypes until F_4 generations. In F_4 and further generations, selection was performed based on general combining ability of these genotypes utilizing yield trials and in broomrape tests in both natural infested areas in summer and also in artificial tests in the pots in winter season in 2011. 529 inbred females, 1312 male lines and 419 candidate hybrids were tested in broomrape tests in 2011; 289, 1032 and 305 of them was found as resistant respectively. After the evaluations of these yield trials and broomrape test results, developed broomrape resistant hybrids as well as tolerant to other stress conditions were sent registration by TARI.

Evaluation of nontransgenic resistance sources of plum to PPV

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Sharka is considered to be the main and most destructive viral disease of genus Prunus in Central Europe. Sharka is caused by the Plum pox virus (PPV). PPV can infect most agriculturally significant species in the genus Prunus, including fruit trees such as plums, peaches, and apricots. The first reliable information about sharka on the territory of the Czech Republic originates from the thirties and forties of the twentieth century. PPV is currently widespread almost on the whole territory. All main plum growing areas are stricken by the disease and the virus severely affects the fruits of susceptible cultivars. Therefore an experiment with evaluation of resistance of selected 32 plum cultivars after artificial inoculation with PPV was established in insect-proof screenhouse. Ten containerized plants of each cultivar in the experiment were artificially inoculated with two strains of PPV (5 plants with serotype M and 5 plants with serotype D) second year after planting. Evaluation of PPV incidence was carried out by observation of symptoms on leaves and by ELISA in 2011. Based on the preliminary evaluation, in the case of cultivars ´Topfirst´, ´Topgigant plus´, ´Tophit plus´, ´Topking´, ´Topstar plus´ and ´Vâlcean´ transmission of PPV was not proved. In contrast, the most pronounced symptoms of PPV were noted in cultivar ´Hauszwetsche´. Obtained results are preliminary. Observation and testing will continue in following years.

Acknowledgement: The work was realized in the framework of research project QI101A123.

Response of surface irrigated wheat (*Triticum aestivum*) to deficit irrigation in the newly reclaimed lands of Nubaria, Egypt

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Wheat is the key staple food crop in Egypt, occupies about 33 percent of the total winter crop area, accounts for 9 percent of water resources and contributes 17 percent of the total value added in Egyptian agriculture. Because of its importance in the Egyptian diet, wheat is considered a strategic commodity in the country. Conventionally, irrigation scheduling has aimed to meet full crop evapotranspiration (ET), as the relationship between ET and crop production of most of the major field crops is linear. Increasingly, the limited availability of irrigation water is forcing farmers in Egypt to apply deficit irrigation (DI - applying less water than crop ET). This practice decreases irrigation demand, allowing water to be diverted to alternative uses. The success of any deficit irrigation technique can be judged by comparing its agronomic effects relative to conventional (optimal) irrigation. Therefore, these studies were conducted on wheat to identify wheat crop stages during which the crops could withstand water stress with limited effect on yield and quality, and draw conclusions on ways of managing irrigation so as to increase water-use efficiency and limit water loss. Two field experiments with wheat (*Triticum aestivum*) cv. Sakha 93 were conducted at Nubaria Agricultural Research Station, El-Nasser farm during 2010/2011 and 2011/2012 seasons in calcareous soils. Surface irrigation methods were used and the crop was planted in basins. Treatments imposed were namely, 1) 100% ETc all stages (T1), 2) 75 % ETc all stages (T2), 3) 50% ETc all stages (T3), 4) 50% ETc at tellering only + 100% the rest (T4), 5) 50% ETc at Booting only + 100% the rest (T5), 6) 50% ETc at grain filling only + 100% the rest (T6), and 7) 50% ETc at tellering + 50% ETc at Filling + 100% the rest (T7). In conclusion, all DI treatments were close to each other in traits of grain yield components except to 50% % ETc all stages was significantly less than all other treatments. 100% ETc all stages scored highest values in all yield components traits. Although 100% ETc all stages scored significantly the highest value of biological yield and grain yield, water use efficiency based on grain yield (WUE_G) and biological yield (WUE_B) of wheat were significantly the lower compared to all other treatments.

Evaluation of interaction effect of salinity stress with nicotinamide on growth, some physiological parameters and yield in faba bean (*Vicia faba* L.) plant

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A possible survival strategy of plants under saline conditions is to use some compounds that could alleviate salt stress effect. One of these compounds is nicotinamide. The effect of exogenously application of nicotinamide with different concentrations (0, 200 and 400 mg/l) on *Vicia faba* L. plant against different NaCl treatments (0, 50 and 100 mM NaCl) was investigated at the greenhouse of National Research Centre, Cairo, Egypt. Salinity stress reduced significantly plant height, dry weight of shoot, photosynthetic pigments, polysaccharides, total carbohydrates, total-N contents of shoot, seed yield, total carbohydrates & total-N of the yielded seeds as compared with those of the control plants. Whereas, salinity induced marked increases in sucrose, total soluble sugars, total free amino acids, proline, lipid peroxidation product (MDA) and some oxidative enzymes (polyphenol oxidase and peroxidase enzymes). Also, salinity stress increased Na^+ contents with the decreases of other macro and micro element content (N^+, P^+, K^+, Mg^+, Ca^{2+}, Fe^{2+}, Mn^{2+}, Zn^{2+} and Cu^{2+}) of shoots and the yielded seeds of faba bean. Foliar spraying of nicotinamide could alleviate the adverse effects of salinity stress as it increased plant height, dry weight of shoot, photosynthetic pigments, polysaccharides, total carbohydrates, total-N contents of shoot and seed yield as well as, sucrose, total soluble sugars, total free amino acids and proline, as compared with those of the corresponding salinity levels. In the meantime, decrease lipid peroxidation product as MDA and the oxidative enzymes (polyphenol oxidase and peroxidase enzymes). Nicotinamide inhibited the uptake of Na^+ and accelerated the accumulation of N^+, P^+, K^+ , Mg^+, Ca^{2+}, Fe^{2+}, Mn^{2+}, Zn^{2+} and Cu^{2+} contents in the shoots of salt stressed plants and enhanced total carbohydrate and total protein percentage and solutes concentrations in seeds of salinity treated plants.

Alleviation of the adverse effects of soil salinity stress by foliar application of silicon on faba bean (*Vica faba* L.)

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Salinity is among the major environmental constraints to crop productivity worldwide**.** In Egypt, salinity problem is of special importance for both the old cultivated area as well as for the newly reclaimed lands. The experiment were carried out under different soil salinity levels (1820, 3850 and 5410 ppm) to investigate the effect of spraying silicon as diatomite at a rate of 0, 250, 500 and 1000 ppm SiO_2 sprayed three times at 35, 60 and 85 days after sowing on growth, yield and chemical composition of faba bean (*Vica faba* L.) *var*. Nobaria 12. Application of Silicon levels significantly increased shoots weight, height and leaf area index as well as Chlorophyll and carotene content as compared with control of non-sprayed plants, however, the highest level of silicon had the superiority effect. Soil Salinity stress significantly reduced pod and seed number and pod weight per plant; however reduction was lower at the salinity level of 1820 ppm than 3850 and 5410 ppm. Silicon application as foliar spray significantly improved pod yield and seed number per plant grown either in normal (1820 ppm) and/or in saline conditions (3850 and 5410 ppm). Potassium content was significantly increased in plants due to foliar application of Silicon under saline soil conditions. Sodium content was higher in plants grown under saline soil condition, however Si application significantly reduced Na content in shoot and seeds of faba bean plants, resulting in a significant increase in K : Na ratio in shoots. Sodium content in shoots had a significant negative correlation with shoot, seed weight, pod number and leaf area index. The higher levels of Si application (1000 ppm SiO_2) were better in increasing growth and yield parameters and decreasing the soil salinity hazard. The increase in Na content due to salinity was significantly reduced in plants receiving Si as foliar application. Increased K content and reduced Na in shoot and seeds may be one of the possible mechanisms of increased salinity tolerance by Si application in faba bean plants.

Effect of nitrogen fertilization on spring barley (*Hordeum vulgare* L.) grain yields, NRA and other physiological parameters under drought stress conditions

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An effect of nitrogen rates (0.0g, 1.0g, 2.0g N per pot) on nitratereductase activity (NRA) in leaves of spring barley (cultivar Kompakt) was investigated in 3-year pot experiment. Plants were grown under optimum moisture regime and drought stress was induced during the growth stages of tillering, shooting and earing, resp. Before and after respective stress period plants were grown under optimal water regime. In all the fertilized and unfertilized treatments, NRA was significantly higher under optimal water regime than in drought stress conditions. Nitrogen fertilization proved strong eliminating effect against stress induced during tillering and in comparison with unfertilized control (6.69 g/pot) it increased grain yield up to 20.72 g/pot (1g N/pot) and 20.27 g/pot (2g N/pot), that is nearly 3-times.

In consequences of N fertilization NRA increased 2-4.5 times comparing to unfertilized control. However, higher activities of NR at the rate of 2g N were not increasing grain yield further on. On contrary, the most negative reaction of plant against stress in combination with fertilization was found when stress was applied during shooting. Relative water content (RWC) in leaves of optimally irrigated and unfertilized plants was significantly higher than in leaves of fertilized and stressed ones. Application of nitrogen fertilization reduced values of net assimilation (P_n) under both levels of water regime up to the interval of 1-5 $\mu mol.m^{-2}.s^{-1}$.

At optimum soil moisture barley leaves showed the highest values of intercellular CO_2 concentration (C_i) in unfertlilized treatments (120-216 $\mu mol\ CO_2.m^{-2}.s^{-1}$). Under stress the results were inverse. Fertilization with N increased C_i with maximum of 438,49 $\mu mol\ CO_2.m^{-2}.s^{-1}$ in growth stage of earing. In general values of stomatal conductivity (g_s) in leaves were higher (73,35-137,37 $mmol.m^{-2}.s^{-1}$) in unfertilized optimally moistered treatments in comparison to the values obtained in plants grown under drought stress conditions.

Biological diversity of wheat, improvement for adaptability under global change and use in organic agriculture (BIOFARM) – A Slovak project on the impact of climatic changes on wheat genetic resources

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In a cooperative project with four Slovak partner institutes, wheat commercial varieties, land races and their wild relatives (*Aegilops biuncialis, Ae. columnaris, Ae. cylindrica, Ae. geniculata, Ae. tauschii, Ae. triuncialis, Triticum aestivum, T. araraticum, T. boeoticum, T. compactum, T. dicoccum, T. monococcum, T. persicum, T. spelta, T. turgidum* a *T. urartu*) are evaluated for traits related to food quality, improved resistance to biotic and abiotic factors as well as industrial processing.

The work will be done in 5 work packages: 1) Evaluation and characterization of wheat varieties and their wild relatives; 2) Studying the efficiency of N uptake and utilization of winter wheat genotypes in organic farming; 3) The screening for metal accumulation rates and tolerance to abiotic stress; 4) Genetic diversity of wheat's for organic farming; 5) Studying drought and high temperature tolerance mechanisms in cereals. Objectives will be the evaluation and characterization of wheat genetic resources and their wild relatives for agromorphological traits and technological quality, use of molecular markers and screening of physiological parameters of selected genotypes under environmental stress.

The project focuses on studying the quality traits related to the increasing productivity for organic agriculture food market, and improving resistance to biotic and abiotic stress. The latter reflects to the fact, that growing of organic products may be affected by future climate changes. Currently the analyses are being performed. Modern hexaploid wheat varieties are superior to obsolete cultivars, wild or diploid types. Overall, less diversity with a trend to higher yield and higher seed weight was found in the field experiments for modern cultivars compared to the other types. Significant differences were observed in the standard cultivars. All the project results will be made available for the scientific and breeder communities.

A general outline of the project will be given and first results will be presented on the following items: determination of variability of traits on the selected set of wheat genetic resources and their wild relatives; identification of wheat storage proteins, measuring the sensitivity/tolerance to certain abiotic stresses and the potential to accumulate nutritionally important elements in grains, estimation of the genetic diversity among the accessions of domesticated and cultivated diploid, tetraploid and hexaploid wheats, which will be suitable for the organic farming, and studying the regulation and adaptation processes within the photosynthetic apparatus of different wheat accessions.

Acknowledgment: This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0197-10.

SESSION II

FOOD, FEED AND BIOENERGY *versus* SUSTAINABLE AGRICULTURE

Topic I

CROP MANAGEMENT FOR FOOD, FEED AND BIOENERGY PRODUCTION

Developping oleic type sunflower hybrids for food and non-food purposes

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Sunflower is one of the important oil crops in the world. Conventional sunflower oil has higher linoleic acid and is so suitable for cooking oil. On the other hand, new modified sunflower oil also developed as high-oleic sunflower oil in recent years and that type of sunflower oil is increasing of importance year by year in food and non-food industries in recent years. It is used widely as salad oil and cooking oil due to light flavor and enhanced oxidative stability in frying processes. In addition, it does not require partial hydrogenation for an increase in product shelf-life, with the additional nutritional advantages. High-oleic sunflower oil is using widely today such as spraying on cereals, crackers, and cookies for retaining freshness and crispness, in the manufacture of non-dairy creamers, snack foods, and frozen desserts, etc. On the other hand, oleic type sunflower is also suitable for non food purposes like for biodiesel, ingredients for cosmetic formulations due to less irritation capacity, lubricant for diesel and gas motors due to high viscosity index and high fluidity at ignition etc. Due to that higher demand in last decades, the development of healthier sunflower oleic types was started by breeding companies both in the world and also in Turkey too. Many high oleic hybrids have been released and seed is commercially available both in Turkey and the world. In Turkey, sunflower hybrids are categorized in three groups as broomrape resistant, non resistant and Imidazilone herbicide resistant hybrids due to heavy broomrape parasite infestation in main production areas. Compatible high oleic hybrids with linoleic types both on seed yield and oil content were registered in all three segments in Turkey in recent years. On the other hand, many sunflower hybrids were developed in National Sunflower Project conducted by Trakya Agricultural Research Institute (TARI), Edirne, Turkey since 1984. The study covered breeding process of oleic type. Many sunflower IMI hybrids developed and tested in regional trials in recent years and sunflower hybrids exhibited higher yield performance was selected. One sunflower IMI hybrids was sent registration trials firstly by TARI in 2012.

Nitrogen deficiency detection and fertiliser variable rate application in cereals using remote sensing technology

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Nitrogen deficiency in cereals is characterized by leaf chlorosis, reduced net assimilation and relative growth rates, lower leaf area, phytomass and grain yield. Over-application can lead to the lodging of the crop and negative environmental impact, *e.g.* leaching or diffuse pollution of excess nitrogen. As Nitrogen in crops varies, there is need to apply Nitrogen as soon as the level of deficiency was estimated. Remote sensing technology uses the information on spectral reflectance of crop. Data obtained are highly correlated with crop parameters and enable to determine the level of nitrogen deficiency. Benefit of this technology is, that the information can be gathered and used quickly. When combining this information with information on position (x, y), the crop requirements can be met site specific.

Due to their availability the use of remote sensing sensors is most spread in Europe. These are mounted on machinery and scan the crop. The information is evaluated and based on crop, particular variety and growth stage the Nitrogen dose can be applied within one machine pass, or later. As the results showed, this Nitrogen management technology brings benefits in two areas:

a) the amount of Nitrogen applied may be reduced without a negative effect on yield,

b) the spatial redistribution of Nitrogen doses targets the site specific Nitrogen requirements of crop. When using these sensors, the variability of applied doses was significant, what has high potential advantages in terms of environment protection.

Acknowledgement: This paper was prepared in the frame of research project funded from the European Union under the title: ITEPAg: Application of information technologies to increase the environmental and economical efficiency of production agro-system, ITSM 26220220014.

Innovative olive (*Olea europaea* L.) production systems under mechanical harvesting: Part 1. Cold tolerance evaluation of two widely used olive varieties

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Olive production (table olives and olive oil) is one of the major trees in the Mediterranean area and in Greece. It represents a significant sector of the agricultural economy, both in terms of area and income. It is also a major component of the daily dietary supplement. Recently new management and production systems have been established and are under evaluation in some countries, which attempt to convert the traditionally hand harvested crop into a completely mechanized harvesting system. A long term study was established in Greece in two contrasting soil-climate locations, evaluating the effect of a number of planting densities, fertilizer and irrigation rates for two of the most commonly used and adapted olive cultivars for mechanical harvesting systems. The long term objective of the project is to evaluate yield, olive oil quality, effects of treatments on soil quality and production economics. This project presents the first scientifically based and long term study in Greece currently. The specific objective of this presentation is to evaluate the initial degree of cold tolerance of the two varieties used (Arbequina and Koroneiki) for a period of two years. The results on cold tolerance showed significant difference between the varieties in one year, while the second year results were variable, due to significant diversity in climate conditions for each location. Significant results on flowering percent were also shown for the first year at both locations The results will be used to advise farmers about the potential risk of cold-tolerance exhibited by each variety in risk-prone climate environments.

Acknowledgment: The support of Anastasopoulos Nurseries (http://www.anastasopoulos-nurseries.com/Default_uk.aspx), providing the plant materials and technical support on this project is sincerely acknowledged.

Technology of growing grain-crops

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Now the wide spectrum of plants growth-regulating preparations of biological and synthetic origin appeared in the agrarian market of Ukraine. However, efficiency of their applications in growing of grain-crops remains weakly studied. In publicity aims, often companies-producers not always give objective and reliable information about application of such preparations in concrete soil-climatic conditions and not take into account the features of growing of separate agricultural plants.

In the Institute of Agriculture Crimea of National Academy of Agriculture Sciences of Ukraine efficiency of the pre-sowing treatment of grain-crops seeds by the different of plant growth-regulating preparations (such as Mars, Agate-25K and so on) was studied in the field experiments in the zone of Steppe of Ukraine during 4 years (2007-2010). It is established, that this agrotechnological method allows to increase the productivity of winter wheat by 0.23-0.29 $t.ha^{-1}$, the net income by 28.2-37.5 $/ha at recoupment of expenses - 0.4-0.5 $. The application this preparations on a winter barley allows to increase the seeds productivity by 0.24-0.34 $t.ha^{-1}$, the net income by 24.6-38.1 $/ha at recoupment of expenses – 0.2-0.4 $.

Influence of irrigation system on the dynamic of carotene level in the carrot roots

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Carrots are grown all over the world. In Latvia carrots have a very important place of daily diet, it ranks second after the cabbages. However the production of carrots is still strongly influenced by climatic conditions, precipitation particularly. Irrigation is a basic requirement to be able to grow high-quality and competitive products. Finding of the most efficient irrigation systems is of high importance, since vegetables have several critical periods when the humidity is particularly important.

The investigations were carried out at Pure Horticultural Research Center in years 2010 and 2011 with the aim to find the most efficient irrigation system ensuring not only high yields, but also high content of biologically active compounds. Dynamic of carotene accumulation in carrot roots during the vegetation season was studied in three variants of irrigation – drip irrigation, sprinkler irrigation and non-irrigated control variant. Hybrid variety 'Nevis' F_1 and variety 'Amsterdam Bak 2 - Sweatheart' were included in the investigation.

In year 2010 there were no significant differences observed between watering variants. In both varieties carotene level ranged with an average of 5.19 - 8.82 mg $100g^{-1}$. In contrast, in year 2011 there was a significant difference between both variants of irrigation and sampling times when accumulated carotene was ranging from 4.88 to 12.19 mg $100g^{-1}$.

Overall, carotene had a tendency gradually increase by each sampling time in year 2010 with the higher temperatures and optimal moisture conditions. Year 2011 showed a good trend in both irrigation variants - for both varieties carotene gradually increased during the growing season. The highest carotene level was observed in sprinkler irrigation variant, but in drip irrigation samples the carotene amount was lower than in samples collected in control variant. The vegetation season of year 2011 was characterized by moderately warm weather and regular precipitation.

The results show that too over-moisture (precipitation 491.9 mm) as in 2010 negatively influence the carotene content in carrot roots. A little cooler, but drier period of 2011 season (precipitation 396.3 mm) increased carotene content.

Biomass yield of giant reed (*Arundo donax* L.) cropped for energy in Croatia

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Giant reed *Arundo donax* L. (*Poaceae* family) is a perennial crop which has been cultivated throughout Asia, Southern Europe, Northern Africa *etc.* for thousands of years. It grows spontaneously and abundantly on Croatian part of Mediterranean coast, with rapid growth and high yield capacity, but until now we have not put much emphasise on this plant that is considered to be one of the most effective energy crops. In the Mediterranean environment among several perennial grasses giant reed is the leading candidate to become prime energy crop, because it produces lignocellulosic biomass that is ideal for fuel, and because it also displays a good adaptability to such environments. Ideally, energy crops should give high yields of useable energy that could be produced with minimum energy input. In this preliminary research two native unimproved riparian populations of giant reed were harvested close to cities Zadar and Poreč on Adriatic coast. Harvests were carried out in autumn at the end of the growing season 2011, and obtained above-ground dry matter biomass yield of giant reed was 24.38 and 35.89 $t.ha^{-1}$ respectively. These results can serve as a good starting point in terms of biomass yield, but in order to determine the possibility of reducing crop input and of improving cultivation methods in giant reed as a biomass crop, we will continue research in particular agronomic aspects of cropping giant reed, and to evaluate the effects of rhizome and stem cutting propagation, fertilisation, harvest time and plant density on its yield and energy efficiency, especially in the cool temperate regions of Croatia.

The effect of supplementary lighting on chosen physical and chemical properties of tomato fruits (*Solanum lycopersicum* L.)

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Tomato (*Solanum lycopersicum* L.) is one of the most important vegetables. In Poland tomato is main vegetable species grown in greenhouses. In the world tomato is the most often consumed as fresh. It is appreciated for it's beneficial effects on the human body, especially for heart diseases. Tomato fruits content organic acids, simple sugars and they are rich in vitamins (A, C, E), carotenoids and phenolic compounds, which cause high antioxidant activity.

The light is one of the most important factors influencing chemical compounds concentration and physical properties in higher plants. Fruits lighted by direct light have higher levels of nutritious substances and secondary metabolites, so it may be useful to supplement or replace traditional method of lighting in greenhouses by LED lamps, which are the source of blue and red light. Those lamps emit light radiation spectrum consisting of a selected wavelength adjusted to the absorption spectrum of chlorophyll a and b, which leads to increase of the photosynthetic system efficiency and synthesis of primary and secondary metabolites. Certain wavelength and light quality promotes various benefits for plants. The blue and red light promotes the plants growth, also increases the content of fresh and dry weight. LED lamps also allow promoting or inhibiting the growth of roots and stems, and influence the flowering. Usage of LED lamps in cultivation as supplementary light source may be beneficial because of advantages such as high light efficiency, extended durability, low shading as effect of small size, adjustable spectra, and low power consumption compared to another lamps.

The research was carried out in autumn-winter period in late 2011 and early 2012. The effect of HPS and LED lamps supplementary lighting on physical and chemical properties of tomato fruits cultivars 'Komeett F_1' and 'Starbuck F_1' was investigated. Used lamp types had similar level of light output, but LED lamps had lower power consumption. Plants growing under natural light conditions were used as a control. Seeds were sown in early August and after five weeks seedlings were planted into the greenhouse. During the harvest cycle, fruit weight and marketable yield were determined, while the quality parameters (dry matter, total sugars, phenolic acids and carotenoids content, firmness and CIE L*a*b) were determined on three sampling dates.

Acknowledgment: The investigation was supported by the project of Faculty of Horticulture and Landscape Architecture in 2011 and 2012.

Effect of controlled traffic farming on yield during long term experiment

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Soil compaction affects the crop production role of soil, such as soil water and nutrient availability, natural biological activity, vulnerability to soil erosion etc. The significant compaction of soil is introduced by machinery wheels. In traditional farming, almost all fields are trafficked. Controlled traffic farming (CTF) is technology which minimizes compacted area of the field. Permanent tramlines are used to conduct all field operations. Controlled traffic farming leaves 80 – 90% of fields permanently without compaction. To be able to achieve this, implement and machinery widths have to be matched. The main advantage is confining the compaction due to machinery movement to less possible area. Effects are in better soil structure, lower fuel consumption and higher yield. Published results report yield increase up to 25% depending on crop and place. As there was no evidence on implementation of this technology in Central Europe, a long term experiment was established at 16ha experimental field in Kolinany (Slovakia). The machinery and layout of machinery movement was selected on base of existing conditions at the University farm. The basic 6 m module of implement width was selected. Spraying and fertilizer distribution has been done with 24 m machinery width. Beside of other parameters, yield has been monitored during all growing seasons since 2009. Crop rotation was as following: 2009 - spring barley, 2010 - oil seed rape, 2011 - winter wheat, 2012 - spring barley.

Acknowledgement: This paper was prepared in the frame of research project funded from the European Union under the title: ITEPAg: Application of information technologies to increase the environmental and economical efficiency of production agro-system, ITSM 26220220014.

Diagnosis of the risks posed by pests for spring wheat sown as facultative crop

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The basis of these studies are two strict field experiments carried out in 2010 - 2011. In the experiment 1 (EXP1) conducted as two-factor, in the split-block design, with 4 replications at Mochełek ($17^o13'$ E; $53^o13'$ N) – an Experimental Station of the UTLS in Bydgoszcz the following factors performed: A - term seeding of spring wheat *cv*. Monsun: a_1 – early facultative (October 2nd decade), a_2 – late facultative (November 3rd decade), a_3 - spring (March 25 - April 5), B – treatments against pests: b_1- control, lack of seed treatment insecticide + no interventional insecticides, b_2 – lack of seed treatment insecticide + interventional mixtures of insecticides, b_3 - seed dressing insecticide + no interventional insecticides, b_4 - seed dressing insecticides + interventional mixtures of insecticides. The spring wheat protection program against pests based on the following considerations: 1) The potential of the bird cherry grain aphid anholocyclic forms in the autumn sowings of spring wheat, which can cause infection with the virus BLDV. 2) The modern seed treatment Astep FS 225 for wheat having a double track: against diseases (prothioconazole) and against pests containing imidacloprid. This treatment was applied in variants B_3 and B_4 in the amount of 200 ml + 400 ml water per 100 kg of seed wheat. 3) The use of interventional treatment in the form of active substances mixture applied at BBCH 31-34 chlorpyrifos + cypermethrin + dimethoate + pirimicarb against cereal leaf beetles and aphids.
In the experiment 2 (EXP2) carried out at Chrząstowo Experimental Station for Cultivar Evaluation we determined the effect of various intensity of chemical protection against fungal diseases on the health of roots, root rot, leaf and head blight of Monsun (qualitative, group A) cultivar of spring wheat sown as facultative (late autumn) and in the spring. The first experimental factor A in this trial was the fore crop of spring wheat: a_1 - monoculture of wheat forms, a_2 - seed corn crop, a_3 – sugar beet. The 2nd factor B was deadline for sowing: b_1 – facultative b_2 – spring, C factor was established as variants of protection against fungal diseases: c_1 - control, without protection treatments of leaves and heads, c_2 – low intensive program consist of one treatment at T2 stage (BBCH 32-65) with prothioconazole and fluoksastrobine, c_3 - middle intensive program based on the two applications performed at the T1 stage (BBCH 30-32) and T2 (BBCH 41-65) with spiroxamine prothioconazole mixture, and the mixture of fluoksastrobine and prothioconazole, c_4 - a very intensive program of disease control based on the three treatments performed in T1 stage (BBCH 29-31), T2 (BBCH 37-51) and T3 (BBCH 65-69) for the full protection of root rot, leaf and head. The first treatment was made with a mixture of prothioconazole and spiroxamine, the second mixture of fluoksastrobine and prothioconazole, while a third mixture of prothioconazole and tebuconazole in doses recommended by the producer.

The influence of white plastic mulch on strawberry productivity, fruit quality and soil microbial activity

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The using of plastic mulch in strawberry production is increasing in Latvia. While black plastic is the most popular between plastic mulches, the interest rouses also on plastic of other colors. Therefore it is important to know the influence of different colored plastic mulches on strawberry plants in Latvia conditions. The investigation was carried out on cultivar 'Sonata' in the Pūre Horticultural Research Centre, Latvia. Plants were planted in 2009 on beds with white plastic with black lower side (white on black) mulch and bare ground with planting density 3.3 plants m^{-2}. Investigation was set in 4 replications with 25 plants per plot. Strawberry production time, yield and fruit quality were evaluated 2009-2011. Soil microbial activity was analyzed in 2011 and 2012. Intensity of soil respiration, activity of dehydrogenase and cellulase were used as indicators of microbial activity. White on black plastic mulch significantly did not influence production time. It increased yield and fruit quality and reduced fruit rot damage compare to bare ground. The dynamic of soil respiration and activity of dehydrogenase were similar for both mulched and unmulched variants. The highest values for these parameters were registered in August. Significantly higher cellulase activity was observed on bare ground compare to white on black plastic mulch.

Topic II

ECOLOGICAL AND TECHNOLOGICAL ASPECTS OF AGRICULTURAL AUSTAINABILITY, QUALITY OF AGROECOSYSTEMS

Preliminary risk analysis and assessment of *Leptinotarsa decemlineata* (Say, 1824) (*Coleoptera*: *Chrysomelidae*) biological control by inundative releases of *Podisus maculiventris* (Say, 1832) and the impact upon the arthropods biodiversity in some potato crops from Romania

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Colorado potato beetle (CPB) is one of the most invasive species around the world, strongly affecting the biodiversity of natural and anthropic ecosystems. CPB is also a major pest of potato crops in all Europe, especially reducing the production and efficiency of potato agro-systems. In this case the most cost-effective opportunity of prevention had already compromised in the first stages of the introduction and the further stages were also inadequate.

Regarding of the highest availability of this species to develop resistance to all waste spectrum of pesticides, the possibility of using various enemies in the biological control of CPB pest populations is now a necessity more than ever.

The use of bio-control agents implies the availability of adequate rearing techniques enabling large-scale production at low costs. Mass production and periodic colonization of predators or parasitoids species by inundative releases is one of the strategies to increase the effectiveness of the biological control. Many authors claimed that biological control offers real potential as a major tactic for central use and maximization in a strategy of integrated control of CPB in natural environment and crops (we cited from the huge number of papers the most significant for the CPB case: Huffaker, 1975; Williams and Leppla, 1992; Hough-Goldstein, 1993; Manole, 1993).

If technically the problem of mass production seems to be solved the only threat remain regarding the fact that the majority of the natural enemies of CPB are alien species and needs to be imported from the native area of CPB origin. The pilot projects must be implemented, and national capacity to manage invasive alien species had been significantly enhanced. The experience and expertise of the agricultural and forestry sectors in evaluation of the risk of deliberate, intentionally introductions analysis need to be used as a knowledge base to adapt measures for invasive species in general. The most tremendous recent case is the *Harmonia axyridis* invasion in all Europe, Romania inclusive.

The first aim of the present paper was to preliminary evaluating of the risk impact of the inundative releases of *Podisus maculiventris* Say upon the local biodiversity fauna. The previous laboratory and field experiments (Manole, 1993) had establish for the first time in Romania that *P. maculiventris* could be a valuable agent for the biological control of CPB in the field conditions. *P. maculiventris* was reared under controlled conditions in the small biostation at the Research Institute for Plant Protection Bucharest (RIPP). The technical line and ensemble of facilities was previously described (Manole, 1993). After mass rearing tests, based to its economic growing in semi-industrial facilities, the four instars larvae of *Musca domestica* host has been recommended for predatory feeding. The obtained results establish the moment and the rate of release in field of potato and effectiveness of predatory rate against CPB in four regions of Romania.

Second aim was imposed by the necessity to involve the ways in approaching the control of the potato pest. Using this biological method of CPB control the consecutively research leave the possibility to a very deep evaluation and knowledge of local species involved in consumption of different stages of pest insect as well as the testing of possibilities of mass

rearing under controlled conditions of the most efficient predators. Many different arthropod species have been considered and evaluated experimentally as potential biological control agents for the CPB, but densities of naturally occurring populations of these predators and parasites are generally low or their native effectiveness hinders these natural enemies to a much greater contribution to CPB control. In the study of this important complex of entomophagous species we are follows to develop some important directions: i) the identification of the species complex of natural enemies; ii) the establishment of specific relationships between the pest populations and the control agents; iii) the maximization of use of efficient enemies.

The augmentative release of species that destroy a large numbers of CPB (eggs, larvae and adults) such as spinner soldier bug, P. *maculiventris* and other Asopinae in the context of an EBPM control program, could provide substantial control early in the season when control is most needed.

Observation regarding the efficacy of Pyrinex 25 CS product to fight against D*iabrotica virgifera virgifera* Le Conte species from maize crops

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The experiments were made at INCDA Fundulea and Agricultural Research and Development of the ASAS resorts, where there were applied 1-2 treatments in a corn crop during the growing season.

The location of the experience was made in the form of randomized blocks containing six repetitions, the parcel size is about 100 m². It have been applied 1-2 treatments between July 29th – August 7th using a dose of 1,5 l.ha^{-1}.

We mention that the climatic conditions in the year of experimentations favorized the evolution of *Diabrotica virgifera virgifera* Le Conte pest, the observation date beeing at 24-48 hours after the application of the treatment.

For control the adults of *Diabrotica virgifera virgifera* Le Conte (western worm of maize) in maize crops with the Pyrinex 25 CS product, based on bifenthrin, by splashing in vegetation.

Following observations using the product Pyrinex 25 CS applied in dose of 1.5 l.ha^{-1}, have observed that determined a high efficacy, in all the 3 experimental points – Lovrin (County Timis), Grabati (County Caras Severin) and Turda (County Cluj).

The treatments were applied when there was a warning, during the sign of panicle, having a density over 10 adults/square m, density determined after performing the survey and 7 adults / yellow trap nonspecific / day.

In all stationary of testing, the efficiency was very good, with values between 89.4% and 90.7% at a dose of use of 1.5 l.ha^{-1} of commercial product. At the untreated variant, the efficiency values were between 12.3% and 27.6% and the average in the three stationary were 19.5%. No recorded of phytotoxicity phenomena affecting crop.

Metcalfa pruinosa Say (*Homoptera*: *Flatidae*) – a new pest of the black currant crops (*Ribes nigrum* L.) in Romania

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Metcalfa pruinosa Say (*Homoptera*: *Flatidae*), the citrus flatid planthopper was detected for the first time as a new harmful insect species of the black currant crops (*Ribes nigrum* L.) in Romania.

In the present paper the attack area detected is geo-refferentiated registered in the black currant crops from the South part of Romania. Our study reveals the species description, the type of the damage and the level of the attack regarding of the populations densities of the harmful insect. Also, the first attempt of the pest risk assessment was made (level of spread, establishment and potential impacts on ecological cultures (economic, social, and environmental). The biological control ways were be, also estimated related to the management of crop production.

The effect of phytoprotection programs application on combating the main apple pests

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In recent decades, positive changes have been occurred on the fruit crops protection, because of new synthetic or natural substances, more effective and less toxic.

In 2011, at S.C.D.P Iaşi was tested a phitosanitary program that aimed especially to control the main pest of apple, being introduced the next generation of plant protection products, such as: Coragen, Proteus, Calypso, Decis 25 WG.

The research was carried out for Idared, Golden delicious and Florina, on tow variants for each variety. Phytosanitary treatments applied for pest control were supplemented with fungicides used to combat major apple deseases. Until blooming tow treatments were applied for each variant, and after the petals fall, treatments were carried out at warning.

Observation and measurements were performed after the treatments and they showed, at the end of each generation, the percentage of attacked fruits by the main apple pests.

These produsts applied in a few treatments have provided a strong efficacy in combating major apple pests: codling moth (*Cydia pomonella L.*), fruit skin moth (*Adoxophyes reticulana*), leaf miner moth (*Phyllonorycter sp.)* and mites (*Panonychus sp.).*

To combat lepidoptera best result were obtained with Calypso 480 SC and Coragen insecticides, and also, products such as Decis 25 WG and Proteus have provide a good health in apple plantation.

Acknowledgment: This work was cofinanced from the European Social Fund through Sectorial Operational Programme Human Resources Development 2007-2013, project number POSDRU/I.89/1.5/S62371"Postdoctoral Schole in Agriculture and Veterinary Medicine area

Observation regarding the efficacy of the Seedoprid 600 FS product to combat D*iabrotica virgifera virgifera* le conte species from maize crops

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At those approximately 25 species of pests economically important from Romania, *Diabrotica virgifera virgifera* Le Conte species – the western corn rootworm. The species is signaled in Romania from 1996 and on the territory of Romania in Nădlac, county Arad.

The experiments have been organized at INCDA Fundulea, at the Agriculture Development Research Stations Livada, Lovrin and Oradea.

The efficacy of the the Seedoprid 600 FS product was analysed in comparaison with the Cruiser 350 FS product, for the seed treatment at a dose of 10 $l.t^{-1}$ and 18.t^{-1}. The active substance of the Seedoprid 600 FS product is imidacloprid 600g.l^{-1}, conditioning form FS, the producing company is Makhtesim Agan.

The tests were performed in 2011, when there were made a total number of 3 tests in those 3 stationary: SCDA Livada, SCDA Lovrin and SCDA Oradea on a hybrid of maize, Fundulea 376.

To carry out the tests, it has been organized an experiment in randomized blocks, the size of experimental parcel was about 100 m², it was made with 2-3 days before maize seeding, which was made between April 24th – May 13rd.

The observations have been taken throughout the vegetation period, being examined the plants with symptoms of "Gooseneck" and by determining the mark on the IOWA scale (an undamaged plant – 6 plants strongly attacked). In terms of product application equipment on seeds, it was used a porzolator with a capacity of 5 kg, and the seeding has been done manually.

The climatic conditions favored the evolutions of the pest, the experiments being placed in conditions of monoculture maize, with moderate infestations, expressed by an average percent in those 3 stations of 23.36 % plants with symptoms "Gooseneck", Oradea (28.80%), Lovrin (13.35%) and Livada (27.93%) and through mark 4,33 on IOWA scale, 4.88 (Oradea), 3.35 (Lovrin) and 4.76 (Livada).

The assesment of the efficacy was made in comparaison with the version control, without seed treatment.

This was very good at those two products, the average being 7.37% at Seedoprid 600 FS product and 7.17% at Cruiser 350 FS product.

At the untreated control, the frecquency of the attack was about 23.36%, and there are significantly loss of production. There weren't recorded any phytotoxicity phenomena that affects the crops.

Diversity and dominance in the weed flora of cereal crops after the conversion to organic farming and extensive conventional farming in the habitat in southern Poland

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The ways of managing the weed species composition and diversity affect the relationship and domination within communities of segetal flora.The intensive use of herbicides generallz reduces the species richness and may be the cause of the adverse domination of individual species. This problem occurs to a much lesser degree in the agriculture carried out in the mountainous areas. Unfavorable physiographic conditions, specific soil types and agrarian structure are not conductive to intensification of agricultural practices and, combined with a mosaic of habitats, offer greater opportunities to maintain floristic diversity of weeds in the crop-fields.

A special opportunities in this regard creates organic farming where the total exclusion of herbicides and associated operations, such as the use of multi-crop rotations, growing crop which improve soil fertility and using orgenic ferrtilizres are applied. The intensive development of this sector in Southern Poland was the reason for undertaking the research on the effects of extensive conventional management and organic farming onsegetal flora in the same habitat conditions.

The aim of this study was to dertmine the diversity of phytocoenoses in cereal crops in the extensive conventional production and in the first years after conversion to organic production under the same soil and physiographic conditions in the Beskid Wyspowy mountains. The study was conducted in the years 2008 – 2010 in the fixes point (49º 41'28 "N 20º 13'59" E) on flysch soils. The research material consisted of phytosociological relevés made by applying the Braun-Blanquet method. Based on them the indices of: Shannon-Wiener diversity (H) and Simpson's dominance (C) for each stand of vegetation in the compared agricultural systems were calculated. The results show that short-term organic farming does not influences significantly the relationship of diversity and dominance within the surveyed phytocoenoses. This indicates the predominant importance of the habitat and the agrarian fragmentation, so that the extensive conventional methods of farming, typical to Polish mountainous areas support weed diversity and conversion to the organic farming do not lead to significant changes in weed flora, in contrast to the areas of intensive agriculture.

Geographical and historical spectrum of weed flora of cereal crops after the conversion into organic farming on the example of mountain soils of Southern Poland

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The interest in agri-environment payments under the Rural Development Programme has led many farmers to switch production to the organic methods. This also applies to farms in Southern Poland mountain areas, where agriculture has numerous features which allow reaching the state of sustainability easily. It can be expected that the change of agricultural practices will affect the diversity and range of geo-historical weed flora, as a result of the total exclusion of herbicides, the use of multi-species crop rotations, growing crop plants which improve soil fertility and the use of organic fertilizers.

Understanding the impact of agricultural conversion on floristic diversity of agrocenosis in the conditions of extensive agricultural production, determined by physiographic and soil factors seems to be interesting from the cognitive and practical reasons. The first aspect is associated with the impact of changes in the management methods on the biodiversity of phytocoenoses, while the second concerns the recognition of the potential risks of weeds against crops competition during the conversion period.

The aim of this study was to compare species richness and geographical and historical diversity of weed flora in cereal crops and its vulnerability to anthropogenic transformations in the conditions of extensive conventional production and in the first years after conversion to organic production in the same habitat.

The study was conducted in 2008-2010 years in the fixed point (49 ° 41'28 "N, 20 º 13'59" E) located in the Beskid Wyspowy (southern Poland) on flysch soils. The research material consisted of phytosociological relevés made by applying the Braun-Blanquet method. The species richness, the geographical and historical spectrum of weed flora and the phytosociological constancy coefficients were determined for all weed species in each of the farming method. Also the indices of wild flora susceptibility to anthropogenic transformation, such as the synanthropization, the archeophytization and the antropophytization values, were calculated. The results show that under agriculturally unfavorable conditions a greater impact on segetal flora is posed by habitat factors, and the meaning of weed management methods is disclosed in a greater dominance of difficult to control weed-species in the organic farming.

A long-term evaluation of recycled residual paper pulp in soil improvement applications

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The study evaluated for four years the effect of residual paper pulp from recycled paper, a waste by-product from an industrial cardboard paper mill company in Greece, in soil applications. The overall objective was to evaluate any effects of various rates of applications of the above material and in a number of crop species, to soil and crop properties and assess its use as a soil improving material. The study was executed in two widely variable soil and climate locations and included two phases: a two years phase when the material was applied every year, and an aftermath two years evaluation period without any application. Various levels of application were used in the first phase and important soil and agronomic crop properties were measured, with emphasis on soil organic carbon changes. A number of crop species were grown continuously during the years, under LISA (Low Input Sustainable Agriculture) systems and zero to minimum crop protection. The results showed significant effects, in both phases and in both soil-climate locations, on soil organic carbon increase, no changes in pH and electrical conductivity and significant yield increases in all crop species. The results indicated strongly the potential use of this material for soil improving applications and the longevity of its effectiveness.

Acknowledgment: The financial support of MEL-Macedonian Paper Mills, S.A. on this project is sincerely acknowledged (http://www.melpaper.com).

Influence of PCB mixture (Aroclor1254) on course of hatching and thyroid hormone concentration of new hatched chicken

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Exposure to polychlorinated biphenyls (PCBs, e.g. Aroclor 1254) induces alterations in the endocrine system of mammals and birds. Sensitivity of the organism to PCBs is particularly high during embryogenesis since mechanisms of xenobiotic detoxification are not fully developed during this period. PCBs molecules exhibit remarkable structural similarity to thyroid hormones (THs), particular attention has been focused to possible effects of these toxicants on the thyroid gland. THs are crucial for normal growth and development as well as for the hatching processes. Taking into consideration this information it was interesting to examine the effect of PCBs mixture on hatching process and TH homeostasis of one-day-old chicken.

Aroclor 1254 was injected *in ovo* at the 4th d of embryogenesis at doses of 0 (control), 10, 100, 1,000 ng/egg (n=120 eggs/group). The incubation was carried out under standard conditions. Course of hatching was recorded for each group. Blood samples were collected from randomly selected one-day-old chickens (n=10 from each group). Following blood sampling, the chicks were decapitated and their livers and hearts were weighed. Thyroid hormones: thyroxine (T_4) and triiodothyronine (T_3) concentrations in plasma samples were determined by RIA method.

The analysis of the course of hatch revealed that chicks exposed to 10 ng/egg of Aroclor 1254 pipped of eggshell (EP) at an average 4-6 h earlier than other groups ($P \leq 0.05$); however, there were no differences in the moment of hatch (H) between all analyzed groups ($P > 0.05$). Moreover, chicks from this group demonstrated higher degree of EP and HP synchronization in comparison with other groups ($P \leq 0.05$).

In control group, the plasma concentration of T_4 of newly-hatched chicks was 12.1±2.43 ng/mL. Aroclor 1254 injected *in ovo* at the highest dose of the PCB mixture decreased the T_4 level by 37% ($P \leq 0.05$). In one-day-old chicks plasma concentration of T_3 was 2.1±0.44 ng/mL. Aroclor 1254 injected at a dose of 10 ng/egg decreased T_3 concentration in newly-hatched chicks by 20% while injected at a dose of 1,000 ng/egg elevated plasma T_3 concentration by 17% ($P \leq 0.05$).

The data presented suggest that injection of PCBs mixture *in ovo* at the early stages of embryogenesis affects chores of hatching and influences thyroid hormone concentration in blood plasma in one-day-old chickens.

Acknowledgment: Full data was published: Lis M.W., Głodek K., Sechman A., Wątor D., Pawlak K. and Niedziółka J.W.2011. Efect of *in ovo* injection of Aroclor 1254 on embryonic development, time of hatching, and blood thyroid hormone levels in one-day-old chicken, Bull. Vet. Inst. Pulawy, 55, 293 -298.

An attempt of thermography application for the coat evaluation in selected species of farming fur animals

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The paper presents the possibility of thermography application to determine the state of fur in chosen domesticated fur animals. The thermograms were performed in December 2009 at ambient temperature (10°C) and 60% relative humidity at the fur animal farm (i.e. Experimental Station of The National Research Institute of Animal Production in Chorzelów Chorzelów Sp. z o.o.; Poland). Thermographs of 20 randomly selected domesticated fur animals representing the fox (*Vulpes vulpes*), the racoon dog (*Nyctereutes procyonoides*), the american mink (*Mustela vison*) and the polecat (*Mustela putorius*) were investigated. InfraCAM SD (FLIR; matrix: 120x120 pixels, refresh rate: 9 Hz, accuracy: 0.12K, the range of temperatures measurement from -10°C to +350°C) was used in the study. Body temperature for these species was 39-40°C for the fox and the raccoon dog, 39.7-40.8°C for the mink and 38-39°C for the polecat. Point temperature, average area temperature and average line temperature for the distinguished body part were analyzed on thermographs with FLIR Quick Repor. Thermographic analysis allowed to determine areas with the highest thermal isolation (the lowest temperature on the surface of the coat). It also identified "the hot spots" (i.e. the areas of high temperature of body surface) important in the mechanism of thermoregulation of these animals.

Thermographic measurements showed that the fox coat was characterized by the best thermal isolation properties among the studied species. The highest thermal isolation of coat was found on the back and tail where the surface temperature was 13.9 ± 1.4°C (maen ± SD). The "hot points" were the eyes (temp. about 33.7°C), the inside of the ear (about 27.5°C) and the paw pads (about 25.5°C). The coat of the raccoon dog is characterized by a lower thermal isolation as compare to the fox. Fur of these species has a tendency to spread, therefore, they have higher heat lost. This is especially true for hair along the back line where the temperature ranges from 13.0 to 17.5°C (average 14.7°C), For comparison, the highest temperature of 23.0 ± 0.4°C was recorded on the surface of the eye. The mink and the polecat are characterized by a very dense but short pile. The temperature of the coat surface on the back varied between 13.4 and 14.8°C. However, fur on the sides of the torso and shoulders characterized by a tendency to spread and reduce thermal isolation (surface temperature of 23.7 - ± 1.3 ° C).

Concluded, thermoisolation properties showed by thermographic measurements correspond with the hair properties evaluated in the aspect of fur quality.

Effect of PCB 126 on AhR receptor mRNA expression in chicken ovarian follicles

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The aim of the present experiment was to study the *in vitro* effect 3,3',4,4',5-pentachlorobiphenyl (PCB 126) on aryl hydrocarbon receptor (AhR) mRNA expression in ovarian follicles of the hen (*Gallus domesticus*). The experiment was carried out on Hy-Line Brown egg-laying hens at the age of 25 weeks. Birds were fed ad libitum and kept in individual batteries of cages at a neutral temperature (18-20°C) and under a photoperiodic regime of 14L:10D. Hens were decapitated 2 h after ovulation, and subsequently white non-hierarchical (1-4, 4-8 mm) and yellow preovulatory (F3-F1) follicles were isolated from the ovary. Intact white follicles and fragments of the theca layer of F3-F1 follicles were incubated in 4 groups in Eagle's medium supplemented with 0.05% bovine serum albumin (BSA), antibiotic-antimycotic solution and 0 (control group), 1, 10 or 100 nM PCB 126 (LGC Standards). The incubation was performed at 38°C for 6 h in an atmosphere of 95% air and 5% CO_2. Following incubation, the tissues were collected and kept in RNAlater (Sigma) at -20°C till AhR gene (NM_204118) expression by means of RT-PCR method. The analysis revealed that both white follicles as well as the theca layer of the preovulatory ones express mRNA of AhR receptor. Higher expression was detected in the theca layer of F3-F1 follicles in comparison with white ones. PCB 126 increased the level of AhR mRNA in 1-4 mm white follicles and two the largest preovulatory follicles (F2 and F1). The results obtained indicate that PCB 126 stimulates transcription of AhR receptor in chicken ovarian follicles. It cann't be excluded that chicken ovary is an organ involved in the process of xenobiotic detoxification.

Acknowledgment: Studies were supported by grant N N303 561 339 (2010-2013).

Effect of ascorbic acid *in ovo* administration on thyroid hormone concentration in thyroid gland and liver of chicken embryo exposed to hyperthermia during hatching

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The aim of this study was to investigate the effect of ascorbic acid (AA) *in ovo* administration on thyroid hormone concentration in the thyroid gland and the liver and of a chicken embryo exposed to hyperthermia during hatching period.

Hatching eggs of broiler chicken (Ross 308 line; n = 360) were *in ovo* injected with AA at a dose of 0 (control) or 2.5 mg/egg on the 17th day of incubation (E17). Next, the eggs from each group were divided into two equal parts that were incubated in standard (T 37.2°C, RH 55-65%) or hyperthermic condition (T 38.5°C, RH 55-65%). Tissues samples (n=10) were collected from embryos on day E18, during internal (IP) and external pipping (EP) and from new hatched chicks (D1). Thyroid hormones: thyroxine (T4), triiodothyronine (T3) and reverse triiodothyronine (rT3) concentrations were determined in tissue homogenates by RIA method.

The concentration of T4 in the thyroid gland of chicken embryos was 16.6 ± 2.43 $ng.g^{-1}$ on the E18 and rapidly increased by 89% at the EP ($P \leq 0.05$). AA *in ovo* administration increased the concentration of T4 at each investigated stage of hatching by 41, 82, 58 and 59% ($P \leq 0.05$), respectively. Exposure of the embryos to hyperthermia did not change T4 concentration in the thyroid gland in comparison to the control ($P > 0.05$). However, AA *in ovo* administration increased T4 concentrations at the IP and D1 by 122 and 64% ($P \leq 0.05$), respectively. The concentration of T4 in the liver tissue was 18.6 ± 2.24 $ng.g^{-1}$ tissue at the E18 and increased to 24.6 ± 4.53 $ng.g^{-1}$ at the IP ($P \leq 0.05$), and gradually dropped to basal level on D1. Administration of AA did not affect the concentration of this hormone in the liver. However, an elevation trend in T4 concentration in the liver was observed in embryos exposed to hyperthermia ($P \leq 0.05$).

The T3 concentrations in the thyroid gland were below the sensitivity of the RIA method. On the other hand, T3 level in the liver of E18 embryos was 42.6 ± 7.73 ng/g and it increased to 64.4 ± 7.48 $ng.g^{-1}$ at the EP ($P \leq 0.05$), and subsequently decreased toward the initial level at the hatch. There were no significant effects of hyperthermia and AA treatment on the level of T3 in the liver.

The concentrations of rT3 in both investigated tissues were below sensitivity of the applied RIA method.

In conclusion, hyperthermia during hatching disturbs thyroid hormone homeostasis in chick embryos. *In ovo* administration of ascorbic acid is able to weaken this disruption by regulation of metabolic process in hatching chicks.

Acknowledgment: Studies were supported by Ministry of Science and Higher Education of Republic of Poland Grant N N311 1351 33.

Effect of UV-B radiation on arbuscular mycorrhizal colonization of two rangeland weeds

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Global change models predict continual reductions in the earth's protective ozone layer. Such reductions are of concern because this layer is the primary attenuator of solar ultraviolet-B radiation (UV-B: 280-320 nm). Increased UV-B radiation levels poses adverse effects on organisms, including plants, depending on the latitudes (Jansen *et al*., 2010). A reduction in biomass accumulation as well as chlorophyll content and levels of UV-B absorbing compounds are often a reliable indication of a plant's sensitivity to UV-B radiation (Greenberg *et al*., 1997). Little is known about how exposure to UV-B radiation affects rhizosphere microbes. Rhizosphere organisms are fed primarily by root-derived substrates and fulfill functions such as mineralization, immobilization, decomposition, pathogeneity and improvement of plant nutrition (Klironomos and Allen, 1995).

Our work aimed at evaluating the effect of UV-B radiation on 1) growth of two rangeland weed species and 2) their root colonization with arbuscular mycorrhizal fungi.

The pot experiment was set up in the greenhouse conditions in 2010. Two species were tested: houndstongue (*Cynoglossum officinale* L.) and cheatgrass (*Bromus tectorum* L.). UV-B radiation was applied in the chambers and provided by 10 UV-B fluorescent tubes. Different levels of UV-B biologically effective radiation: 4, 6 and 8 kJ $m^{-2}.d^{-1}$ were obtained by using different numbers of layers of cellulose acetate film or Mylar film as a control (no UV-B radiation). After 13 weeks experiment was terminated. Morphological measurements of plants were performed. Root mycorrhizal colonization was carried out using MacGonigle (1991) method, after staining roots in trypan blue.

As a result, plants growing in the highest dose of UV-B radiation were shorter and accumulated lower biomass in the aboveground parts, as compared to control plants. The highest dose of UV-B influenced the root arbuscular mycorrhizae colonization significantly. In the both species a significant decrease of hyphae colonization and arbuscule development was noted after growth in 6 and 8 kJ $m^{-2}.d^{-1}$ UV-B.

Influence of microbial preparations and mineral fertilizers on nutrition level of southern chernozem

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The decline of agriculture intensification, that took place at the time of transition of national economy of ukraine on market basis, resulted in a considerable loss in soils of nutritives and reduction to content of humus. For maintenance and recreation of soils fertility it is necessary to enter measures, that will provide them the rational use (Nosko, 2010; Balaev *et al*., 2010). Among such measures an important role belongs to application of microbal preparations in technologies of agricultural cultures growing.

The aim of our researches consisted in determination of influence the joint use of preparations on the basis of phosphate mobilizing bacteria and mineral fertilizers on the nutritious level of soil and productivity of wheat winter in the agroclimatic conditions of crimea. The field experiments was conducted in 2008-2010 on next backgrounds: without a fertilizer and by bringing of mineral fertilizer (Nitroamophoska) at a rate of P_{30}, P_{60}, P_{90}. Soil: southern chernozem carbonate. Such biopreparations as phosphoenterin, albobacterin, polymyxobacterin was used for seeds bacterization. The control variants are without bacterization.

It is showed that with bacterization on the phase of booting plants in soil rhizosphere of plants increases the content of p_2o_5 on the unfertilized plots (on 11-16 % against control) and for bringing of mineral fertilizers at a rate of P_{30} and P_{90} (on 14 - 23 % and 18 - 28 % accordingly). The bacterization also promoted to increasing of content elements of organic substance elements in soil. On plots without a fertilizer it was on 7-17 % comparatively with control, by bringing fertilizers at a rate of P_{30} and P_{60} - on 3 % and 11-25 % accordingly.

The improvement with bacterization of southern chernozem nutritions level in plants rhizosphere assisted the increasing of their productivity. It is showed that most rational is combination of bacterization with bringing of mineral fertilizers at a rate of P_{30}: the productivity of winter wheat grain increase on 17 - 37 % comparatively with control.

Thus, the results of our researches showed, that joint use of preparations on the basis of phosphate mobilizing bacteria assisted the improvement of southern chernozem nutritious level in the rhizosphere of winter wheat and increasing of grain-growing productivity plants. It can be recommended as method of increasing the plants productivity and preservation of soil fertility.

Dynamics role of phenolic acids and total phenolic contents in nickel treated buckwheat (*Fagopyrum esculentum*) plant

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In this study, *Fagopyrum esculentum* (common buckwheat) exposed to different nickel (Ni) concentrations viz. 0, 0.5, 1.0, 3.0 and 5.0 mM for different duration via foliar treatment have been investigated for Ni accumulation, malondialdehyde (MDA), total phenolics and phenolic acids contents. In leaves Ni accumulation significantly increased in dose-dependent manner. Plants exposed for 72 h, showed visible damages of leaves, which were rebounded as chlorosis and irreversible necrosis. The MDA and total phenolic contents increased at 24 h of Ni treatments. HPLC data revealed that phenolic acids are in good relation with treatments concentration and durations. After 24 and 48 h the contents of chlorogenic, *p*-hydroxybenzoic, hesperetic, *p*-anisic and caffeic acids were increase in Ni treated leaves. On the other hand, *p*-hydroxybenzoic, hesperetic, *p*-anisic, *p*-caumaric, caffeic were decreased observed after 72 h of Ni exposure. Vanillic and cinnamic acid follwed same pattern and were increased significantly at 3.0 and 5.0 mM after 48 h of Ni exposure. It may suggest that buckwheat can be possible hyperaccumulators of Ni, because high accumulating of Ni in tissue by foliar treatment. Furthermore, the analyzed phenolic acids have potential role as antioxidants, which provide tolerance capacity to buckwheat against foliar Ni treatment.

Topic III

FOOD PRODUCTION, QUALITY, PRESERVATION AND SAFETY

Characterization of quality and genetic identification of Uzgen rice

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The aim of this study was the identification and characterization of the quality of Uzgen rice in Kyrgyzstan. This research contributed to the maintaining the cultivation of the traditional crop - Uzgen rice in southern Kyrgyzstan, as well as to the improvement of environmental protection, health and living standards of the population. In frames of the research we have established a qualitative analysis of autochtonic Uzgen rice for its certification, production management and marketing. We collected the original autochtonic rice varieties "Ak uruk" (Arpašali), "Kara Kulturuk" coming from Uzbekistan, and varieties "Kazim", "Nazer", "Tokol" and "Ris Kitajskij", "Ris Uzgenskij" available commercially in Kyrgyzstan. We conducted chemical analyzes on rice samples for the content of proteins, ash, fat, carbohydrates, energy value, starch and dietary fiber. The protein content according to Kjeldahl averaged 8.04%, while in the samples of the variety "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. The ash content of rice samples was in average 1.68%, while in the variety "Ak uruk" it was from 1.74 to 2.59%. 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 variety "Ak uruk" ranged from 76.80 to 72.11 g, and the starch content averaged 70.29%. Energy value was 1519.79 to 1480.25 kJ/100 g. In the molecular identification of gliadins using electrophoresis (A-PAGE) we found heterogeneity among the tested varieties, in contrast the varieties “Ak uruk” and “Kuimul” were shown to be lines. The research on the samples of rice varieties from southern Kyrgyzstan demonstrates the importance of the variety "Ak uruk" for its preservation and protection of its diversity in future. The variety of the Uzgen rice "Ak uruk" was certified for autochtonity and quality for its use in agriculture and nutrition. The traditional local rice variety “Ak uruk”, which had been rescued from the disappearance, has won a gold medal and diploma for best debut at the international exhibitions Agroprodexpo 2011 in Bishkek and the exhibition UniversalExpo later that year.

Acknowledgment: This work was supported by the Slovak Center for Communication and Development, n.o. with allowance SlovakAid SAMRS/2009/08 of project “Uzgen Rice – Strategy on Combating Poverty and Development of Minor Entrepreneurship through the Support of Traditional Agriculture in Southern Kyrgyzstan” and by the Operational Programme Research and Development for the project: “Implementation of the research of plant genetic resources and its maintaining in the sustainable management of Slovak republic” (ITMS: 26220220097), co-financed from the resources of the European Union Fund for Regional Development.

Radiocaesium in selected forest and non-forest berries

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Ingestion radiation doses can be elevated in some areas as a result of few foodstuffs which are collected from the wild contaminated by fallout after Chernobyl NPP accident. Few forest and/or non-forest plant fruits (berries) can be the most notable contributors to radiocaesium (^{137}Cs) intakes among these foodstuffs. This study brings new data on the ^{137}Cs content in blueberries, rowan berries, blackberries, raspberries and rose hips sampled in northeast upland area of the Czech Republic. Also radiocaesium transfer from soil to berries was analyzed. Samples of the fruits together with the upper soil environment under the plants were taken on pre-selected locations of Jeseniky PLA. The ^{137}Cs activity was measured by gamma spectrometric analysis using HPGe detector. Radiocaesium activity concentrations in the berries ranged from undetectable values to 86.5 Bq kg^{-1}, were different among the plant fruits studied, and correlated with altitude of the sampling areas (r=0.8027). The highest values were measured in blueberries, where the average activity concentration reached value of 53.8 Bq kg^{-1}. The lowest values of the activity (0.2 Bq kg^{-1} in average) were measured in rose hips. With published data comparable values of aggregated transfer factors (soil to berries $T_{ag}=5.5\times10^{-2}$ m^2 kg^{-1}) were found only in blueberries. However, the measured values of the ^{137}Cs activity concentration in the berries did not exceed the intervention limits for foodstuffs. The radiocaesium values in studied plant fruits probably do not contribute significantly to the radiation ingestion doses.

Acknowledgment: This study was funded by Faculty of Agronomy of Mendel University in Brno.

Effect of storage temperature on survival rate of S*almonella enteritidis* in kefir after fermentation

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The aim of this study was to determine and compare survival rate of *Salmonella* Enteritidis in samples of kefir inoculated after fermentation and stored at different temperatures.

The samples of kefir were inoculated with the mixture of three *S.* Enteritidis strains and stored at 5, 10, 15, 20 and 25°C for 32 hours. The numbers of salmonellae were determined every four hours. From each sample a series of decimal dilutions were prepared and plated onto Brilliant Green Agar. The plates were incubated at 37°C for 24 - 48 h under aerobic conditions. The colonies grown on culture media were counted, bacterial counts were multiplied by the appropriate dilutions, and numbers of bacteria (colony-forming units) were calculated. The bacterial counts were transformed into logarithms and statistically analysed using IBM SPSS Statistics 20. The experiment was performed in five replications.

It was found that numbers of bacteria decreased linearly with storage time in all samples groups. Storage temperature significantly influenced survival rate of *S.* Enteritidis. In samples stored at 5ºC the numbers of salmonellae decreased at the lowest rate and D-value (time required for reduction of bacteria by 1 log unit) amounted to 34.78 hours. In kefir samples stored at other temperatures D-values amounted to 28.04 h at 10ºC, 24.32 h at 15ºC, 22.23 h at 20ºC and 17.35 h at 25ºC.

Acknowledgement: Research was supported by the Grant from the National Centre for Research and Development (NCBiR) No. N R12 0097 06.

Method for species identification of animal components in commercial samples of pet food

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Species identification of animal components in feed is an important research topic due to food allergies in domestic animals. The study was conducted on 8 samples of dog food and 10 samples of cat food (including 3 samples of hypoallergenic food). Analysis was performed to determine the presence of chicken, goose, duck, turkey, pig, sheep and cattle components. The method is based on analysis of a gene fragment encoding ATPase 6-8 for identification of bovine, pig, chicken and ovine components, and 12S-rRNA fragment of mitochondrial DNA (mtDNA) for identification of the other poultry species. Mitochondrial DNA was chosen for the analyses on account of its stability and resistance to external agents. These characteristics of mtDNA allow it to be used for analysis of processed material such as feed.

DNA is isolated from the analysed sample and amplified in the presence of specific primers. Amplification products are separated in agarose gel. The electrophoretic pattern shows the presence (or absence) of a specific product for a given group of animals. The result is evaluated by determining the presence or absence of a PCR product. Animal components are identified based on a DNA product of 212 bp (pig), 266 bp (chicken), 271 bp (bovine), 212 bp (ovine), 110 bp (duck), 103 bp (turkey) and 112 bp (goose). The present analysis demonstrated that only one of the tested feeds contained a pig component undeclared by the manufacturer, while the composition of all the other foods was consistent with expectations.

Content of chlorophyll and carotenoids in dry Dill (*Anethum graveolens* L.) depending on drying method

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Dill (*Anethum graveolens* L.) is an annual plant with spicy odor, originally native to Mediteannean area. Dill has been used in traditional medicine for much kind of stomach aches, dyspepsia and liver diseases and even insomnia. Fresh and dry dill is used in salads, sauces and in pickles. Drying is one of the most know method of preservation, preventing herb from unwanted biochemical changes. Drying also enable to protect properties and quality of the product. Attractiveness and high quality of dill depends not only on odor but also on on the content of such compounds as chlorophyll pigments and carotenoids. Chlorophyll is a main pigment of seasonal vegetables. Carotenoids like vitamin C and polyphenols have got strong antioxidative effect. In leafy vegetable losses of these compounds are noticeable during storage and processing, especially in high temperature.

The experiment was carried out in 2011, on the Experimental Field and the Basic Chemical Analysis Laboratory of the Department of Vegetable and Medicinal Plants SGGW. The effect of preservation method on chlophyll and carotenoids content in dried Dill ('Lukullus, 'Moravan', 'Super Dukat', 'Szmaragd' and 'Turkus' varieties) was investigated. Harvest of herb was carried out on June 30th, August 17th and October 3rd. After harvest, raw material was divided into three parts and was dried in 35 °C and 50 °C in convective dryer or freeze-dried in -50 °C, immediately.Total carotenoids and chlorophylls were determined by spectrophotometric method. The highest concentration of tested compounds was observed in freeze-dried material. This conservation method allows to keep the highest quality of dill.

Acknowledgment: The investigation was supported by the project of Faculty of Horticulture and Landscape Architecture in 2011.

Influence of fertilization system on quality of cucumbers grown in southern Romania

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Growing cucumbers in our country is in most cases the organic system and the system of chemical and organic fertilization. These types of cultures can influence vegetable quality due to increased photosynthesis process that plants from absorbing nutrition, accumulation and metabolism of different elements. These phenomena are more intense in greenhouses and solariums.

Because a culture of cucumbers occupy land for four months, support vegetative growth and build upon the phases fertilization constitutes a mandatory technology. Fertilization based on soil cucumber crops is limited to a moderate amount of fertilizer because the roots awareness that do not support high concentrations of minerals in soil. Phases fertilizations made in traditional fashion are also relatively difficult to implement due to limitations of fertilizer (maximum 50 $kg.ha^{-1}$ active ingredient) and because their incorporation into the soil is technologically difficult because of the shallow roots of cucumber plants.

Experience has been placed in a private solarium on a farm in southern Romania, in six experimental variants, three repetitions, with repetition of 5 m^{-2} plots. Experience has been protected by buffer strips, respecting the rules specific experimental technique bifactorial experiences of solariums.

The biological material used in experiments consisted of cultivars Triumph F1 - (domestic hybrid, created from SCDL Buzau) and Mirabelle F1 - (at Seminis).

During the growing season was followed: production, kg / plant and $kg.m^{-2}$ and determinations were made on its quality in terms of consumption and international regulations.

Influence of controlled atmosphere on the cabbage storage quality

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During last decade vegetable production in Latvia and in Lithuania has tendency to grow. In the same time new organizations of producers are developing. Common logistic and marketing systems develop rapidly. Therefore qualitative long term storage facilities become topical problem for vegetable growers in Latvia. In the Western and Central Europe vegetables are stored in controlled atmosphere (CA) already. Nevertheless composition of biologically active compounds and other factors influencing storage ability for Baltic vegetables differs from vegetables produced in Europe due to different climate and soil conditions as well as applied plant protection system. Till now storage was organized in storage rooms with controlled temperature and relative humidity, but not gas composition. Therefore marketing period often is relatively short and at the end of the winter, spring mostly imported vegetables are offered for customers. Latvian vegetable growers are able to produce high quality vegetables in broad assortment, but limiting factor is short marketing period and high mass and quality losses during storage period. The solution is vegetable storage in CA.
Cabbage was stored in CA atmosphere during the wintering periods of 2010/2011 and 2011/2012 in the storage house of Pūre Horticultural Research Centre, Latvia. Storage room was equipped with ULO pallet system "Besseling" 20 channels atmosphere control station. Control equipment analyzes amount of O_2 and CO_2 in air sample which periodically is sucked from storage unit. Adjustment of the O_2 and CO_2 ratio is kept by injection of N_2 or O_2.

The best results in the investigation were obtained by cabbage storing in the O_2 level between 2-5 % and CO_2 between 5 and 7 %. The high quality cabbages stored in CA exceeded control for 42 to 59 % after 6 month storage.

Acknowledgement: This work was supported by a grant from the EUREKA E 15363 BaltVeg Stor project.

Influence of storage conditions on quality of ‘cherry’ tomato fruits (*Solanum lycopersicum* L. var. *cerasiforme*)

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It is proved that daily intake of fresh and processed tomato fruits decreases risk of chronic diseases, like cardiovascular diseases and cancer. Lycopene and other carotenoids protect health because of antioxidant activity. Tomato fruits are the main source of lycopene, and important source of β-carotene, the precursor of vitamin A. Physical, chemical and sensory traits of tomato fruit can be modified by environmental factors. Many studies indicate that the key factor for plant growth, yield, fruits quality and their storage ability may be the growing medium used in greenhouse cultivation. Nowadays, the most popular growing medium in a modern soilless vegetable cultivation is a rockwool. However, rockwool is not suitable for recycling, so a new environmental friendly growing medium is needed to protect environment. Good alternative for the rockwool may be a coconut fibre. It is a biodegradable material of good physical and chemical traits. After completing the growing season, coconut fiber slabs can be composting and then use as organic soil fertilizer.

The study was carried out in 2012 in the greenhouse and laboratories of the Department of Vegetable and Medicinal Plants of Warsaw University of Life Sciences. The objective of the study was to determine the effect of different growing mediums on the yield and fruits quality of 'cherry' tomato cultivars. Two cherry tomato cultivars – ‘Dasher’ and ‘Pareso’, were taken for the experiment. The seeds were sown in December, seedlings were planted in January to rockwooll and coconut fibre slabs. Fruits were harvested in June at 3rd and 5th stage of maturity, according to USDA classification (light-red) and stored for three and fourth weeks with different concentration of 1-MCP. The factors for the three-factors experiment were: concentration of 1-MCP, growing medium type and stage of maturity. There were determined for the fruits: total and marketable yield, dry matter, total sugars, soluble solids, phenolic acids and carotenoids content and CIE L*a*b.

The study showed that both growing mediums used in the experiment allowed to obtain a comparable yield, of similar fruit quality. Therefore, the coconut fibre could be used as a good, environmental friendly growing medium, an alternative to rockwool as a medium for greenhouse cultivation of 'cherry' tomatoes.

Acknowledgment: The investigation was supported by the project of Faculty of Horticulture and Landscape Architecture in 2012.

Fruit quality changes during tomato ripening

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Investigation was carried out at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry. The aim of experiment was to evaluate fruit quality in different tomato varieties at different tomato ripening stages. The following fruit quality parameters were evaluated: lycopene, ascorbic acid and color coordinates. It was established that tomato fruit maturity at harvest is very important factor, which determines fruit quality and biochemical composition. Amount of lycopene and β-carotene had increased gradually during tomato ripening. That can be related with chlorophyll degradation and carotenoids synthesis processes. Amount of ascorbic acid increased in some varieties during fruit ripening, but in others – fruit ripening stage had no effect on amount of ascorbic acid. So the amount of ascorbic acid, mainly, was determined by tomato genotype and less influence had fruit ripening stage. It was determined correlation between amount of carotenoids and color coordinates. Coordinate L^* had negative correlation with the content of lycopene. Tomato fruit color lost lightness and value of color coordinate a* went up during tomato ripening.

Acknowledgement: *Postdoctoral fellowship is being funded by European Union Structural Funds project "Postdoctoral Fellowship Implementation in Lithuania".

SESSION III

WORKSHOP – RECENT ADVANCES IN PLANT BIOTECHNOLOGY

Topic I

MORPHOGENESIS AND EMBRYOGENESIS *IN VITRO*

Studies for the micropropagation of *Amelanchier canadensis* cultivar 'Rainbow Pillar'

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Amelanchier canadensis cv. 'Rainbow Pillar' is an ornamental shrub bearing edible fruits of high quality. The species originates from North America.

Micropropagation is by far the most effective method of vegetative propagation in *Amelanchier sp*.

At the Fruit Research Station Cluj the initiation of *Amelanchier in vitro* cultures and the proliferation of axillary shoots was studied. The rooting of axillary shoots was done *in vitro*, followed by *ex vitro* acclimation of the rooted plantlets. Shoots generated in the multiplication phase were also successfully rooted directly *ex vitro* without an *in vitro* rooting phase.

In the initiation phase, only the explants consisting of apical buds generated plantlets. In the multiplication phase MS medium with 0.7 mg/l BAP proved to be optimal, 1 mg/l BAP also gave good results and 2 mg/l BAP proved to be excessive. Wheat starch at 50 g/l was successfully used as a gelling agent. Multiplication by microcuttings yielded superior results regarding proliferation rates, while *in vitro* layering diminished proliferation rates but yielded more vigorous shoots. The explants containing the apical bud yielded plantlets of superior quality.

In vitro rooting was successful on hormone-free MS medium with 50 g/l starch, using whole shoots as explants. The MS variants gelled with agar, with or without IBA yielded poor results. The *ex vitro* acclimation of the plantlets rooted *in vitro* was done in various substrates: Jiffy7 pellets, floating perlite beds and in floatation hydroculture.

Direct *ex vitro* rooting of shoots generated in the multiplication phase was also accomplished, with optimal results in Jiffy7 pellets, the survival rates being reasonably high but still mediocre as compared to the ones obtained by using plantlets rooted *in vitro*.

Acknowledgement: This work was possible with the financial support of the Sectoral Operational Programme for Human Resources Development 2007-2013, co-financed by the European Social Fund, under the project number POSDRU/107/1.5/S/76841 with the title „Modern Doctoral Studies: Internationalization and Interdisciplinarity”.

Profile of *Aloe* secondary metabolites and *in vitro* assessment of radical scavenging activity by membrane lypoperoxidation

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The antioxidant properties of Aloe-based preparations are reported in literature, although sometimes conflicting and incomplete information can be found. The scientific community still quite agrees that the polyphenols fraction, particularly characteristic anthrones and chromones may be strongly related to radical scavenging activity. The discrepancies in the literature are probably related to the different techniques of extraction, preparation and storage, the use of different leaf portions and/or the use of plants from different species and age. The present study was therefore designed to evaluate the antioxidant activity of different leaf portions of *Aloe barbadensis* Mill. and *Aloe arborescens* Mill. plants, the two species most commonly used. The antiradical activity was evaluated *in vitro* by testing DPPH and ORAC, on different portions of leaf and on pure secondary metabolites isolated by TLC chromatography. Concurrently, to support the information thus obtained, total polyphenols, flavonoids and flavonols were determined in each material tested, and the anthrones and chromones profile was assessed by tandem mass spectrometry with target determinations (LC-QQQ) and untarget screening analysis (LC-QToF).

Thsee results were correlated to the lypoperoxidation index evaluated by determining the malonic dialdehyde produced by red blood cells membrane after irradiation with UV light, in presence of the test extracts. This test was assumed to be closer to *in vivo* conditions than the previous ones.

Albeit the leaf outer green rid was the most active against free radicals in all cases, scavenging activity differed between the two species and in particular was higher in *Aloe arborescens*. As far as concerns the most active pure molecules, the results from chromone were at highest values. Aloeresin A, a glucosilated chromone, is particularly effective in countering the radicals, while aloesone and aloesin (not glucosilated and glucosilated respectively) were found to be active in the DPPH test. The analysis of the phytochemical profile confirmed the role of polyphenols, and of chromones in particular, justifying the differences between the two species tested.

The importance of *in vitro* cultures to study the effects of cadmium ions

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Most studies about the effects of heavy metals were studied on intact plants and therefore little is known about their effects in *in vitro* cultures. *In vitro* cultures of conifers are suitable models to study the influence of such abiotic factors (physiological and biochemical characteristics). Important is their ability to resist the adverse effects of heavy metals, which plays an important role in their use in phytoremediation technology. Somatic embryogenesis is the process of development of embryo (or embryo-like structures), without fusion of gametes from somatic cells or from plant tissues in *in vitro* conditions. Somatic embryos undergo similar morphological, structural and physiological stages of their development as embryos in the seeds. The main goal of this work is to give a view of the impact of cadmium ions on the growth (fresh and dry weight) and morphology in two celllines of hybrid firs: *Abies alba* x *Abies cephalonica* (line AC 78) and *Abies alba* x *Abies numidica* (line AN 72) during the period of cultivation (0^{th}-20^{th} day). Both lines we used were induced from immature zygotic embryos and long-term maintained in Petri dishes in *in vitro* conditions on a nutrient medium DCR (BAP - 1 $mg.l^{-1}$). In the exponential growth phase (8^{th} day) the tissue were transferred to DCR medium enriched with two different concentrations of $Cd(NO_3)_2.4H_2O$: 250 μM and 100 μM. Samples for analysis of the growth (increase in fresh weight and dry weight) were performed at 5 days (0^{th}-20^{th}) by five repeats. Changes in tissue morphology caused by cadmium ions were observed under a light microscope through squashed preparations stained with 2% acetocarmine and fluorescein diacetate. Effect of cadmium ions was manifested in the macromorphology of tissue - on the control medium (DCR without cadmium) tissues were white to yellowish-white in color, sometimes translucent with prominent somatic embryos. After 10 days cadmium ions in both concentrations caused tissue browning due to the accumulation of toxic products (mainly phenols) and visual loss of tissue mass. Cadmium ions also affected the tissue micromorphology. At the beginning of the cultivation were observed bipolar structures with well-organized embryonic part composed of meristematic cells and strongly vacuolated elongated suspensor cells formed in bundles. Effect of cadmium ions was shown for several days of culture. At higher concentrations of cadmium were observed unorganized meristematic cells that were weakly associated with suspensor or were loosely scattered in the tissue without any organization. Cadmium ions in both celllines had slightly stimulatory effect during the first days of cultivation: DCR + 100 μM slightly increased the growth of both lines in comparison to the control medium; but after about 10 days the growth of culture was inhibited. In conclusion, cadmium ions have a negative effect on the micromorphology of somatic embryos, which resulted in incoherence, disintegration and abnormal organization of bipolar somatic embryos. Generally, the effects of heavy metal ions lead to slower growth, or stop it completely after some time (depending on the concentration of metal compounds and the exposed plant), which was confirmed in other experimental models (1, 2).

Acknowledgment: The work was funded by the project VEGA 2/0144/11 and COST FP0701.

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Chitinases and glucanases in the process of somatic embryogenesis of *Pinus nigra* Arn. and hybrid firs

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In our work, 17 embryogenic cell lines of *Pinus nigra* Arn. and 7 embryogenic cell lines of hybrid firs (*Abies alba* x *A. cephalonica* and *A. alba* x *A. numidica*) with different embryogenic potential were used with the aim to study the role of chitinases and glucanases in somatic embryogenesis. The embryogenic potential of cell lines was characterised on the basis of structural observations and maturation capacity of somatic embryos. For biochemical analyses suspension cultures were prepared.

The chitinolytic activity of the extracellular protein fractions was analysed in cultivation media of embryogenic lines of *P. nigra* (11 embryogenic lines with high embryogenic potential, 6 with low embryogenic potential) and hybrid firs embryogenic lines (6 high, 1 low embryogenic potential). In case of *P. nigra* the presence or absence of chitinase isoforms does not correlate significantly with the high or low embryogenic potential. In case of firs two chitinase isoforms were absent in the embryogenic line with low embryogenic capacity (AC79), whereas the same two isoforms are present in all other tested lines. This might indicate a correlation between chitinase isoforms and the high or low embryogenic potential of tested lines.

Glucanase activity was detected from cultivation media of 12 lines of *P. nigra* and of 6 hybrid fir lines with high embryogenic potential. SDS-PAGE analysis of these lines showed the presence of six glucanase isoforms in cultivation media, having different abundance in different embryogenic lines - glucanase isoform with a molecular weight of ~ 33.8 kDa was present in all examined embryogenic lines. In the cell line AN72, apart from the mentioned glucanase isoform, we detected another glucanase isoform with a molecular weight of ~ 41.2 kDa.

Analyses of profiles of extracellular chitinases and glucanases in cultivation media of embryogenic tissues suggest that these profiles are results of the heterogenity of cell cultures and that the probability of a direct correlation between the presence or absence of particular chitinase or glucanase isoforms and embryogenic potential is low. However, the isoenzyme profiles of these enzymes, together with the ratio of accumulation/activity can be important components of the embryogenic process.

Acknowledgment: The financial support from the Slovak Grant Agency VEGA, proj. no. 2/0144/11, is highly appreciated.

Micropropagation and adventitious regeneration of *Rubus* spp.

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The principal advances in application of biotechnological approaches in agriculture, horticulture and forestry were done during past decades. The assumptions were created for incorporation of tissue culture and genetic engineering into breeding and horticulture praxis, mainly for rapid propagation of high quality plants and creation of new breeding material. The presently available *in vitro* regeneration and micropropagation techniques are often inefficient and unreliable therefore it is necessary to devote considerable attention to optimization of culture conditions mainly in regards to genotype specific claims. *In vitro* techniques acquire a high practical importance mainly in fruit tree species, not only for production of quality planting material, because of elimination of pathogen, but also as a system for application of genetic engineering. *In vitro* propagation and adventitious organogenesis was studied in different *Rubus* spp., however the development of efficient and widely applicable regeneration system is in these species complicated because of highly genotype-dependent regeneration ability.

In our experiment, shoot proliferation ability of *Rubus idaeus* L. cvs. 'Black Jewel', 'Tulameen' and 'Willamette'; *Rubus fruticosus* L. cvs. 'Black Satin'; *R. ursinus x R. idaeus* cv. 'Loganberry' and *R. fruticosus x R. Idaeus* cv. 'Tayberry' was studied. The branches with dormant apical and axillary buds were collected from mature donor plants during February and March, cut into single-node segments and sterilized by washing under running tap water for 1h, by immersion in 70% (v/v) ethanol for 2 min., 0.1% (w/v) mercuric chloride with 3 drops of Tween for 6 min., followed by washing the explants thoroughly with sterile distilled water (3 changes, each 15 min). The isolated buds, from which the upper scales were removed after sterilization were cultured on MS medium supplemented with 30 $g.l^{-1}$ sucrose, 8 $g.l^{-1}$ Phytoagar, 2 $mg.l^{-1}$ BAP, 0.2 $mg.l^{-1}$ IBA, at pH 5.7 for shoot initiation. For further proliferation of *in vitro* initiated axillary shoots, the shoots were cultured on the same medium with lower BAP (0.5 $mg.l^{-1}$) with subculture every 4 weeks. The induction of adventitious regeneration on the leaves and petiols of *in vitro* plants was tested in cv. 'Čačanska Bestrna' by use of 1, 2 and 5 $mg.l^{-1}$ BAP, TDZ and zeatin, each in combination with 0.05 $mg.l^{-1}$ IBA. The cultures were maintained in the growth cabinet at 23 ± 2°C with a 16 h photoperiod (50 $\mu mol.m^{-2}.s^{-1}$ white fluorescent illumination). From the tested cultivars, the highest shoot multiplication was observed in cv. 'Black Satin' (6.2 shoots/explant) and Black Jewel (4.0 shoots/explant), while in the rest of cultivars the multiplication coefficient reached the values 1.17-2 shoots/explant. In these cultivars the improvement of shoot proliferation protocol is needed. For adventitious shoot regeneration in cv. 'Čačanska Bestrna' the petiols showed to be the good responsive explants on which the highest shoot induction was achieved on medium with 1 $mg.l^{-1}$ TDZ and 0.05 $mg.l^{-1}$ IBA.

Acknowledgment: The work was supported by Slovak Grant Agency VEGA, project no. 2/0040/11.

Method for micro propagation and callus induction in *Mentha piperita* L. for "*in vitro*" biomass production

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In the paper the study carried out in laboratory conditions is related to the protocol of the method of micro propagation and callus induction in *Mentha piperita* L. and of media constituents for efficient "*in vitro*" biomass production. Mint family species (*Lamiaceae*), including peppermint and spearmint, are important medicinal and aromatic crops valued for the essential oils that are produced in glands on the leaves. Adventitious shoots were initiated either directly from morphogenetically competent cells of explants or primary callus. Leaf explants were used to initiate multiple shoot on Murashige and Stoog (MS) medium supplemented with 6-benzyaminopurine (BAP) (5 $mg.l^{-1}$) and (NAA) naphthalene acetic acid (0.5 $mg.l^{-1}$). Profuse rooting was achieved when the well-grown shoots were cultured on half strength MS medium supplemented with indole-3-acetic acid (2 $mg.l^{-1}$). The perspective of this first, preliminary stage of the research was to develop a rapid system for regenerating "*in vitro*" clonal tissue proliferation and finally the process of proliferation will be tested like reliable method for large-scale biomass of *Mentha* essential monoterpene oils production.

Proteomic analysis of somatic embryogenesis in *Zea mays* L.

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Maize is one of the world's three most widely cultivated crops (along with wheat and rice) and is arguably the most economically important cereal crop on a worldwide basis. Tissue culture and induction of embryogenesis from somatic cells are the main techniques necessary for practical application of advanced biotechnological tools for targeted improvement of the plant. Technical developments within this field of biotechnology have allowed grater reproducibility of experimental results and numerous investigations have demonstrated the utility of these techniques in the study of many biological topics, especially in genetics, plant physiology and development. Proteomic biological processes are typically studied in isolation, and seldom are efforts made to coordinate results obtained using structural, biochemical, and molecular-genetic strategies. Proteomic analyses have transcended their initial purely descriptive applications and are being employed extensively in studies of posttranslational protein modification, protein interactions, and control of metabolic networks. In our experiments, callus induction and plant regeneration was tested using various explants (immature embryos, mature embryos, roots, coleoptiles, leaves and anthers) of maize (*Zea mays* L.). Yield of embryogenic callus was highest when immature embryos were used as a primary explant and reached level of 10%. This experiment compares the proteome of embryogenic callus and non-embryogenic callus of *Zea mays* L. line A18. Proteins were resuspended in rehydration buffer (8 M urea, 2 M thiouream 2 % CHAPS, 50 m M DTT, 0,5 % ampholytes pH 5-8) and resolved by two-dimensional (2-D) electrophoresis. Gels in triplicates (from embryogenic and non-embryogenic callus) were stained by colloidal coomassie blue, scanned by using a densitometer (GS-800, Bio-rad). In the future we will analyze gels by using PDQuest 8.0 software. The 2-D electrophoresis will be combined with MALDI TOF/TOF MS/MS analysis, and unique proteins will be identified and classified into functional groups.

Acknowledgment: This work was supported by the grand APVV-0115-07 and COST FA 0903.

Genotype-dependent differences in shoot proliferation ability *in vitro* of *Vaccinium corymbosum* L. cultivars

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Interest for cultivation of non-traditional small fruit species has an increasing tendency in many countries including Slovakia. For effective production of berries an intensive cultivation of berry species cultivars is desirable which show high productivity under climate and soil conditions of Slovakia. *Vaccinium* spp. are, in regards to their high nutritional value, considered as biologically valuable small fruits with positive impact on human health. Presently, the efforts are focused on elaboration of efficient systems for clonal propagation *in vitro* of a broad assortment of productive *V. corymbosum* L. cultivars which became very attractive not only for direct consummation but also for food industry. Micropropagation has become an important part of commercial propagation for many plants, however the multiplication ability is highly genotype-dependent and development of widely applicable multiplication system efficient for many cultivars is complicated. The most frequently used micropropagation method for commercial mass production of plants utilizes axillary shoot proliferation from isolated apical or axillary buds under the influence of a relatively high cytokinin concentration. This method is the most reliable for production of true-to-type plants. For micropropagation of *V. corymbosum* L. cvs. 'Aurora', 'Chandler', 'Goldtraube', 'Toro', 'Liberty' and 'Hannah's Choice' the branches with dormant buds were collected from mature donor plants during February and March. The branches were cut into single-node segments and sterilized by washing under running tap water for 1 h, by immersion in 70% (v/v) ethanol for 2 min., 0.1% (w/v) mercuric chloride with 3 drops of Tween for 6 min. followed by washing the explants thoroughly with sterile distilled water (3 changes, each 15 min). The isolated dormant apical and axillary buds, from which the upper scales were removed after sterilization, were cultured on WPM medium supplemented with 25 $g.l^{-1}$sucrose, 8 $g.l^{1}$ Phytoagar, 1.0 $mg.l^{-1}$ zeatin and 0.2 $mg.l^{-1}$IAA, pH 4.5 - 5.0. For further proliferation of *in vitro* initiated axillary shoots, the shoots were cultured on the same medium with 0.5 $mg.l^{-1}$ BAP and subculture every 4 weeks. The cultures were maintained in the growth cabinet at 23 ± 2^{o}C with a 16 h photoperiod (50 $\mu mol.m^{-2}.s^{-1}$ white fluorescent illumination). The cultivar multiplication ability was followed during 3 subcultures and multiplication coefficient (Q) was calculated. The significantly highest shoot multiplication was achieved in cv. 'Aurora' (Q=3,26). The cultivars 'Chandler', 'Hannah's Choice' and 'Goldtraube' created one homogeneous group with Q=2.91, 3.05 and 3.08, respectively. Cultivars 'Liberty' and 'Toro' showed the lowest shoot multiplication ability with Q=1.77 and 1.92, respectively. Comparing subcultures, the highest shoot multiplication was abserved after 1^{st} subculture (3.16) with lower multiplication in the 2^{nd} (2.40) and 3^{rd} subcultures (2.43). Our results confirmed that *in vitro* shoot proliferation ability is highly genotype-dependent, therefore some protocol modifications may be necessary in different cultivars.

Acknowledgment: The work was supported by Slovak Grant Agency VEGA, project no. 2/0040/11.

The share of androdiploids among regenerants from *in vitro* anther culture of *Capsicum spp*.

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The induced androgenesis is the effective biotechnology tool using for rapid genetic stabilization of the hybrid recombinants. Usefulness of the method depends on the androgenic property of species, cultivars or breeding lines. Genotype plays the main role among factors influencing on the practical results of *in vitro* anther culture. Some of accessions, sweet and big fruited forms for example, are very effective in anther culture. On the other hand, pungent genotypes are, in general, very low responsive. A few species regenerate a number of diploids as a result of chromosome doubling during the culture. The androgenic character of diploids is unquestionable when microspores are the explants. The diploid regenerants from culture of anthers may be both gametic or somatic in the origin. In the investigation on the source of diploid plants the marker gene method was used. Four original F_1 hybrids of *Capsicum* spp. were created by crossing of two soft-flesh, hot and red fruited lines with three hard-flesh, sweet and red or yellow fruited cultivars. The breeding lines selected from (*Capsicum frutescens* L. x *C. annuum* L.) hybrid marked "4" and "9" were the maternal forms of donor plants. Polish cultivars `Luba`, `Mino` and `Sono` served as a pollen grains source. The initial forms differed in regard to mature fruit colour, pericarp structure and taste. Mentioned features are monogenetic and conditioned by marker genes. The F_1 donor plants were soft-flesh, hot and red fruited. The diploid plants derived from *in vitro* anther culture of *Capsicum* spp. F_1 hybrids were the subject of experiment. Thirty five diploid plants (one third of the total regenerants number) obtained in the anther culture were the subject of marker gene analysis. The difference in relation donor plant- regenerant phenotype concerning one of the marker feature were observed in sixteen plants. Nine of diploids were different in respect of two and one of three characters. The results of experiment confirmed androgenic origin of 74% diploid plants.

Topic II

GENETIC TRANSFORMATION STRATEGIES FOR PLANT IMPROVEMENT

Genetic transformation of *Rubus fruticosus* L. mediated by *Agrobacterium tumefaciens*

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Traditional breeding approaches for horticultural woody species are limited by their long reproduction cycle, high heterozygosity and polyploidy. The use of genetic engineering can provide a relatively rapid acquisition of the desired characteristics and permits the introduction of useful agronomic traits without altering the cultivar features. This requires the development of *in vitro* systems for the genetic transformation and transgenic plant regeneration. The aim of this work was to optimise transformation and regeneration conditions for selected cultivar of *Rubus fruticosus* L. ´Čačanska Bestrna´. For this, three agrobacterium strains characterized by different virulence *A. tumefaciens* LBA 4404, C58 and AGLO in combination with two binary vectors (separately) pTS2 and pCambia 1304 which differ in selection marker gene, were used to transform leaf discs and petioles as the primary explants. The T-DNA of pTS2 contained β-glukuronidase *gus* reporter gene and selection marker *npt*II gene. The T-DNA of pCambia1304 carried fusion reporter gus:gfp gene and selection marker *htp*II gene. The results showed that the process of transformation was possible to achieve by use of all three bacterial strains. Therefore, for further experiments we decided to use less virulent strain LBA 4404. Better indirect shoot regeneration from explants after transformation was achieved under selection pressure of hygromycin. Moreover, compared with leaf discs, petioles showed higher shoot regeneration ability. Putative transgenic calli and shoots were analysed by histochemical detection of GUS activity. The analyses showed that 51.5% and 43.2% of calli formed from leaf discs and petioles, respectively, were GUS-positive. Isolation of genomic DNA from putative transgenic shoots was performed following four different protocols. From the tested isolation protocols, the modified Doyle and Doyle (1990) protocol was the only good working one. Presence of the *gus*, *gfp* and *hpt*II genes in putative transgenic shoots which showed resistance to higher concentrations of hygromycin (15 - 25 $mg.l^{-1}$) was detected by polymerase chain reaction. The presence of the all genes was proved by PCR analyses but the final confirmation of transgenic status of regenerated shoots should be approved by Southern blotting. Further optimization of transformation and regeneration conditions are still in process.

Acknowledgement: The work was supported by Slovak Grant Agency VEGA, project no. 2/0040/11.

Isolation and characterization of tissue-specific promoters and their use in biotechnology

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Biotechnology research is currently focused on the targeted transgene expression in certain types of tissues/organs, which is directed by the specific promoter activity. One of such applications involves generation of selectable marker-free transgenic plants using the self excision Cre/*lox*P system that is controlled by a pollen or embryo specific promoter. Our aim was to test the activity of four *Arabidopsis thaliana* promoters which are characterized by the specific activity in pollen and/or embryo in transgenic tobacco plants. For transformation of plants the *Agrobacterium tumefaciens* system was used. The T-DNA of plant vector constructs contained the *gfp:gus* reporters that were directed by the tested tissue-specific promoter and a selectable marker gene under the control of the double *CaMV*35S promoter. In addition to the basic set of constructs, their derivatives, which contained 1 kb, 2 kb and 5 kb DNA spacer, cloned between the tested tissue-specific promoter and double *CaMV*35S promoter, were prepared. After regeneration of all series of transgenic plants, the ectopic and specific activities were monitored in non-targeted (callus, shoot, stem and root) and targeted (pollen, embryo) tissues, respectively. Our results showed that the enhancer of the *CaMV*35S2 promoter can alter the specific pattern of activity to non-specific if the distance between the *CaMV*35S2 promoter and ATG codon of the reporter gene directed by the tested promoter was less than 3 kb. When the specific activity in pollen and embryo was analyzed, it was found that the promoters *MXL* and *DLL* were characterized by the specific activity in the pollen grain as well as in the pollen tube of transgenic tobacco plants. In auto-excision Cre/*lox*P strategy this enables them to excise the selectable marker gene during the pollen development. In case of the *DLL* promoter, the specific activity was also confirmed in the embryo during the torpedo stage of its development. Based on the activity profile, the *DLL* promoter can be used in marker-free transgenic plants generation using the Cre/*lox*P strategy and it is expected that removal of the selectable marker gene will occur in developing embryo.

Acknowledgement: This work was funded by the Slovak Grant Agency VEGA project no. 2/0062/11 and by EEA Financial Mechanism SAV-EHP-2008-02-01.

Influence of topology of heterologous epitopes in *Potato virus X* based viral vector on their expression in plants

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Plants are among the most economical producers of biomass. They only require sunlight, water, carbon dioxide and minerals, but provide an optimal system for the expression of recombinant proteins free of contamination by bacterial toxins or animal pathogens. Furthermore, they offer an eukaryotic protein modification machinery, allowing subcellular targeting, proper folding, and post-translational modifications. However, the production of heterologous proteins in plants at quantities sufficient for practical use remains a constant challenge for scientists.

The plant virus-based transient expression system can produce large quantities of desired proteins in a relatively short time. Chimeric plant viruses are promising vectors for use in vaccination strategies. Viral replication rapidly amplifies genes that are engineered into a suitable position of the viral genome. The production of plant-derived vectors is a novel and particularly up-and-coming approach to the creation of vaccines.

Several viral vectors were constructed using the full-length cDNA of *Potato virus X* (PVX). In our study we use the PVX-based expression vector pgR106, which was designed to combine advantages of *A. tumefaciens* mediated transfection as well as of virus infection.

As a model antigen we chose the immunodominant Human papillomavirus type 16 (HPV16) E7 epitope. We would like to develop the conditions that will lead to higher expression level and stability of transiently expressed heterologous antigens, in our case HPV16 E7 epitope. We produce this epitope situated in four different locations in the loops connecting α-helices and β-strands which are assumed to be located on the exterior part of PVX coat protein (CP) particles.

Our results provide a benefit for further development of PVX-based epitope presentation system for the production of other antigens in plants. Selecting different positions in the PVX CP for the fusion of an epitope increases possibility of obtaining an ideal recombinant virion for subsequent animal immunization.

Acknowledgement: This research is supported by the grant No. P501/12/1761 of the Czech Science Foundation and grant No. 631412 of the Charles University Grant Agency.

Genetic transformation of conifers via particle bombardment and *Agrobacterium tumefaciens*

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In recent years, genetic transformation protocols have been developed for several conifer species. Due to high regeneration capacity of the conifer embryogenic cultures they are characterised as ideal tissues for transgenosis. The most important feature of the embryogenic tissues is the presence of bipolar structures – somatic embryos that are capable of development and whole plant (trees) regeneration.

Somatic embryogenesis has been initiated in *Pinus nigra* Arn. and hybrid firs (*Abies alba* x *A. cephalonica* and *Abies alba* x *A. numidica*). The long-term storage of tissues occurred on the solid culture media. The introduced DNA consisted of the *uidA* reporter gene under the control of double CaMV 35S promoter and the *nptII* selection gene.

In *Pinus nigra* (cell line E104) stable transformation has been achieved via particle bombardment. The integration of foreign genes has been confirmed histochemically as well as by PCR analysis. Similarly, in hybrid firs (*Abies alba* x *A. cephalonica*, cell lines AC2 and AC78, and *Abies alba* x *A. numidica*, cell line AN72) transgenic tissues have been obtained by genetic transformation using *Agrobacterium tumefaciens*. The PCR-positive embryogenic tissues produced small plantlets and out of 36 analysed emblings in 11 of them the presence of reporter *uidA* as well as *nptII* selection genes was confirmed.

Acknowledgement: The work was granted by MVTS - COST FP 0905 (Slovak Academy of Sciences) project.

Topic III

MOLECULAR MARKERS IN PLANT BREEDING

Species discrimination of cat and human DNA on the basis of cytochrome *b*

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Species identification is useful for analysing biological traces of humans and animals who became victims of road accidents. Among animals, cats are frequent vehicle knockdown victims, and they are also illegally killed for their skin and lard, which are used in folk medicine. For these reasons, it is important to develop a method for species identification of biological material from domestic cats *(Felis catus*) and humans (*Homo sapiens*).

Primers fc-104/F (5'-CGGCTCCTACACCTTCTCAG) and fc-104/R (5'ACATTTGGC CTCATGGTAGG) flanked a cytochrome *b* fragment of mtDNA belonging to *Felis catus* (NC_001700), while primers hs-81/F (5'-TATCCGCCATCCCATACATT) and hs-81/R (5'-GTGTGAGGGTGGGACTGTCT) flanked a region of the human cytochrome *b* (NC_012920.1).

Appropriate primers were selected based on analysis of their specificity and the differences in the length of the PCR products obtained. These primers were used to perform cross-reactions for cattle, pigs, dogs, horses, cats and humans, which gave no falsely positive results. A PCR product of 104 bp was obtained for feline DNA and a product of 81 bp for human DNA. Because both these PCR products are short, they can also be used for amplification of DNA from degraded traces. The developed method enables the potential content of human and feline DNA to be determined rapidly and conclusively in the analysed biological material. This method could also be further developed to identify both species simultaneously in a multiplex reaction.

Determination of genetic diversity structure, apple scab and powdery mildew resistance genes in apple (*Malus* x *domestica*) genetic resources by molecular markers

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Apples (*Malus* x *domestica* Borkh.) belong to the main fruit species and they are the most important fruit in Europe. Research and Breeding Institute of Pomology Holovousy Ltd. is the national centre for maintaining and preservation of apple genetic resources (1087 accessions). Accurate and permanent identification of plant material within germplasm collection, information about genetic structure of germplasm collection and determination of resistance genes in germplasm collection are important for both conservation and utilization of genetic resources collected in genebank. The aims of our study were to evaluate a genetic diversity structure, genetic relationships and resistance genes to scab (*Venturia inaequalis*) and powdery mildew (*Podosphaera leucotricha*) in the collection of 273 apple accessions from national genetic resources by molecular markers. In our analyses, we used six molecular markers of resistance genes (*Vf*, *Vm*, *Vbj*, *Vr* and *Vh*) to scab and three molecular markers of resistance genes (*Pl-w*, *Pl-1* and *Pl-d*) to powdery mildew. Molecular marker of major *Vf* scab resistance gene was detected in all *Vf* scab resistant apple cultivars and three small-fruited *Malus* spp.: *Malus* Evereste, Golden Gem and Hilleri. Molecular markers of *Vr* and *Vh* scab resistance genes were detected in 21 *Vf* scab resistant cultivars, 58 reference world apple cultivars and 82 old and local apple genotypes. Molecular markers of powdery mildew resistance genes were detected in small-fruited *Malus* spp.: *Malus* Evereste, Golden Gem, prof. Sprengeri and Hilleri; and genotypes 'Hagloe Crab', 'Borovinka' and 'Tita Zetei'. Molecular markers of scab resistance genes *Vm* and *Vbj* resistance genes were not detected. For genetic diversity structure analysis, we used a set of 10 microsatellite SSR loci. SSR molecular data were successfully used in binary and alllelic input format for all genetic diversity analyses. We compared traditional hierarchical clustering techniques and PCoA with the model-based Bayesian cluster analyses in relation to subpopulation differentiation based on breeding history and geographical origin of apple cultivars and landraces. The outputs of our analyses were useful for enhancing of apple collection management, sampling of core collection, enlargement of resistance sources and improvement of breeding process.

Acknowledgement: This work was supported by the National Agency for Agricultural Research of the Ministry of Agriculture of CR in project QH72163.

Plant pathogenic fungus mediated synthesis of silver nanoparticles

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Fabrication of metal nanoparticles by using fungi is known as Mycofabrication. In the present study we have screened eighteen *Phoma* sp. (six species were isolated from soil and infected plant part and twelve species were procured from Institute of Microbial Technology, Chandigarh) for the mycofabrication of silver nanoparticles (AgNP's). Out of eighteen, seventeen *Phoma* sp. demonstrated mycofabrication of AgNP's which were characterized by UV-Vis spectrophotometry, FTIR, XRD, TEM, SEM, Nanoparticle Tracking and analysis system and Zeta potential measurement. SEM and TEM analysis shows the mycofabrication of polydispersed spherical AgNP's, with the exception by *P. sorghina* (MTCC- 2096), which revealed the fabrication of silver nanorods.

Antibacterial activity of mycofabricated AgNP's by all *Phoma* sp. was performed against *E. coli* (ATCC- 39403) and *S. aureus* (ATCC-25923) and antifungal activity against *C. tropicalis* (NCIM- 3110) and *A. niger* (NCIM-1207). Maximum inhibition was shown by AgNP's synthesized by *P. glomerata* and minimum inhibition by *P. medicaginis*. Overall AgNP's mycofabricated by *P. glomerata* showed greater efficacy against gram positive bacteria (*S. aureus*) with MIC of 1.2 ± 0.14 $\mu g.ml^{-1}$ as compared to gram negative bacteria with MIC of 1.8 ± 0.20 $\mu g.ml^{-1}$.

To understand the mechanistic aspect of mycofabrication the effect of pH, temperature, silver nitrate, fungal filtrate and light intensity were studied for the mycosynthesis of silver nanoparticles by *P. glomerata* and *P. sorghina.* The involvement of protein was found to be absolute for the mycofabrication but the process failed to follow the Michaelis-Menton kinetics of enzyme catalyzed reaction. The three steps hypothetical mechanism i.e. activation, nucleation and reduction for the mycofabrication spherical AgNP's is proposed. Present study will be useful for the stable and rapid mycofabrication of AgNP's.

Extracellular method for synthesis of AgNP's was found to be rapid, simple, easy and eco-friendly and can be used as new generation of antimicrobial agents.

Topic IV

APPLIED PLANT BIOTECHNOLOGY

Plant cryopreservation – the method of choise for the long-term storage of plant cells tissues and organs

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Cryopreservation is the storage of biological material at ultralow temperatures (usually at – 196 °C, the temperature of liquid nitrogen) and is based on the arrest of metabolic functions of cells. Over the past decades successful cryopreservation techniques have been developed for a wide range of plant species.

Among the techniques, the classical slow-freezing protocol is often used for cryopreservation of dedifferentiated *in vitro* cultivated plant cells. This protocol has been used for cryopreservation of conifer embryogenic tissues such as *Pinus nigra* Arn. and hybrid firs *Abies alba* x *A. cephalonica* and *Abies alba* x *A. numidica*. The recovery (regrowth) of tissues after thawing was cell line dependent. For *Pinus nigra* altogether 46 cell lines have been cryopreserved and 35 of them (76.1%) survived storage in liquid nitrogen with individual regrowth frequencies ranging between 10 and 100%. The growth of regenerated tissues as well as their maturation capacity or structural features of somatic embryos were not negatively affected by cryopreservation. In hybrid firs the tissue regeneration after cryopreservation reached 100% with individual frequencies for cell lines between 37 and 100%. The growth of hybrid firs cryopreserved tissues was comparable to that of control (non-cryopreserved tissues). During the cryopreservation procedure the bipolar organisation of somatic embryos desintegrated but in the post-thaw recovery phase the original structural features were restored. The hybrid firs tissues also retained their capacity to produce whole plantlets.

Our results suggest the slow-freezing protocol is suitable for long-term storage of conifer embryogenic cultures.

Acknowledgment: The work was supported by the Slovak Grant Agency VEGA, proj. no. 2/0144/11.

Results of *in vitro* thermotherapy and chemotherapy of apple cultivar Jarka

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Apple cultivar ´Jarka´ was selected for application of *in vitro* thermotherapy at 34 ± 0.5 °C and chemotherapy on medium with 20 mg.l^{-1} of antivirotikum rbavirin. The presence of viruses in selected initial trees was detected by ELISA testing before the beginning of sanitation procedures. Cultivar ´Jarka´ was infected with *Apple chlorotic leaf spot virus* (ACLSV) and with *Apple stem pitting virus* (ASPV). ´Jarka´ was successfully multiplied in *in vitro* cultures. Multiplication coefficient was 2.3 ± 0.1 for ´Jarka´ after four weeks of cultivation on MS medium with 1.5 mg.l^{-1} BAP. The heat treatment (34 °C ± 0.5 °C) and chemotherapy (ribavirin 20 mg.l^{-1}) were applied to the *in vitro* cultures on the same MS medium with 1.5 mg.l^{-1} BAP as for multiplication for the period of 30 days. After a culture period of 30 days, the apical part of the axis (about 3 mm in length comprising the apical meristem plus two-three primordial leaves) was dissected under a laminar flow hood and transferred to a fresh multiplication MS medium with 1.5 mg.l^{-1} BAP for regeneration. Twenty *in vitro* explants were taken in each treatment. After the end of chemotherapy, 11 (55 %) clones of apple cultivar ´Jarka´ were free of all tested viruses after repeated ELISA testing. In contrary, only 1 (5 %) clone of ´Jarka´ was virus-free after thermotherapy. The obtained results demonstrate the effectiveness of the system of virus elimination by a combination of *in vitro* cultures, chemotherapy with ribavirin and subsequent removing of apical meristematic region. Relatively high percentage of obtained virus free plants confirms high antiviral activity of ribavirin against ASPV and ACLSV.

Acknowledgement: The work was realized in the framework of research project MSM2527112101 and RO0612.

Biotechnology of growing legumes

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Department of microbiology of Institute of Agriculture of Crimea NAAS has collection of useful microorganisms, over 200 effective strains: rhizobia for soybean, kidney beans, chickpea, pea, bread bean (fava), esparcet, alfalfa and other legumes; associative nitrogen fixing and phosphate mobilizing bacteria; microorganisms-antagonists of phytopathogens, entomocide activity strains, plant growth-promoting strains etc.

Efficiency of the joint using highly active specific strains of nodule bacteria and microorganism polyfunctional action is scientifically motivated on the base of the many year experimental studies. This agrotechnology includes several obligatory elements such as seeds pre-sowing bacterization and plants treatment on vegetation.

Designed biotechnology provides increasing to efficiency of symbiotic nitrogen fixation and yields of grain and herbs legumes by 20-47%, contents of protein in grain of soybean, kidney beans, chickpea, pea, bread bean (fava) by 2-6 % and in green mass esparcet, alfalfa by 1-3 %. However, such biotechnologies allow to protect the plants from phytopathogens and phytophagans, to increase profitability of production by 10-110%, to get the ecological safe and competitive products.

Growth and monoterpene production in shoot cultures of peppermint (*Mentha* x *piperita* L.) *in vitro* conditions

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Monoterpenes are aromatic volatile substances used in pharmaceutical and flavouring industries of the world. Menthol is the most important monoterpene produced by Peppermint as a natural product with wide applications in cosmetics, flavours, beverages and therapeutics. The aim of this work was to optimize the protocol for multiplication of Peppermint and to evaluate *in vitro* produced monoterpenes. Nodal explants derived from field grown plants of Peppermint were inoculated on MS medium (Murashige and Skoog, 1962) supplemented with different concentrations of cytokinins BAP, ZEA, KIN (0.5 or 1 $mg.l^{-1}$) alone or in combination with NAA (0.01 $mg.l^{-1}$) for shoot multiplication. Shoot induction was observed after 15 days and scoring was done after six weeks of culture by counting all shoots on the explants. The best results were achieved by using concentrations of 0.5 $mg.l^{-1}$ BAP, when the number of *de novo* formed shoots reached 25.18 shoots per explants. Pulegone (81.12 %) was dominant compound in *in vitro* grown plants (2 months-old) amongst a total of other 15 different compounds. The presence of high amount of pulegone in *in vitro* cultured shoots of *Mentha* x *piperita* L. may be interesting for the large-scale production of this terpenoid. Our results have also shown that the composition and amount of the mentha oil can be changed by culturing on different media using different growth hormones and culture conditions.

Acknowledgement: We acknowledge the support within the APVV project LPP 0026-09, and the VEGA project 2/0075/12.

Some applications of biotechnology methods for plant breeding acceleration

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Obtaining of doubled haploid (DH) wheat, barely and triticale plants by anther culture method is an important biotechnological approach, which enables significant shortening of breeding process. Nevertheless, this technology often is problematic due to relatively low yield of pollen-derived embryos and green plants-regenerants, and because of high frequency of albino plants-regenerants. The best protocols for producing DH lines by anther culture from barley, spring and winter wheat and triticale hybrids from parents with unknown androgenic response were elaborated. As an initial material were used breeders hybrids of F_1, F_2 and F_3 generations. The cold pre-treatment were applied for all used crops. The positive influence on embryogenesis of cupper (2.5 mg/l $CuSO_4$ x $5H_2O$) adding in induction mediums was found. After 3-6 weeks wheat and triticale embryos and calli were transferred onto 190-1 regeneration medium, barely embryos and calli were transferred on M_1 regeneration medium. Green plants-regenerants of barely were obtained only if pre-treatment by mannitol was used. The best for wheat and triticale embryo obtaining was AMC medium, but higher frequency of green plant regeneration was observed if AMC medium with Cu was used for embryos obtaining.

Two *in vitro* (anther and callus cultures) methods for obtaining flax breeding initial material were applied. Androgenic response of used hybrids ranged from 1 to 11% and was depending from genotype and growing conditions. Regeneration was observed only from diploid callus.

To start hemp breeding very important was to find out optimal conditions of cloning and cultivating of hemp breeding material. The best medium for seeds shooting *in vitro* was medium with a half of MS medium salts, but for plant cultivation the best was MS medium with activated carbon.

Different molecular marker methods were used to find out genetic variability in somaclonal plants-regenerants of different crops, to detect flax rust resistance alleles, for early hemp of female plants identification.

Phytoremediation strategies applied *Panicum virgatum* to the decontamination of soils polluted with heavy metals

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Heavy metals contamination can be a consequence of industrial activities that eliminate residues in the soil that in long terms, promote their accumulation. The majority of the sources are originated by human actions like metal manufacture and mining industries with storage, disposal and transportation problems. Numerous methods of metal clean up strategies were developed and phytoremediation is a new, promising, quickly developing technique.

The aim of the study was to assess the effects of $CuSO_4x5H_2O$ salts on development and physiological activity of *Panicum virgatum* as energy plants and their usefulness in Cu uptake from environment.

The plants of *Panicum virgatum* were grow up in soil watered with copper salt $CuSO_4x5H_2O$ at dosages twice higher than provides standard, at natural conditions of environmental. Lengths of roots, height of plants, activity of electrolyte leakage, chlorophyll content was measured during plant development, while the quantity of copper, nitrogen, potassium, phosphorus in plants was evaluated in the middle of growing season. Activity of photosynthesis [Pn; μmol CO_2 m^{-2} s^{-1}], transpiration [E; mmol H_2O m^{-2} s^{-1}], stomatal conductance [Gs; mol H_2O m^{-2} s^{-1}], intercellular carbon dioxide concentration [Ci; μmol mol^{-1}] was measured infra-red gas analyser (TPS-2, PP Systems, USA). Activity of acid (EC 3.1.3.2) (AcPase) and alkaline phosphatase (EC 3.1.3.1) (AlkPase) in leaves were examined also. The content of copper in plants and soil samples, was measured, calorific value, heating value (kJ kg^{-1}), heat of combustion (kJ kg^{-1}) and ash content (%) in *Panicum virgatum* plants harvest. The research showed that *Panicum virgatum* can absorb copper from environment. The activity of acid and alkaline phosphatise, net photosynthesis, gravity system, water efficiency, transpiration and electrolyte leakage in the plants was changed comparison with control.

The results of present study suggest that *Panicum virgatum* plants were able to accumulate and tolerate the copper from soil, produce of the energy biomass and clean the metal from environment.

Acknowledgement: Research where sponsored by Ministry of Science and Higher Education in Poland, Grant No. N N304 385338

Tissue expression and subcellular localization of THF1 in dodder and its host plant

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It has been shown previously that the Thylakoid Formation Protein 1 (THF1), a nuclear-encoded plastid-localized protein, is involved in thylakoid membrane differentiation, in plant - fungal and plant - bacterial interactions and in sugar signalling with its preferrential localization to plastids. Localization of THF1 protein to plastids in stable transformed *Cuscuta europaea* stems, agree with previous observations of other authors. Western blot analysis, evidencing the highest levels of the THF1 protein in dodder stem attached to the host *Nicotiana benthamiana*, in the haustorium and *N. benthamiana* stems attacked by *Cuscuta*. In young 7-day-old dodder seedlings and flowers without host the the THF1 protein was not detected. Our immunofluorescence localization analyses revealed that in addition to plastids, the THF1 protein localizes also to the plasma membrane and plasmodesmata in developing *C. europaea* haustorium, most abundantly in the digitate cells of the endophyte primordium. Based on the extra-plastid localization pattern of the protein in the plasma membrane and plasmodesmata of the haustorium, our data support rather signalling function of the THF1 protein in the complex relationship between *C. europaea* parasite and its host.

Acknowledgements: This work was supported by Slovak Grant Agency APVV 06K11225 and SPP Grant Foundation 2011.

Evaluation of nontransgenic resistance sources of plum to PPV

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Sharka is considered to be the main and most destructive viral disease of genus *Prunus* in Central Europe. Sharka is caused by the *Plum pox virus* (PPV). PPV can infect most agriculturally significant species in the genus *Prunus*, including fruit trees such as plums, peaches, and apricots. The first reliable information about sharka on the territory of the Czech Republic originates from the thirties and forties of the twentieth century. PPV is currently widespread almost on the whole territory. All main plum growing areas are stricken by the disease and the virus severely affects the fruits of susceptible cultivars. Therefore an experiment with evaluation of resistance of selected 29 plum cultivars after artificial inoculation with PPV was established in insect-proof screenhouse. Ten containerized plants of each cultivar in the experiment were artificially inoculated with two strains of PPV (5 plants with serotype M and 5 plants with serotype D) second year after planting. ELISA tests were carried out in years 2011 and 2012. Symptoms of PPV on leaves of 29 cultivars were evaluated during vegetations 2011 and 2012. M strain of the PPV spread in the artificially infected cultivars quicker then D strain. In the first year M strain infected 43 % cultivars contrary to 34 % infection rate of D strain. After two years of observation, D strain of PPV was not proved in cultivars ´Durancie´, ´Ortenaur´, ´Soufriau´, ´Topfive´, ´Topstar plus´, ´Reeves´ and ´Toptaste´ and M strain in cultivars ´Durancie´, ´Topfirst´, ´Topfive´, ´Topking´ and ´Valcean´. The most pronounced symptoms of PPV on leaves were observed on cultivars ´Toprend plus´, ´Victoria´ (distorted leaves) and ´Ersinger´, ´Valjevka´ (distinct yellow ring spots scattered over all leaves). Obtained results are preliminary. Observation and testing will continue in following years.

Acknowledgement: The work was realized in the framework of research project QI101A123.

In vitro thermotherapy and chemotherapy of apple cultivar 'Jarka'

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Apple cultivar ´Jarka´ was selected for application of *in vitro* thermotherapy at 34 ± 0.5 °C and chemotherapy on medium with 20 mg l^{-1} of anti-viral drug ribavirin. The presence of viruses in selected initial trees was detected by ELISA testing before the beginning of sanitation procedures. Cultivar ´Jarka´ was infected with *Apple chlorotic leaf spot virus* (ACLSV) and with *Apple stem pitting virus* (ASPV). ´Jarka´ was successfully multiplied in *in vitro* cultures. Multiplication coefficient was 2.3 ± 0.1 for ´Jarka´ after four weeks of cultivation on MS medium with 1.5 mg · l^{-1} BAP. The heat treatment (34 °C ± 0.5 °C) and chemotherapy (ribavirin 20 mg l^{-1}) were applied to the *in vitro* cultures on the same MS medium with 1.5 mg l^{-1} BAP as for multiplication for the period of 30 days. After a culture period of 30 days, the apical part of the axis (about 3 mm in length comprising the apical meristem plus two-three primordial leaves) was dissected under a laminar flow hood and transferred to a fresh multiplication MS medium with 1.5 mg l^{-1} BAP for regeneration. Twenty *in vitro* explants were taken in each treatment. After the end of chemotherapy, 11 (55 %) clones of apple cultivar ´Jarka´ were free of all tested viruses after repeated ELISA testing. In contrary, only 1 (5 %) clone of ´Jarka´ was virus-free after thermotherapy. The obtained results demonstrate the effectiveness of the system of virus elimination by a combination of *in vitro* cultures, chemotherapy with ribavirin and subsequent removing of apical meristematic region. Relatively high percentage of obtained virus free plants confirms high antiviral activity of ribavirin against ASPV and ACLSV.

Acknowledgement: The work was realized in the framework of research project MSM2527112101 and RO0612.

Evaluation of currant perspective varieties

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There were 7 varieties of red currant (´Detvan´, ´Heinemann's Rote Spatlese´, ´Jonker van Tets´, ´Losan´, ´Rovada´, ´Rubigo´, ´Tatran´) and 5 varieties of white currant (´Blanka´, ´Jantar´, ´Orion´, ´Primus´, ´Viktoria´) observed in this work. Evaluated vegetative traits were quantity of blossoms, quantity of fruits, and beginning of picking maturity. Evaluated fruit traits were size, firmness, taste, weight of 100 fruits, refraction, and length of bunch. The highest quantity of fruits was found in red varieties ´Detvan´ and ´Tatran´, and white varieties ´Primus´ and ´Jantar´. The longest bunches were detected in red varieties ´Tatran´ and ´Detvan´, and white varieties ´Blanka´ and ´Viktoria´. The taste of red varieties was balanced, the ´Jantar´ variety had the best taste from white currants.

Acknowledgement: The work was realized in the framework of research project QI111A141 and MZe 206553/2011-17253.

A non-destructive assessment method for sugar beet crop diseases

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The aim of this study was to develop a remote sensing method for detection and differentiation of sugar beet diseases in experimental trials. In order to use the specific remote detection instruments (a dual system of OCEAN OPTICS spectrophotometers), we elaborated experimental patterns of imagistic data collecting and created an innovative platform that could be used in field research on small plots (when patterning infections by artificial inoculations). A large number of spectral vegetation indices were calculated and correlation analyses showed strong association between some of this vegetation indices and severity of diseases. Results suggested that remote sensing using spectral reflectance can be non-destructive and accurate method to assess sugar beet diseases. Using this method has the advantages that help the users to warn about the pest infection risk in due time and protection treatments alerts will be given in an early stage of contamination.

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