



**1st International Conference on
Scientific Actualities and Innovations in Horticulture 2016**

SAIH2016

"Development and technology"

Kaunas, June 2-3, 2016

1st announcement

Program and Abstracts

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Symposium Venue

Europa Royale Kaunas Hotel

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SAIH2016 Outline Conference Schedule, June 2, 2016

8.00 - 9.30	REGISTRATION	
9.30 – 9.45	Welcome speech Zenonas Dabkevičius (Lithuanian Research Centre for Agriculture and Forestry, Director) Audrius Sasnauskas (Institute of Horticulture, LRCAF, Director)	
Keynote Lecture		
9.45 – 10.15	KL1	Luigi Lucini (Italy). Effect of plant biostimulants on crops at metabolome level
Oral Presentations		
10.15 – 10.30	OP1	Akvilė Viršilė (Lithuania). Lighting effects on nitrate metabolism in lettuces
10.30 – 10.45	OP2	Mariana Maante (Estonia). Effect of defoliation on grapes maturity parameters
10.45 – 11.00	OP3	Jurga Miliauskienė (Lithuania). Supplemental UV-B induce changes of phytochemical properties and antioxidant activity in medicinal/aromatic plants
11.00 – 11.30	POSTER SESSION. COFFEE BREAK	
Keynote Lecture		
11.30 – 12.00	KL2	Audrius Sasnauskas (Lithuania). Breeding of horticultural plants in Lithuania: an overview
Oral Presentations		
12.00 – 12.15	OP4	Ilze Gravite (Latvia). New plum cultivars in Latvia

12.15 – 12.30	OP5	Danguolė Juškevičienė (Lithuania). Productivity and morphological features of garlic cultivars in Lithuania
12.30 – 12.45	OP6	Birutė Frercks (Lithuania). Genetic characterisation of the Lithuanian tomato cultivars using microsatellite markers
12.45 – 13.00	OP7	Rytis Rugienius (Lithuania). Accumulation of anthocyanins in fruits under different environmental conditions
13.00 – 14.00	LUNCH	
Keynote Lecture		
14.00 – 14.30	KL3	Sirichai Kanlayanarat (Thailand). Quality management in thai mango supply chains to meet the needs of consumers: a case study of mango exporting to japan market
Oral Presentations		
14.30 – 14.45	OP8	Darius Kviklys (Lithuania). The crop load and rootstock effect on alternate bearing of apple tree
14.45 – 15.00	OP9	Aurelijus Starkus (Lithuania). Bound between leafy and yield self-regulation in different apple-tree genotypes
15.00 – 15.15	OP10	Solvita Zeipina (Latvia). Changes of biologically active compounds in nettle (<i>Urtica dioica</i> L.) leaves during vegetation period
15.15 – 15.30	OP11	Viktorija Vaštakaitė (Lithuania). Intermittent illumination of supplemental LEDs affects carotenoid production in microgreens
15.30 – 16.00	POSTER SESSION. COFFEE BREAK	
16.00 – 16.15	OP12	Neringa Rasiukevičiūtė (Lithuania). Innovative horticultural crops plant protection

16.15 – 16.30	OP13	Dalia Urbonavičienė (Lithuania). Supercritical carbon dioxide extraction of lycopene from tomatoes by response surface methodology and characterization of extracts
16.30 – 16.45	OP14	Ramunė Bobinaitė (Lithuania). Pulsed electric fields pre-treatment for enhanced juice extraction and recovery of phenolic antioxidants from various berries and their by-products
16.45 – 17.00	OP15	Krista Tiirmaa (Estonia). The storability of apple variety 'Cortland' in a controlled atmosphere storage facility
17.00 – 17.15	OP16	Seyed Mahyar Mirmajlessi (Estonia). Real-time PCR technique for detection and quantification of <i>Verticillium dahliae</i> from field samples

SAIH2016 Conference Tour, June 3, 2016

9.00	Leaving Europa Royale Hotel, Kaunas
11.00 – 11.30	Technical tour to blackcurrant plantation (F. Šlėvė farm)
12.30 – 13.45	Visiting Hill of Crosses (Šiauliai)
14.00 – 15.00	Lunch
15.30 – 17.00	Science-Business-Innovations: „Chololate workshop – degustation“
19.00	Return to Europa Royale Hotel, Kaunas

Abstracts of Oral Presentations

KL1: Effect of plant biostimulants on crops at metabolome level

*Luigi Lucini*¹, *Youssef Rouphael*², *Giuseppe Colla*³

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Plant biostimulants are compounds that are applied to crops to promote growth, yield, resistance to stresses and nutrient use efficiency. They can be mainly grouped in protein extracts, seaweed extracts and microorganisms, although a variety of products have been introduced in agricultural practices. The use of biostimulants in horticulture is gaining a rapidly growing consensus, with their market showing a positive trend since several years. The European Biostimulants Industry Consortium is pushing European Community to provide with regulations for their placement in the market, thus requiring proving their efficacy and demonstrating their mode of action.

At our Institute, high-resolution MS metabolomics have been applied to clarify lettuce response under challenging conditions (25 mM NaCl), using a commercial leguminosae protein hydrolysate as biostimulant. Biomass was increased by the stimulant, as compared to control (salinity, without biostimulant); biochemical changes evidenced the involvement of oxidative stress mitigation, biosynthesis of osmolites and stimulation of terpenes.

In a further study, the commercial formulations based on *Ascophyllum nodosum* seaweed were tested on soybean. Metabolomics revealed a cytokinin-like hormonal activity, together with increase of light harvesting pigments and the involvement of stress related compounds such as phenolics and terpenes.

Concluding, the use of metabolomics allowed clarifying the mechanisms underlying biostimulation effects, as well as to support their use in horticulture.

Notes:

OP1: Lighting effects on nitrate metabolism in green lettuces

Akvilė Viršilė¹, Sandra Sakalauskienė¹, Julė Jankauskienė¹, Ramūnas Sirtautas¹, Viktorija Vaštakaitė¹, Algirdas Novičkovas², Aušra Brazaitytė¹

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²Vilnius University, Institute of Applied Research, Lithuania.

Due to the increased use of synthetic nitrogen fertilizers in intensive agriculture, green vegetables tend to accumulate higher concentrations of nitrate than in the past. However, the novel greenhouse technologies, including lighting, also have some specific impacts on plant physiological processes and allows to control certain aspects of plant growth, development and metabolism. Light – it's spectra, intensity, timing effects – is the efficient tool for targeted modifications in nitrate assimilation processes. The aim of this study is to review the works performed at Lithuanian Research Center for Agriculture and Forestry, institute of Horticulture, seeking to control nitrate contents in red and green leaf lettuce (*Lactuca sativa* 'Red Cos' and 'Green Cos') and explore the metabolic traits between nitrate assimilation and photosynthesis processes. This research was funded by a grant (No. MIP-60/2015) from the Research Council of Lithuania.

OP2: Effect of defoliation on grapes maturity parameters

Mariana Maante, Ele Vool, Kadri Karp

Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Department of Horticulture, Estonia. E-mail: mariana.maante@mail.ee

One widely used agrotechnical technique in grape growing is defoliation. Previous defoliation researches have been focus on *Vitis vinifera* L. cultivars, but little is known how it affects hybrid cultivars in cool climate conditions. The aim of the research was to determine defoliation effect on hybrid grape cultivars 'Hasanski Sladki' and 'Zilga' maturity parameters. The experiment was carried out in Estonian University of Life Sciences in 2013 and 2014. Experiment was performed using four different leaves removal treatments: (1) no leaf removal; (2) leaves removed from the east side of the cluster when berries were green and pea sized; (3) leaves removed from the east side of the cluster at the beginning of veraison; (4) leaves removed from both side of the cluster at the beginning of veraison. The content of soluble solids, titratable acids, anthocyanins, total phenolics, pH and the ratio of soluble solids and titratable acids was determined. Also yield components like bunch weight, 10 berries weight and berries per bunch were determined. The soluble solids content was higher and titratable acids showed the lowest content when leaves were removed at the beginning of veraison. Also, grapes were sweeter when leaves were removed from both side of the cluster at the beginning of veraison. The content of total phenolics ranged from 153 to 398 mg 100 g⁻¹ and showed highest content on both cultivars when leaves were removed one side of the cluster at the beginning of veraison. Berry anthocyanin content was more dependent on the cultivar and weather, than on defoliation treatment. Juice pH content ranged 3.01 to 3.88 and was highest when leaves were removed both side of the cluster. Defoliation increased maturity index. Yield components were more dependent on the cultivar

and weather, than on defoliation treatment. This presentation is about grape cluster zone defoliation in cool climate condition

Notes:

OP3: Supplemental UV-B induce changes of phytochemical properties and antioxidant activity in medicinal/aromatic plants

Jurga Miliauskienė, Pranas Viškelis, Edita Dambrauskienė, Sandra Sakalauskienė, Pavelas Duchovskis
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The environment plays an important role in the production of active compounds in plants, and thus the active compounds in medicinal/aromatic plants may change in response to environmental changes. The aim of this study was to evaluate the physiological changes and biochemical profile of basil (*Ocimum basilicum* L.), oregano (*Origanum vulgare* L.) and thyme (*Thymus vulgaris* L.) plants exposed to supplemental UV-B irradiation. Experiment was conducted in controlled-environment growth chambers. Plants were placed in one of the three environments: reference (no supplementary UV-B light) and two different supplementary UV-B light (2 kJ or 4 kJ m⁻² day⁻¹). The research results showed that antioxidant system activity and phytochemical composition of investigated plants depended on applied UV-B dose and plant species. In oregano, supplemental UV-B light of 4 kJ induced accumulation of photosynthetic pigments, anthocyanins and phenolic compounds. Any applied UV-B dose induced greater amounts of ascorbic acid and DPPH free-radical scavenging capacity. In basil, UV-B treatment reduced photosynthetic pigment and anthocyanins content; increased accumulation of total phenolic compounds and DPPH free-radical scavenging capacity, and ascorbic acid content was UV-B dose-dependent. In thyme, supplemental UV-B light of 2 kJ increased content of phenolic compounds and DPPH free-radical scavenging capacity. Supplementary UV-B light of 4 kJ reduced anthocyanins and DPPH free-radical scavenging capacity in thyme. Ascorbic acid content reduced at both UV-B doses. Oregano and basil plants exposed to supplemental UV-B irradiation subjected to accumulate a greater content of essential oil. While thyme plants accumulated less content of essential oils at supplemental UV-B light. These results provide the indication that applied supplemental UV-B irradiation is important environmental factor to optimize the secondary metabolite production and to obtain superior quality of herbal material.

Notes:

KL2: Breeding of horticultural plants in Lithuania: an overview

*Audrius Sasnauskas*¹, *Vidmantas Bendokas*¹, *Tadeušas Šikšnianas*¹, *Dalia Gelvonauskienė*¹, *Rytis Rugienius*¹, *Bronislovas Gelvonauskis*², *Birutė Frercks*¹, *Ingrida Mažeikienė*¹, *Aurelijus Starkus*¹, *Rasa Karklelienė*¹, *Audrius Radzevičius*¹, *Danguolė Juškevičienė*¹, *Nijolė Maročkienė*¹, *Eugenijus Dambrauskas*¹, *Vidmantas Stanys*¹

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²Plant Gene Bank, Lithuania.

At Institute of Horticulture, Lithuanian Research Centre of Agriculture and Forestry (IH-LRCAF) orchard plant breeding is focused mainly on pome fruits (*Malus domestica*; *Pyrus communis* L.); stone fruits - sweet cherry (*Prunus avium*), sour cherry (*Prunus cerasus*), plum (*Prunus domestica* L.); small fruits - blackcurrant (*Ribes nigrum*), strawberry (*Fragaria annanassa*; *Fragaria vesca*), wild strawberry (*Fragaria vesca* L.), raspberry (*Rubus idaeus*); japanese quince (*Chaenomeles japonica*) and others. Over 90 new improved fruit cultivars is developed in IH-LRCAF. Research is focused on improving cold hardiness, resistance to diseases and insects, and yield as well as shipping and shelf life qualities; as well as on fruit quality, plant development and biotechnology applications. The preservation of genetic resources is also the primary goal.

49 new vegetable cultivars and hybrids were created at IH-LRCAF since 1987 and the result of all breeding work is more than 70 cultivars of vegetables and rare plants. Vegetable breeding is focused on: onion (*Allium cepa*), garlic (*Allium sativum*), radish (*Raphanus sativus*), tomato (*Solanum lycopersicum*), cucumber (*Cucumis sativus*), bean (*Phaseolus vulgaris*), pepper (*Capsicum annum*), red beet (*Beta vulgaris*), carrot (*Daucus sativus*), cabbage (*Brassica oleracea*) and others. More than 60 species are grown in the collection of rare vegetable and spice plants.

Notes:

OP4: New plum cultivars in Latvia

Ilze Gravite, Edite Kaufmane

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To find new cultivars for the assortment of plums grown in Latvia, at the Institute of Horticulture (former Latvia State Institute of Fruit Growing) testing of cultivars from Germany, Belarus and Latvia was carried out. For all cultivars *P. cerasifera* was used as rootstock, trial was planted in spring of 2008. It included three W.Hartmann's cultivars ('Tipala', 'Tegera', 'Haganta') from the Hohenheim University, one cultivar from Belarus Horticultural institute, and two hybrids from our common breeding programme with Swedish breeder V.Trajkovski, later named 'Zane' and 'Laine'. Flowering time for all cultivars was from end of April to beginning of May. Ripening time for cvs. 'Tegera', 'Tipala' and 'Renklod Sovetskij' was middle of August, for cv. 'Zane' end of August to beginning of September, for cv. 'Laine' middle of September, but for cv. 'Haganta' end of September to beginning of October. All cultivars had good yield and fruit quality except cv. 'Haganta' which had problems with good ripening in Latvia conditions in years with bad weather (low solar energy, temperatures and humidity, and early autumn). Evaluation of fruit parameters was done by points, 1–5. Highest taste evaluation showed cv. 'Zane' (4.6–4.7 points), best appearance – 'Haganta' (4.7–5.0) and 'Laine' (4.3–4.5 points), the best stone separation had cv. 'Tegera' (4.6–4.9 points). Good average yield per tree had 'Laine' (average yield per years 19.0 kg), but largest average fruit weight had cvs. 'Renklod Sovestkij' and 'Zane' (52.3 g and 46.5 g). Further evaluation in different regions of Latvia will be done for cultivars 'Tegera', 'Renklod Sovetskij', 'Laine' and 'Zane'. In 2016 cultivar 'Laine' will be handed in for registration in Latvia.

Notes:

OP5: Productivity and morphological features of garlic cultivars in Lithuania

Danguolė Juškevičienė, Rasa Karklelienė, Audrius Radzevičius, Nijolė Maročkienė, Eugenijus Dambrauskas

Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry, Lithuania. E-mail: d.juskeviciene@lsdi.lt

Food and Agriculture Organization of United Nations presents an information about the increasing of garlic consumption and the demand for food processing as well as growing areas every year. Therefore breeding of new varieties that are resistant to biotic and abiotic factors and distinguished according productivity and quality is very important. The aim of the research carried out 2012–2014 at the LRCAF Institute of Horticulture was to determine the productivity and to assess the morphobiological features and the peculiarities of generative development of new garlic variety 'Dangiai'. Variety 'Žiemiai' was selected for the comparison of productivity and morphological features. Generative development of eleven accessions was estimated in the field collection. The research data showed that total yield of garlic bulbs was obtained from 15.46 to 16.48 t ha⁻¹ and the output of marketable yield reached 99.6 %. The bulb shape of the variety 'Dangiai' was flat oval. The ground colour of bulb dry external scales was white with the anthocyanin stripes. The amount of cloves was determined from 6 to 7 in a bulb with radial distribution. The data of generative development observation showed, that the frequency of true seed formation reached 8.5 %. True seeds formation creates a possibility for applying of selective clones for breeding purposes, propagation of virus-free planting material and maintenance longevity of planting material. Garlic variety 'Dangiai' was included in the National List of Plant varieties 2016 and Common catalogue EU of varieties of vegetable species.

OP6: Genetic characterisation of the Lithuanian tomato cultivars using microsatellite markers

*Birutė Frercks*¹, *Jūratė Bronė Šikšnianienė*¹, *Simona Grušaitė*², *Rasa Karklelienė*¹, *Audrius Radzevičius*¹, *Vidmantas Stanys*¹

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²Vytautas Magnus University, Lithuania.

The aim of this study was to evaluate the genetic diversity of the 12 tomato (*Solanum lycopersicum* L.) cultivars, developed in Institute of Horticulture Lithuanian Research Centre for Agriculture and Forestry. For this purpose, 11 previously published microsatellite markers (SSR) were used. Among them, a total of 28 alleles were detected. On the basis of polymorphism information content (PIC) value, the primers Tom59–60 and TMS52 were the most polymorphic. Only one scorable allele for all cultivars was amplified using Tom47–48, LESSRPSG**b**, SSR572 and Tom144 primers. Therefore, for the UPGMA cluster analysis a set of six polymorphic primers were used. Genetic diversity varied from 0.13 to 0.80, in average 0.42. On this diversity level in the dendrogram the cultivars grouped into four clusters, where the third of them consists of just one cultivar 'Balčiai'. In the first cluster of the dendrogram the cultivars 'Milžiniai' and 'Skariai' were grouped together statistical significant. This can be depended on common morphological traits: both cultivars have the green shoulder and are indeterminate. In the second cluster of the dendrogram the cultivars and 'Jurgiai' were grouped together statistical significant. This grouping is probably caused by genetic relationship, as in the same cluster cultivars 'Viltis' (the parent of cv. 'Laukiai') and 'Aušriai' (the progeny of cv. 'Jurgiai') are present. The knowledge about the genetic background of Lithuanian tomato cultivars will be helpful for planning purposeful crosses in tomato breeding programs.

Notes:

OP7: Accumulation of anthocyanins in fruits under different environmental conditions

Rytis Rugienius, Tadeušas Šikšnianas, Vidmantas Bendokas, Gražina Staniënė, Jūratė Bronė Šikšnianiënė, Birutė Frercks, Vidmantas Stanys
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Plants exposed to various stress conditions often increase synthesis of anthocyanins - natural plant pigments and antioxidants in response. The aim of our investigations was to evaluate the amount and composition of anthocyanins in different fruit plants and to analyze expression of regulatory and structural genes in anthocyanin synthesis pathway under different conditions. It was revealed in the study that quantity and composition of anthocyanins in fruits depended on the plant species and agro-climatic conditions in different years. Quantity of anthocyanins in ripe fruits collected in 2011–2015 ranged: in black currant – 425.0–462.0, gooseberries – 44.4–391.0, sweet cherries – 0.1–178.0, cherries – 277.6–580.0, strawberries – 5.46–76.9 mg/100 g. Quantity of anthocyanins in black currant berries of different years was significantly more stable than in cherries and strawberries. It was found that fruit yield and amount of anthocyanins in fruits depends on the watering rate and ambient air temperature. Watering 50 % water rate had no effect or slightly delayed wild strawberry cropping, but 25 % of water rate decreased fruit weight and yield at the end of fruiting. Berries of plants grown under water deficit accumulated up to two times more anthocyanins at certain periods of cropping than control plants. The highest amount of anthocyanins and lowest pelargonidin-3-glucoside and cyaniding-3-glucoside ratio under water deficit is observed when air temperature does not exceed 20 °C. Analysis of *Fragaria vesca* plants grown *in vitro* revealed that various osmotics had different impact on gene expression of anthocyanin synthesis pathway. Addition of 9 % sucrose in grown medium increased gene

expression. However exposure to 5–12 % Polyethylene glycol lowered it. Ultraviolet and blue light favored gene expression, while the red light did not had effect.

Notes:

KL3: Quality Management in Thai Mango Supply Chains to Meet the Needs of Consumers: A Case Study of Mango Exporting to Japan Market

Sirichai Kanlayanarat^{1,2}, *C. Watanawan*¹, *B. Mathulaprungsan*¹, *C. Wongs-Aree*^{1,2}

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² Postharvest Technology Innovation Center, Commission of Higher Education, Thailand.

Thai mango cv. 'Nam Dok Mai' is an important commercial fruit of Thailand for exporting to Japan market where sets up a very high quality standard of the fruit. A Thailand exporter established the capital infrastructure for preparing high quality mango for Japan market under the Japan-Thailand Economic Partnership Agreement (JTEPA). Since the high stringency of investigation of pesticide residue remaining as well as fruit fly and disease contamination at the Japan plant quarantine, the mango quality management has to be started from the upstream supply chain at farm level and followed by the supply chain operation to the market. The mango growers must affirm their orchards under the Japan Good Agricultural Practice certification when the best practice manual was prepared by the Department of Agricultural, Ministry of Agriculture and Cooperatives, Thailand. GAP-certified orchards were selected to be a partner of mango exporting company. Mango fruit were bagged 40 days before harvesting in order to minimizing anthracnose disease caused by *Colletotrichum gloeosporioides* which is a very serious postharvest problem at the market places. A week before harvesting, the fruit were randomly sampled to check pesticide residues under the plant quarantine regulation whereas after harvested, the fruit were thoroughly checked for a suitable maturity, primarily sorted and uniformly weighed at local farm packing houses. At the packing house of exporting company, the fruit have to be washed and cleaned by chlorinated water, then dipped in 50 °C hot water for 5 minutes. All fruit were

cooled down in normal temperature water for 1–2 minutes, quickly dipped in 400 ppm ethophon, and then air dried. After graded and sized according to the quality standard, the fruit were passed through vapor heat treatment at 47 °C constant of pulp temperature for 20 minutes for killing habitat insects. Fruit were then protected by individual foam net and packed in a carton box containing 3/5 kg/box. Boxes were transported by refrigerator trucks at 13 °C to the airport and shipped by airfreight.

Notes:

OP8: The crop load and rootstock effect on alternate bearing of apple tree

Darius Kviklys, Alina Viškelienė, Jonas Viškelis, Giedrė Samuolienė

Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry, Lithuania. *E-mail: d.kviklys@lsdi.lt*

Stabile crop is a precursor of successful apple growing. Most of apple cultivars in North Europe distinguish in biennial bearing. The physiological, biological and technological investigations were conducted in 2014–2016 and were focused on studying of a range of vegetative and reproductive responses to varying crop load, fruit distribution on a tree and rootstocks. More intensive thinning of cv. 'Ligol' resulted in a significant decrease of yield, amount of photosynthesis pigments, but significant increase of fruit weight, leaf area and accumulation of hexoses. Heavy crop load resulted in an increase of inhibitor phytohormones and return bloom was suppressed the following next year. The phytohormones data obtained in autumn was not as informative as those obtained in early spring, according to which flowering and yield may be predicted. Fruit quality did not depend on fruit distribution in the tree and the annual yield of 50 t per ha may be maintained. Though higher contents of flowering promoter hormones and lower contents of inhibitory hormones were detected in buds on the shoots where inflorescences were totally removed, the yield did not depend on fruit distribution in previous year. Rootstock significantly influenced yield, growth, productivity, and mineral accumulation in apple trees, but the alternate bearing index was high with all investigated rootstocks. The strategy of crop load manipulation during different growth periods of orchard life is in preparation stage and will be introduced in commercial orchards in our country and in North eastern region of Europe.

OP9: Bound between leafy and yield self-regulation in different apple-tree genotypes

Aurelijus Starkus, Vidmantas Stanys

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There are more than 5 thousands apple tree varieties in the world. In economic aspect it is very important that apple-trees bear fruits every years. In order to improve fruits quality and reduce year off effect, technologies of apple tree flowers and immature fruits thinning are applied. This job requires a lot of work. In economic and ecologic aspect, the most effective way to solve this problem is to identify or create varieties, which eliminate immature fruits by themselves and bear fruits every years. Naturally self-shedding of apple flowers and immature fruits is not common feature, but very important for yield regulation. Our job aim is to identify different apple tree genotypes with different mechanisms of yield regulation. For this purpose there was evaluated data on parental stability of different genotypes in our apple collection. We selected 22 genotypes that were opposite in fruiting stability and studied bounds between types of shoots leafy and immature fruits shedding.

Notes:

OP10: Changes of biologically active compounds in nettle (*Urtica dioica* L.) leaves during vegetation period

Solvita Zeipiņa^{1,2}, *Ina Alsiņa*¹, *Līga Lepse*²

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Consumers more and more are care about healthy and balanced diet. Stinging nettle (*Urtica dioica* L.) leaves traditionally are used in early spring as a leafy vegetable in salads and soups. Leaves are a good source of some important minerals and vitamins. The investigations are carried out at Institute of Horticulture, Latvia University of Agriculture. The research aim was to evaluate composition of biochemical compounds in four different stinging nettle clones of local origin. Investigation was carried out in two different soils and under two growing technologies. Two harvesting approaches were used in the trial: 1) new shoots of 10–15 cm length cut two times during vegetation period and 2) 7–10 cm long shoots cut five times per vegetation period. Content of pigments, vitamin C, phenols, flavanoids and antiradical activity was analysed. Differences between all clones were observed. Significant differences between harvest times were found in the content of vitamin C. Also significant differences were stated in content of pigments (anthocyanins) between clones. High differences between soils were not observed.

OP11: Intermittent illumination of supplemental LEDs affects carotenoid production in microgreens

*Viktorija Vaštakaite*¹, *Aušra Brazaitytė*¹, *Akvilė Viršilė*¹, *Julė Jankauskienė*¹, *Giedrė Samuolienė*^{1,2}, *Ramūnas Sirtautas*¹, *Pavelas Duchovskis*^{1,2}

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We investigated how intermittent illumination of different wavelengths (455, 470, 505, 590 and 627 nm) of supplemental LEDs affected production of carotenoids in mustard (*Brassica juncea* L. 'Red Lion') and basil (*Ocimum basilicum* L. 'Sweet Genovese') microgreens. The plants were grown within a controlled-environment growth chamber (21/17±2 °C day/ night; 55±5 % a relative air humidity) under high pressure sodium (HPS) lamps (Philips, UK) (~180 μmol m⁻² s⁻¹; 16 h photoperiod). Four frequencies of intermittent lighting (2, 32, 256 and 1024 Hz) and a continuous light (0 Hz; control) of supplemental LEDs were employed, keeping the light intensity constant (~20 μmol m⁻² s⁻¹). The contents of violaxanthin, neoxanthin and lutein in microgreens were determined by HPLC/DAD. The results showed that all frequencies of intermittent illumination of supplemental LEDs led to significantly (P≤0.05) decreased contents of all determined carotenoids in mustard. The intermittent lighting with 455, 470 and 590 nm LEDs at 2 Hz increased content of neoxanthin in basil. In addition, all supplemental wavelengths of LEDs at 2 Hz led to increased contents of lutein. The same tendency was determined at 32 Hz, except under 590 nm wavelength when the concentration of lutein significantly decreased. In contrary, all supplemental LEDs at all frequencies of intermittent illumination had negative effect on accumulation of violaxanthin in basil. In conclusion, the effects of intermittent illumination depended on supplemental LEDs wavelength, and varied among plant species.

Notes:

OP12: Innovative horticultural crops plant protection

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Photosensitization is an innovative method for eliminating fruit pathogens based on simultaneous use of light and a photosensitizer. *Botrytis cinerea* Pers.:Fr. infections caused seriously reduce soft fruit yield and postharvest quality. The photosensitizers Na-Chl (β -Na-chlorophyllinogen) and ZnO (zinc oxide) postharvest effect on strawberry cv. 'Dar Select' were investigated at the LRCAF Institute of Horticulture in 2013–2014. This study aimed to evaluate the efficacy of innovative plant protection for reducing strawberry grey mould. Experimental treatments included 1) control, 2) Na-Chl and 3) ZnO. Field Treatments were conducted at BBCH 85–87 24 h before harvest. Fruits assessments were after 4 days on stimulated storage at 5–7 °C. Obtained data indicated that *Botrytis cinerea* was the main strawberry pathogen in 2013–2014. At the 4-th day of storage the number of grey mould infected strawberries in Na-Chl treatment were lower 2013 – 10 % and 2014 – 43 %, compared with the control. The ZnO reduced *B. cinerea* 13 % and 22 % after 4 days of storage. The photosensitizers Na-Chl and ZnO has a tendency to prolong strawberry fruits shell life. This research was funded by a grant SVE-02-2012 from the Research Council of Lithuania.

OP13: Supercritical carbon dioxide extraction of lycopene from tomatoes by response surface methodology and characterization of extracts

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Nowadays the development of more attractive functional food is important for the consumers' health. The use of concentrated carotenoids extracts from tomato by-products in traditional foods may improve functional properties of the product while increasing the efficiency of the industrial processing of tomatoes. In red tomatoes lycopene is almost exclusively found in the all-*trans*-form, but during processing lycopene can undergo isomerisation which may enhance its antioxidant properties and biological functions. The industrial processing of tomatoes into tomato products generates large amounts of by-products, such as peel, pulp and seeds. These by-products creates a major disposal problems for the industry in terms of costs and potential negative impact on the environment, but they also represents a promising, low-cost source of carotenoids (primarily lycopene) which may be used in the end-products because of their favourable nutritional and technological properties. Therefore, the aim of the research was to evaluate and select tomato cultivars with the highest content of pigments and to study the chemical composition of the supercritical carbon dioxide extracts from tomatoes.

Carotenoids and its *cis*-isomers (lycopene and β -carotene) in tomatoes and extract from tomato by-products 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 LRCAF Institute of Horticultural (Lithuania) greenhouses collection). The highest amount of lycopene (9.5 mg 100 g⁻¹ fw) was established in red colored fruits supercritical CO₂ extract of Lithuanian cultivar 'Svara'. The main geometrical lycopene isomer was *9-cis*. The total *cis*-lycopene

isomers content in the SCE-CO₂ extract at optimal parameters was 65 %. The predicted optimal extraction process parameters were 40 °C temperature, 55 MPa pressure and 180 min extraction time. This work was supported by the grant from the Research Council of Lithuania, No. MIP-62/2015.

Notes:

OP14: Pulsed electric fields pre-treatment for enhanced juice extraction and recovery of phenolic antioxidants from various berries and their by-products

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Pulsed electric fields (PEF) processing has been shown to be promising as a milder and more efficient alternative to conventional cell disintegration techniques used to increase mass transfer. The aim of the study was to investigate the influence of PEF pre-treatment of various berries (bilberries, raspberries and sour cherries), both on the extraction yield and quality of the juice obtained by pressing, and on the recovery of phenolic antioxidants from berry by-products. PEF pre-treatment was carried out in a laboratory scale, batch-type treatment chamber. Prior to mechanical pressing, berry tissues were exposed to PEF treatments of varying electric field strength (1–5 kV/cm) and total specific energy (1–12 kJ/kg). The PEF pre-treatment of berries before pressing increased the juice yield by 25, 35 and 45 % for raspberries, bilberries and sour cherries, respectively, as compared with the control juice. The application of PEF had no impact on qualitative characteristics of raspberry juice, but it significantly increased total phenolic, total anthocyanin contents and ferric reducing antioxidant power (FRAP) of bilberry and sour cherry juice. Significantly higher amounts of phenolic antioxidants were extracted from the by-products of PEF pre-treated berries. Furthermore, FRAP of the extracts obtained from the by-products of PEF pre-treated berries was 24, 25 and 80 % higher (for raspberries, sour cherries and

bilberries, respectively). The results of this study show the potential of PEF to improve the efficiency of the industrial processing of berries.

Notes:

OP15: The storability of apple variety 'Cortland' in a controlled atmosphere storage facility

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We compared the storability and quality of the apples of the variety 'Cortland' stored in uncontrolled and controlled atmospheres. The study took place during four growing seasons (from 2008 to 2012) at the Polli Horticultural Research Centre in Southern Estonia (58°07'N, 25°32'E). The apples were picked from dwarfing trees planted in 2001 and stored in 10 kilogram batches and in three repetitions in plastic crates that had plenty of air holes. The apples were stored at +2 °C, with air humidity between 62 and 87 %. The storage options were uncontrolled atmosphere and controlled atmospheres (3 % O₂:5 % CO₂ and 1.5 % O₂:1.5 % CO₂, and in one year 2 % O₂:0.5 % CO₂ and 1.5 % O₂:0.5 % CO₂). Firmness of fruit, dry matter content in juice, organic acid and vitamin C content were measured four times: at the start of storage, in January, March, and May. At each time storage loss was measured as well as storability of apples at room temperature during five days. The variety 'Cortland' can be stored well until January in a storage facility with uncontrolled atmosphere, with storage loss slightly over 5 %. Using controlled atmosphere can extend the storage time until March, with storage loss of less than 8 %. In the controlled atmosphere option 3 % O₂:5 % CO₂, the flesh of the apples may turn brown.

Notes:

OP16: Real-time PCR technique for detection and quantification of *Verticillium dahliae* from field samples

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The objective of the current research was to develop a sensitive and specific SYBERGreen real-time PCR assay for detection and quantification of *Verticillium dahliae* Kleb. directly from field-grown strawberries and soil of different areas in Estonia. For this purpose, plant (root) and soil samples were randomly collected from different points in each field. Total genomic DNA of samples were then extracted using DNeasy Plant Mini Kit and analyzed by proposed assay using a specifically designed primer pair. Also, for assay validation, a standard curve was constructed by plotting the logarithm of known concentrations of serially diluted genomic DNA extracted from standard *V. dahliae* isolates against threshold cycle (Ct) values. The results showed that, the lowest amounts of pathogen detected in soil and root were 7×10^{-2} pg μl^{-1} and 3×10^{-2} pg μl^{-1} of target DNA, respectively. The technique used in this study was highly accurate and sensitive and so allowed reliable quantification of the pathogen without culturing, facilitating the screening of the pathogen in diverse areas. To our knowledge, it was the first study about using real-time PCR technique in quantifying *V. dahliae* in Estonian strawberry fields and may provide agricultural institutes a means to estimate incidence of *Verticillium wilt* outbreak and improve disease control strategies.

Abstracts of Poster Presentations

P1: Genetic background of resistance to gall mite in *Ribes* species

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Hybridisation between resistant *Ribes* species could be one of the most effective methods to solve the problem of gall mite infection by development of cultivars with natural resistance to gall mite. Interspecific hybrids have low agronomical value. The backcrossing programme to restore acceptable fruiting characters was undertaken. Molecular markers for two genes Ce from *R. uva-crispa* and P from *R. nigrum ssp. sibiricum* responsible for resistance to gall mite were established. However, genetic background of resistance to gall mite in other *Ribes* species remains unknown. The aim of our study was to establish origin of resistance to gall mite among *Ribes* species and hybrids using molecular markers and to assess inheritance of resistance genes. It was demonstrated that resistance to gall mite is determined by Ce gene in *R. aureum* and *R. sanguineum*, by P gene in *R. americanum* and *R. aureum*. Ce and P genes are in homozygous state in *R. aureum*, *R. sanguineum* and *R. americanum* species. Presence of the molecular markers and resistance to gall mite fitted an expected Mendelian segregation ratio in hybrids. We established 32.4, 44.4, and 75.0 % hybrids with pyramid genetic resistance in *R. nigrum* × *R. americanum*, *R. nigrum* × *R. sanguineum* and *R. nigrum* × *R. aureum* families, respectively.

P2: Stress regulating properties of bacterial endophytes in apple (*Malus × domestica* Borkh.) culture in vitro

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Vegetative propagation methods are commonly used for horticultural plants of Rosaceae family, such as apple, pear, cherry, peach and strawberry. Development of in vitro micropropagation methods is important for plant biotechnology research and agricultural applications. In vitro environment imposes unfavorable conditions that lead to imbalance of plant physiological equilibrium and induction of oxidative stress, which occurs via production and accumulation of reactive oxygen (ROS) species. ROS cause lipid peroxidation leading to membrane injury, enzyme inactivation and DNA damage. It has been demonstrated that endophytic microorganisms play important role in plant acclimation and stress response. The aim of this study was to characterize oxidative injury and to assess stress regulating properties of bacterial endophytes in apple shoot culture grown under in vitro conditions. It was shown that endophytic bacterial strains *Pseudomonas orientalis* and *Curtobacterium flaccumfaciens* associated to apple cells in suspension, and demonstrated ROS reducing properties as well as activated JAR gene involved in induced systemic resistance pathway. Shoots of apple cv. 'Gala', 'Golden Delicious' were cultivated on Murashige and Skoog medium supplemented with 0.75 mg l⁻¹ 6-benzylaminopurine and 3 % sucrose. An assessment of ROS production using histochemical tissue staining revealed that superoxide production was mostly detectable in leaf and injured tissues, while higher concentration of H₂O₂ was characteristic to upper parts of stems of the shoots. Damage of membrane lipids of the shoots was more prominent during first week after replanting and during onset of senescence of the culture. Stress regulating properties of *P. orientalis* and *C. flaccumfaciens* in the apple shoot culture was assessed, and differences in shoot morphology and oxidative injury was established.

P3: Cultivation of green vegetable soybean under Lithuanian climate conditions

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Green vegetable soybeans worldwide are a minor crop, but it is quite popular in East Asia. With climate change, such plants could be beginning to grow in colder climatic zones. The aim of study was investigate potential of vegetable soybean cultivation in Lithuania. It was investigated six varieties of vegetable soybeans: 'Aoshizuku', 'Chiba green', 'Kaohsiung No9', 'Midori Giant', 'Sapporomidori' and 'Sayamusume'. Soybean sown in rows, spacing of 70 cm. Field size: 9.8 m², the accounting area – 4.9 m². The experiment conducted with three replications, arranged randomly. Soya seeded at the end of May and harvested at the end of September. Our data showed that plants of 'Chiba green' variety was the lowest. Such plants had higher chlorophyll index and photosynthesis intensity. 'Midori Giant' had more branches then plants of other varieties. The highest yield had 'Chiba green'. Unmarketable yield of this variety was lower compared to others. Higher protein content was in beans of 'Chiba green' variety. However, between varieties was no differences in soluble carbohydrates and micro- and macroelements content. In summary, first year results revealed that from tested cultivars most suitable and useful for the cultivation under Lithuanian climate conditions was 'Chiba green' vegetable soya variety.

P4: The combination of mild water conditions and short-term UV-B radiation: a novel method to produce spinach plants with higher nutritional value

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Intensive farming techniques and methods are used to obtain higher yield. However, the nutritive value of vegetables are generally reduced in this agriculture system. Several authors have applied mild environmental stress, such as UV-B exposition and drought conditions, to crops in order to improve the nutritional quality. Nevertheless, some uncertainty remains about the response of *Spinacia oleracea* plants. For this purpose, the interactive effect of mild water stress and short term UV-B radiation on two different varieties of spinach plants (Andromeda H and Matador) were studied. Accumulation of some organic metabolites (phenolic compounds, ascorbic acid and carotenoids) were determined. Plants were placed in different growth chambers at 18/13 °C day/night temperature and 12 h photoperiod. Experiment started at 21 day after germination. Plants were grown in peat substrate at two moisture regimes: normal (~40 %) and mild drought (<25 %). After 7 days effect of substrate moisture plants were exposed to 0, 1 and 2 kJm⁻² day⁻¹ UV-B for 1 day. Increases in phenolic compounds and carotenoids contents were found in leaf of spinach Matador under the UV-B exposure. Nevertheless, these results were not found for Andromeda variety, highlighting the importance of variety in increasing this metabolite compounds. The interaction of UV-B exposure and mild water conditions mostly increased the ascorbic acid content in both spinach varieties. Our study indicates that the exposition of spinach plants to combination of the mild stress conditions studied could be a valuable strategy to produce spinach plants with higher nutritional value.

P5: Photosynthesis parameters in different leaves of cucumber and tomato transplants influenced with HPS and supplemental blue and green LED light

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The aim of study was to investigate the effects of lighting emitting diodes and high-pressure sodium lighting effects on photosynthesis parameters of cucumber ('Mandy' F1, 'Mirabelle' F1) and tomato ('Magnus' F1, 'Cunero' F1) transplants. Transplants were grown using a high-pressure sodium lamps (HPS) with supplemental blue (455, 470 nm) and green (505, 530 nm) light-emitting diodes (LED) lighting in greenhouse. PPFD was $\sim 180 \mu\text{m m}^{-2} \text{s}^{-1}$, LED to $\sim 15 \mu\text{m m}^{-2} \text{s}^{-1}$. Gas exchange parameters of transplants were measured with portable photosynthesis system LI-6400XT. It was found, that the combination of lighting, photosynthesis and transpiration intensity is lowest in the first leaves, but greatest for the youngest third-fourth leaves of the transplants. It is determined that HPS lamps and HPS with supplement blue 455 nm or green 505 nm LEDs lamps were useful to improve normal photosynthetic functioning and quantitatively mediates third fully developed leaf responses resembling in tomatoes transplants. HPS lamps lighting has positive effect on photosynthesis parameters in fully developed second-third leaf in cucumber transplants. The results suggest that HPS lamps, can guarantee the quality of photosynthesis parameters in second-third leaves of cucumber and third leaves of tomato transplants.

P6: Flowering initiation in cabbage (*Brassica oleracea*) and black radish (*Raphanus sativus*)

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Flowering initiation is one of the most important plant developmental decisions is the switch from vegetative to reproductive growth. Moreover, the right timing of the floral initiation is essential for the optimal production of fruits and seeds that ensures reproductive success. The aim of this work was to analyze influence of soluble solids in vegetable, sucrose and phytohormones in apical meristems during flowering initiation in white cabbage (*Brassica oleracea* L.) vs. 'Rocktor' F1 and black radish (*Raphanus sativus* L.) 'Murzynka'. Vegetables grew according to the field technology test. During winter, vegetables were stored at 1–4 °C, humidity 90 %. Developmental rate was observed during winter storage and after planting in the field. During storage of biennial plants (white cabbage and black radish) sprouts, apical meristems differentiated, forming inflorescence axis elements and developed till IVth organogenesis stage. Total sugar and soluble solids content during storage increased as the moisture absorbed by accumulated polysaccharides were cleaved to monosaccharides. The main sugar detected in the vegetable's apical meristems and cabbage stem was sucrose. The main sugar in black radish hypocotyl was fructose. Significant increase of indole-3butyric acid was detected during differentiation of apical meristems in both plants, whereas an increase of indole-3-acetic acid and zeatin occurred only during micro- and macrosporogenesis and gametogenesis.

P7: The evaluation of 10 sweet cherry cultivars from Russia, Belarus and Ukraine in Latvia climatic conditions

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Changeable weather conditions during last years, when temperature sharply drops still in February, significantly influence growth and yield of sweet cherries. Therefore it is important to choose winter hardy, adapted to local conditions cultivars suitable for growing in integrated production systems. The aim of research was to evaluate the adaptability of sweet cherry cultivars bred in Eastern Europe to Latvia conditions. The trial was established at the Institute of Horticulture in Pūre in 2006. Ten cultivars: 'Iputy', 'Michurinka', 'Rannaja Rozovaya', 'Bryansk 3-36', 'Bryanskaya Rozovaya', 'Severnaya', 'Gronkovaya', 'Bryanochka', 'Ovstuzhenka', 'Amazonka', that are bred in Russia, Belarus and Ukraine, were used in the trial. Cultivars were grafted on *P. mahaleb* rootstock and planted with distance 3×5 m. Data were collected in 2008–2015. Tree height (m), crown volume (m³), winter hardiness (scores 0–5), flowering intensity (scores 0–5), yield (scores 0–5) were evaluated, as well sensory evaluation of fresh and frozen fruits (scores 1–5) was done. 'Severnaya', 'Bryanskaya Rozovaya', 'Ovstuzhenka', 'Bryansk 3-36', 'Gronkovaya' were the most winterhardy between tested cultivars. 'Severnaya' had high winter hardiness of flower buds and it was flowering and yielding every year. While 'Rannaja Rozovaya', 'Amazonka', 'Michurinka' can be damaged in hard winters. 'Iputy' had the largest fruits (5–6 g) between tested cultivars, as well 'Amazonka' and 'Bryansk 3-36' (4.5 g). According to results of sensory evaluation 'Iputy', 'Ovstuzhenka', 'Bryansk 3-36' get the highest scores, while 'Severnaya' the lowest.

P8: Effect of orchard floor management on mineral nutrition, yield and fruit quality of 'Rajka' apple cultivar in organic orchard

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Different orchard floor management systems were tested in organic apple tree orchard: soil in interrows was managed as sward, fallow or green manure (white mustard); sward-fallow, green manure-fallow and green manure-sward combinations in alternate interrows were implemented equally. The experiment was conducted in 2010–2012 with 'Rajka' apple trees on rootstock P 60 spaced at 4×1.25 m. The least soil mineral nitrogen content was under sward, while calcium, magnesium and manganese content here was the highest. Differences in fruit tree mineral nutrition were established. The least leaf nitrogen and the highest leaf phosphorus and potassium content were in sward interrow management system. The highest average yield was in treatment with white mustard grown for green manure. Average fruit weight from sward treatment was less in the year of heavy crop. Fruits from sward, sward-fallow and green manure-sward treatments were better covered with the red blush.

P9: Productivity and fruit quality of new and commercially important raspberry cultivars

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Newly released raspberry cultivars 'Vizija' (selection No 91–22–9–15) and 'Mistika' (selection No 91–22–9–19) from breeding program at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry were compared with commercially important cultivars 'Meteor', 'Solnyshko' (both from Russia), 'Norna' and 'Veten' (both from Norway). Field and laboratory tests were carried out in 2010–2014. Phenological phases (vegetation, flowering and fruiting periods), plant growth habit (height, stem diameter, number of stems), yield, fruit quality parameters (weight, attractiveness, taste, titratable acidity, soluble solids, dry matter, anthocyanins, phenolics and ascorbic acid) and plant winter hardiness were evaluated. Plants of 'Norna' cultivar showed the best winter hardiness and produced the highest yield (5.33 t ha⁻¹). The highest berry sugar content (6.03 %) was found in 'Solnyshko', whereas berries of 'Veten' had the highest titratable acidity (1.97 %) and the lowest sweetness value (2.89). Both recently released cultivars had attractive large fruits. 'Vizija' was also characterized by early ripening and good inner berry quality. Yield of both cultivars was similar to the yield of standard cultivar 'Meteor'. New cultivars distinguished for high content of anthocyanins (58.1–62.9 mg 100 g⁻¹). 'Vizija' fruits had 25.0 % and 'Mistika' 15.5 % more anthocyanins than standard cultivar.

P10: Qualitative description of apples cv. 'Ligol' picked from various positions of tree

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The aim of this research was to investigate the differences between apples (cv. 'Ligol') that were picked from different positions of tree: bottom, top, east and west sides of apple-tree. Research was carried out at the Institute of Horticulture, Lithuanian Research Center for Agriculture and Forestry in 2014 and 2015. Chemical composition (total sugars, ascorbic acid, soluble solids, acidity, dry matter), color indices, fruit flesh and peel firmness were measured. Fruits, that were picked from the bottom of apple-tree, had significantly lower amounts of total sugars (11.67 %, in comparison to top (12.8 %), east (12.3 %) and west (12.5 %)), soluble solids (12.8 %, in comparison to top (13.8 %), east (13.5 %) and west (13.7 %)) and dry matter content (14.2 %, in comparison to top (15.3 %), east (15.0 %) and west (15.4 %)) compared to fruits, that were picked from other tree positions. Ascorbic acid content was almost the same in all samples (about 7.60–7.80 mg/100g) and position in tree didn't had influence to this fruit quality attribute. Acidity was lowest in the fruits at the top of trees (0.53 %), but the difference was not significant. Fruit flesh firmness were not significantly different between each other, yet peel firmness was significantly firmer in fruits from the top of the tree (346 N/cm²). Fruits from bottom were significantly less firm than all other fruits (313 N/cm²). Fruit color measurement showed, that fruits from bottom of trees had significantly highest value in L* (lightness = 54.1), b* (yellowness = 28.3) and significantly lower value in a* (redness = 16.1) CIELab color space coordinates. Fruits at the top were dark red (L* = 33.0; a* = 31.0). Fruits in east and west side of trees had similar colors. In conclusion, we observed a tendency, that apples from top and west sides has better quality, than apples that grew in bottom or east side of the apple-tree.

P11: Concentration of bee pollination in the orchards to increase the apple fruit yield in Belarus

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During the 2013–2015 different elements of technology of fruit production of apple cultivars of the Belarusian selection 'Darunak', 'Belorusskoye sladkoe' ('Belorussian Sweet'), 'Nadzejny' using bee pollination were studied. The main elements of the technology have been individual arrangement of bee hives in the garden with spacing in 2 rows of fruit trees, elimination of a blooming dandelion, location of crops of a rape from a blossomed garden no closer than 3 kilometers, removal of capped brood bees and installation the pollen catchers to stimulate the flight activity of bees. It is established that the increase of density up to 6 bee colonies per 1 hectare of apple orchard (1660 trees per 1 hectare) provides a yield increase in 20–80 % and the yield of apples of the highest and first grades to 98 % depending on the cultivar-rootstock combinations.

P12: Planting scheme (nutrition space) effect on growth, productivity and fruit quality of dwarf apple trees in 10–15 years old orchard

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The experiment was performed in ten-fifteen year old apple orchard at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2010–2015. Trees of cv. 'Auksis' on P 60 rootstock were spaced at 3×1.50, 3×1.25, 3×1 and 3×0.75 m. Trees planted at 3×1.5 m had the largest trunk circumference, the highest number of shoots and total shoot length, formed the highest number of inflorescences and gave the biggest yield per tree. 3×1.25 m spacing significantly decreased trunk circumference, the number of shoots and inflorescences. The densest (3×0.75 m) planted trees were significantly smaller and gave lower yield per tree. The highest yield per plot area was achieved in the densest orchard, though the average fruit weight, size and fruit colour was decreased significantly. The same negative effect on fruit quality was recorded at 3×1 m spacing. Based on complex evaluation of tree growth, productivity, yield and fruit quality parameters in mature orchard 3×1.25 m is the optimal spacing of cv. 'Auksis' apple trees on P 60 rootstock. Such nutrition space is optimal for high and stable yields, ensures high fruit quality and moderate tree growth. In the case of less winterhardy apple varieties or rootstock combinations and as a consequence shorter orchard life span apple trees should be planted at 3×0.75 m in order to achieve high early yields.

P13: Strawberry early harvest opportunities using FVG high tunnels

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To find the possible use of high tunnels in strawberry production for qualitative early harvest, evaluation was done for five years (2009–2014). The study was carried out at the Institute of Horticulture (Latvia State Institute of Fruit-Growing). FVG (FOLIEN-Vertriebs GmbH) type of high tunnels with film cover "SUN SAVER 5 PRO" as well as few additional covers as Agryl (17 and 23 g m⁻²) and perforated film (perforation 500 m²) were tested. Following parameters were evaluated: fruit yield, yield dynamics, average fruit weight, as well as the factor influencing these parameters - air temperature. Cultivars 'Honeoye', 'Rumba', 'Polka' and 'Sonata' were used in trial. Cultivar 'Honeoye' and 'Rumba' were the most appropriate for early harvest according their harvest time production dynamics. The highest percentage of quality fruit yield was for cultivar 'Sonata'. In the trial most productive was 'Polka', but this cultivar wasn't suitable for obtaining of early harvests under covers, because of long production period. Also these study years show that not only early covering of film is important, but also temperature outside is significant. In 2014 relatively high temperatures were observed in March, which was the reason why first yield was picked on 21 May, other years with additional cover they started only in first dates of June.

P14: Tomato fruit quality changes according to their ripeness stage

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Investigation was carried out at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry. The research objective was ten tomato (*Solanum lycopersicum*) varieties. The following fruit quality parameters at six different ripening stages were evaluated: amount of carotenoids (lycopene and β -carotene), soluble solids (in fresh tomato matter), dry matter, also fruit skin and flesh firmness and colour indexes (CIE L*a*b*) were determined. According to experimental data it was established correlation between colour indexes and tomato fruit quality attributes. Therefore, it was determined correlation between tomato ripening stage and amount of carotenoids.

P15: Estimation of the productivity and biochemical composition of carrot (*Daucus sativus* Röhl.) hybrids 'Ieva' and 'Rokita'

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Experiments carried out in 2011–2015. New carrot hybrids 'Ieva' ir 'Rokita' were compared with the introduced accessions. Productivity, morphological features and biochemical composition of root crop were evaluated. 'Ieva' H – depends Nantes roots type (representative LRCAF IH). Carrots presented medium early (120–130 days) duration of vegetation period. Shape of root was cylindrical, blunt, medium length and diameter. Phloem and xylem was determined bright orange. The amount of carotene reached on average 21–22 mg %. The xylem was founded small, narrow obtriangular to narrow oblong. Hybrid is suitable for autumn harvest and winter storage. 'Rokita' H – depends Nantes roots type (representative LRCAF IH). Vegetation duration 128–132 days. Shape of root was cylindrical, blunt, medium length (22–25 cm) and diameter (4.2 to 4.6 cm). Phloem and xylem was observed bright orange. Hybrid accumulates 20–22 mg % carotene, 11–12.5 % soluble solids, 7.5–8.5 % of total sugar. It is recommended for cultivation in the loamy humus soil with optimal acidity (pH 6.0 to 7.0). Suitable to grow for autumn harvest and for storing.

P16: Substrate impact on nitrate assimilation in red and green leaf lettuce

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The aim of this study was to evaluate the impact of substrate type on nitrate assimilation and associated physiological aspects in lettuce. Red and green leaf lettuce plants (*Lactuca sativa* 'Red Cos' and 'Green Cos') were cultivated in closed phytotron (21/17 °C) chamber, under high pressure sodium (HPS; 18 h, 200 $\mu\text{mol m}^{-2}\text{s}^{-1}$) illumination for 21 days from sowing. Lettuces were cultivated in plastic trays, 24 75 ml cells per tray; 3 plants per cell. Neutralized peat, zeolite and vermiculite were used as substrates, plants were watered with mineral nutrient solution equally. Nitrate and nitrite contents, nitrate reductase activity, total protein contents, chlorophyll index and photosynthesis intensity were determined at the end of the growth experiment. The results show, that substrate has the remarkable effect on nitrate uptake and assimilation processes, which are highly interconnected with plant photosynthetic properties.

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P17: Influence of treating preceding crop residues with nitrogen fertilizers and humic substances on plant productivity and soil properties

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Changing climate and anthropogenic activities have negative influence on ecosystem stability and long-term productivity of soil and plant.

Objective of research to investigate of the influence of nitrogen fertilizers (ammonium nitrate and carbamide), humic substances (humistar, 10 or 20 l ha⁻¹) and their combinations on the soil properties and plant productivity. The experiments were carried out in the trial field of Institute of Horticulture, LRCAF with four replications and plots were systematically placed. The soil was loamy low-carbonaceous leached soil IDg8-k / *Calc(ar)i-Epihypogleyic Luvisols (LVg-p-w-cc)*. Topsoil depth – down to 25–26 cm.

Winter wheat residues – stubble and straw chopped to 3–6 cm in length, are treated with preparations and mulched down to the depth of 10–12 cm. In late autumn the field is deep ploughed. In the fields the white cabbage was grown on a flat surface, 70×50, under intensive growing technology.

The highest marketable yield of white cabbage and higher contents of organic matter, humus and total nitrogen in the soil in autumn were observed after preceding crop residues had been treated with humic substances and ammonium nitrate.

P18: Condition of garden plants growing in urban greeneries

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In 2009–2015 the monitoring of status of green plantations in Alytus and Kaunas cities was carried out according to the Landscape law (2008.01.14, No D1-31) program “Concerning the monitoring of the green plantations and the status of green plantations”. The monitoring was carried out at seven of street protective green plantations – 358 woody garden plants (9 genus, 12 species, 2 cultivars, 1 hybrid) and 16 recreational greeneries – 349 plants (15 genus, 21 species, 3 cultivars). During the research period were no injuring observed on plants at protective greeneries: *Berberis thunbergii* 'Purpurea', *Cornus alba*, *Corylus avelana*, *Crataegus mollis*, *Hippophae rhamnoides*, *Padus avium*, *Sorbus aucuparia*; at recreational – *Amelanchier spicata*, *Berberis thunbergii*, *Corylus avelana*, *Cornus alba*, *Juglans mandshurica*, *Juglans sp.*, *Mahonia aquifolium*, *Malus toringo*, *Padus avium*, *Prunus spinosa*, *Sambucus nigra*. After estimating the average injuring grade (system of 0–4 grades) there was estimated *Viburnum opulus* growing at protective street green plantations to be annually injured by pest *Pyrrhalta viburni* ($4\pm 0.38-0.07\pm 0.4$), annual scab (*Venturia inaequalis*) injuries on ashberry trees *Sorbus intermedia* and *S. thuringiaca* 'Fastigiata' were not so significant and in 2010 and 2011 were injured by $1.83\pm 0.1-1.15\pm 0.13$ grades. *Gymnosporangium sabine* in recreational green plantation has been injuring *Pyrus pyrester* ($0.01\pm 1.02-1.33\pm 1.4$) every year; *Phragmidium tuberculatum* injured *Rosa canina* ($0.01\pm 0.04-3\pm 0.41$) and *R. rugosa* ($1.02\pm 0.1-4\pm 0.41$); *Sorbus aucuparia* annually injured *Venturia inaequalis* ($0.01\pm 0.18-1.7\pm 0.21$). Injuries of morphological origin (defoliation and discoloration) were more intense in 2013–2015: *Sorbus aucuparia* at recreational green plantations, average injury grade – 0.25 ± 1.45 and *Berberis thunbergii* at street greeneries – 0.22 ± 0.04 grade.

P19: Evaluation of grow conditions of *Botrytis cinerea* from horticultural crops

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In order to investigate the *Botrytis cinerea* pathogen biology were carried out in vitro experiments. There were investigated six culture media, three grow temperatures and two light regimes for the studying the effect of media on growth the fungus. Experimental data showed that different culture media, temperature and light regime had influence on cultural and morphological characters of the fungus *B. cinerea* extracted from different plant hosts. The highest *B. cinerea* isolates, extracted from *Brassica oleracea* var. *capitata*, colony diameter (1.82 cm) was observed on potato dextrose agar, followed by plate count agar (1.50 cm) and beer universal agar (1.50 cm) after 4 days of incubation at 24 h in dark, 20 °C. Although, the radial growth of the fungus extracted from *Allium cepa* was maximum on potato dextrose agar (dark – 1.50, light – 1.42 cm), followed by beer universal agar (dark – 1.49, light – 1.44 cm) after 4 days of incubation at 20 °C. A similar trend of colony growth was observed in fungus from *Malus domestica* on potato dextrose agar (dark – 1.54 cm) and beer universal agar (dark/light – 1.40 cm) after 4 days of incubation at 20 °C.

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P20: Chemical control of dicotyledonous weeds in established carrot crops

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Field experiments in established carrot crops to investigate herbicide metobromuron efficacy were carried out at the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2014. Soil type in this area is sandy or sandy-loam *Calc(ar)i-Epihypogleyc Luvisolls (LVg-p-w-cc)*. Ploughing layer – 22–25 cm in depth, little humus (1.58 %), neutral pH (pHKCL 7.0). Having finalized carrot sowing all the experimental area was sprayed with Stomp CS – 2.9 l ha⁻¹. The rates of 0.3 l ha⁻¹, 0.5 l ha⁻¹, 0.625 l ha⁻¹ and 1.25 l ha⁻¹ of herbicide metobromuron were analysed in the established carrot crop. The herbicide metobromuron rates of 0.3 l ha⁻¹, 0.5 l ha⁻¹ and 0.625 l ha⁻¹ were sprayed 2 times when the carrots were at BBCH 12–13 and BBCH 13–14 growth stages, while the rate of 1.25 l ha⁻¹ was applied once on the carrot crop at BBCH 13–14 stages of growth. Several weed species dominated in the crop, namely: *Echinochloa crus-galli* L., *Galium aparine* L. and *Matricaria inodora* L. After sprayings with herbicide metobromuron at different rates weed destruction percentage at the end of the vegetation season amounted to respectively: *Echinochloa crus-galli* L. – 43–60 %, *Galium aparine* L. – 97.5–100 % and *Matricaria inodora* L. – 70–82.5 %. The herbicide rates sprayed did not present any negative effect neither on the yield nor its qualitative indicators.

P21: *Rhexocercosporidium carotae* confirmed as a pathogen of *Daucus carota* for the first time in Lithuania

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The occurrence of a new disease on carrot (*Daucus carota*) roots during storage became as one of the most important problems in Lithuanian carrot production. Carrots with specific injury symptoms (blackish spots with irregular edges) were observed in 2005–2007 and 2012–2013. The disease was a dominant problem in some farms under cold storage conditions in 2014–2015, when the damage reached up to 50–77 %. Fungus has been isolated from injured carrots and identified as *Rhexocercosporidium carotae* (Årsvoll) U. Braun (sin. *Acrothecium carotae*, *Pseudocercosporidium carotae*) applying morphological-cultural analysis. *R. carotae* was found on stored carrots in 1965 in Norway for the first time, now it is widespread across the Europe. The disease poses a threat since 2004, when new technologies allowed long storage in low temperatures. The disease is often known as Acrothecium rot. Despite of the fact that the disease is known for a long time, the knowledge of its etiology is lacking.

This work carried out within the framework of the long-term research programs “Harmful organisms in agro and forest ecosystems” implemented by LRCAF.

P22: Forecasting models for horticulture integrated plant protection

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The main research strategies of plant protection in horticulture are to investigate forecasting systems of the key pests and diseases using modern warning equipment. Investigation on the efficiency of forecasting models for pests and diseases in horticultural plants under Lithuanian climate conditions using internet forecasting system iMETOS®sm (Pessl Instrumental, Austria) was started at the Institute of Horticulture in 2007. In the meteorological stations there are introduced models for *Venturia inaequalis*, *Cydia pomonella*, *Erwinia amylovora* onion neck rot and strawberry *Botrytis spp.*, *Alternaria dauci*, *Psilae rosae*, *Delia antiqua* infection risk detection and control during vegetation. The forecasting models are basis for horticulture IPM which to optimize or reduce applications of plant protection products.

This project supported by Lithuanian Ministry of Agriculture and carried in long-term programs “Horticulture: agro-biological basics and technologies” and “Harmful organisms in agro and forest ecosystems” implemented by LRCAF.

P23: Monitoring of Diamondback moth (*Plutella xylostella* L.) in white cabbages

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The diamondback moth, (*Plutella xylostella* L.), is one of the most harmful insect pests of cabbage in Lithuania and other parts of the world where cabbage are grown. The investigation was conducted 2015 at the Institute of Horticulture, LRCAF. Four pheromone traps were set out across the field. These traps are suitable for detection of occurrence and monitoring of the flight of the diamondback moth. The attractive range of the pheromone is relatively small, there for is a need of several traps. The development of this pest mostly depends from weather conditions. Our experiment showed that abundance of *P. xylostella* varied from 5 till 71 moths per trap and was registered two peaks of abundance on July 2 and August 5–13. The number of *P. xylostella* was compared among treatments using a single factor analysis of variance (ANOVA). There were found significant differences between abundance of *P. xylostella* on the fist trap and others three.

This work was carried out within the framework of the long-term research program “Harmful organisms in agro and forest ecosystems” implemented by LRCAF.

P24: Efficiency of some insecticides against Diamondback moth (*Plutella xylostella* L.) in white cabbage

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White cabbage is widely cultivated vegetable in the Lithuania. One of the most harmful pests of cabbages is Diamondback moth (*Plutella xylostella* L.). The investigation was conducted 2015 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 59.3 till 69.5 %. There were no significant differences (ANOVA) found in abundance of larvae between all treated plots, but Steward was more effective than Decis EC (54.9–55.9 %) and Karate Zeon 5SC (43.9–60.9 %).

This work was carried out within the framework of the long-term research program “Horticulture: agro-biological basics and technologies” implemented by LRCAF.

P25: Investigation of mosaic virus in wild cucumber *Echinocystis lobata* (Michx.) Torr. et A. Gray

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Invasion by non-native species represents one of the greatest threats to biodiversity worldwide and is considered a major component of global change. *Echinocystis lobata* is an riparian species imported from America to Europe because of its fast growing, vertical greening and lifelong white flowers. In our continent the species has expanded to moisture and rich soil places, depressing local flora, isolating it from sunlight and diminishing growth of plants. Invasive plants might be carriers of infection, dangerous for cultivated plants. Cucumber mosaic virus (CMV) was first reported in 1910s in USA as the agent of cucumber disease. CMV has the largest host range of any virus. Mosaic caused by cucumber mosaic virus (CMV) may infect *Cucurbitaceae* family plants growing in a greenhouse and outdoor. Symptoms vary with the species of plant infected and the environmental conditions. In some cases, certain environmental conditions bring out symptoms while other conditions mask or hide symptoms. Symptoms: mosaic pattern of light and dark green (or yellow and green) spots on the leaves. We investigated the potential of the virus occurrence in the wild cucumber *Echinocystis lobata*. Plants were collected in various places along Nemunas basin rivers (Nevėžis, Dubysa, Neris, Merkys, Nemunas) in Lithuania. The leaves were collected from 25 sites, 15 plants. Plants were collected into paper bags. The percentage of individuals infected by virus was calculated according to visual infection symptoms – leaf spots, which have appeared in almost all investigated sites along rivers. The percent of damaged leaves varied from 80 till 95 %. The viral DNA identification and investigation of possible source of viral infestation for cultural cucumbers still continues.

This work was carried out within framework of National Program titled under Sustainability of Agro-, Forest and Water Ecosystems (Project No. SIT-2/2015).

P26: Phytosanitary condition of the genus *Salix* in urban plantations

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In 2001–2015 3 species and 1 cultivar of *Salix* genus were studied and their phytosanitary condition was evaluated in Alytus and Kaunas cities. *Salix alba* and *S. alba* 'Tristis' grow only isolated or in small groups in urban greeneries. Their damages were of noninfectious origin: leaves discoloration, defoliation and dry tree branches. The average grade of damage (V) was up to 2.0 ± 0.12 because of lack of moisture in 2009, 2014 and 2015 summer. More *Salix* plants grow in recreational greenery. *S. fragilis*, *S. alba* 'Tristis' are more damaged by *Venturia saliciperda* (V to 3.07 ± 0.78). Every year *S. caprea* is damaged by *Melampsora caprearum* (V from 1.09 to 4 ± 0.20). In 2011-2013 in Alytus and Kaunas 7 *S. caprea* trees had wounds on their trunks which symptoms were caused by *Phytophthora* sp. Since 2014 the disease has not manifested probably because of the climate conditions unsuitable for *Phytophthora* sp. Pathogens.

P27: Effect of drying methods on the quality of sliced pumpkin (*Cucurbita maxima* Duch.) cubes

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The object of this investigation was sliced pumpkins cv. 'Big Max' and 'Fantazija' cubes. Sliced pumpkin cubes (10×10 mm) were dried using an active ventilation, convection, infrared, vacuum, circulating fluidized beds, and sublimation drying methods. Chemical composition (dry matter, ascorbic acid, phenolic compounds and carotenoids, antioxidant activity) of dried pumpkin cubes and dried pumpkin powder color indicators were determined.

Among the drying methods, infrared dried pumpkin cubes had a little more of ascorbic acid and phenolic compounds, but they change in color was greater and tested dried cubes did not had good organoleptic properties. More carotenoids remained in pumpkins dried by convection and the circulation fluidized bed methods. Dried pumpkin cubes of cultivar 'Big Max' had good organoleptic and chemical characteristics. Pumpkins dried by vacuum and lyophilization had greater remains of ascorbic acid (respectively 130 and 106 mg 100g⁻¹) and carotenoids (respectively 47.45 and 52.78 mg 100 g⁻¹). The dried pumpkin cubes had greater radical scavenging activity, respectively 10.47 and 9.65 μmol g⁻¹. Pumpkins cultivar 'Fantazija' is best to be dried under vacuum or sublimation.

P28: Storage of Plum Fruits in Modified and Controlled Atmosphere in Belarus

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During 2011–2014 years plums of seven European and American plum cultivars of *Prunus domestica* L. ('Dalikatnaya', 'Narach', 'Venera', 'Vengerka belorusskaya', 'Volat' (Belarus), 'Stanley' (USA), 'Favorita del Sultano' (Italy)) and six hybrid plum cultivars of *xPrunus cerasifera* Ehrh., *xPrunus salicina* Lindt. ('Asaloda', 'Lodva', 'Vetraz-2' (Belarus), 'Alyonushka', 'Kometa', 'Zolushka' (Russia)) were stored in four atmosphere types: normal atmosphere (NA), modified atmosphere (MA), standard controlled atmosphere with 5 % CO₂ and 3 % O₂ (CA) and controlled atmosphere with ultra low oxygen with 2 % CO₂ and 2 % O₂ (CA ULO) at 0±0,5 °C and +2±0,5 °C for two months at the Department of Fruit Storage and Processing of the Institute for Fruit Growing. After storage percent of sound plums and incidence of storage disorders, weight loss, physical and chemical characteristics (soluble solids, firmness, springiness, level of endogenous ethylene) were determined. Then shelf life storage of sound plums was defined during two weeks at +18 °C. After cold storage the best results were obtained with CA ULO at 0 °C for all plum cultivars. The maximal number of sound fruits was 95,4 % for 'Stanley', 92,4 % for 'Volat', 91,6 % for 'Narach' among plums and 83,9 % for 'Asaloda', 81,6 % for 'Kometa' among hybrid plums. 83,7 % for 'Stanley', 82,4 % for 'Volat' and 68,5 % for 'Kometa' into CA ULO at +2 °C were selected respectively.

P29: Optimization of 30 kV power pulsed electric field system

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Contemporary researchers face a shortage of powerful pulsed electric field generators, which prevents from further scientific progress. The main purpose of work was to develop and optimise precise power pulsed electric field system which would be used to analyze the transfer of bio-molecules from plant raw materials. This would result in improvement and efficiency of certain food processing techniques, such as pasteurization, extraction, etc. Pulsed power system for high voltage pulse generation consists of power supply, energy storage, switching units and pulse transformer. Electric field pulses can be both: exponential and square-wave. The peak voltage range is up to 30 kV and the peak current range is up to 260 A, both parameters are able to be controlled. The average power is 6 kW. This system enables users to generate bipolar pulses, which are crucial for improvement of the life-time of electrodes. This function is essential for industry, as it contributes to decrease in service cost by extending the undisturbed time of system performance. Adjustable pulse lengths from 3 to 100 μ s, while repetition rate is up to 100 Hz. Device contains a self-check function, which tests the connected load before generation, and continuously monitors current in load. If current changes considerably (overcurrent or load was interrupted) system automatically stops in 120 ns. This system is unique, because it is designed in a way that enables external sensors to be connected. This function allows monitoring and controlling generation by measuring physical parameters in treatment chamber, such as: temperature, flow rate, pressure, or material density. The successful development of this system was possible because of innovative technological solutions, such as SiC semiconductor devices, extremely fast feedback, optical fiber control signals connections, self-learning mathematical control algorithm and multistage-bipolar HV generators.

P30: EU FRUIT NETWORK - A new HORIZON 2020 project

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The European Fruit Network (EUFRUIT) includes 12 countries focussed on 4 thematic areas of critical for the competitiveness and innovation potential of the European Fruit sector: a) new cultivar development and evaluation; b) minimise residues on fruit and the environment; c) optimising storage and fruit quality; d) sustainable production systems. EUFRUIT will coordinate and support innovation through developing a framework for relevant stakeholders and it will establish a systematic approach for knowledge gathering and dissemination. The physiological, biochemical, genetical, plant protection and technological insides will be evaluated in regard to vegetative and reproductive responses to fruit quality and sustainable production. The European fruit sector will create both for the industry with respect to competitiveness, sustainability and efficiency and society through ensuring the security and safety of fruit; underpinning human health and wellbeing.

The knowledge about novel methods, technologies, the best practices and growing strategies will be introduced to growers and society in our country and in Europe.

P31: Forest climate change vulnerability and adaptation assessment in Himalayas

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Forests offer an important basis for creating and safeguarding more climate-resilient communities over Hindu Kush Himalayan region. The forest ecosystem vulnerability assessment to climate change and developing knowledge base to identify and support relevant adaptation strategies is realized as an urgent need. The multi scale adaptation strategies portray increasing complexity with the increasing levels in terms of data requirements, vulnerability understanding and decision making to choose a particular adaptation strategy. We present here how such complexities could be addressed and adaptation decisions could be either directly supported by open source remote sensing based forestry products or geospatial analysis and modelled products. The forest vulnerability assessment under climate change scenario coupled with increasing forest social dependence was studied using IPCC Landscape scale Vulnerability framework in Chitwan-Annapurna Landscape (CHAL) situated in Nepal. Around twenty layers of geospatial information on climate, forest biophysical and forest social dependence data was used to assess forest vulnerability and associated adaptation needs using self-learning decision tree based approaches. The increase in forest fires, evapotranspiration and reduction in productivity over changing climate scenario was observed. The adaptation measures on enhancing productivity, improving resilience, reducing or avoiding pressure with spatial specificity are identified to support suitable decision making. The study provides spatial analytical framework to evaluate multitude of parameters to understand vulnerabilities and assess scope for alternative adaptation strategies with spatial explicitness.

P32: Flowering, reproductive behaviors and their effects on grain yields of newly bred single cross hybrids of yellow maize (*Zea mays* L.) in winter in subtropical Nepalese Himalayan foot plain

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Research was initiated to identify Nepalese maize (*Zea mays* L.) landraces as a potential source of alleles for improving grain yield of three single crosses representing the three major heterotic patterns used in Nepal. Flowering and reproductive behaviors of fifteen newly bred single cross hybrids of yellow maize have been examined in winter growing them in an RCBD trial planting their seeds on October 2, 2015 in subtropical foot plain of Himalaya. For flowering (FB); emergence of male organ (emergence of tassel or tasseling or TSS) from apical node of the stem, anthesis, silking, browning of silk or withering of silk (silk senescence or S SEN), tassel-anthesis interval (TAI), anthesis-silking interval (ASI), silking-silk senescence interval (S INI-S SEN Interval) of the hybrids have been examined dissecting the plant population (PP) into four equal parts (percent) as the first earliest, second earliest, third earliest and terminal 25 % of the PP denominated as 25, 50, 75 and 100 % respectively of the each of the fifteen hybrids. So, whether third earliest 25 % and terminal 25 % silk emerging PP denominated as SILK 75 and SILK 100 % respectively will get enough pollen from the PP of the same hybrid can be determined through ASI 75 and ASI 100 of the hybrid PP So, study of flowering and reproductive behavior of newly bred maize hybrids are indispensable to confirm high grain yielding hybrid with trait of simultaneous anthesis and silking (synchrony).

P33: In vitro seed germination and seedling development of *Coelogyne flaccida* Lindl. (*Orchidaceae*)

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Coelogyne flaccida Lindl. an epiphytic orchid native to Nepal, has high ornamental and medicinal values and is found at elevations ranging from 900 to 1100 m. In this work in vitro seed germination and seedling development of this orchid was carried out on 0.8 % (w/v) agar solidified Murashige and Skoog (MS) medium supplemented with different combinations of α -Naphthalene acetic acid (NAA) and 6-Benzylaminopurine (BAP). MS medium supplemented with 0.5 mg/L BAP and 0.5 mg/L NAA was found to be the ideal condition for the complete development of the seedlings. The germination started after six weeks of culture and developed seedlings were obtained after 22 weeks of culture on the medium supplemented with 0.5 mg/L BAP and 0.5 mg/L NAA. In the medium without hormone application, germination started after five weeks, but roots were not developed even after 32 weeks of culture, suggesting the usefulness of NAA in root induction. The present study has provided useful information that both phytohormones, BAP and NAA are necessary for the fast growth and development of the in vitro grown seedlings.

P34: Effect of exogenous polyamines enhances somatic embryogenesis via suspension cultures of spine gourd (*Momordica dioica* Roxb. ex. Willd.)

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An efficient method of somatic embryogenesis using exogenous polyamines through suspension culture protocol was developed from leaf derived callus of spine gourd (*Momordica dioica* Roxb. ex. Willd.). Embryogenic callus was originated from cut slices of leaf explants on MS solid medium supplemented with 4.4 μM 2,4-D with addition of polyamines (putrescine, spermidine and spermine). Putrescine at a concentration of 1.0 μM showed maximum increase in fresh weights of embryogenic calli. The maximum frequency of somatic embryos (30.3 %) was observed on MS medium supplemented with 3 % (w/v) sucrose and 3.3 μM 2,4-D for three weeks of culture. The MS liquid medium augmented with 3.3 μM 2,4-D and 0.5 μM putrescine was effective to achieve high frequency of somatic embryo induction (59.0 %). Moreover addition of PAs to the embryogenic media resulted in lowering of endogenous free PA level of 21-day-old embryogenic calli. Thus, when the media was supplemented with exogenous PAs a positive correlation was found to exist between somatic embryogenesis enhancements and decrease in endogenous free PA levels. Sustained cell division resulted in the formation of cell aggregates and then progressed to globular, heart and further to torpedo and cotyledonary stages within 5 weeks. Transfer of individual embryos on to a fresh MS basal medium with no plant growth regulators was able to achieve complete maturation. Conversion of embryos into plants was achieved on 1/2 strength MS semi solid medium containing 0.5 μM gibberellic acid (GA3) and 1.5 % sucrose. Twenty two percent of somatic embryos were converted into true-to-type fertile plants. Regenerated plantlets were successfully hardened, with a survival rate of approximately 76 %, and established in the field.

P35: Tillage, residue, fertilizer and weed management on phenology and yield of spring maize in Terai, Nepal

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With the aim of developing crop management technologies that reduce the yield gap of maize (*Zea mays* L.) in Nepal, a study was carried-out to determine whether the grain yield of maize could be manipulated through tillage, residue, and nutrient and weed management practices. The effect of tillage (conventional and no tillage), residue (residue retained and residue removed), fertilizer (recommended doses of fertilizer and farmers' doses of fertilizer) and weed management practices (herbicide use and manual weeding) on phenology and grain yield of maize were investigated under maize-rice cropping system in Rampur, Nepal during 2013. The experimental results revealed that no tillage had significant effect on grain yield (6.64 Mg ha^{-1}) and phenological parameters like days to silking, physiological maturity and seed fill duration. Similarly, residue retained treatment had significant effect on grain yield (7.02 Mg ha^{-1}) and phenological parameters. Research dose of fertilizer had significant effect on phenological parameters and grain yield (8.42 Mg ha^{-1}). However, weed management factor did not influence significantly on grain yield and phenological parameters. The grain yield increased in no tillage by 23.19 % over conventional tillage, residue retained by 39.84 % over residue removed, recommended doses of fertilizer by 132.60 % over farmer dose of fertilizer. Thus, no tillage, residue retention, recommended doses of fertilizer and use of herbicide for weed management can be alternative technologies for sustainable higher grain yield.

P36: Nutrient status of natural and healthy sissou forest and declining plantation sissou forest (*Dalbergia sissou* Roxb.) in Nepal

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Sissoo (*Dalbergia sissou* Roxb.) is a nitrogen fixing leguminous tree species with natural habitat in the lowland region of Nepal called Terai up to an altitude of 1000 m. For the last few years, this economically important tree species has been dying rapidly in the plantation forests. On the contrary, its status in the natural forest in riverine areas has been unknown yet. The paper compares the nutrient status of natural and healthy sissou forest with declining plantation sissou one. It is evident from this study that both stands do not differ very much with respect to their soil and plant nutrients. Therefore it was concluded that the water logging of soil was the main factor responsible for the decline of plantation sissou forest.

P37: *Plectranthus forskohlii* (Wild) Briq. (Syn: *Coleus forskohlii*) – A compendium on its botany and medicinal uses

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Plectranthus forskohlii (Wild). Briq. (Syn: *Coleus forskohlii*) is an important indigenous medicinal plant in India. It has been used in traditional Ayurvedic medicine for curing various disorders and this is the only source of the diterpenoid forskolin. Forskolin is used for the treatment of eczema, asthma, psoriasis, cardiovascular disorders and hypertension, where decreased intracellular cAMP level is believed to be a major factor in the development of the disease process. A comprehensive account of the morphology, distribution, medicinal uses, phytochemistry, pharmacological activities, analytical methods and biotechnological approaches for forskolin production reported are included in view of the many recent findings of importance on this plant.

P38: Stability and reliability analysis of Highland tropical quality protein maize (*Zea mays*) three-way and single-cross hybrids in winter in subtropical Nepalese Himalayan foot plain

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Quality protein maize (QPM) contains the opaque-2 mutation, which increases the concentration of lysine and tryptophan in the grain endosperm and roughly doubles the biological value of maize protein, as well as additional modifier genetic systems to maintain tryptophan and lysine content in the endosperm and to make the endosperm vitreous and similar to that of normal maize. Developed by CIMMYT and partners, QPM can improve the diets of the poor in areas where maize is a staple crop and also serves as a low-cost, high-quality animal feed. A primary goal of CIMMYT is to identify maize cultivars that perform well under marginal agronomic environments managed by resource poor farmers, as well as under optimal conditions. Such yield stability can be evaluated by running yield trials at multi-locations. This study was carried out to determine the yield performances and yield stability of 43 white-grained tropical lowland QPM hybrids across 8 locations in the 2015B growing season. Single parameter estimates of stability for individual genotypes and spatial modeling of stability reactions were made using four different analyses including: Shukla's Stability Variance, Eskridge's Reliability estimate, an Additive Main Effect and Multiplicative Interaction (AMMI) model and a sites regression model (SREG).

P39: Spatial distribution, advanced regeneration and stand structure of Nepalese Sal (*Shorea robusta*) forests subject to disturbances of different intensities

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We investigated the spatial distribution, advanced regeneration and stand structure of five *Shorea robusta*-dominated forests in 25 ha plots subject to disturbances of different intensities. We aim to elucidate the relationships of advanced regeneration and spatial patterns of the tree species with degree of disturbance magnitude. Sixty-seven tree species were recorded in the forest plots; 41 species were found in the least disturbed forests, while only 10 species were found in the heavily disturbed forests. We found 5320 trees with >1.5 cm diameter at breast height, in total, and found that moderately disturbed forests contained the highest advanced regeneration (sapling)/pole densities. No significant differences were observed in stem basal area among forests. The overall stand density changed quadratically across the disturbance gradient. A strong inverse relationship was found between the overall stand density and diameter class in the least disturbed and moderately disturbed forests. Ten species showed variation in their dispersion patterns across the disturbance gradient. Most of the socio-economically important tree species analyzed showed little or no regeneration in the least and most heavily disturbed forests. Individual species showed different responses to disturbance ranging from ‘tolerant’ (*Shorea robusta*, *Lagerstroemia parviflora* and *Symplocos spp.*) to ‘sensitive’ (*Trewia nudiflora*, *Adina cardifolia* and *Terminalia alata*). We concluded that moderate disturbance intensity not only ensures high stand density, but also enhances the advanced regeneration of socio-economically important tree species and affects their dispersion patterns. Future management strategy must balance the consumptive needs of the local community with those of species conservation by allowing regulated access to the forests.

P40: An evaluation of musculoskeletal disorder and socioeconomic status of farmers in West Nepal

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Rice cultivation contains several tasks and workers were compelled to adopt some harmful and awkward posture during performing those tasks. These type repetitive jobs may be related to occupational health hazards like musculoskeletal disorder (MSD). In the present investigation different MSD related problems of the workers have been assessed and also identify the socioeconomic status of the farmers considering the issues of community health development. In this connection a simple and easily applicable questionnaire technique has been apply in the agricultural field during performing rice cultivation tasks. The results showed that a large number of workers could not complete their primary education (33.0 % to 43.0 %) and remained below the poverty line (91.3 %). From the MSD assessment lower back problem was prevalent (48.8 %) among the workers when all rice cultivation tasks were consider together, but it was extremely prevalent in reaping job (92.0 %) and transplantation job (84.0 %). It was concluded that MSD among the workers might be related to the stressful work posture, long duration jobs, nature of jobs and use of ill-fitted hand tools. So, some free-hand exercise, proper work-rest scheduled and awareness program may be helpful for reducing the MSD and proper handling of hand tools.

P41: Climate change and its impact on Nepalese agriculture

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Exponential growth of CO₂ and other greenhouse gasses in the atmosphere is causing climate change. It affects agriculture, forestry, human health, biodiversity, snow cover and aquatic to mountain ecosystems. Changes in climatic factors like temperature, solar radiation and precipitation have potentials to influence crop production. Despite many efforts possible on combating impacts of climate change, there are still difficulties in Nepalese agriculture. With an average of 0.06 °C/yea, a rise in temperature from 1975 to 2006 by 1.8 °C has been recorded in the country. Problem of frequent drought, severe floods, landslides and mixed type of effects in agricultural crops have been experienced in Nepal because of climate change. Study done on CO₂ enrichment technology at Khumaltar revealed that the yield of rice and wheat increased by 26.6 % and 18.4 % due to double CO₂, 17.1 % and 8.6 % due to increase in temperature respectively. A crop simulation model (DSSAT) to study the effects of CO₂, temperature and rain in NARC showed positive effect in yield of rice and wheat in all regions, but negative effect in maize especially in Terai. In Nepalese agriculture, the time has come for the authorities to find out adaptive measures to mitigate the effects to reduce untold natural calamities and miseries due to recent erratic weather pattern.

P42: Potato tuberization in long photoperiodic conditions

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The study aimed to observe the influence of day-length on tuberization of three potato varieties ('Trezor', 'Christian' and 'Cumidava') in geographical conditions with long photoperiod. Varieties belonged to three different maturation groups: early, semi-early and semi-late. Potatoes were planted at three different dates and data was collected at 20, 25 and 45 days from emergence. The number of stolons formed at 20 days from emergence was greatly influenced by the number of day-light hours, the influence being greatest in the case of early and semi-early varieties. At 25 and 45 days from emergence varieties had similar reactions to photoperiod with differences being negatively highly significant when having 15.0 and 15.5 hours of day-light in comparison to 14.5 hours of day-light. Great differences were observed under different photoperiod conditions in the case of tuber development. In long photoperiod conditions, like the case of Romania, plating should take place so that tuberization occurs at the beginning of May when 14.5 hours of light per day are available. Getting over this photoperiod threshold determines great reduction in tuber number.

P43: Physiology of temperate and tropical orchids-An overview

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Epiphytic orchids are characterized by thick and succulent leaves with thick cell walls, cuticles and small substomatal chamber whereas those of terrestrial species are thin. Usually mature leaves are photosynthetically active. The base of the stem of sympodial epiphytes, or in some species essentially the entire stem, may be thickened to form what is called a pseudobulb that contains nutrients and water for drier periods. Terrestrial orchids may be rhizomatous or form corms or tubers which contain reserve carbohydrates. A marked increase in respiration following pollination has been observed in orchids. Activities of a number of enzymes like catalase, peroxidase, polyphenol oxidase, ascorbic acid oxidase and glycolic acid oxidase increased following pollination. All orchid species are mycoheterotrophic during germination and reliant upon fungi to complete their lifecycle. All thin leaved orchids fix CO₂ via C₃ pathway. C₄ pathway occurs primarily in plants of tropical origin growing under high light and high temperature conditions, E.g, *Arundina graminifolia*. The majority of plants in the Orchid family uses Crassulacean Acid Metabolism or CAM photosynthesis to fixate carbon dioxide. In these plants, the carboxylating enzyme for dark fixation is phosphoenolpyruvate carboxylase (PEPCase). An orchid leaf will have greater rates of photosynthesis at higher levels of atmospheric CO₂ concentration. In *Cymbidium*, the process from flower bud induction in the new growth to blooming can be divided into three stages, Flower Bud Initiation in the New Growth (Stage I), Flower Spike Initiation (Stage II) and Spike Elongation and Blooming (Stage III). Orchid pseudobulbs serve as water storage, carbohydrate storage and mineral storage organ.

Notes:

A series of 21 horizontal lines for writing or drawing.

