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Program and Abstracts

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Symposium Venue

Europa Royale Kaunas Hotel
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Conference dedicated to

SAIH2018 Outline Conference Schedule, June 4-6, 2018

Monday, 4-June	
8.00 – 9.30	**REGISTRATION**
9.30 – 9.45	**Opening** Gintaras BRAZAUSKAS (Lithuanian Research Centre for Agriculture and Forestry, Director) Audrius SASNAUSKAS (Institute of Horticulture, LAMMC, Director) Giedrė SAMUOLIENĖ (Institute of Horticulture, LAMMC, Deputy Director for Research)
Session 1. Ecological and Technological Aspects. Keynote Lecture	
Chairs	*Laila IKASE* (*Institute of Horticulture, University of Life Sciences and Technology, Latvia*)
9.45 – 10.15	**Neringa RASIUKEVIČIŪTĖ.** The influence of LED light on *Botrytis cinerea* biometric and biological features (Lithuania)
Oral Presentations	
10.15 – 10.30	**Zanda REZGALE.** Incidence of postharvest pathogens on apple during storage (Latvia)
10.30 – 10.45	**Mirosław SITAREK.** Performance of 'Sylvia' and 'Karina' sweet cherry trees on five clonal rootstocks in long-term investigation (Poland)
10.45 – 11.00	**Edgars RUBAUSKIS.** Yield potential and apple orchard sustainability on dwarf rootstocks (Latvia)
11.00 – 11.30	**COFFEE BREAK**
11.30 – 11.45	**Lina ŠERNAITĖ.** The antifungal activity of plant extracts against *Botrytis cinerea* Pers (Lithuania)

11.45 – 13.00	**Flash presentations**
11.45	**Armina Morkeliūnė.** Essential oils against strawberry anthracnose
11.50	**Magdalena Nawrotek.** Soil acidity and salinity from roundabouts in Rybnik and Oświęcim
11.55	**Laisvūnė Duchovskienė.** Can *Tetranychus Urticae* Koch. be a wild cucumber *Echinocystis Lobata* (Michx.) pest?
12.00	**Veranika S. Kamardzina.** Phytosanitary condition of apple scab resistant and immune cultivars of domestic breeding, cultivated in the orchards of Belarus
12.05	**Constantina Chireceanu.** Survey on the presence of the leafhopper *Scaphoideus titanus* Ball in vineyards in Western Romania
12.10	**Alma Valiuškaitė.** Challenges of *Cydia pomonella* L. control under climatic changes
12.15	**Aliaksandr Mikhniuk.** Effectiveness of the herbicide Alion, SC in the apple-tree nursery
12.20	**Jovita Liutkutė.** Antifungal effect of oregano essential oils on *Alternaria* spp.
12.25	**Iwona Kowalska.** Effect of mycorrhiza on yield and quality of lettuce grown on medium with different levels of phosphorus and selenium
12.30	**Elena Survilienė-Radzevičė.** The incidence of new pathogens on carrots roots in storage
12.35	**Asta Bylaitė.** Early response to *Botrytis cinerea* infection in two different varieties of lettuce
12.40	**Daiva Burokienė.** Fungal diseases of cold-stored *Daucus carota* in Lithuania
12.45	**Ilma Rimkevičienė.** Modernisation and development of information, advisory and training electronic services in the field of integrated plant protection

12.50	**Danguolė Kavaliauskaitė.** Impact of concentrated and granulated organic fertilizers on yield of white cabbage and soil productivity
12.55	**Maria Caus**. Influence of plant growth regulator Reglalg application on physiological responses in *Cucumis sativus* L. seedlings and *Solanum lycopersicum* L. plants
CONFERENCE PHOTO	
13.00 – 14.00	**LUNCH**
Session 2. Product Quality and Post-harvest. Keynote Lecture	
Chairs	*Ewa HANUS-FAJERSKA* (*University of Agriculture in Krakow, Poland*)
14.00 – 14.30	**Rosa Maria RODRIGUEZ JASSO.** Bio-Assisted extraction for active compounds production from vegetable and fruit by-products (México)
Oral Presentations	
14.30 – 14.45	**Dina ELISOVETCAIA.** Evaluation of antioxidant activity and phenolic compounds of *Juniperus sabina* from the Republic of Moldova and Slovakia (Republic of Moldova)
14.45 – 15.00	**Dalia URBONAVIČIENĖ.** Biologically active compounds composition and antioxidant activity of tomatoes SCE-CO_2 extracts (Lithuania)
15.00 – 15.15	**Reelika RÄTSEP.** Evaluation of seed content and composition of fatty acids in blackcurrant (*Ribes nigrum* L.) genotypes (Estonia)
15.15 – 15.45	**COFFE BREAK**
15.45 – 16.00	**Bożena MATYSIAK.** The effect of supplementary white, blue and red LED lighting on growth and quality of leafy greens grown in a greenhouse during wintertime (Poland)

16.00 – 16.15	**Stanisław KANISZEWSKI.** Effects of supplementary lighting with the new LED lamps on the growth and quality of tomato and cucumber transplants (Poland)
16.15 – 16.55	**Flash presentations**
16.15	**Cristina Petrisor.** Organic acids and sugars profile of some grapevine cultivars affected by yellows grapevine symptoms
16.20	**Anna Kolton.** Plants' pigments during pre- and post-harvest treatments of lettuce 'Redin'
16.25	**Edita Dambrauskienė.** The *Coriandrum sativum* essential oil effect on *Cucumis sativus* seeds
16.30	**Grzegorz Bazylak.** Inulin composition exerting protective effect against storage of tumorigenic ioxynil residues in garlic
16.35	**Olena Vergun.** Evaluation of plant raw material of *Galega officinalis* L. and *Galega orientalis* Lam.
16.40	**Ramunė Bobinaitė.** Physicochemical characteristics of fruit leathers supplemented with berry press residues
16.45	**Mahdi Mirzaei.** Evaluation of *Pseudomonas* and *Pantoea* bacteria as antagonistic agents for biological control of fire blight
16.50	**Katsiaryna Vasekha.** Apple anthracnose and some chemical measures of the disease control in Belarus

Tuesday, 5-June	
Session 3. Genetics, Physiology and Breeding. Keynote Lecture	
Chairs	*Azadeh NASRAZADANI* (*Isfahan Azad University, Iran*)

9.45 – 10.15	**Anna KOLTON.** Relation of nitrate reductase and protein phosphatase 2A activity in tomato seedlings under hypoxia stress in root system (Poland)
Oral Presentations	
10.15 – 10.30	**Dessislava TODOROVA.** Exogenous auxin-type compounds amend PEG-induced physiological responses of pea plants (Bulgaria)
10.30 – 10.45	**Małgorzata PODWYSZYŃSKA.** *In vitro* polyploidisation of tulips (*Tulipa gesneriana* L.) and phenotype evaluation of tetraploids (Poland)
10.45 – 11.00	**Laila IKASE**. Breeding apples for improved biochemical content and firmness at Institute of Horticulture, Latvia (Latvia)
11.00 – 11.30	**COFFEE BREAK**
11.30 – 11.45	**Magdalena KULIG.** Problems with intra- and interspecific breeding of irises (*Iris* sp.) (Poland)
11.45 – 12.00	**Lidia SAS PASZT.** Influence of bioproducts in the organic cultivation of horticultural plants on increasing populations of beneficial microorganisms in the rhizosphere of these plants (Poland)
12.00 – 13.00	**Flash presentations**
12.00	**Rasa Karklelienė.** Jerusalem artichoke cultivar ‘Sauliai’
12.05	**Olga Grygorieva.** Variation of fruits morphometric parameters of *Elaeagnus multiflora* Thunb. germplasm collection
12.10	**Antanina Stankevičienė.** The variety and status of *Sorbus* L. genus plants at greneries of Lithuanian cities
12.15	**Monika Czaja.** Leaf characteristics of *Ginkgo biloba* L. growing in an urban environment outside of its habitat

12.20	**Małgorzata Podwyszyńska.** Evaluation of nuclear DNA content / ploidy level of the rootstocks of genus *Prunus* used for plum cultivation
12.25	**Elžbieta Jankovska-Bortkevič.** Effects of polyamines on cold stress resistance of common bean
12.30	**Ingrida Mažeikienė.** RNA stability and infectivity of Blackcurrant reversion virus
12.35	**Sławomir Michałek.** The effect of pre-sowing treatment of seeds with silver nanoparticles on the early developmental stages of green beans
12.40	**Aušra Brazaitytė.** The impact of photoperiod on the growth and internal quality of mustard microgreens
12.45	**Svetlana Pavlova.** New pesthole of plum pox virus in Odessa region (Ukraine)
12.50	**Dzintra Dēķena.** The influence of plum rootstock on the flowering intensity depending on the content of dry matter and reducing sugars in the annual shoots
12.55	**Viktorija Vaštakaitė.** The contents of mineral elements in tatsoi microgreens grown in different substrates
13.00 – 14.00	**LUNCH**
Session 4. Applied Horticulture	
Chairs	*Bożena MATYSIAK* (*Research Institute of Horticulture, Poland*)
14.00 – 14.15	**Ewa HANUS-FAJERSKA.** How plant choice may influence ecosystem services, landscape and air quality in cities (Poland)
14.15 – 14.30	**Carmen Otilia RUSĂNESCU.** Impact of biochar use in agriculture (Romania)
Oral Presentations	
14.30 – 14.45	**Begea MIHAELA.** Increasing the production of eggplant and pepper in the conditions of improving the garden soil through ecological fertilization (Romania)

14.45 – 15.00	**Vida MILDAŽIENĖ.** Molecular processes involved in plant response to pre-sowing seed treatment with cold plasma and electromagnetic field (Lithuania)
15.00 – 15.15	**Nidal SHABAN.** Life Science Universities address the challenge of the Sustainable Development Goals. Case study-Bulgaria and Serbia (Bulgaria)
15.15 – 15.45	**COFFEE BREAK**
15.45 – 16.00	**Šarūnė MORKŪNAITĖ-HAIMI.** *Malus* × *domestica* lipid remodeling during acclimation and seasonal changes (Lithuania)
16.00 – 16.15	**Auwal Ibrahim MAGASHI.** Performance evaluation of soybeans (*Glycine max* (L.) Merr.) genotypes across different locations (Nigeria)
16.15 – 16.50	**Flash presentations**
16.15	**Vilija Snieškienė**. Medicinal plants in Lithuania-Poland border farmsteads
16.20	**Maria Tartaglia.** The defence responses in tomato-aphid interaction in plants grown on soil with biochar
16.25	**Jonas Viškelis.** Geographical fruit growing location affects the antioxidant activity of apple fruits
16.30	**Ewa Hanus-Fajerska.** The importance of sea aster as new multipurpose species
16.35	**Agnieszka Z. Lis-Krzyścin.** The effect of fertilisation on chemical composition of rose leaves
16.40	**Bożena Matysiak.** Frost tolerance of selected Rosa cultivars from the collection of Gene Bank at Research Institute of Horticulture in Poland during spring deacclimation under warming climate
16.45	**Vidmantas Bendokas.** Pre-breeding for future challenges in Nordic fruit and berries – a new 'NORDFRUIT' project
17.00 – 20.00	**CONFERENCE DINNER**

Wednesday, 6-June	
9.00 – 19.00	**Conference Tour**
9.00	**Leaving Europa Royale Kaunas Hotel**
11.00	**Technical tour to Audrius Juška Farm (http://audriausjuskosukis.lt)**
13.00	**Lunch**
15.30	**Technical tour to Orchard Farm**
19.00	**Return to Europa Royale Kaunas Hotel**

Abstracts of Oral Presentations

The influence of LED light on *Botrytis cinerea* biometric and biological features

Neringa Rasiukevičiūtė, Asta Bylaitė, Aušra Brazaitytė, Alma Valiuškaitė, Viktorija Vaštakaitė, Akvilė Viršilė, Pavelas Duchovskis, Giedrė Samuolienė

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The supplemental lighting is used to illuminate plants in controlled environments for higher quality and yield. An increasing risk of pathogens resistance to chemical fungicides encourages the search for innovative solutions in plant protection. Light-emitting diodes (LED) by selecting specific light spectrum could prevent pants damage by the pathogens. The aim of this study was to determine the effect of light quality on the morphological features and kinetic parameters of *B. cinerea.* Research carried out at the LAMMC Institute of Horticulture in 2017-2018. The single spore *B. cinerea* LT13B_FRA_76 isolate about 7-mm diameter was placed in the centre of Potato dextrose agar (PDA). The plates with isolate were grown 21±2°C 7 days at 4 h photoperiod under different monochromatic LED spectrum: royal blue (455 nm), blue (470 nm), cyan (505 nm), yellow (590 nm) and red (627 nm). The control was covered with aluminium foil. The illumination was 20±2 μ mol m^{-2} s^{-1}. The research data shows that different monochromatic LED light influence biometric and biological features of *B. cinerea*. The highest inhibition after 1-day growth was cyan (505 nm) but after 2-days was red (627 nm). After 7 days of growth under LED, the grey mould sporulation differed. The fungus under cyan (505 nm) mycelium was aerial without sclerotia. The distribution of sclerotia varied among treatments. The research data shows that LED light affect grey mould growth, but this research is in the initial stage and needs further analyses.

Keywords: grey mould, growth, monochromatic, mycelium, sclerotia.

Acknowledgements.

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Notes:

Incidence of postharvest pathogens on apple during storage

Zanda Rezgale, Inta Jakobija, Regina Rancane

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Significant part of harvested apples are lost in storage because of the fruit rots caused by phytopathogenic fungi. In Northern Europe, the most common causal agents are *Neofabraea* spp. causing Bull's eye rot, *Colletotrichum* spp. - bitter rot, *Monilinia fructigena* - brown rot and *Botrytis cinerea* causing grey mould. The main aim of this study was to acquire information about apple rot-causing pathogenic fungi and their incidence on different apple cultivars during fruit storage. Experiment was conducted in Latvia from 2014 to 2016. Fruits from six apple cultivars harvested from orchards with integrated pest management and stored in non-modified atmosphere storages were examined. Observations were made two times during storage – 3 months after harvest and at the end of storage. Morphological characteristics were used to identify fruit rot-causing fungal pathogens. The highest incidence of fruit rot was detected on cultivar 'Antej', reaching 10.4 % infected fruit of all examined, 'Auksis' with 8.6 % infected fruit and 'Dace' with 8.0 %. The least fruit rot affected cultivar was 'Sinap Orlovskij' - 1.9 %. Significantly higher ($p<0.05$) proportion of fruit rot causing pathogens were fungus *Neofabraea* spp. with 32.0-45.6 % of infected fruit depending on cultivar and *B. cinerea* (16.8-45.4%). The lowest proportion 0.5-19.7 % among pathogens was *Colletotrichum* spp. Significantly higher ($p<0.05$) occurrence of post-harvest pathogens were detected at the second observation time. There were differences in susceptibility to fruit rot causing pathogens among cultivars.

Keywords: cultivar, brown rot, Bull's eye rot, bitter rot, grey mould.

Notes:

Performance of ‘Sylvia’ and ‘Karina’ sweet cherry trees on five clonal rootstocks in long-term investigation

Mirosław Sitarek

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In the field experiment, fourteen-year-old ‘Sylvia’ and ‘Karina’ sweet cherry trees (*P. avium* L.) grafted on ‘GiSelA 3’, ‘GiSelA 5’, ‘Piku 4’ and ‘Weiroot 72’ clonal rootstocks were compared with trees of the same cultivars on the standard rootstock ‘F 12/1’. The trees grew in a grey-brown podzolic soil, at a distance of 5 × 2.75 m (727 trees ha^{-1}) in the Experimental Orchard in Dąbrowice (Central Poland). The experimental design was a randomized complete block with four blocks and three trees representing each cultivar/rootstock combination in a block. Trees were trained to Vertical Axis as a Vogel Central Leader system. The experimental orchard was irrigated.

The data collected included tree vigour (expressed as trunk cross-sectional area - TCSA), yield and fruit weight as well as content of soluble solids in fruit. Based on TCSA, the largest ‘Sylvia’ and ‘Karina’ trees were on ‘F 12/1’, and the smallest were on ‘GiSelA 3’. The results revealed that the all rootstocks tested in comparison to ‘F 12/1’, significantly reduced the growth of sweet cherry trees. The highest cumulative yields for the years 2008-2017 were harvested from ‘Karina’ trees grafted on ‘GiSelA 5’, while the lowest – from ‘Sylvia’ on ‘GiSelA 3’. Rootstock effects on yield efficiency were consistent between the two cultivars, with the most yield efficient trees on ‘GiSelA 3’, ‘GiSelA 5’ and ‘Weiroot 72’, and the least efficient were trees on ‘F 12/1’. Trees of both cultivars grafted on ‘GiSelA 3’ produced significantly smaller fruits than those grafted on ‘F 12/1’. Effects of rootstock on content of

soluble solids in fruit were modest and statistically insignificant. After fourteen growing seasons, rootstock did not affect survival of ‘Sylvia’ and ‘Karina’ trees. No tree decline and no incompatibility symptoms between rootstock and scion were found. Root suckering was not a problem in this trial.

Keywords: growth, yield, fruit quality, rootstock effect, soluble solids, survival of trees.

Acknowledgements.

This work was performed in the frame of Interreg Baltic Sea Region Programme, Project InnoFruit: Advancement of nontechnological innovation performance and innovation capacity in fruit growing and processing sector in selected Baltic Sea Region countries. Project co-financed by the European Union from the European Regional Development Fund and by Polish found for international scientific projects for years 2016-2019.

Notes:

Yield potential and Apple Orchard Sustainability on Dwarf Rootstocks

Edgars Rubauskis

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M.9 is a very popular choice among dwarf rootstocks taking into account productivity, fruit quality and orchard management, however it has comparably low winterhardiness. There are some alternatives discovered to obtain both smaller trees and better pest resistance. This was a reason to test rootstocks in low temperature conditions and temperature fluctuations during dormancy like in Latvia. In 1998 there was a trial planted with cultivars 'Auksis', 'Zarja Alatau' and 'Spartan' on dwarf rootstocks: Pajam 1, Pajam 2, Mark, M.9 337, M.9 756, M.9 Burgmer 984, M.9 Nic. 29, M.9 Fleuren 56 and M.9 Jork. Since establishment of the trial some unfavourable periods occurred including winters of 1998/1999 and 2002/2003. The trees of cultivar 'Spartan' were the most damaged. At the same time only some damages of trunks were observed for the cultivar 'Zarja Alatau'. After nineteen years the cultivar 'Auksis' had the biggest number of survived trees (75.0 %). All trees of the cultivar 'Auksis' on the rootstock M.9 Burgmer 984 survived. In average most trees survived and yielded on the rootstock Mark (77.8 %). The significant difference among the rootstocks was not found analyzing growth of trees - trunk cross-sectional area (TCSA). The cultivar 'Auksis' had smallest trees – the TCSA 58.0-88.1 cm^2 in 2017. A little stronger growth had cultivars 'Zarja Alatau' and 'Spartan'. If taking into account the average yield per tree potentially a little more productive apple trees were on the rootstocks M.9 337 and M.9 Burgmer 984 (29.6-30.2 t per ha). However, taking into account the number of lost trees the most productive combination of cultivars 'Auksis' and 'Zarja Alatau' were on rootstock M.9 Burgmer 984 - respectively 28.6 and 25.5 t per ha, for cultivar 'Spartan' - on Mark - 27.5 t per ha.

In 2014 there were obtained theoretically highest yields: in the combination ‘Auksis’ / M.9 756 - 65.1 t per ha, ‘Zarja Alatau’ / M.9 Burgmer 984 - 89.4 t per ha and ‘Spartan’ / Pajam 2 - 102.0 t per ha. In the years with high yield the fruit size was the smallest. Comparably bigger fruits had the cultivar ‘Auksis’. Finally, from the all rootstocks compared in this trial the rootstocks M.9 Burgmer 984 and Mark could be suggested for the best orchards sites combined with winterhardy cultivars that will provide orchard productivity and sustainability.

Keywords: *Malus*, productivity, winterhardy, sustainability, M.9.

Notes:

The antifungal activity of plant extracts against *Botrytis cinerea* Pers.

Lina Šernaitė[1], Alma Valiuškaitė[1], Neringa Rasiukevičiūtė[1], Edita Dambrauskienė[1], Pranas Viškelis[1, 2, 3]

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There is a growing demand for biological plant protection because of new and emerging plant diseases. Nowadays plant pathogens are getting or have already acquired resistance to chemical plant protection products. Conventionally chemical pesticides used in disease control are related to various problems; it is already known that synthetic fungicides and insecticides have a negative effect on the environment and human health. Strawberry grey mould, induced by *Botrytis cinerea*, can cause large damage to the yield and quality of the fruits.

The aim of this research is to evaluate plant extracts efficiency against *Botrytis cinerea*, isolated from strawberry. The research was carried out at the LAMMC Institute of Horticulture, Lithuania. The plant extracts of *Carum carvi, Anethum graveolens, Nigella damascena, Coriandrum sativum* seeds and *Mentha* × *piperita* leaves were obtained by subcritical CO_2 extraction. The inhibition of *B. cinerea* was evaluated at several concentrations. The extracts were mixed together with the PDA medium and 10 mm diameter 7 day old mycelium were placed on each plate with the extracts and were incubated at 22 ^{o}C in the dark. The inhibition effect on the growth of the pathogen colonies was evaluated after 1, 2 and 3 days. *Carum carvi* and *Anethum graveolens* seeds extracts were the most effective to reduce the growth

of *B. cinerea*. *C. carvi* seed extract demonstrated 87.35 % and 86.73 % inhibition at the concentrations of 800 µl and 1000 µl (per liter of the growth medium). *A. graveolens* seed extract respectively demonstrated 85.51 % and 87.96 % inhibition at the concentrations of 800 µl and 1000 µl (per liter of the growth medium).

Alternative ways to control and cure plant diseases are needed. *Carum carvi* seed and *Anethum graveolens* seed extracts showed potential for the further *in vitro* research of biological products against strawberry pathogens.

Keywords: *Carum carvi*, *Anethum graveolens, Nigella damascena, Coriandrum sativum*, *Mentha* × *piperita*, inhibition.

Notes:

Bio-Assisted Extraction for Active Compounds Production from Vegetable and Fruit By-products

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Interest and demand for novel and active natural molecules has intensified the development of plant-derived compounds known as bioactives that either promote health or can be toxic when ingested. Nowadays, vegetable and fruit by-products and wastes are desired for production of this kind of bioactive molecules due their biological properties, which are of interest in cosmetic, food, pharma, biotech and soft chemical industries. Traditional extraction techniques have demonstrated several disadvantages and undesirable considerations of cost, environmental impact, yield, efficiency, among others, provoking the necessity for development of alternative extractive procedures, all of them are focused on the enhancement to release of these bioactives from plant cells by cell disruption and extraction through the cell wall. Now, biological, thermal, phisical and green-chemical procedures can be used as assistance techniques or pretreatments before extraction. In our group, several technologies have been used to extract the bioactives, particularly, enzyme and microbial technologies. However, the industrial application of these both biotechnologies is not currently exploited to its maximum potential within the industrial sector. Here, we present and discuss the use of environmentally friendly bio-assisted extraction of bioactive compounds from plant sources, particularly for food and nutraceutical purposes. In particular, we discuss the enzyme-assisted extraction and fermentation-assisted extraction

of phenolics and terpens from agri-food wastes as examples of a process of potential value to the food industry.

Keywords: Bio-assisted Extraction, Bioactives, Enzyme-assisted Extraction, Fermentation-assisted Extraction, Vegetable and Fruits byproducts.

Notes:

Evaluation of antioxidant activity and phenolic compounds of *Juniperus sabina* from the Republic of Moldova and Slovakia

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The aim of this study was to investigate the antioxidant activity and the content of total phenols, flavonoids and phenolic acids in leaves (needles) of *Juniperus sabina* L. (Cupressaceae) cultivated in different countries. Leaf samples were collected from central zone of the Republic of Moldova (RM) and various regions of Slovak Republic: Nitra city (SN), Cerveny Klastor village (SPV) and Tatra Mountains (SPM) of Pianiny region. The antioxidant activity was evaluated by DPPH method; total phenolic content with Folin-Ciocalteu reagent, flavonoids content by aluminum chloride method and phenolic acids with Arnova reagent. Obtained results showed that the extracts from *Juniperus sabina* needles in concentration of 20 mg ml^{-1} possessed the strong antioxidant activities (%): RM (79.14±1.48); SN (78.91±1.54); SPM (78.11±0.82); SPV (68.84±2.74). The direct correlation between the total phenolic content and antioxidant activities of studied samples was evaluated. The

impact of flavonoid compounds and phenolic acids in activities of *Juniperus sabina* leaves to scavenge the free radicals was determined.

Keywords: extracts, plants, *Juniperus sabina*, antioxidant activity, flavonoids, phenolic acids, polyphenols.

Notes:

Biologically Active Compounds Composition and Antioxidant Activity of Tomatoes SCE-CO_2 Extracts

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There is increasing interest in the ability of diets rich in carotenoids and polyphenols to modulate age-related diseases and promote healthy ageing. Systematic approach is expected to provide comprehensive data on the antioxidant capacity of tomato and to facilitate the development of processing schemes for the isolation and fractionation of tomato into valuable ingredients. The antioxidant activity of hydrophilic and lipophilic fractions, obtained by supercritical carbon dioxide extraction (SCE-CO_2) and remaining solid residues after extraction were evaluated. Carotenoids, its *cis*-isomers and polyphenols in different tomatoes varieties, SCE-CO_2 extract and solid residues after extraction were determined by high performance liquid chromatography (HPLC/DAD). The carotenoids were analyzed in freeze dried fruits of five different tomato cultivars (tomatoes were grown in LAMMC Institute of Horticulture (Lithuania) greenhouses collection). The antioxidant capacity of SCE-CO_2 extracts and extracts from freeze dried tomatoes matrixes and remaining solid residues was evaluated by means of DPPH radical scavenging activity (DPPH-RSA) and QUENCHER procedure. The obtained results indicate that in most cases hydrophilic phase possessed significantly higher radical scavenging capacity, reducing power and total phenolic content as compared to freeze dried tomatoes. SCE-CO_2 yielded 25 g of lipophilic fraction per 100 g of freeze dried tomato matrix, with the activity of 251±3.4 μmol TE/g extract as measured in DPPH assay. A positive correlation was found between the total

polyphenolic compounds in samples and their DPPH-RSA (R = 0.84). The SCE-CO_2 reduced the radical scavenging activity of hydrophilic compounds, indicating that considerable part of hydrophilic compounds with particular antioxidant capacity still remains in the solid residue.

Keywords: lycopene, isomers, tomato, supercritical fluid, extracts, antioxidant activity.

Acknowledgements.

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Notes:

Evaluation of seed content and composition of fatty acids in blackcurrant (*Ribes nigrum* L.) genotypes

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Twenty two blackcurrant genotypes 'Karri', 'Almo', 'Ats', 'Elo', 'Varmas', 'Mairi', 'Asker', 'Pilenai', 'Vuciai', 'Ben Alder', 'Ben Nevis', 'Ben Lomond', 'Ben Sarek', 'Intercontinental', 'Titania', 'Öjebyn', 'Lentjai', 'Pamyati Vavilova', 'Zagadka', 10B, 1-96-16 and 2-96-51 were evaluated in two subsequent years. Berry weight, percentage of seeds in the berries and content of fatty acids in the seeds were determined. The composition of fatty acids was identified and quantified using gas chromatography.

Blackcurrant berry weight varied between 1.0 and 1.7 g, depending on the genotype, being the highest in genotypes 'Mairi', 'Karri', 'Intercontinental' and 'Lentjai'. The seed content in berries ranged from 2.2 to 4.6 %, and was the highest in 'Karri' and 'Elo'. On average of two years, the total fatty acid content in the seeds ranged from 24.4 to 31.2 %, showing the highest levels in 'Ben Nevis', 'Pamyati Vavilova' and 'Asker'. The content of fatty acids per fresh weight of berries varied between 0.6 and 1.3 % and was highest in 'Karri' and 'Elo'. The most abundant fatty acids identified in blackcurrant seeds were linoleic acid (LA) ranging from 40.1 to 48.6 %, followed by α-linolenic acid (ALA) from

11.7 to 16.5 %, oleic acid from 10.5 to 16.4 % and γ-linolenic acid (GLA) from 10.9 to 15.6 %. The content of fatty acids correlates positively with the proportion of seeds per fresh weight of berries.

Keywords: blackcurrant, berry weight, seed composition, essential fatty acids.

Notes:

The effect of supplementary white, blue and red LED lighting on growth and quality of leafy greens grown in a greenhouse during wintertime

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Growth, morphology and quality of green- and purple-leaved basil (*Ocimum basilicum* L.), lamb's lettuce (*Valerianella locusta* (L.) Laterr.) and rocket (*Eruca sativa* L.) *grown in a greenhouse with supplementary illumination with white,* blue (440 nm) and red (660 nm) LEDs, all at *130* μmol/m^{2}s, *in winter time were studied.* Under white LED and red LED lights, fresh weights of above-ground parts of lamb's lettuce and rocket were the highest, whereas under blue LED light were the lowest. For green- and purple-leaved basil, no significant differences in biomass production were observed when different light quality were applied. Supplementing with blue LED light resulted in more compact growth of green-leaved basil plants, as compared to plants grown under natural illumination and those supplemented with white and red LED lights. A Force-A Dualex Scientific+ device was used for non-destructive evaluation *of flavonols, anthocyanins and chlorophyll contents in* plants. Blue LED light led to a significantly increased flavonol contents in plants. The flavonol indexes of leafy greens grown under blue LED light was increased by 33 % in both green- and purple-leaved basil, 25 % higher in lamb's lettuce and 26 % higher in rocket than under white supplementary light treatment. There were no significant differences between LED light treatments in chlorophyll indexes for green leafy vegetables, except of lower chlorophyll indexes in green- and purple-leaved basil grown under red LED light.

Keywords: *Eruca sativa*; *Ocimum basilicum*; *Valerianella locusta*; crop improvement; flavonols.

Notes:

Effects of supplementary lighting with the new LED lamps on the growth and quality of tomato and cucumber transplants

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Insufficient amount of light in the winter months creates the need for artificial lighting of seedlings intended for earlier plantings. The purpose of the lighting is to shorten the time needed to produce the seedlings as well as obtain a good quality seedling. In the experiment the 300W LED set of lamps developed by the M-Tech company were compared to the HPS sodium lamps 600 W commonly used in this crops. The supplementary lighting was used between 8 and 24 hours, excluding the lamps when the intensity of solar radiation outside the greenhouse exceeded 200 $W \cdot m^{-2}$. Control plants were grown without supplementary lighting. LED lamps were mounted at the appropriate height and distance ensuring comparable radiation intensity in relation to HPS lamps. In order to evaluate the growth and development of plants irradiated with both types of lamps, the same level of PAR radiation was assumed at plant height, which in conditions without day light was 70-80 $\mu mol/m^2/s$. In day conditions, the intensity of PAR radiation was higher because it was the sum of the radiation of lamps and daylight reaching the greenhouse. After 39 days from the sowing of tomato seeds of the cv. Altadena F1 (January 15 – February 22) a good quality tomato was obtained with artificial lighting of LED and HPS seedlings. The production of Pacto F1 cucumber seedling under both types of lamps lasted 36 days (29.01-6.03). Insufficient amount of light resulted in inhibition of plant growth in control plants. These plants had much lower height, number and span of leaves, fresh and dry mass and their shoots were thinner compared to the lighted ones. LED lighted plants were slightly lower than lighted with HPS

lamps, while they were more stocky and compact, had a larger diameter of the stem and a better developed root system. Furthermore, these plants throughout the growing period had a higher content of chlorophyll and flavonoids. It is worth emphasizing that in the production of seedlings of both tomato and cucumber with LED lamps, 50 % less electricity was used compared to HPS lamps.

Keywords: artificial lighting, LED, HPS, lamps, tomato, cucumber, transplants.

Notes:

Relation of nitrate reductase and protein phosphatase 2A activity in tomato seedlings under hypoxia stress in root system

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Plants are affected by many stress factors. One of them is hypoxia, defined as deficient of oxygen. Plant roots are affected by lower oxygen level due to poor soil or medium aeration as well as soil compaction. During stress metabolic processes are disturbed. For example, nitrogen metabolism is changed during hypoxia stress. Reaction for stress condition required signal perception and transduction including proteins post-translational modifications. Phosphorylation and dephosphorylation of proteins is provided by kinases and phosphatases. One of serine/threonine protein phosphatase is PP2A, participating in the regulation of responses to biotic and abiotic stresses. During hypoxia stress higher nitrate reductase (NR) activity was observed in many species. Activity of NR is regulated by phosphorylation of serine residue and further reaction with 14-3-3 protein. The aim of this study was to compare the activity of PP2A and NR in tomato seedlings during low oxygen stress in root system. Tomato 'Faworyt' was cultivated in hydroponic system. Nutrient solution was aerated. After 25 days plants were divided into two groups: control (aerated) and stress (hypoxia - medium without aeration) and cultivated for the next 7 days. Roots and leaves of plants were evaluated separately. Higher nitrate reductase activity was observed in roots treated with stress conditions and this corresponded with higher PP2A activity. In the case of leaves, NR activity was similar in control and hypoxia treated plants, the

same observation was for PP2A activity. According to obtained results the PP2A activity is correlated with NR activity in hypoxia treated roots of tomato seedlings.

Keywords: low oxygen stress, post-translational modification, nitrogen metabolism.

Acknowledgements.

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Notes:

Exogenous auxin-type compounds amend PEG-induced physiological responses of pea plants

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Drought is among the abiotic stresses, which considerably decrease the agricultural production worldwide. The effects of exogenous auxin-type compounds 1-[2-chloroethoxycarbonyl-methyl]-4-naphthalenesulfonic acid calcium salt (TA-12) and 1-[2-dimethylaminoethoxicarbonylmethyl] naphthalene chlormethylate (TA-14) on drought stress responses induced by polyethylene glycol (PEG) in garden pea (*Pisum sativum* L.) plants were investigated. Preliminary application of TA compounds partially restored the normal growth of PEG-treated plants, led to less accumulation of proline, phenolic compounds and low-molecular thiols and did not provoke malondialdehyde buildup. The pea plants pretreated with auxin-type compounds displayed reduction in hydrogen peroxide content and consequently lower oxidative stress levels. This was confirmed by a decrease of the activity of the antioxidant enzymes superoxide dismutase, catalase, and guaiacol peroxidase. Taken together these results showed that the preliminary application of TA-12 and TA-14 reduced the negative effects of drought stress in pea plants.

Keywords: antioxidants, auxin physiological analogues, drought stress, *Pisum sativum* (L.), stress markers.

Notes:

In Vitro Polyploidisation of Tulips (*Tulipa gesneriana* L.) and Phenotype Evaluation of Tetraploids

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Within the tulip polyploids, in recent horticulture production, the most important are triploids. However with respect to usefulness in breeding, tetraploids are more priced as compared to triploids where the later are usually sterile. Three diploid tulip cultivars ('Fringed Black', 'Victor' and Pol-D 32) were used for the studies. *In vitro* adventitious shoot cultures were treated with antimitotic agents (colchicine 200 mg L^{-1}, oryzalin 5 mg L^{-1}, amiprophos methyl [APM] 15 mg L^{-1} or trifluralin 100 mg L^{-1}) in order to obtain tetraploids. The treatments with colchicine turned out to be the most phytotoxic, resulting in the reduction of the survival rate to 50 % in 'Fringed Black' and to 0-12.5 % in two other cultivars. Among the three tulip cultivars, homogenous tetraploids were obtained only for 'Fringed Black'. Each of the antimitotic agents induced the formation of polyploids, with the highest number for colchicine treatments for which in total 20 tetraploids were detected. Phenotype was evaluated in the fifth growing season. For tetraploids, percentage of flowering plants was lower (33.3 %), as compared to diploids (100 %). In tetraploids, flowering was delayed on average by six days. Tetraploid leaves and flowers were significantly smaller compared to diploids: leaf width by 30 %, tepals by 45 %. Tepals were more rounded and more fringed in tetraploids. Flower stems of tetraploids were shorter by 40 % but their diameters were slightly larger as compared to diploids. Stomata were longer by 30 % and pollen grain diameter was larger by 25 % in tetraploids. Tetraploids were fertile,

pollen germination was on average 6.3 % whereas in diploids 30.3 %. The tulip tetraploids obtained in this study can be used for further breeding and crossed with diploids in order to obtain triploid cultivars.

Keywords: *in vitro*, chromosome doubling, *Tulipa gesneriana*, colchicine, amiprophos methyl, oryzalin.

Notes:

Breeding apples for improved biochemical content and firmness at Institute of Horticulture, Latvia

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Fruit eating quality is a crucial factor for the consumer choice of a cultivar. Fruit flavour is characterized biochemically by their sweetness (Brix), acidity and sugar-acid balance. Another important parameter of fruit quality is flesh firmness. Content of polyphenols, on the other side, characterizes the health value of apples. Higher fruit firmness, sugar and acid content are important also for longer preservation of eating quality during storage. The aim of the apple breeding program at Institute of Horticulture, Latvia, is to obtain new apple cultivars with soluble solids content 12-14 °Brix or higher, total acid content about 0.4-0.8 %, total polyphenol content 100-200 mg $100g^{-1}$ (dessert apples), fruit firmness at eating maturity over 5 kg cm^{-2} (at harvest 7-8 kg cm^{-2}). For this aim, cultivars with high fruit quality were included in crosses since 1997. Fruits of more than 100 elite apple hybrids have been analyzed for their content of soluble solids, acids, polyphenols and firmness. Hybrids and variety candidates with the best complex of biochemical characteristics and flesh firmness were selected: 'Monta', 'Felicita', 'Paulis', DI-93-15-46, H-94-3-71a, Nr. 16-97-86, Nr. 16-97-95, Nr. 28-97-4, Nr. 29-97-20 and others. For these characteristics they significantly surpass cultivars commercially grown in Latvia. Hybrids with soluble solids exceeding 15-16 °Brix, polyphenol content over 200 mg 100 g^{-1}, low or high acid content also were selected, as potentially suitable for wine and

cider making: Nr. 16-97-34, Nr. 19-97-98, Nr. 19-97-154, H-7-03-47, crabapples H-19-05-1 (Pičuks), H-17-05-27 (Auce). Most of the selected hybrids are scab resistant.

Keywords: soluble solids, total acids, total polyphenols, flesh firmness.

Notes:

Problems with intra- and interspecific breeding of irises (*Iris* sp.)

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The investigation was carried out to test the traditional method of breeding beardless irises. The achievement of new hybrids with better useful characteristics are necessary for planting in polluted and dry soils or use as biological waste water treatment. Intra- and interspecific breeding was conducted within the *Laevigatae* - *Iris pseudacorus*, *I. versicolor* and *Sibiricae* - *I. sibirica* series and their cultivars, and inter-series breeds with a *Spuriae* series species *I. graminea*. Fresh and stored pollen viability was assessed. The germination and pollen tube development in the pistil tissue was performed on the modified fluorescence method involving callose staining in pollen tubes. Intra- and interspecific breeding has shown that pre- and post-zygotic barriers exist which make it difficult to obtain seeds at various breeding stages. Types of disturbances in the pollen grain affect germination on the stigma in the development and growth of the pollen tube, the style and in the ovary. Seeds were only obtained from a few such crosses. The viability of both fresh and stored iris pollen is high. Pollen tubes of the tested irises needed 24 to 72 hours to reach the ovules. Traditional breeding methods are insufficient to obtain interspecific hybrids.

Keywords: *Iris*, interspecific breeding, pollination, pollen tube growth, pistil.

Notes:

Influence of bioproducts in the organic cultivation of horticultural plants on increasing populations of beneficial microorganisms in the rhizosphere of these plants

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Normal development of plants in all natural communities, as well as in orchards and vegetable crops, is determined by the proper development of the root system and the activity of the processes occurring in the rhizosphere, including the beneficial effects of symbiotic mycorrhizal fungi and rhizosphere bacteria. The mycorrhizal mycelium increases the absorptive surface of roots and availability of phosphorus, whereas Plant Growth Promoting Rhizobacteria (PGPR) and symbiotic mycorrhizal fungi support the growth and development of plants. Rhizosphere bacteria often act synergistically with mycorrhizal fungi as bioprotectors against plant pathogens, or produce compounds that stimulate plant growth, e.g. vitamins and plant hormones.

Experiments conducted at the Department of Microbiology of the Research Institute of Horticulture have shown that the tested mycorrhizal substrate, peat substrate, manure, compost and sawdust increased, to the greatest extent, plant growth, soil fertility and the development of the root system in strawberry, blackcurrant and apple. The results show a significant increase in plant growth and mycorrhizal frequency in the roots of mulched plants and those fertilized with organic fertilizers, in comparison with plants fertilized with NPK in integrated cultivation. NPK fertilization in integrated

fruit production significantly reduces the formation of mycorrhizas in the roots of fruit plants and limits the occurrence of beneficial groups of microorganisms in the rhizosphere soil. The microbiological bioproducts, i.e. the bacterial-mycorrhizal inoculum, lignite-based fertilizers, compost, biochar and humic acids, used in the organic cultivation of vegetable and fruit plants, increased the numbers of bacteria of the genera *Bacillus*, *Azotobacter* and *Pseudomonas*, and the populations of actinomycetes and microscopic fungi in the rhizosphere soil of these plants.

Keywords: bioproducts, microorganisms, rhizosphere.

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Notes:

How plant choice may influence ecosystem services, landscape and air quality in cities

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Different forms of green infrastructure plays an important role not only in moisturizing, cleaning, and cooling of city microclimate but also in preventing excessive pollution of urban soils. Acoustic screens covered with perennial evergreen climbers prevents from overabundant traffic noise, screens out aerial particulate matter, improve the aesthetic of landscape. Additionally, in the case of green façades this kind of greenery provide an valuable approach to reduce the thermal load of buildings. Furthermore, as far as the older street trees are concerned they considerably contribute to cooling effect up to one hundred meter from their canopy. Another interesting possibility may be 'living walls' creating. In such a case it can be used both plant material rooted in the ground, in kind of containers and those which is planted in pots embedded on the wall. The living wall systems also provide habitats indispensable to augmentation of fauna diversity in cities. Another set of beneficial influence of such green infrastructure on urban environment are considerable reducing of the rainfall run-off rates or counteracting stress reactions of inhabitants as a result of their experience with nature. During the lecture a particular examples of ecosystem services will be pointed out, and the particular role of acoustic screens as vertical gardens will be underlined.

Keywords: climbers, noise attenuating, green infrastructure, urban ecosystem.

Notes:

Impact of biochar use in agriculture

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With a view to the sustainable development of agriculture, it is necessary to efficiently capitalize on own resources to increase the level of energy independence of technological processes, to reduce the use of fertilizers and minerals with the aim of increasing the productive potential of agriculture. Researches on the use of biomass for energy production have led to the conclusion that plant carbon, called biochar, resulting from pyrolysis and gasification processes, is a valuable amendment to agricultural soils and an efficient and very economical way to seize carbon. Using biohazard can increase the diversity of agricultural land in an environmentally sound manner in areas with severely depleted soils, limited organic resources and insufficient water for plant development; Increasing the number of microorganisms beneficial to the soil. Biochor can become a true colony of microorganisms. Experimental biomass gasification activities were carried out, biochor was produced from vineyards by controlled pyrolysis at 750 °C in order to increase soil fertility. By incorporating the biochor into agricultural soils, an increase in fertility is achieved by increasing plant production.

Keywords: horticulture, biomass, micro-gasification energy potential, biochar.

Notes:

Increasing the Production of Eggplant and Pepper in the Conditions of Improving the Garden Soil through Ecological Fertilization

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This paper aims at highlighting the increase in the yield production of pepper (*Capsicum annuum* L.) and eggplant (*Solanum melongena* L.) cultivated in a soil agro chemically improved with waste resulting from the baker's yeast industry (molasses distillation remains and purging sludge). This waste is rich in nutritive elements such as nitrogen, phosphorus and potassium, as well as in calcium and magnesium, therefore being used as an environmentally friendly fertiliser.

The tests were carried out in 2017, in a garden soil scarce in humus and nutritive elements (nitrogen, phosphorus and potassium) from the Bistriţa-Năsăud County (Romania). The experimental variants consisted in treating the eggplant and the pepper with waste from the baker's yeast industry, in various concentrations, applied only once at the root by distribution, thus reaching a phasial fertilisation.

The biometrical measurements and the statistic calculations showed both the uniformity of the relevant parameters of the waste materials derived from the baker's yeast industry, for their utilisation in agriculture, as well as in the increased yield production of vegetables with superior quality as compared to the control variants. The experimental data were represented by the level of the nutritive elements

(N, P, K, Ca and Mg) from the wastes studied and by the level of the same nutrients in the leaves of pepper (*Capsicum annuum* L.) and eggplant (*Solanum melongena* L.).

The tests carried out within the experiments have shown that the wastes from the baker's yeast industry (spent molasses and purging sludge) had the potential to be used for soil fertilisation as complex fertilisers.

Keywords: environmentally friendly fertilisers, wastes from the baker's yeast industry, yield per plant, N / P / K in soil, N / P / K in leaves.

Notes:

Molecular processes invoved in Plant Response to Pre-sowing Seed Treatment with Cold Plasma and Electromagnetic Field

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New emerging interdisciplinary field of research on cold plasma (CP) and electromagnetic field (EF) applications for agriculture is directed towards exploiting of the potential of plant functional plasticity. Seed stress induced by treatment with CP and EF leads to improved seed germination, faster seedling growth and other beneficial effects. Our recent studies were focused on considering the observed plant responses in the context of seed physiology and development. The experiments were performed on 3 perennial woody species, 2 perennial medicinal plants and 4 annual plant species (*Helianthus annuus, Arabidopsis thaliana*; *Raphanus sativus, Fagopyrum esculentum*). We report novel findings important for understanding of CP and EF treatment effects: (1) the extent of the observed effects on germination is dependent on seed dormancy status characterized by seed hormonal balance

(the most important is ratio between absisic acid, ABA and gibberrelins, GA). We showed that seed treatments induce rapid decrease in ABA/GA ratio indicating that CP and EF are extremely powerful dormancy breaking agents; (2) seed treatments modulate H_2O_2 production in germinating seeds, so that CP treatments inhibiting germination decrease ROS generation while EF treatments stimulating germination result in increased ROS generation; (3) seed treatments induce substantial changes in the amount of secondary metabolites (SM) and antioxidative activity in leaves growing seedlings of *E. purpurea*, *T. pratense* and *F. esculentum*. That may possibly lead to increased seedling establishment and defense potential (SM function as antioxidants, antimicrobial compounds or means for plant communication); (4) results of differential proteomic analysis performed on control, CP and EF treated *H. annuus* seeds and leaves of seedlings have revealed significant changes in expression of more than 30 proteoforms in seeds and more that 100 proteoforms (30 % of identified proteoforms involved in photosynthesis) in leaves, indicating that plant stress response induced by seed treatment with CP and EF involves multiple changes in plant gene expression and develop in time.

Keywords: Cold plasma, Electromagnetic field, Phytohormones, Plant stress response, Pre-sowing seed treatment, Proteomics, Secondary metabolites, Seed dormancy.

Notes:

Life Science Universities address the challenge of the Sustainable Development Goals. Case study-Bulgaria and Serbia

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Life science universities have actual opportunity to make a major contribution in sustainable development by responding with a new narrative on how to change society to live in the future.

The Sustainable Development Goals (SDGs) are a collection of 17 global goals set by the United Nations. The broad goals are interrelated though each has its own targets to achieve. The total number of targets is 169. Education is one of the most powerful and proven vehicles for sustainable development. Quality Education "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Obtaining a quality education is the foundation to improving people's lives and sustainable development. Major progress has been made towards increasing access to education at all levels and increasing enrolment rates in schools particularly for women and girls. Basic literacy skills have improved tremendously, yet bolder efforts are needed to make even greater strides for achieving universal education goals. Which presents an opportunity to take a lead on the SDGs and to lead other academic disciplines to push the sustainability imperative.

ISLE is an Association of renowned international Higher Education Institutions, Research Institutes, Companies, NGOs, Foundations and individuals interested in Innovating in, Teaching and Promoting Sustainable Development in Life Sciences, Applied Sciences and Social Sciences in Europe

and worldwide. The main target of this article involved principles of (Education for Sustainable development ESD) in their curricula. One role of universities in sustainable development is to find answers for important societal questions. Second role of universities in sustainable development is to educate global citizens for sustainable development. Third role of universities in sustainable development is to reduce the footprint of campus operations.

Keywords: Sustainable, Education, Goals, Life Science.

Notes:

Malus × *domestica* lipid remodeling during acclimation and seasonal changes

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Membrane integrity is crucial condition for freezing tolerance in plants. Acclimation at low, non-freezing, temperature allows plant to remodel their membranes and prepare for the winter.

We used an UPLC-MS/MS-based lipidomics platform to observe compositional changes of lipids during low temperature adaptation in *Malus* × *domestica* cultivars. Head group specific neutral losses and fragments were used for determining the lipid class. Fatty acid composition of glycerolipids was determined using accurate mass MS/MS collision induced dissociation.

The main lipid classes measured were monogalactosyldiacylglycerol (MGDG), digalactosyldiacylglycerol (DGDG), sulfoquinorosyldiacylglycerol, phosphatidylglycerol, phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine, phosphatidylinositol (PI), phosphatidic acid, diacylglycerides (DG) and triacylglycerides. The major fatty acids observed were 18:3, 18:2, 18:1 and 16:0. Small amount of 16:1 was found from MGDG and DGDG. The fatty acid profile of *Malus* × *domestica* corresponds to a 18:3 plant.

We observed a marked increase in the amount of polyunsaturated fatty acids in membrane lipids of acclimated *in vitro* plantlets, compared to the control samples. In *Malus* × *domestica*, cold adaptation of cellular membranes may be mainly accomplished by remodeling of fatty acid residues in order to maintain membrane fluidity at low temperatures.

Lipid changes were observed in field grown *in vivo* plant samples collected during different vegetation periods (spring, autumn, winter). Lipids typical for spring, autumn and winter fell in three distinct groups. Lipids relevant to spring made biggest group containing members of all lipid classes except PI. High abundance of different DG species during spring implies intensive lipid remodeling at this period. Autumn specific group of lipids was the smallest. Winter lipids typically had more unsaturated and longer acyl groups.

Keywords: fatty acids, *in vivo*, *in vitro*, lipid classes, liquid chromatography - mass spectrometry.

Notes:

Performance evaluation of soybeans (*Glycine max* (L.) Merr.) genotypes across different locations

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The research was conducted at three different locations: Gaya, Gumel and Dutse Sudan Savanna agro-ecological zone of Nigeria in 2015 rainy season to assess some quantitative characters of soybeans varieties. Experimental material consist of three varieties TGX-1987-10F, TGX-1955-4F, TGX-1835-10E all the varieties were laid in Randomized Complete Block Design (RCBD) and replicated three times. Growth and yield characters observed during the experiment were recorded with a significant difference among the three varieties. The result revealed that, the performance of the variety TGX-1835-10E was better in Dutse and Gaya than the other two varieties in the same locations. Thus, farmers in these areas could be advised to use TGX-1835-10E for commercial production.

Keywords: Soybean, Genotype, Different locations and evaluation.

Notes:

Abstracts of Flash Presentations

Essential oils against strawberry anthracnose

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Colletotrichum spp. is a significant fruit pathogen, causing economically important losses of temperate, subtropical and tropical fruits worldwide. The pathogen can affect most parts of the plant and causes yield losses up to 80 %. The pathogen can adapt to cooler climatic conditions due to long tropical warm-days period influenced by climate change. Current management strategies for this fungus comprise the exploitation of cultivar resistance, cultural, chemical, and biological control methods, and preventive strategies such as disease-forecasting models. Anthracnose becomes one of the significant pathogens necessitates exploring novel control strategies, especially for the day – neutral strawberries. The growing resistance to chemical pesticides needs new solutions in controlling diseases before and after harvest. Essential oils can be applied as one of the eco-friendly plant protection controlling plant pathogens.

This study aimed to evaluate the antifungal effect essential oils of *Thymus vulgaris, Salvia officinalis, Coriandrum sativum, Mentha piperita, Hyssopus officinali*s against strawberry *Colletotrichum* spp. The research was carried out at the LAMMC Institute of Horticulture. The inhibition of mycelial growth was evaluated at concentrations 200 µl/l, 400 µl/l, 600 µl/l, 800 µl/l and 1000 µl/l. The isolate fragment (10-mm) placed in the centre of PDA with different essential oil. Plates incubated 25 ^{o}C in 24 h dark and evaluated after 1-5 days. The efficiency against pathogen between *S. officinalis* and *C. sativum* was very similar. *H. officinalis* highest efficiency observed after 5 days at concentration 800 µl/l (2.96 cm). *M. piperita* slightly inhibited - 2.81cm after 5 days at concentration

1000 µl/l. Our data indicate that evaluated concentrations are not suitable for *Colletotrichum* spp., but may be higher concentrations will show better results. *T. vulgaris* essential oil completely inhibited *Colletotrichum* spp. growth at concentrations > 200 µl/l. The results of *T. vulgaris* essential oil study show that it could be an effective biocontrol agent to control strawberry *Colletotrichum* spp.

Keywords: antifungal activity, *Colletotrichum* spp., *Thymus vulgaris*, *Salvia officinalis*, *Coriandrum sativum, Mentha piperita, Hyssopus officinali*s.

Soil acidity and salinity from roundabouts in Rybnik and Oświęcim

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Soil samples were collected in two following years in spring and autumn from the central islands of roundabouts located in Rybnik and Oświęcim. In total, 30 objects were selected for research, 14 of which were located in the Oświęcim town (Małopolska province) and 16 in Rybnik town (Silesia province). The pH and EC of the soil was determined and the content of selected macro and micronutrients. The acidity analysis of collected soil samples showed a higher pH value for the soil from Oświęcim roundabouts compared to soil samples from Rybnik roundabouts. There were no differences in the total salt concentration in the soil of the examined objects, its level did not exceed 2 mS cm^{-1}. There were no differences in the examined factors depending on the season and the world side. The most likely cause of observed differences in the pH level of substrates between the examined cities is a different geological structure of the area of Małopolska and Silesia.

Keywords: roundabout, acidity and salinity, urban soils.

Can *Tetranychus Urticae* Koch. be a wild cucumber *Echinocystis Lobata* (Michx.) pest?

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Wild cucumber *Echinocystis lobata* (Michx.), the representative of *Cucurbitaceae* family, is invasive species in Lithuania. *Echinocystis lobata* is an riparian species imported from America to Europe. In our country this species widespread in moisture and rich soil places, depressing local flora, isolating it from sunlight and redusing growth of plants. The prevalence of pests was evaluated of *E. lobata*. For this purpose populations of this species were investigated within 2015-2016 periods along different riverbanks and any pests was not found. In 2016 were collected cucumber leaves with two spotted spider mite (*Tetranychus urticae* Koch.) adults and removed from them. In laboratory was removed *Tetranychus urticae* Koch. adults from cucumber (*Cucumis sativus* L.) leaves and placed 10 adults on the surface of *E. lobata* (from two different location) and bean leaves. The laboratory assay was set up in five replicates and leaves placed on moistened cotton pads in Petri dishes. *T. urticae* adults survive and lay eggs like on beans leaves, until leaves had defoliated. Any significant differences were not found between numbers of *T. urticae* on different plants leaves. The harmful organisms of *E. lobata* are not abundant, but in future *T. urticae* can be potential pest of wild cucumber.

Keywords: *Cucumis sativus* L., invasive species, two spotted spider mite, riparian species.

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Phytosanitary condition of apple scab resistant and immune cultivars of domestic breeding, cultivated in the orchards of Belarus

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In Belarus apple is a commercially important fruit crop. The belarusian breeding cultivars resistant or immune to apple scab are preferable for growing. However, due to minimal protective measures against the diseases, with time the resistance to scab is lost and cultivars are more intensely affected by other diseases and damaged by pests.

The aim of the studies was to assess the species composition and harmful organism development on belarusian apple scab resistant cultivars.

As a result of the studies, there have been no differences in the species composition of phytophages on resistant apple cultivars. However, the number of sucking insects (mites and aphids) on them has been 4-7 times higher than on the affected ones. The preferential damage of belarusian breeding resistant cultivars by the invasive pest species, such as *Xyleborus dispar* F. is noted.

In apple cultivars, selected as resistant to scab and cultivated in the commercial orchards over time, this property is lost and the disease severity varied considerably on cultivars with monogenic resistance (from 0.1 % to 32.2 % on leaves and 0.1-23.0 % on fruits) and on polygenic resistant ones (on leaves was up to 58.7 %, on fruits – up to 68.0 %).

In the apple collection orchard of the “Institute for Fruit Growing”, the immune and resistant cultivars have lost scab resistance during 3 years and can be infected by the disease in a different degree. Powdery mildew affects both cultivars with polygenic (‘Zaslavskoe’, ‘Verbnae’) and monogenic

(‘Belorusskoe sladkoe’, ‘Nadzejny’, ‘Syabryna’) resistance. The incidence of bark anthracnose can reach 71.4 %. The development of leaf spot diseases complex (up to 10.4 %) and brown rot (2.6-15.2 %) was at the depressive-moderate level.

It is determined that the smaller leaf scab damage, the higher the incidence of other spot diseases on them and the greater fruit damage, the higher fruit rot incidence on them.

Keywords: apple-tree, immune and resistant cultivars, diseases, pests.

Survey on the presence of the leafhopper *Scaphoideus titanus* Ball in vineyards in Western Romania

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Scaphoideus titanus Ball is the vector of Flavescence dorée phytoplasma affecting a number of wine growing areas in Europe. The paper presents the results of two-year (2016 and 2017) survey on the presence of the leafhopper *S. titanus* in vineyards showing simptoms characteristic to yellows diseases from Banat and Crişana vine-growing regions (Western Romania). Twenty vine plantations generated under the reconversion and restructuring program in viticulture in Romania were investigated. The yellow sticky traps technique was employed to capture the insects. *S. titanus* was present in all surveyed vine plantations. The population abundances of the cicadellid differed between plantations, depending on the age and cultivars, and were also variable between years. The data gathered in this study offer useful information and constitute an important step forward in assessing the population sizes and phytosanitary risk of the leafhopper in the vineyards from Western Romania.

Keywords: *Scaphoideus titanus*, survey activity, Romanian grapevine.

Challenges of *Cydia pomonella* L. control under climatic changes

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Codling moth is a key pest in almost all regions where apples are grown. The climatic changes of the latest years led to an obvious change in the biological cycle of the *Cydia pomonella* L. This work presents the results obtained during 2012-2014 at the LAMMC Institute of Horticulture. The trial established in apple orchard where levels of codling moth infestation were constant over several last growing seasons. The presence and flight activity was monitored by pheromone traps (Biobest, Belgium) arranged throughout trial. Numbers of moths caught were recorded at regular intervals. The flight period of codling moth was from 19 ± 5 May and continued until 23 ± 5 August. Under Lithuanian conditions, it can develop two generation, which is not typical, but last years conditions favorable for mating and egg-laying were recorded almost during entire flight period. During all experimental year applications of insecticides were made twice per season. First application against moth eggs was performed at the end of May after four day period of high moth activity and highly favorable weather conditions for egg-laying. The second application was approximately two weeks after first and intended to control hatching larvae. For the application used diverse insecticides to control moth. The insecticides used in all treatments significantly reduced codling moth damage. The best for control codling moth larvae was achieved with 200 gai *chlorantraniliprole* – 94 % at rate 0.4 l ha^{-1} and 200 gai *acetamiprid* – 93 % at rate 0.25 kg ha^{-1}. The less efficiency – 70 % demonstrated 300 gai *indoxacarb* at rate 0.25 kg ha^{-1}. The results indicate that only two treatments efficiently reduced the initial infestation, however, high codling moth population density at the beginning of July and presence

of the second generation led to heavy infestation in the late season. Therefore furthers research are needed for precise investigation of codling moth population variability under climatic conditions changes.

Keywords: acetamiprid, codling moth, chlorantraniliprole, egg-laying, indoxacarb, larvae, mating.

Effectiveness of the herbicide Alion, SC in the apple-tree nursery

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The apple tree is the most common fruit crop in Belarus. To increase the gross harvest and the fruit quality, it is necessary to renew regularly the planting stock, introduce more resistant to noxious organisms and high-yielding cultivars. The quality of seedlings grown in nurseries is affected by a large number of factors, a significant place among which is the weed vegetation, because of the high weed infestation the standard material output is significantly reduced. Weeds are the reserves of many pests and pathogens, including viral diseases.

The objective of our studies has been to study the effective ness of the herbicide Alion, SC in the apple tree nurseries.

Field experiments have been conducted in the first field nursery in the industrial orchard of "Voskhod" in 3 repetitions. The rootstock 54-118 has been planted in the nursery in 2017. The researches have been carried out according to the generally accepted methods in herbology.

Herbicides have been applied on May 3, for weed seedlings.

It has been found that in 30 days after treatment in the variant with Alion, SC 0.2 l/ha (indaziflam 500 g/l) application the weeds number in comparison with control (without treatment) has been reduced for 99.4 %, in 60 days – for 72.9 %, in the standard variant (Stomp professional, MS, 4.4 l/ha) – for 99.0 %; 65.3 %, accordingly. Similar results have been obtained for weed weight reduction: in 30 days in the experimental variant, it has been decreased for 99.6 %, in 60 days - for 74.5 %. The 1-st grade rootstocks output when applying the herbicide Alion, SC has made 92.6 %, when using Stomp

Professional, MS - 82.3 %. In the non-herbicide variant, we have obtained up to 3.4 % of the 1-st grade rootstocks, the 2-nd grade - 61.8 % and 34.8 % of non-standard ones. The negative effect of the herbicide Alion, SC on the apple tree has not been noted.

Keywords: apple-tree nursery, herbicides, weeds, seedlings quality, herbicides efficiency, Alion SC.

Antifungal effect of oregano essential oils on *Alternaria* spp.

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The present study of essential oils of oregano essential oils was designed to compare effect on *Alternaria* spp. This study aimed to evaluate the inhibition of *O. vulgare* subsp. *hirtum* and *O. vulgare* essential oils against cabbage *Alternaria* spp. The essential oil of *O. vulgare* subsp. *hirtum* and *O. vulgare* were extracted from fresh leaf material by hydrodistillation method with Clevenger apparatus. The oregano material was grown at the LAMMC Institute of Horticulture, Lithuania. The inhibition of *Alternaria* spp. growth was evaluated at concentrations 200 µl/l, 400 µl/l and 600 µl/l. The isolate of the pathogen of 10-mm diameter placed in the centre of Petri with Potato dextrose agar. Plates were incubated 22 ^{o}C and evaluated after 1-7 days of incubation. The ability of *O. vulgare* subsp. *hirtum* and *O. vulgare* essential oils inhibit *Alternaria* spp. slightly differed. The *O. vulgare* highest inhibition after 3 days observed at concentration 600 µl/l (86.99 %). *O. vulgare* subsp. *hirtum* inhibited – 91.06 % after 3 days at concentration 400 µl/l. After 7 days *O. vulgare* inhibition was higher than *O. vulgare* subsp. *hirtum.* regano essential oil can inhibit the formation of *Alternaria* spp. pathogens, but futher research are needed.

Keywords: essential oil, inhibition, *Origanum vulgare* subsp. *Hirtum*, *Origanum vulgare.*

Effect of mycorrhiza on yield and quality of lettuce grown on medium with different levels of phosphorus and selenium

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Arbuscular mycorrhizal fungi (AMF) are in symbiosis with over 80 % of vascular plants. Hyphaes of AMF increase the nutrient uptake area of the root system of the host plant, which may improve its nutritional status. The development of the mycorrhizal structures, such as hyphaes, depends on the level of available P in the root zone. If the symbiosis with AMF increases nutrient uptake by the plant, it may be assumed that it also increases the uptake of Se. Se is a necessary component in the metabolism of mammals, while it is not a nutrient for plants. Se contained in plants consumed is the most effective method of enrichment of human diet in this element. The aim of this study was to determine the effect of AMF on Se uptake by lettuce, grown in the medium with different P and Se levels.

The experiment was conducted in the foil tunnel, in the spring period. Lettuce plants of Valeska var. were grown in pots filled with peat substrate. In this three-factorial experiment the treatments were: inoculation of the roots by mycorrhizal vaccine or not (+AMF or -AMF), P level in the peat substrate, i.e. 70 or 140 mg dm^{-3}, and Se level in the peat substrate, i.e. 0, 6 or 12 mg dm^{-3}. Se was applied as Na_2SeO_3.

After reaching of harvest maturity, plants were harvested and the yield was assessed. Microscopic preparations were made from the isolated root system, in which the presence of mycorrhizal structures was determined. In the leaves, the contents of macro- and microelements, including Se were determined

by the ICP-OES technique. The contents of sugars (fructose, glucose and sucrose) and vitamine C were determined by the capillary electrophoresis. +AMF and P level influnced the nutritional status of plants, but Se status was influenced mostly by +AMF and Se level.

Keywords: mineral composition, biofortification, symbiosis.

Acknowledgements.

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The incidence of new pathogens on carrots roots in storage

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The quality and nutritional value of vegetables in long-term storage many cases depend on the manifestation of pathogenic organisms. It is observed that a number of new pathogenic fungi that have not previously been detected cause various damages of carrot roots. Species composition of pathogenic organisms has changed due to a number of factors such as varieties, cultivation technologies, marketable preparation, comparing short-term crop rotation in specialized farms, and climatic changes. To gain insight into the pathogens causing the damages were carried out among crops harvested in 2016 and 2017. Carrots samples were collected from storehouses 2 times at February-April months from vegetable growing farms. Four popular carrots varieties in Lithuania were examined 'Narbone', 'Nerac', 'Niland' and 'Nipomo'.

For investigation, 1605 isolates have been isolated from 5600 carrots samples for the identification of pathogens. It has been determined that the carrots root damage on average amounted to 25.12 %. Pathogens belonged to fungus species *Alternaria radicina* (26.44 %), *Botrytis cinerea* (11.46 %), *Mycocentrospora acerina* (8.75 %), *Rhexocercosporidium carotae* (19.79 %), *Rhizoctonia solani* (9.89 %), *Sclerotinia sclerotiorum* (21.88 %), *Streptomyces scabies* (1.49 %), *Thielaviopsis basicola* (7.94 %) and *Cylindrocarpon* (3.63 %), *Fusarium* (3.89 %), *Pythium* (17.45 %), *Phytophthora* (10.94 %) genus. The incidence of diseases on carrots in storage mainly depended on soil properties,

which are very closely related to crop rotation. Such fungus species, as *M. acerina*, *R. carotae*, *Cylindrocarpon* spp., *Pythium* spp., *Phytophthora* spp. genus are new obtained pathogens in carrots crops and their control require optimal decision systems.

Keywords: carrots, diseases, fungal, pathogens, long-term storage.

Early response to *Botrytis cinerea* infection in two different varieties of lettuce

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Lettuce (*Lactuca sativa* L.) is one of the green leafy vegetables daily consumed because of its nutrients value and easy growing technology. *Botrytis cinerea* causes the grey mould disease of lettuce. On purpose to control grey mould infection is important to know its fungal pathogenesis and plant‘s response after infection.

‘Lollo Bionda’ and ‘Lollo Rossa’ lettuce were grown for 5 weeks in the growth chamber. Day/night temperatures of 21±2 / 17±2 °C were established with a 16-h photoperiod and relative humidity of 50–60 %. The single-spore *B. cinerea* isolate LT13B_FRA_76 maintained on Potato Dextrose Agar (PDA) at 22 °C in the dark for 7 days. Then isolate of 50 mm diameter was used on ‘Lollo Bionda’ and ‘Lollo Rossa’ lettuce varieties for inoculation. Evaluated chlorophyll and flavonol indices, then observed its dynamics during 10 days lasting experiment every day.

Our results revealed that first symptoms of disease exposed at the 3rd day of artificial infection. *B. cinerea* damaged about 5–10 % at the 3rd day of experiment and 25–75 % at the 10th day. The infection was higher on red leafy ‘Lollo Rossa’ lettuce than green leafy ‘Lollo Bionda’, that tendency remained till the last day of experiment. Chlorophyll indices decreased in both lettuce varieties leaves after 24 hours of inoculation. Four days later infected green and red leafy lettuce showed higher chlorophyll index than healthy plants, but till the 10th day infected and healthy plants chlorophyll indices

reached approximately the same level. In contrast, flavonols index tended to increase in healthy and infected lettuce daily till the end of the experiment. It was noticed that flavonol indices of infected plants increased higher than healthy plants. In conclusion chlorophyll and flavonol indices could be a tool to diagnose early symptoms of disease before lesions on leaves become visible, but further research is needed.

Keywords: *Botrytis cinerea*, inoculation, lettuce, chlorophyll index, flavonol index.

Fungal diseases of cold-stored *Daucus carota* in Lithuania

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Carrots (*Daucus carota*) are important crops for a lot of farms. To keep them available for the market all year round, carrots are often kept in cold storages after harvesting for long periods of time. However, fungal pathogens actively damage many cold-stored carrots every year which results in huge losses of profit for the carrot growers: affected vegetables cannot be sold, they have to be rejected for the market, so the loss may reach up to 30 % of a harvest. For this reason, the survey of carrots with specific disease symptoms (blackish spots with irregular edges) from four varieties, 'Nerac', 'Niland', 'Narbone' and 'Nipomo', was performed in 2014–2017.

Disease control measures depend on precise identification of causal agents. Thus, in total, 302 isolates of fungi were gathered; 28 morphological groups based on morphological features of cultures, spores and hyphae were obtained. Also, *Rhexocercosporidium carotae*-like pathogen by the symptoms of the disease, culture and spore morphology analysis according to Årsvoll (1965) was identified. Consequently, all fungal isolates are being further investigated using molecular methods and determining their pathogenicity.

Keywords: carrot, *Daucus carota*, cold-storage, fungal diseases, pathogens, *Rhexocercosporidium carotae.*

Modernisation and development of information, advisory and training electronic services in the field of integrated plant protection

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PI Lithuanian Agricultural Advisory Service (LAAS) tenders an integrated plant protection information, consulting and training information system IKMIS, which presents electronic services for farmers intended for more sustainable and "green" farming. The system IKMIS provides 4 free electronic services: provision of information on the distribution of harmful organisms in crops all through Lithuania; use of electronic catalogues of diseases, pests and weeds as well as plant protection products registered in the country for farmers; provision of interactive consultations regarding the issues of integrated plant protection; and organization of remote training for farmers, agricultural specialists and advisers with certificate issue. The services have been developed taking account of the European agricultural issues relevant today while implementing the EU strategy for sustainable pesticide use, the Plant Protection Law of RL and other legal acts. The system is available at www.ikmis.lt or via a special portal for farmers www.agroakademija.lt. The information system IKMIS is adapted for Lithuanian agricultural business needs.

The application of integrated plant protection on farms is very important as a lot of global problems can be addressed: reducing risks and impacts of pesticide use on human health and environment, encouraging the development and introducting to integrated pest management and

alternative approaches or techniques in order to reduce dependence on the use of pesticides, environmental conservation by its lesser pollution with chemical plant protection means; and the production of safer and higher quality food products without reducing yields. Farmers with new knowledge can manage their farm resources available in more efficient and rational ways thus reducing farm costs. The information available in the IKMIS system is a key to a successful and environmentally friendly future farm.

Keywords: information, consultation, IKMIS, plant protection.

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Impact of concentrated and granulated organic fertilizers on yield of white cabbage and soil productivity

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Due to the increase in the technical and energy potential of agriculture and the intensification of anthropogenic activities is already noticeable negative effects: soil acidification, decline in organic matter, deterioration of quality and increased pollution. Organic fertilizers are soil improvers. Investigations were carried out at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry experimental fields in 2015-2016 to assess the effect of concentrated granulated poultry manure fertilizers used at the different time on the yield of white cabbage, the quality of production and the effect on soil agrochemical properties. Soil type in this area was sandy or sandy-loam *Calc(ar)i – Epihypogleyic Luvisolls (LVg-p-w-cc)*. In the experiments were grown 'Socrates' H white cabbage. According to the results of investigations, the highest white cabbage marketable yield (80.5 t ha^{-1}) was obtained by application concentrated and granulated organic fertilizers in autumn and inserted them into the soil, and in the vegetation period fertilizing by mineral fertilizers. In this variant and in variant, where concentrated and granulated organic fertilizers were used in early spring, in the soil samples, which were taken in autumn after harvest, retained a higher content of humus (accordingly 1.82-1.94 %), organic carbon (1.06-1.12 %) and total nitrogen (0.099-0.147 %). This suggests that the soil has remained richer for plants next year. The residual of mineral nitrogen in the soil decreased accordingly by 8.1-10.8 kg ha^{-1}. Reduced mineral nitrogen content means a reduction in nitrogen

leaching possibility. The highest amount of vitamin C (7.80 mg per 100 g of products) in heads of white cabbage was found after using and inserting organic fertilizers in autumn and mineral fertilizer in vegetation period. The minimum amount of nitrates was after using and inserting concentrated granulated organic fertilizers in autumn.

Keywords: humus, organic fertilizers, poultry manure, white cabbage, yield.

Influence of plant growth regulator Reglalg application on physiological responses in *Cucumis sativus* L. seedlings and *Solanum lycopersicum* L. plants

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Applications of plant growth regulator (PGR) Reglalg preparation diluted with water in various ratios for treatments of *Cucumis sativus* L. seeds and for plants spraying of *Solanum lycopersicum* L., (early repining cv 'Julihirsutian' and late repining cv 'Anatolie') cultivated under field conditions were evaluated for their influence on some physiological processes. Pre-germination treatments of cucumber seeds with Reglalg preparation significantly increased germination and seedling growth parameters, as well as total polyphenols content and their antioxidant activity in plantlets roots. Also Reglalg application to cucumber seeds caused the decrease of peroxidase and catalase activity in seedling roots. Foliar application of Reglalg preparation during vegetation, each 10th day, increased the vigorously of tomato plants and diminished the activity of chitinase in leaves, compared to control plants. The changes of tomato leaf chitinase activity during vegetation of early and late repining cultivars were different, but at the lower level then in control. This study demonstrated that Reglalg preparation application has the beneficial effects on plants growth and development, due to its appropriate actions to the performance of physiological processes.

Keywords: cucumber, physiological parameters, plant growth regulator Reglalg, tomato.

The first study of Solanaceae family (tomato and pepper) thrips in the Béjaia region (Algeria)

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Our study has for object the evaluation of the seasonal fluctuations and the damage of *Frankliniella occidentalis* on two species of the family Solanaceae (*Capsicum annuum* and *Solanum lycopersicum*). For this, we chose two methods of sampling visual counting and blue water traps, during the month of January and September 2015. The selected plots for the follow-up of this study are located north of the Algerian (Béjaia). From the data collected, we noticed that the presence of this insect is very variable depending on the vegetative stage of the two cultures studied. The first attacks start from the beginning of March with a low number of 3 to 6 thrips/leaf. To reach a maximum in July. During the period from June to August 2015, we recorded an infestation rate of over 50 % on peppers.

Keyword: *Frankliniella occidentalis, Capsicum annuum, Solanum lycopersicum,* fluctuations, damage, Béjaia.

Monitoring of onion fly (*Delia antiqua* Meig.) emergence in onion crops using a forecasting system

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Onion fly *Delia antiqua* Meig., is an important pest of onion, *Allium cepa* L. in Lithuania. Recently *D. antiqua* first generation larvae cause the greatest damage by feeding on onions seedlings. Investigation was carried out at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2015-2017. Onion fly hibernates as a pupa in the soil. The flight of the *D. antiqua* starts when soil temperature exceeds more than 10 °C for more than 10 days. For onion fly control optimization, *D. antiqua* emergence forecasting system iMETOS®s model, based on soil temperature accumulation, was used. By model, emergence of *D. antique* adults of first generation varied from 13 till 19 of May depends on year. Yellow sticky traps (IVOGR –System) were used to monitor onion fly too. The model helps to select optimal application time for onion fly occurrence and lets to control this pest more effectively.

Keywords: *Alium cepa*, emergence, forecasting system iMETOS®s, generation.

Acknowledgements.
The study was supported by Project No. 02.3.1-CPVA-V-529-01-0003.

Efficiency of some insecticides against small cabbage white (*Pieris rapae* L.) in sustainable growing white cabbage

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In Lithuania cabbage is an important vegetable, which is attacked by a few of lepidopterous species. One of them - *Pieris rapae* is a cosmopolitan butterfly species become more and more harmful pests for cabbages. The investigation was conducted 2017 in the Institute of Horticulture, LRCAF. There were evaluated insecticides Steward 30 WG (a. i. indoxacarb 300 g kg^{-1}) at rate 0.085 kg ha^{-1}, Decis EC (a. i. deltamethrin 25 g l^{-1}) at rate 0.30 l ha^{-1} and Karate Zeon 5SC (a. i. lambda-cihalotrin 50 gl^{-1}) at rate 0.15 l ha^{-1}. The experiment was designed by randomized blocks at four replications. Mortality of larvae after two applications of Steward varied from 65.8 % till 100.0 %. There were no significant differences (ANOVA) found in abundance of larvae between all treated plots. Efficiency of Steward was higher than Decis EC (54.1 – 69.8 %) and Karate Zeon 5SC (53.3 – 72.2 %). Insecticide Steward 30 WG is enough effective and suitable for use in sustainable vegetables growing system.

Keywords: deltamethrin, indoxacarb, lambda-cihalotrin, mortality.

Parasitoids of Diamondback moth (*Plutella xylostella* L.) in white cabbage

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White cabbage *Brassica oleracea* var. *capitata* L. is widely cultivated vegetable in the Europe as well in Lithuania. Diamondback moth (DBM) (*Plutella xylostella* L.) larvae cause economic damage in cabbage in the fields. In order to save infested plants pest control is necessary in most cases. A lot of insecticides are now ineffective in the control of DBM. There can help parasitoids attacking DBM larvae and pupae. The objective of this research was to determine parasitoids species influence on pupa mortality of DBM. Field samples (DBM pupas) were collected from the cabbages in the experimental fields at the Institute of Horticulture (55°08′ N, 23°80′ E) where cabbage was grown. The collected pupae were kept in test - tubes at 22 ± 2 °C. Each pupa was observed daily in the laboratory until the adult pest or parasitoid emergence. As a percentage of the parasitoids recovered from the pupae of DBM was: *Diadegma fenestrale* Holmgr. – 60.0 % of all pupas, *Oomyzus* sp. 3.2 %. *Diadegma fenestrale* was very significant parasitoid reducing the number of diamondback moth. Besides parasitoids, an unidentified entomopathogenic fungus was also recorded.

Keywords: entomopathogenic fungus, *Diadegma fenestrale*, *Oomyzus* sp., pupa.

Horn meal - a natural nitrogen fertilizer - effects apple tree mineral nutrition and productivity

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Effect of horn shavings on 'Ligol' apple tree cultivar on rootstock P 60 was investigated in the experimental orchard of the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2012–2015. Two fertilizer rates were tested: 50 and 100 kg ha^{-1} N. Horn shavings (14.1 % N) were applied at the end of autumn or at the beginning of vegetation in the spring. In one of treatments, 100 kg ha^{-1} N rate was divided equally into both autumn and spring. The effect of horn shavings was compared with the effects of ammonium nitrate (34.4 % N) and the unfertilized treatment.

The least amount of mineral nitrogen was found in unfertilized orchard soil and fertilized with 50 kg ha^{-1} N horn shavings in the spring – 7.0-7.12 mg kg^{-1}. In all other cases fertilizers increased the amount of soil mineral nitrogen to 9.31-14.27 mg kg^{-1}. 50 kg ha^{-1} N of horn shavings, used in autumn was more effective than used in spring.

The lowest leaf nitrogen content was from apple trees that grew in the unfertilized orchard soil or fertilized in the spring with 50 kg ha^{-1} N of horn shavings – 1.92-1.95 %. In other cases, the leaf nitrogen content was significantly higher – 2.02-2.05 %. Apple trees with lowest leaf nitrogen content gave the least average yield – 34.5 to 36.6 t ha^{-1}. The highest yield was obtained from fruit trees

fertilized with 50 kg ha^{-1} N of ammonium nitrate applied in spring or horn shavings applied in autumn – respectively 42.4 and 41.4 t ha^{-1}.

The influence of horn shavings on the studied parameters was similar to that of ammonium nitrate. Horn shavings like nitrogen fertilizer could be used in organic apple orchards.

Keywords: soil, mineral nitrogen, leaf nitrogen, yield.

Acknowledgments.

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Carrot *Alternaria dauci* infection prediction with iMETOS®sm

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Alternaria dauci infect carrots leaf, roots on seeds occur as spores. The pathogen survives in soil and residues. Primarily infection occurs on leaf petioles but during storage occurs black root rots. The research was carried out at the LAMMC Institute of Horticulture, Lithuania. The study aimed to evaluate the Alternaria leaf blight according to iMETOS®sm forecasting model. iMETOS®sm TomCast Alternaria forecasting model calculates favourable conditions for the disease development. Forecasting model helps to select the optimal time for the fungicide application. Assessment of forecasting model data showed that optimal conditions for *A. dauci* development depend on that year's meteorological conditions. In 2016 favourable days for Alternaria leaf blight spread in June-August were 57 days and in 2017 – 58 in Kaunas distr. According to Alternaria forecasting model data in 2016 Disease Severity Value (DSV) reached highest point (4) on 23 of August. The following factors determined risk periods for infection: the air temperature wain average was 17.3 °C, leaf wetness period lasted 1240 minutes, and relative humidity was 91.4 %. Different results obtained in 2017, the DSV measure reached 4 in 12-13 and 26 of July. Infection risk periods on 12-13 July were: the air temperature was within 14.9–18.2 °C, leaf wetness period lasted approximately 1410 minutes, and relative humidity was 98.0-88.2 %. Risk period in 26 of July was: air temperature 18.8 °C, leaf wetness period 1210 min., and relative humidity was 95.1 %. Then DSV reaches the highest point the conditions for *Alternaria dauci* conidia formation and spread of infection is extremely favourable. According to forecasting model data mostly favourable conditions for Alternaria leaf blight infections formed July

and it was determined due to certain weather conditions. In different agro-climatic regions prevalence of Alternaria leaf blight, infection should be assessed individually. The use of Alternaria forecasting model for carrot protection against *A. dauci* allows optimising the usage of fungicides and using them only when needed.

Keywords: Alternaria leaf blight, DSV, Forecasting.

The reduced plant protection system for apple scab control

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The objective of this trial was to estimate the effect of reduced plant protection system for efficient apple scab control. The research was carried out at the LAMMC Institute of Horticulture in 2013–2016. Apple trees of cultivars 'Connell Red' and 'Rubin' on P 60 rootstock were tested in a full bearing orchard. Reduced plant protection system was based on forecasting system iMETOS®sm. This system recorded meteorological conditions and calculated the apple scab infections at three levels: light, medium and high. The same active ingredients of plant protection products were used not more than two times per season. Preventive treatments (a.i. *cooper hydroxide*, *thiram*, *captan*, *mancozeb*, *dithianon*) were made before the start of rain period if wet period associated with a high ascospore or conidia spread was predicted. Curative treatments (a.i. *cyprodinil*, *difenoconazol*e, *trifloxystrobin*, *kresoxim-methyl*, *pyrimethanil*) were made after the wet period at recommended application rates. The number of high scab ascospore risk varied from 6 to 22 times, it depended on meteorological conditions during the seasons in 2013–2016. The number of high scab conidia risk was from 11 to 40 times according to the year. The maximum number of risks by forecasting system iMETOS®sm was recorded in 2013. Scab susceptible cv. 'Connell Red' on average was sprayed twelve times, when cv. 'Rubin'- nine times. The assessment of scab disease level on leaves and fruit made when symptoms occurred. The efficacy of reduced plant protection system for scab control on susceptible cultivar was 85-89 % when on medium susceptible cultivar – 95-98 %. Reduced plant protection system did not guarantee total scab control; therefore damaged fruits should be thinned manually. Fruit thinning played an essential role in

commercial apple management because after reducing the crop load allows the fruit that remains to become larger and better quality.

Keywords: scab infection, iMETOS®sm, efficacy.

Organic acids and sugars profile of some grapevine cultivars affected by yellows grapevine symptoms

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Yellows grapevine is a group of infectious diseases which are usually associated with phytoplasma pathogens, affecting production and survival of grapevine. The objective of this work was to studying sugars, acids and total phenols of different wine grape cultivars affected by specific symptoms to phytoplasmoses. Berry samples of four cultivars, collected from Miniș-Măderat (Arad County) and Odobești (Vrancea County) vineyards, were analyzed. Individual sugars and organic acids compounds were identified and quantified in grape berry by the high performance liquid chromatography (HPLC) method using DAD and RID detectors, while total phenolic compounds by using spectrophotometry. The content and composition of sugars and acids varied considerably between healthy and symptomatic plants. Analysis of grape revealed significant reduction in sugars (fructose and glucose) of grapes from symptomatic vines relative to non-symptomatic vines. Higher values of acidity were obtained in grapes of symptomatic vines compared to non-symptomatic vines. Differences in acids content between grapes of symptomatic and non-symptomatic vines were more pronounced at Pinot Noir variety, with significantly lower concentrations of malic acid and higher tartaric acid concentrations in grapes from symptomatic vines in both locations studied. Grapes affected by

phytoplasma symptoms did not differ significantly from their healthy counter parts in succinic acid content. Also, a significant decrease of total phenolic compounds was observed in symptomatic compared to asymptomatic grape berry. Results in this paper showed a clear negative effect of phytoplasmoses symptoms on grape fruit composition.

Keywords: HPLC analysis, grape composition, phenolic compounds, phytoplasmoses.

Plants' pigments during pre- and post-harvest treatments of lettuce 'Redin'

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Plants pigments like chlorophylls, carotenoids as well as anthocyanins are beneficial for human health. Their accumulation in plant tissues is affected by many factors. The influence of light on the synthesis of these compounds was studied in many experiments. However, there is just a few information about accumulation of pigments as a result of pre- and post-harvest treatments. In our experiments two hypotheses were tested: i) the increase of pigment concentration will be significant after just few days of special lightning before harvest, ii) light and temperature are critical for pigments synthesis or degradation after harvest. Plants of *Lactuca sativa* 'Redin' were cultivated in greenhouse with natural solar radiation. Seven days before harvest plants were moved to chamber and lighted with LED lamps (composition of diodes: red 630 and 660 nm, blue 450 nm, green 520 nm, UVA 360 nm; light composition: red 53 %, blue 29 %, green 15 % and UVA 3 %, light intensity 200 μmol m^{-2} s^{-1}). After harvest plants were kept in plastic bags for 4 days in i) dark with cold temperature (4 ^{o}C), ii) dark with room temperature (21 ^{o}C) and iii) light (75 μmol m^{-2} s^{-1}) with room temperature. The decrease of chlorophyll pigments content was observed after 4 days of storage (the highest changes in the case of light with room temperature treatment), but the carotenoids content was similar in each treatment. Anthocyanins content was nearly double after lightning with LED lamps but changed after storage

(depending on storage conditions). The highest changes among all pigments were observed in the case of the anthocyanins. The obtained results indicate dynamic changes of pigments content in leaves of 'Redin' lettuce affected by pre- and post-harvest conditions. This findings needs further investigation and should be included in management/trading of horticultural commodities.

Keywords: chlorophylls, carotenoids, anthocyanins, UVA, storage.

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The *Coriandrum sativum* essential oil effect on *Cucumis sativus* seeds

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The effect of aromatic plant essential oils on vegetable seed pathogens has been investigated at the Institute of Horticulture. The hydrodistillation of essential oil using the Clevenger-type apparatus done from dry coriander seeds. The essential oils obtained from 0.4 % to 1.2 %. Seeds were treated with coriander essential oil concentrations: 200; 400; 600; 800; 1000 µl. The antifungal effect of essential oils has been detected against *Fusarium*, *Alternaria* and *Penicillium* fungi species on the surface of cucumber seeds. The *C. sativum* essential oil inhibited pathogens at the concentrations of 800 and 1000 µl. The highest concentrations of essential oil slightly reduced the germination of cucumber seeds. The germination of seeds was 96 % at 1000 µl essential oil, 97 % at 800 µl and 99 % at 600 µl of essential oil on cucumber seeds. The highest germination rate (100 %) were obtained using 200 µl and 400 µl essential oil concentrations. The positive effect of coriander essential oil may be used for protection of cucumber seeds against pathogenic fungi in future.

Keywords: coriander, cucumber, germination, inhibition.

Inulin composition exerting protective effect against storage of tumorigenic ioxynil residues in garlic

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Ioxynil (IO) is iodocyanophenolic type herbicide used in raw crop protection of garlic (*Allium sativum* L.) and linked with suppression of thyroid hormones and induction of various tumors in mammals by inhibiting of intercellular communications related with connexin43 assembled gap junction channels (Leithe et al., 2010). Residual amounts of IO as commonly consumed with garlic should be continuously monitored to enable elimination of this xenobiotic. Ability of plant derived inulin chains for highly specific recognition, binding and transport of iodine containing thyroid hormones was observed in our previous electrochemical study (Mitrofan et al., 2015). On this basis formation of intermolecular bioconjugates between iodine containing IO and model inulins, as structurally similar to originated in garlic native inulins (GNIs), could be postulated and used to predict tendency for IO storage by garlic treated as source of probiotic dietary fiber. Thus, content of IO and its bioconjugates was determined by SPE-CE-MS/MS and SPE-CE-hyphenated with potentiometric detection using originally developed series of liquid-membrane microsensors containing nanodiamond particles

functionalized with four structurally different types of commercial inulins as IQ (oligofructans), HD (short polyfructans), TEX (long polyfructans) and IN (dodecylated polyfructans). GNIs was isolated by ultrafiltration, ion-exchage and gel-chromatographic procedures and analyzed by ^{1}H and ^{13}C NMR. Superior limit of detection for assay of free IO (20 ng/g d.m.) was obtained using constructed microsensors based on TEX. Mean content of IO in garlic samples was 55 ng/g (range 36÷178 ng/g) and was accompanied by increased ratio of polyfructans fraction in mixture of oligo and polyfructans forming the GNIs. Polyfructan fraction of garlic inulins is possible potential nanocarrier of traceable amounts of stable ioxynil bioconjugates which could easy penetrate into lower section of human intestine.

Keywords: garlic, polyfructans, ioxynil, bioconjugates, sensors, electrophoresis.

Evaluation of Plant Raw Material of *Galega officinalis* L. and *Galega orientalis* Lam.

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It was investigated plant raw material of *Galega officinalis* L. (goat's-rue) and *Galega orientalis* Lam. (fodder galega) which are known as fodder crops with high productivity of green mass. The current study was aimed to evaluate an accumulation in dry plant raw material of selected plants the total content of polyphenols, phenolic acids, and flavonoids as compounds with antioxidant activity by spectrophotometric method. Also, it was determined calorific value of dry raw of under-ground parts of investigated plants during vegetation. Study of dry *G. officinalis* raw showed that accumulation of total polyphenol content in different organs was in range from 9.13±0.30 to 32.76±1.26 mg GAE g^{-1} (gallic acid equivalent), phenolic acids – from 3.65±0.24 to 15.17±0.12 mg CAE g^{-1} (caffeic acid equivalent) and flavonoids – from 10.08±0.94 to 65.75±5.05 mg QE g^{-1} (quercetin equivalent). In raw of *G. orientalis* was identified total polyphenol content from 6.73±0.23 to 26.77±0.51 mg GAE g^{-1}, phenolic acids – from 3.52±0.39 to 18.52±1.64 mg CAE g^{-1} and flavonoids – from 6.09±0.67 to 46.72±0.26 mg QE g^{-1}. It was established that less concentration of studied compounds found in the stems for both species. It should be noted that content of phenolic acids in the leaves was decreased during vegetation, and flavonoids in stems – increased for both species. Content of polyphenols in the leaves and generative organs, phenolic acids in the generative organs and flavonoids in the leaves

decreased in raw of *G. orientalis* during vegetation. The caloricity of selected plants during vegetation was from 3789.80 to 4227.40 Cal g^{-1} for *G. officinalis*, from 3800.00 to 4267.80 Cal g^{-1} for *G. orientalis*. The most calorific value was noted at the stage of budding for both species.

Keywords: *Galega officinalis* L., *Galega orientalis* Lam., polyphenols, phenolic acids, flavonoids, calorific value.

Physicochemical characteristics of fruit leathers supplemented with berry press residues

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The aim of the work was to supplement apple and black currant fruit leather with dried sea buckthorn, blackcurrant and raspberry press residues powders, and to evaluate the effect of the press residue additive on the content of total phenolics, total anthocyanins, antioxidant activity and textural properties of the leathers. Fruit leather was supplemented with three different powders (1) freeze-dried sea buckthorn press residue (moisture content 10.4 %) (2) conventionally dried black currant press residue (moisture content 9.2 %) and (3) freeze-dried raspberry press residue (moisture content 4.6 %). The contents of total phenolics, total anthocyanins, antioxidant activity, colour and textural properties of fruit leathers were evaluated. The content of phenolic compounds in powdered sea buckthorn, black currant and raspberry press residues was 13.7, 24.3 and 28.5 mg g^{-1} (dw) respectively. The content of anthocyanins in black currant press residue powder was 14.5 fold higher than in raspberry press residue powder. Addition of berry press residue powders reduced hardness of fruit leathers. Fruit leather supplemented with sea buckthorn press residue was 1.8 times softer than the control. The highest content of phenolic compounds was found in the fruit leather with dried sea buckthorn press residue powder 670.7 mg 100 g^{-1} (dw). The content of anthocyanins in fruit leathers supplemented with black currant and raspberry press residue powders was significantly higher compared to control sample (60.4 and 47.4 mg 100 g^{-1}, respectively). Berry press residue powders increased antioxidant activity of fruit

leathers. DPPH free-radical scavenging activity of fruit leathers supplemented with dried sea buckthorn press residue powder was 9.5 % higher compared to control.

Keywords: antioxidant activity, fruit leathers, berry press cakes, phenolic, texture.

Acknowledgements.

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Evaluation of *Pseudomonas* and *Pantoea* bacteria as antagonistic agents for biological control of fire blight

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Fire blight caused by *Erwinia amylovora*, is an important bacterial disease of pome fruits which is reported throughout the world. Since there are some environmental considerations on the disease control by using of chemicals, biological approaches are of top interests to research on. In the present study, the antagonistic potential of some epiphytic bacteria against *E. amylovora* were evaluated by field experiment. For this purpose, *E. amylovora* which was isolated from an apparently infected pear orchard in Qazvin province was used. To isolate epiphytic bacteria, leaf samples from healthy pear and apple orchards in Qazvin and Tehran provinces were collected and cultured in nutrient agar according to conventional bacteriological method. The isolated bacteria were screened for growth inhibitory effects on *E. amylovora* by using of *in vitro* antibiosis test. Two isolates which showed significant inhibitory effect were selected for further evaluation. These two isolates which were originated from apple trees of Tehran and pear trees of Qazvin, were then identified as *Pantoea* spp. and *Pseudomonas* spp. respectively by the use of different morphological, biochemical and physiological tests. In the field test, the blossoms of three groups of 5 pear trees were sprayed with *Pseudomonas* spp., *Pantoea* spp. (both at 10^8 cfu/ml) or the same volume of sterile water as control group. After 48 hr, all trees were inoculated with *E. amylovoa* at 10^9 cfu/ml. The results showed that 14 days after inoculation of *E. amylovora*, *Pseudomonas* spp. and *Pantoea* spp., could reduce blighted blossoms at 73.7 % and 86.4 % respectively as compared with the control ($p<0.01$). The findings from orchard experiments clearly indicated that

these two bacterial isolates exert considerable antagonistic activity which could be efficiently used as biological agents in the control of fire blight.

Keywords: fire blight, biological control, *Pseudomonas* spp., *Erwinia amylovora*, *Pantoea* spp.

Apple anthracnose and some chemical measures of the disease control in Belarus

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In Belarus the harmfulness of apple anthracnose has increased after an extension of the orchards, grown under the intensive technology, and new cultivars introduction. In the studies of foreign authors it has been discovered that the causal agents of the disease are 4 pathogenic fungi within the fungal genus *Neofabraea,* characterized by different level of pathogenicity and aggressiveness. In Belarus orchards the pathogens are responsible for production of cankers on limbs and trunks of apple trees. Canker phase can cause severe damage to plants, kill newly planted trees by girdling shoots, and reduce the vigour of trees with a resultant reduction of fruit yield. The incidence of the disease can reach up to 90 %. The cankers serve as the source of inoculum for inciting Bull's-eye fruit rot.

The aim of the researches was to assess the spread incidence of anthracnose canker on apple tree shoots and the efficacy of the fungicide Topsin M, SC (thiophanate-methyl, 500 g/kg) application. The trials have been done during 2015-2016 in the orchard of "The Institute for Fruit Growing" on belarusian breeding apple cultivar 'Imant'.

As a result of the researches it is noticed that the intensive anthracnose spread occur, starting from the 'petal fall' stage, and without protection measures the number of infected shoots can reach 41.9-61.0 % to the end of the season. During 2 years of studies it has been determined that 2 and 3 times applications of Topsin M, SC fungicide in dormancy period (after pruning trees), 'pink bud' and 'petal

fall’ stages have reduced the disease incidence up to 66.3-70.6 % in comparison with the variant without treatment. The efficacy of the product has reduced to 60.8 % without spraying during pruning period.
Keywords: apple, anthracnose, incidence, fungicide efficacy.

Valorization of Selected Agro-industrial By-products

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Juice pressing is a common way of industrial fruit and vegetable processing. During this processing, a considerable amount of by-product (press cake) is generated. The by-products from plant materials processing are sources of complex carbohydrates, proteins, lipids, and phytochemicals and can be material for commercially important substances. The aim of the work was to evaluate chemical composition and antiradical properties of press cakes obtained after juice pressing of rowanberries, carrots and red beetroots. Freeze-dried press cake powders were investigated. Total phenolics, DPPH radical scavenging activity and total sugars content of the samples were determined. In addition, carotenoids were analyzed in the press cakes of rowanberries and carrots, and the total betalain content in the press cake of red beetroots.

The red beetroot press cake powder contained the highest total sugars content. The highest content of total phenolics was detected in the press cake powder of rowanberries (1502.3 mg/100 g dw), followed by red beetroot and carrot press cake powders (158.0 and 97.7 mg/100 g dw, respectively). The DPPH radical scavenging activity of rowanberry press cake power was 64.9 μmol TE/g dw, whereas antiradical activity of vegetable press cake powers was up to 25 times lower.

The by-products of fruit and vegetable processing are inexpensive and valuable material for the extraction of value added ingredients for food and non-food applications.

Keywords: carrot, red beetroot, rowanberry, press cake, chemical composition, antiradical activity.

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Jerusalem artichoke cultivar ‘Sauliai’

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Jerusalem artichoke is an alternative plant with the ability to form a numerous of tubers and distinguishes with the nutrition value. Jerusalem artichoke cultivar ‘Sauliai’ is perennial, herbaceous, flowering plant. Therefore, the breeding of unconventional plants is very important in Lithuania.

Jerusalem artichoke cultivar ‘Sauliai’ have been developed at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry during the 2012–2017 period. Individual and mass selection was employed for the development of Jerusalem artichoke cultivar. The breeding of ‘Sauliai’ was focused on the productivity. Jerusalem artichoke was planted last ten days period of October in all year investigation. Tubers of Jerusalem artichoke were harvested second ten days period of May. The soil of the experimental site was a *Calcic Endogleyic Luvisol* (*LV-gl-n-cc).* According to our data of the four-year studies, the plant length of stem was 1.7–1.9 m and diameter 1.8–2.4 cm. Cultivar ‘Sauliai’ is characterized by leaf medium size and the yellow flowers. Results in our investigation showed, that the size and shape of the tubers depend not only on the genotype, but also on the environmental conditions. The colour of tuber skin is white. Weight of tubers reached 90–185 g and the productivity to 86 t ha^{-1}. Tubers accumulated 15.6 % of total sugar and 4.6 % of ascorbic acid approximately.

Keywords: cultivar, breeding, Jerusalem artichoke, selection, tuber.

Variation of fruits morphometric parameters of *Elaeagnus multiflora* Thunb. germplasm collection

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Elaeagnus multiflora Thunb. (cherry elaeagnus, cherry silverberry, goumi, gumi) has long been grown in China, Korea, and Japan. It has been for centuries cultured as a decorative as well as for food and medicinal plant. This species is known in Chinese traditional medicine.

The objects of the research were 30-year-old plants of *Elaeagnus multiflora*, which are growing in the Forest-Steppe of Ukraine in M. M. Gryshko National Botanical Garden of NAS of Ukraine (NBG). They are well adapted to the climatic and soil conditions. Observations on the collections genotypes of *Elaeagnus multiflora* in the period 2016-2017 were performed during mass fruiting. Pomological characteristics were conducted with four replications on a total 30 fruits per genotypes. The following measurements were taken: fruit weight, in g, fruit length, in mm, fruit diameter, in mm and seed weight, in g, seed length, in mm, seed diameter, in mm.

Their morphometric parameters were following: fruit weight from 0.32 to 1.89 g, fruit length from 7.60 to 19.54 mm, fruit diameter from 4.39 to 10.32 mm, seed weight from 0.10 to 0.41 g, seed length from 7.40 to 13.30 mm, seed diameter from 1.34 to 5.07 mm. The shape indexes of fruits and seeds were found ranging from 1.25 to 1.56 and from 2.90 to 4.04, respectively. The analysis of coefficient of variation showed the difference of variability in morphological characteristics between *Elaeagnus*

multiflora samples. Data showed that the most variability of important selection characteristics are the average cumulative seeds weight – from 18.72 to 36.61 %, seeds diameter – from 10.46 to 24.29 %, fruits weight – from 9.15 to 22.24 %. The other characteristics are more or less stable.

This study is significant as first selection work in Ukraine. Obtained results are important for breeding new varieties of *Elaeagnus multiflora* as well as their practical use. The results of the study are helpful for understanding the variability and attempting the selection of superior desirable *Elaeagnus multiflora* accessions for bringing to commercial cultivation.

Keywords: *Elaeagnus multiflora*, fruits, seeds, morphometric parameters.

The variety and status of *Sorbus* L. genus plants at greneries of Lithuanian cities

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The main requirement for urban greeneries is durability and longevity. Constant monitoring of plant status is very important for new planting selection and also maintaining old growth. In 2009–2017 the greeneries monitoring was carries out in Alytus and Kaunas cities, which have a large variety of woody plants. The status of plant *Sorbus* L. was evaluated, 3 species, 2 cultivars. These are mature and newly planted trees at protective street and recreational plantations. These plants had injuries of physiological origin (defoliation, discoloration, necrosis, dry branches) and fungal diseases, causative agents – *Venturia inaequalis* (Cooke) G. Winter and *Phyllosticta sorbi* Westend. Injuries of physiological origin were frequent among newly planted plants: the strongest appeared in dry summer of 2015: discoloration of *Sorbus* × *thuringiaca* 'Fastigiata' was 1.95±0.14, deloliation – 0.94±0.14, necrosis – 0.03±0.14. They also had fungus-caused injuries of spot: *Venturia inaequalis* (0.46±0.10), *Phyllosticta sorbi* (1.40±0.11). Other newly planted *Sorbus aucuparia*, *S. intermedia* and its cultivar 'Browers' than injuries of physiological injuries from 0.03±0.14 to 0.75±0.08 grades. *S. aucuparia*, *S. intermedia* growing at protective street greeneries in 2014–2017 had physiological injures of 0.03±0.04–1±0,2 grades, during 2009–2017 annually 0–0.28±0.04 by rust fungi (*Venturia inaequalis*) and in 2016 *Sorbus intermedia* – spot causitive agent *Phyllosticta sorbi* (0.44±0.04). *Sorbus aucuparia* at recrational greeneries in 2015–2017 for the spring soaking in Kaunas Oak park, had injuries of physiological origin of 0±0.16–1.76±0.10 grades. *S. aucuparia* and *S. intermedia* plant species were

injured annually by *Venturia inaequalis* (0.01±0.19–1.38±0.38), in 2016 and 2017 – *Phyllosticta sorbi* (0.44±0.80–1.21±0.08).

Keywords: greeneries, *Sorbus* L., Lithuania.

Leaf characteristics of *Ginkgo biloba* L. growing in an urban environment outside of its habitat

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Some authors state, that *Ginkgo* is highly adaptable to various conditions, including urban areas. Although most of the research is taken in the Asian continent – in China and Japan, where the species is common. In Poland it is an exotic tree, seldom planted in public urban areas until the recent years. The aim of this work was to estimate the influence of urban environment on leaf characteristics of *Ginkgo biloba* L. Authors assumed that all of the urban-generated stress factors are magnified in non-native habitat for *Ginkgo*. On the other hand, the 'urban environment' is a very imprecise term. Within the city, we can distinguish areas with better and worse conditions for plant growth and development. Evaluation includes selected physiological parameters, to examine condition of *Ginkgo* trees in urban environment in specific climate fluctuations in southern Poland. Chlorophyll *a* fluorescence was probed with the OJIP-test, also chlorophylls and carotenoids contents were determined, as well as electrolyte leakage was estimated. The laboratory analyses were carried out on 91 trees. Trees were classified in two groups according to age: juvenile trees without sex expression and mature trees with sex expression. Second qualification comprised five groups according to particular place of growth in urban area. Investigated parameters showed disturbance of the photosynthetic performance in trees growing along streets. Increase of energy dissipation (DI_0/RC, DI_0/CS) suggests that *Ginkgo* will not promise longevity in

those specific conditions. Research implies that despite recommendations for planting in urban environment across central Europe, *Ginkgo* suffers from anthropogenic stress in this area.

Keywords: chlorophyll *a* fluorescence, OJIP-test, environmental stress, photosynthetic efficiency, urban trees.

Evaluation of Nuclear DNA Content / Ploidy Level of the Rootstocks of Genus *Prunus* Used for Plum Cultivation

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For breeding purposes, evaluation of nuclear DNA content was performed in order to determine ploidy level of rootstocks of genus *Prunus* for plums. In the first stage of the research, the conditions of flow cytometry analysis (with application of propidium iodide for DNA staining) (FCM/PI) were optimized: type of buffer for nuclei extraction and incubation time as well as selection of internal standards (genotypes with known nuclear DNA content). Repeatable results and relatively good-quality histograms were obtained using Partec extraction buffer with 1 % PVP addition, with incubation time longer than 50 min. The best internal standard for FCM analysis of *Prunus* rootstocks with a nuclear DNA content from about 0.5 to 1.4 pg proved to be *Solanum lycopersicum* (2C = 1.96 pg), which peaks 2C and 4C did not coincide with the peaks of the genotypes tested, but overlapped partially with the peaks of *Prunus* genotypes with larger genomes tested. For rootstock genotypes with a nuclear DNA contents from 1.8 to 2.3 pg, *Glycine max* (2.91 pg) or *Zea mays* (2C = 5.44 pg) were selected as the internal standards. In the second stage, the optimized method and well-chosen internal standards allowed to assess with high precision the nuclear DNA content / ploidy level of *Prunus* genotypes of the rootstocks for plums. For the standard *Prunus* genotypes of the known chromosome number, 2C DNA values was 0.68 pg for diploid *P. cerasifera* var. *divaricata* Led. 'Anna', the value of 1.18 pg for triploid 'Gisela 3' (*P. cerasus* 'Schattenmorelle' × *P. canescens*) and 2.16 pg for hexaploid *P. domestica* 'Eruni'.

In four rootstock genotypes (‘Ferciana Ishtara’, ‘VVA-1’, ‘Druzba’ and ‘GF 667’) 2C values ranged from 0.61 to 0.67 pg indicating their diploid chromosome number. Three rootstocks were identified as hexaploids (‘St. Julien A’, ‘Pixy’ and ‘GF 655/2’) owing to their DNA contents from 2.07 to 2.23 pg. The rootstock ‘P 8.13’ was considered as pentaploid due to their 2C value of 1.64 pg which was approximately two and a half times more than in diploid *Prunus* sp. (2C DNA = 0.66 pg). The ploidy level of genotypes of plum rootstocks was discussed in relation to morphological and agronomical traits.

Keywords: genome size, rootstock, *Prunus domestica*, flow cytometry.

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Effects of polyamines on cold stress resistance of common bean

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Polyamines (PAs) are nitrogen containing organic molecules, widely distributed in plants. Putrescine (Put), spermidine (Spd) and spermine (Spm) are the most commonly found PAs. The influence of exogenous application of various PAs (0.1 mM) on cold resistance of common bean (*Phaseolus vulgaris* L.) was studied in laboratory and field conditions. Selected parameters such as content of leaf photosynthetic pigments, free proline, malondialdehyde and hydrogen peroxide as well as the activities of ATPase were estimated in the third pair of leaves.

Our study showed that in the case of freezing temperatures (18 h) in laboratory conditions, the accumulation of proline was significantly increased when putrescine was applied. In not stressed shoots, the influence of polyamine application on proline accumulation was not significant. Experimental results showed that the number of seeds per pod wasn't so much affected by putrescine sprayed on bean plants in the field. The number of pods per plant and seeds per plant were very similar to control. So application of putrescine hadn't a significant effect on the yield of common bean. H_2O_2 accumulation was significantly increased by the application of the PA spermidine. Other PAs mainly reduced H_2O_2 uptake. The activities of ATP-ases were dependent upon the status of the membranes influenced by freezing temperatures and were lower in control plants than in treated by PAs.

Keywords: hydrogen peroxide, malondialdehyde, ATPase, proline, *Phaseolus vulgaris* L.

RNA stability and infectivity of Blackcurrant reversion virus

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Blackcurrant reversion virus (BRV) belongs in the subgroup c of genus *Nepovirus*. BRV vector is gall mite (*Cecidophyopsis ribis*) and both photogenes are widespread in all countries where blackcurrants are grown. *R. nigrum* is the primary natural host of BRV, although natural infestations occur also in other *Ribes* ssp. Some *Ribes* spp. species and cultivars are resistant to BRV or *C. ribis*, and the origin of resistance to virus is not clear. Several molecular markers related to resistant to BRV and *C. ribis* have been identified in several *Ribes* spp. genotypes. Reliable molecular markers are useful for selection of *Ribes* spp. cultivars with inherited genetic resistance to BRV and *C. ribis*. The aim of our study was to establish genetic diversity and infectivity *in vitro* of BRV and to assess the ability of molecular markers in order to distinguish resistant *Ribes nigrum* cultivars.

Occurrence and genetic diversity of BRV were established by PCR. The 3' RNA1 and RNA2 of virus are highly similar and most stable untranslated parts of genome. These parts are involved in the strand synthesis initiation, regulation and translation. Heterogenic infection of BRV in the same plant of 'Gojai' was detected. Different BRV isolates were selected with restriction enzymes *Apa*I and *Hha*I. Homology among sequences of 3'UTR from 94.6 to 99.6 % was found. Stability of virus RNA1 and RNA2 in phosphate buffer and BRV infection capacity of inoculation *in vitro* were evaluated. Freshly prepared inoculation buffer was the most infectious for contamination of cultivars 'Dainiai' and 'Vernisaz'. Five specific oligonucleotide primer pairs were used for detection of virus RNA1 and RNA2 in inoculation buffer and in inoculated plants. Resistance to BRV of *Ribes* species and cultivars by

inoculation *in vitro* were investigated. ‘Aldoniai’, ‘Dainiai’, ‘Didikai’, ‘Domino’, ‘Katiusa’, ‘Minaj Shmyriov’, ‘Ritmo’, ‘Smaliai’ and ‘Viktor’ remained virus free after inoculation treatment *in vitro*. Cultivars ‘Vernisaz’, ‘Senjorai’, ‘Tauriai’, ‘Titania’ and ‘Gojai’ were susceptible to BRV. The presence of the 8 molecular markers (SCAR, SSR and AFLP) linked to resistance to BRV and *C. ribis* in 16 *R. nigrum* cultivars and 8 *Ribes* species were established. Factorial analysis has shown that tested molecular markers grouped according to the dependence on resistance to *C. ribis* or BRV. One specific molecular marker for detection of genotypes with resistance to gall mite and virus among *Ribes* spp. was not found.

Keywords: BRV, inoculation, molecular marker, resistant, *Ribes* spp.

The effect of pre-sowing treatment of seeds with silver nanoparticles on the early developmental stages of green beans

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Green bean is a nutritious ingredient in the human diet and, in many countries, its share in the structure of vegetable production is gradually increasing. It is a thermophilic plant, sensitive to chilling temperatures and water deficiency, especially in the early stages of its development. In the temperate climatic zone in the spring time coolness often occurs, hence it is a critical period in the development of green bean. In order to improve the resistance of bean to cold stress in horticulture practice, various treatments and technologies are implemented, including nanotechnology, in which it is used, among others metallic silver. Silver nanoparticles (AgNPs) are non-ionic forms, size 1 to 100 nm, occurring in solution in very large dispersion. Thanks to the microscope size and the large interaction surface, they exhibit biological properties at very low concentrations.

In our study the effect of pre-sowing treatment of seeds with nanosilver on the early developmental stages of two cultivars of green bean (Delfina, Bali) were investigated. Germination of seeds was tested under controlled laboratory conditions, while the dynamics of emergence and the early stage of vegetative development of plants were examined in field conditions.

The results of laboratory tests have shown that the pre-sowing conditioning of bean seeds in the nanosilver solution positively affects the dynamics of germination of seeds and the biological quality of seedlings obtained from them. In field studies, the beneficial and consequential impact of the applied

treatment on the dynamics and uniformity of emergence as well as on the development and biological quality of seedlings, evaluated on the basis of biometric and physiological parameters, was significant. The results of the study also showed that the treatment improves the resistance of both varieties of green bean to pathogen infections and chilling stress, but to a greater degree of Delfina than Bali.

Keywords: bean, chilling stress, nanosilver, nanotechnology, seed conditioning, vegetables.

The impact of photoperiod on the growth and internal quality of mustard microgreens

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Microgreens is a popular type of leafy vegetables because of biologically active substances that are important for daily nutrition in humans, and as decorative elements due to the variety of shapes and colours. They are often cultivated under indoor conditions, where light parameters, including photoperiod, are one of the main factors influencing plant growth and the biosynthesis of biologically active substances. The study was aimed to evaluate the effects of light-emitting diodes (LED) lighting photoperiod on growth and internal quality parameters of mustard microgreens under controlled environmental conditions. The mustard (*Brassica juncea* L., 'Red Lion') microgreens were grown under different LED lighting photoperiods – 8, 12, 16, 20 and 24 h. For lighting treatments, the main LED lighting units consisting of blue 455 nm, red 638 nm and 665 nm, and far-red 731 nm LED were used. The total photosynthetic photon flux densities (PPFD) at 300 μmol m^{-2} s^{-1} were maintained. Our results revealed that the 8 h photoperiod led to hypocotyl elongation in mustard microgreens. The shortest hypocotyls of mustard were formed under the 24 h. The 20 h led to higher fresh weight and enlarged leaf area of mustard. The 24 h photoperiod led to decreased chlorophyll index in mustard. No significant differences for chlorophyll index under other photoperiods were determined. The significantly higher contents of phenolic compounds and the DPPH free radical scavenging activity were determined in

mustard under the 20 and 24 h and the total anthocyanins - under 8 h and 12 h photoperiod of LED lighting. The 8 h and 20 h photoperiod led to significantly higher contents of ascorbic acid, β-carotene and lutein-zeaxanthin. The 24 h photoperiod of LED lighting resulted in significantly lower contents of the investigated metabolites. In summary, the photoperiod of 20 h was the most suitable for growth and internal quality of mustard microgreens.

Keywords: *Brassica juncea* L., carotenoids, DPPH, growth, phenolics, total anthocyanins.

Acknowledgements.
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New pesthole of plum pox virus in Odessa region (Ukraine)

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Plum pox virus (PPV) causes sharka - the quarantine viral disease of stone fruit trees. The disease causes heavy losses in susceptible varieties of stone fruit crops. On the territory of Ukraine there are 5 areas under the quarantine. Odessa region takes the third place in Ukraine in PPV disease. Objective – to conduct phytosanitary monitoring of planted stone fruit crops in different districts Odessa region based on modern information technology with GPS system, the preparation of an electronic map, which will register the coordinates of the potentially dangerous PPV-infection as accurately as possible. For the last few years, we were carrying out a phytosanitary monitoring of hundreds hectares of stone fruit orchards on the territory of Odessa region. To conduct phytosanitary zoning and determination of potential areas for the progress of the disease in different districts Odessa region, we have used the modern method of geographical information system (GIS). We conducted monitoring on plantations of peaches, cherries, apricot, nectarines and all planting sour and sweet cherries. In 2016-2017, during inspection of stone fruit orchards in Razdelnaya and Tatarbunary districts of Odessa region typical symptoms of PPV on plum trees were revealed, on peach and cherry trees have atypical symptoms of PPV. To identify the virus the infected plants were subjected to visual diagnostics. All samples were analyzed with ELISA, and positive samples were tested by PCR. Among the stone fruit crops, PPV-positive were: the peach and sour and sweet cherry in Razdelnaya district, and sweet cherry in Tatarbunary districts. PPV-M strain was the only strain of the virus detected in every hotbed in these districts. GIS-aided maps were constructed showing PPV spread in Razdelnaya and Tatarbunary districts. Timely diagnosis, the

geospatial data, and the ability to generate detailed maps, are key to the success of PPV containment vectors control and prediction of the spread of pests.

Keywords: Plum pox virus, disease, stone fruit trees, hotbed, geospatial data.

The influence of plum rootstock on the flowering intensity depending on the content of dry matter and reducing sugars in the annual shoots

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Sharp temperature fluctuations, when thaws are changing with frost, have been observed in the Baltic region with changing climate more and more often. Therefore, the question about rootstock influence on the winter-hardiness of plum tree flower buds is becoming actual. The choice of rootstock is the main precondition for establishing of high yielding and sustainable plum orchard. Freezing of flower buds is one of the most significant winter damages for stone fruits. The aim of the investigation was to compare the changes of the content of dry matter and reducing sugars in the annual shoots during wintering period and its influence on the wintering ability of trees. The dynamics of reducing sugars in one-year shoots during the wintering period were investigated during two successive seasons (2010/2011 and 2011/2012) in two locations. Orchards were planted in 2001 in Institute of Horticulture (Latvia) and in Polli Horticultural Research Centre (Estonia). Well known hybrid plum 'Kubanskaya Kometa' (*Prunus rossica* Erem.) was grafted on eight clonal rootstocks 'St. Julien A', 'Brompton', 'Ackermann', 'Pixy', GF8/1, G5/22, GF655/2, 'Hamyra' and eight generative propagated rootstocks 'St. Julien INRA 2', 'St. Julien d'Orleans', 'St. Julien Noir', 'Brompton', 'Wangenheims Zwetsche', 'St. Julien Wädenswill', 'Myrobalan' and *Prunus cerasifera* var. *divaricata*. Trees spacing was 5 × 3 m. Plots were designed in randomised layout, in four replications per rootstock with three trees per plot.

Shoot samples were harvested two times during the wintering period – in the end December and in the end January. Dry matter content (mg g^{-1}) was detected in laboratory. The concentration of reducing sugars (mg g^{-1} DW) was determined by Bertran's method. The tree flowering intensity was scored using the scale from 1 to 5, where 1 = no flowers, 5 = abundant flowering. As one of the most stable rootstock/graft combinations in the trial was variant with using 'GF655/2' as rootstock where dry matter content was between 491 and 525 mg g^{-1} and reducing sugars 37.5 – 49.2 mg g^{-1}, flowering intensity scored between 2.5 and 4.

Keywords: *Prunus rossica*, rootstocks, winter- hardiness, 'Kubanskaya Kometa'.

The contents of mineral elements in tatsoi microgreens grown in different substrates

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Microgreens are well known as a type of young vegetables with fully development cotyledon or one pair of small true leaves. The selection of suitable substrate is very important for the accumulation of nutrients such as mineral elements in short time like microgreens grow. The aim of the study was to evaluate the contents of macro and microelements in tatsoi (*Brassica rapa* var. *rosularis*) microgreens grown in different substrates. Microgreens were grown in greenhouse (9 days, 22/18 ± 2 °C day/night temperature, 60 ± 5 % a relative air humidity) during winter season. The high-pressure sodium (HPS) lamps (SON-T Agro, Philips) were used as supplemental lighting to natural daylight, and the total photosynthetic photon flux density (PPFD) about ~160 ± 10 µmol m^{-2} s^{-1} was measured. Three different substrates were chosen for experiment – peat (PROFI 1), coconut fiber's (ORGANIX COCOSUBSTRATAS) and compost (Organic compost Universal). The contents of macro and microelements were determined using microwave-assisted acid digestion and ICP-OES techniques. The significantly ($p<0.05$) higher contents of potassium, sulphur and magnesium in tatsoi grown in coconut fiber's and compost were determined, in comparison to peat. The same tendency was observed on microelements iron and zinc contents in tatsoi. However, the highest ($p<0.05$) contents of phosphorus

and calcium in microgreens grown in peat were evaluated. In conclusion, the accumulation of mineral elements in tatsoi microgreens depends on substrate they are grown in.

Keywords: *Brassica rapa*, macroelements, microgreens, microelements, substrates.

The influence of potassium formate foliar application on physiological parameters and yielding of spinach under drought and cold conditions

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The yielding of spinach (*Spinacia oleracea* L.) depends mainly on water and minerals availability in soil, including potassium. Because it is a plant with a short growing season, and potassium is applied before seed sowing there is a danger of insufficient supply of plants in this element, which in addition to nitrogen is taken up by plants in the largest amount. This is particularly important for plants growing under stress conditions, such as: periodic water deficit in the soil or chilling temperatures. Under these conditions, the uptake of water and minerals by plants is limited. In addition, these stresses cause a decrease in the turgidity of plant cells, reduction of chlorophyll content and disturbance of photosynthesis and other physiological processes, and, as a consequence, reduction in the size and consumption quality of crop.

The only way to quickly supplement the potassium deficiency in plants is to apply foliar fertilization with this nutrient. The rate of penetration of potassium cation into leaf tissues depends on the type and properties of the chemical form of this element. The results of previous studies indicate that potassium formate (HCO_2K) is the most physiologically effective form of potassium in foliar nutrition. It is an organic potassium compound currently being tested and implemented in the agricultural and horticultural practice by Perstorp.

The obtained results clearly indicate that foliar application of potassium formate influenced the resistance of spinach plants (cv. ‘Matador’) to stress periods of drought and chilling stress. Foliar feeding plants with potassium formate were characterized by better physiological parameters such as the intensity of net photosynthesis, photochemical efficiency of the photosystem II, the content of assimilative pigments and minerals. In addition, the yield of spinach leaves fed with a tested potassium form was significantly higher than that of non-fertilized plants in both optimal and stress conditions.

Keywords: chilling, chlorophyll, drought, foliar nutrition, potassium formate, spinach, vegetables.

LED light intensity affects shoot development and leaf architecture of *Gerbera jamesonii* Bolus

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Light is essential for plants' growth and development. It determines morphogenesis during *in vitro* culture and research studies have indicated that the mixture of red and blue light spectrum is the most appropriate. However, light intensity is also very important and affects plant's development and shoot multiplication.

The objective of this study was to investigate the effect of different light intensities on growth parameters of *Gerbera jamesonii* 'Big Apple' shoots multiplicated *in vitro*. The culture was conducted on Murashige and Skoog (1962) medium enriched with 0.5 μM NAA and three combinations of BA: 1, 2.5 and 5 μM. The spectrum of red (70 %) and blue (30 %) LED light mixture was used and three photosynthetic photon flux density (PPFD) combinations were tested: 40, 80 and 120 μmol m^{-2} s^{-1}. White fluorescent light (40 μmol m^{-2} s^{-1}) was used as an additional control. Biometric observations of shoot number and height, plantlet fresh and dry weight and leaf blade and petiole architecture parameters were evaluated after six weeks of culture.

It was shown that the studied levels of light intensity and cytokinin content in the medium had an effect on some of the morphometric parameters of the propagated shoots. Twofold higher light intensity, compared to control (40 μmol m^{-2} s^{-1}), did not affect the number of formed shoots, but 120 μmol m^{-2} s^{-1} inhibited their formation; in the latter case, the shoots were the shortest. Each increase in light intensity

above the standard value enlarged the leaf blade area and its width. A decrease in the diameter and length of the leaf blade and the length of the petiole was observed at 120 μmol m^{-2} s^{-1}.

The highest multiplication coefficient was recorded on medium with 5 μM BA. Shoots propagated on this medium were characterized by the lowest content of dry matter; they also had reduced all leaf architecture parameters.

Keywords: blue and red LED, multiplication rate, leaf blade, petiole length.

Petals of wild Polish roses as potential nutraceutical foods

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Nowadays, culinary arts are attempting to improve the aesthetic food presentation. Petals of many rose species are one of the most commonly used edible food decorations. The consumption of rose petals has a centuries-old tradition. In ancient Rome, various species of roses were used to prepare purees and omelettes. In Poland, petals of *Rosa rugosa* are commonly used as aromatic jam to enhance the taste of the pastry. In China and Korea, *R. chinensis* and *R. rugosa* are used in teas, cakes and as medicinal remedies of various illnesses. At present, edible flowers gain back the attention of chefs, restaurants owners and are becoming increasingly popular due to their extraordinary and glamorous appearance as a garnish of many dishes and desserts. Despite ornamental and sensory factors, edible flowers, especially rose petals, have an important nutritional value and are a rich source of bioactive compounds.

This study aimed to determine the pro-healthy value of petals of 4 wild Polish rose species from Caninae: *Rosa agrestis, R. canina, R. dumalis* and *R. rubiginosa.* Petals have been collected from plants grown in the natural environment in the south of Krakow, as well as from plants from the field collection. The total antioxidant capacity (TAC) was determined by DPPH and FRAP methods. The contents of total phenols and total flavonoids were measured using a spectrophotometer.

We have demonstrated that rose petals have high antioxidant activity. Analyses of pro-health properties of rose petals showed differences between rose genotypes that were also dependent on their origin. The highest TAC-FRAP and total phenols were observed in petals from the natural environment (*in situ*), and the lowest FRAP value was recorded in *Rosa dumalis* petals.

Our experiments demonstrate that Polish wild roses can be a new source of nutraceuticals due to their high antioxidant and chemoprotective value, contributing to their popularization for use in human nutrition.

Keywords: antioxidant activity, DPPH, FRAP, phenols, flavonoids.

Cluster analysis of purslane (*Portulaca oleracea* L.) cultivars under different saline conditions

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Purslane (*Portulaca oleracea* L.) seed of eight genotypes imported from different regions of Asia, tested at the Experimental station, school of agriculture and Biology in April 2017. The genotypes was compared among themselves to find the salt tolerate and salt sensitive genotypes, uniform size and full grain seeds of purslane were selected and seeded directly into the mixed matrix, which was composed of garden soil and perlite (7:3). Each basin included 7-10 seeds. After 6 weeks, NaCl was added in five concentrations of 0, 25, 50, 100 and 200 mM. To avoid osmotic shock of salinity, saline treatment was imposed incrementally by increasing the concentration of 50 mM every other day until the final concentration was reached. The salt treatment of different groups came to the final concentration on the 5 day, with four replications. Plants were irrigated every 2 days, and each time for 100 ml per basin under different salt concentrations. After 45 days, the seedlings were harvested, morphological attributes; plant height, fresh weight and dry weight of the aboveground and underground parts were measured to evaluate the effect of different NaCl treatments on the growth of purslane-potted plants. Based on cluster analysis and statistical values we find that, six genotypes showed similarities in morphological attributes and showed suitable performance. However, “Pakistan” local (‘PL’) showed a great performance under all salinity conditions, contrary “Liaoning, China” local (‘LCL’) showed insightful performance compared to others genotypes. In conclusion, Based on our findings “Pakistan”

local (‘PL’) should be consider as a salt tolerant and “Liaoning, China” local (‘LCL’) as a susceptible among above-mentioned genotypes.

Keywords: cluster, genotypes, morphological, purslane.

Medicinal plants in Lithuania-Poland border farmsteads

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2017 in the Lithuania-Poland border farmsteads flower gardens were detected 82 species of medicinal plants. It was detected 50 species in Lithuania and 72 species in Poland. Most of these plants are decorative. Part of these plants are traditional Lithuanian flower gardens plants. According to their growth time plants were divided into four groups: 1) plants which were grown from 15-16 centuries, 2) from 17-18 centuries, 3) from 19 centuries and 4) from 20 centuries.

Keywords: Lithuania-Poland border, medicinal plants, traditional Lithuanian flower gardens plants.

The defense responses in tomato-aphid interaction in plants grown on soil with biochar

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Plants are affected by environmental variations and are subject to various types of stress. The resistance or susceptibility of plants to stress depends on the mutual characteristics of the plant and the stress. The plant can counteract the stress through the expression of specific genes, through changes in metabolism or through quantitative and qualitative variations of gene expression.

Biotic stress is due to the action of viruses, bacteria and small insects and is the cause of most of the reduction in crop yield. Biochar is a fine-grained vegetable carbon that is obtained from the pyrolysis of different types of plant biomass, and, if added to the soil, it can improve soil characteristics and at the same time reduce carbon emissions. It also appears to have an unclear role in the activation of systemic resistance responses to pathogens. Biochar has a carbon content of about 90 %, its high porosity increases the retention of water and nutrients by reducing the need for water and fertilizers and increasing agricultural yield.

Aphids (*Halyomorpha halys*), are one of the major sources of biotic stress for the tomato (*Solanum Lycopersicum*), a crop of significant agri-food and socio-economic importance, especially in the Mediterranean area and in southern Italy. In this study the differential protein expression of tomato leaves infected by aphid and grown on control soils and on biochar-modified soil it was analyzed to evaluate the biochar role in resistance to plant pathogens. As already seen in a our previous work which analyzed the effects of another type of biochar on tomato plants not subjected to stress, the preliminary

results of the proteomic analysis show that the addition of biochar in the soil induces an up-regulation of the proteins involved in the growth and therefore of the productivity of the plant, but at the same time causes a reduction in the expression of the proteins involved in the defense pathways.

Keywords: biochar, tomato, biotic stress, proteomic.

Geographical fruit growing location affects the antioxidant activity of apple fruits

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The aim of this research was to evaluate the antioxidant activity of apples cv. 'Auksis' and the contribution of individual phenolic compounds to this antioxidant activity, from fruits, that were grown in different geographical locations: Poland, Lithuania and Estonia. Statistical differences were evaluated using Tukey's HSD test at p=0.95. Reducing and radical scavenging profiles of freeze-dried apples were determined and phenolic constituents were identified using ultra high-performance liquid chromatography. Antioxidant activity was evaluated by FRAP (ferric reducing antioxidant power) and ABTS (2,2-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid) postcolumn assays. Fruits grown in Poland had significantly lower both radical scavenging and reducing activity, in comparison to fruits that were grown in Estonia (Trolox equivalent values varied from 4.97 to 16.33 μmol/g and from 6.77 to 20.78 μmol/g respectively). Fruits grown in Lithuania had intermediate antioxidant activity results between Polish and Estonian apples. In conclusion, apples grown more in northern geographical areas, have better antioxidant activity parameters, and these apples with determined antioxidant profile could be applied in the production of smart and innovative pharmaceutical or functional food ingredients.

Keywords: ABTS, Estonia, FRAP, Lithuania, *Malus* × *domestica*, Poland, Trolox.

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The importance of sea aster as new multipurpose species

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The sea aster (*Aster tripolium* L.), a salt marsh halophyte that has gained interest as extremely plastic species with a high degree of adaptation to saline habitats, has recently become an excellent model to study tolerance mechanisms. Moreover, this species have been pointed out as potential cash crop vegetable for replacing usual crops that cannot tolerate the excess salt in an increasingly salinized world because about 5.2 billion ha of agricultural land in the world suffer from dryness and salinization. Owing to their mild salty taste and high nutritional value of *A. tripolium* it is valued as gourmet health food (Ventura et al. 2013; Cacador et al. 2015).

The anatomical structure justify halophytic nature of the sea aster, even without any secretory elements such as salt glands or other glandular structures on the leaf surface. The stem strengthening is made up of phloem fibers, placed in periphloemic area of the stele. The shoot paracytic stomata apparatus involved in the plant adaptation strategy to elevated soil salinity is remarkable feature of the species (Bercu et al. 2012). This unique phenotype has become the object of ecological research. Micro-distribution and seed germination of *A. tripolium* as an endangered plant in Tokyo and a keystone species of salt marshes in England is currently investigated by Kuramoto et al. (2016). The study on polymorphism within the species have shown that the variation between the saline and brackish marsh populations is mainly genetically controlled, whereas variation within saline marsh ones is mostly environmentally controlled (Huiskes et al. 2000), and as a result of studies carried out by Uno et al. (1998) it was proved that Samip A, B and C genes play an important role in the salt-adaptable strategy

in sea aster. Furthermore, it has been reported (Otte et al. 2011) that *A. tripolium* can effectively uptake arsenic by forming an iron plaque around the roots that adsorbs this toxic metalloid.

Nowadays, the physiological and biochemical mechanisms are relatively well described for several halophytes. This opens a new possibilities for which physiology can be allied to biotechnology identifying the key genes under these processes, which can be introduced into non-tolerant crops allowing their cultivation in arid and saline lands or increase the phytoremediation and desalination capacity of certain species.

Keywords: halophyte, salt marsh, salt tolerance, crop, remediation.

The effect of fertilisation on chemical composition of rose leaves

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The aim of the research was to optimise rose fertilisation. Rose plants 'Graham Thomas', 'Heritage' and 'Warwick Castle', budded on the rootstocks *Rosa multiflora* L. were grown in sandy loam soil. Different basic (Yara Mila Complex, Substral Rose, Kristalon Green) and top dressing fertilization (urea, potassium nitrate, ammonium nitrate) were applied. Three times during vegetation the chemical substrate parameters were evaluated. The available macroelements were detected by the universal methods, and their content was assessed using the ICP technique. In July, upper mature (5-7 leaflets) leaves were collected, then dried and analyzed with ICP-OES for essential macro- and micronutrients after digestion in a microwave system with HNO_3, organic nitrogen was detected by Kjeldahl method. FT-Raman measurements were also performed on lyophilized leaves roses using the Thermo Scientific Nicolet™ NXR 9650 FT-Raman spectrometer.

The content of P, K, Mg, B, Cu and Zn in the leaves of roses, regardless of the variety and method of fertilization, were at a level close to the optimum, while the content of Ca, Fe and Mn exceeded the optimal values. The effect of fertilization on Mg, Cu and Zn concentration in the leaves has not been detected. The basic fertilization influenced the content of P, K, Ca, S and B, Fe, Mn. More B, Ca and Mn were found in the leaves after using potassium nitrate in top dressing fertilization. It was shown that the fertilizers used, both in basic and top dressing fertilization, did not affect the change in the content of leaf compounds. In all varieties, spectral bands derived from carotenoids, chlorophyll and flavonoids are

very well visible. In addition, bands indicating the presence of polyphenols, and lipids in the leaves were also observed. The features of the chemical composition characteristic only for a specific variety were not found in any of the tested varieties.

Keywords: macroelements, microelements, chemical compounds, *Rosa*, fertilisers.

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Frost tolerance of selected *Rosa* cultivars from the collection of Gene Bank at Research Institute of Horticulture in Poland during spring deacclimation under warming climate

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Climate warming and increasing temperature variation with risk of unseasonable warm spell may cause premature loss of cold hardiness (deacclimation) of plants grown in a temperate zones including garden roses. Shifting phenological patterns as earlier start to the growing season consistent with climate warming may increase the risk of subsequent freezing injury. The aim of the study was to determine cold hardiness of 10 garden roses belonging to different USDA plant hardiness zones during deacclimation. The experiment was carry out using 8-year old plants from field collection of garden roses located in Skierniewice, Poland (lat. 51˚57'N), including 4 climbing roses ('Flammentanz', 'Florentina', 'Sympathie', 'That's Jazz') and 6 shrub roses ('Astrid Lindgren', 'Chopin', 'Louise Odier', 'Schwnensee', 'Uncle Walter' and 'Venrosa'). Freezing tolerance of upper and lower stems of current season's stems were evaluated two times during deacclimation period on control (+4 °C) and one subfreezing temperature (-18 °C) in the second decade of February and the first decade of March 2018 using the electrolyte leakage method. In addition, the assessment of overwintering of plants grown in the field collection was carried out for two consecutive years (2017 and 2018). At the first date, subfreezing temperature only caused a rather small increase in REL (relative leakage of electrolytes) values (averages 9.8 %) compared to control (averages 7.3 %), suggesting that selected *Rosa* genotypes not

notable stressed at the lowest temperature reached by the freezer (-18 °C). At the second date, REL values for control stems not exposed to subfreezing temperatures in freezer increased to 34, 30 and 32 % for lower stems of ‘Chopin’, ‘Uncle Walter’ and ‘Venrosa’, and to 41, 32, 46 and 34 % for upper stems of ‘Chopin’, ‘That's Jazz’, ‘Uncle Walter’ and ‘Venrosa’ respectively, which was probably due to warm spell followed by frost episodes with min. temperature -17.5 °C recorded on 2nd March. In the first decade of March a significant decrease in stem cold hardiness was detectable. However, lower stems of ‘Flammentanz’, ‘Florentina’, ‘Louise Odier’, ‘Schwnensee’ and ‘Sympathie’ were the most tolerant to subfreezing -18 °C temperature in this time with REL values not exceeding 20 %. The greatest damage of the lower stems was noted for ‘Chopin’, ‘Uncle Walter’ and ‘Venrosa’ with REL values in the range 35-40 %. Upper stems of climbing Rosa ‘Flammentanz’ were the most tolerant (REL 12 %) and ‘Chopin’, ‘That’s Jazz’, ‘Uncle Walter’ and ‘Venrosa’ were the most sensitive to subfreezing temperature -18 °C with REL values 40, 37, 48 and 38 % respectively. The correlation between electrolyte leakage at -18 °C using artificial freezing of stem sections and 2 years of replicated, field-based freezing injury data and overwintering garden roses were mostly very high.

Keywords: electrolyte leakage, freezing tolerance, Rosa.

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Pre-breeding for future challenges in Nordic fruit and berries – a new 'NORDFRUIT' project

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The market and production of fruit and berries are continuously developing, both in range of species, cultivars, branding and fruit marketing. Apple and strawberry is the most important crop in the Scandinavian and Baltic countries. The focus of this project is to strengthen pre-breeding cooperation, validate available germplasm resources by genetic and phenotypic characterization in order to widen the parental pool aimed at genetic resources enhancement by increasing diversity for targeted traits. The 'NORDFRUIT' project includes 7 countries focused on 4 thematic areas: a) networking and dissemination, b) phenotyping, c) genomics and resistance, d) germplasm development.

Outcome of this project - standardized phenotyping protocols and genomic tools on the well-defined and genetically characterized germplasm will enable to convert from phenotype-based selection into genome-informed selection. 'NORDFRUIT' will become a first step in this direction. Marker-assisted breeding, complemented with the global genomic prediction will help to reduce the number of breeding cycles, making the breeding progress more efficient. The specific goals for this study will be set in the next stage of 'NORDFRUIT'.

Keywords: apple, genetic resources, strawberry.