Review of the activities of the Lithuanian Research Centre for Agriculture and Forestry

ANNUAL REPORT FOR 2016

MAJOR FACTS :

✓ The Lithuania Research Centre for Agriculture and Forestry (hereinafter the Centre):

✓ Employed a total staff of 601, including 193 researchers and 408 other employees; had 50 doctoral students (p. 5).

✓ Completed 23 international and 50 national research projects, funded by the Research Council of Lithuania, Ministry of Education and Science, Ministry of Agriculture, Ministry of Environment and undertook over 80 outsourcing work projects for national and foreign economic entities (p. 13).

✓ Conducted 6 long-term research programmes (p. 10).

✓ Ten of the Centre's Crop varieties were included in the National Plant Variety List and EU Common Catalogue of Agricultural Plant and Vegetable Varieties (p. 38).

✓ Published over 70 scientific publications in the journals, refereed and indexed in the "Clarivate Analytics Web of Science" database, 12 chapters of books published by international publishers, over 30 scientific publications in peer-reviewed periodical journals (p. 10).

✓ Arranged 9 conferences, 30 seminars and field days (p. 45).

CONTENT

RELEVANT INFORMATION

✓ Dr. Gintaras Brazauskas took office as director of Institute of Agriculture; Dr. Vidas Damanauskas took office as director of Joniškėlis Experimental Station.

✓ On January 28, Cryobiology Laboratory was opened at the Institute of Horticulture. It is the first laboratory of such type in the Baltic countries. Research on the mechanisms of plant resistance to cold will be conducted and gene fund of all vegetatively propagated plants will be stored in this laboratory.

✓ On June 28, Institute of Horticulture was granted accreditation to consult on the agri-environment and farming in the protected areas.

✓ On September 26, the National Accreditation Bureau certified that Analytical Department of the Agrochemical Research Laboratory of the Centre complies with the requirements of LST EN ISO/IEC 17025:2005 and is accredited to carry out the testing of soil and active substances in plant protection products.

✓ Buckwheat cultivars VB ‘Vokiai’ and VB ‘Nojai’ developed at Vokė Branch of the Centre were started to be cultivated in Finland. Product manufacturers carry out research on the suitability of locally grown buckwheat for the production of flour, pasta and other products.

1. MISSION

The Centre's mission is to conduct basic and applied research relevant to science, national economic development, social and environmental needs, rational and sustainable use of land, forest and natural resources and high quality production in compliance with the envisaged major directions of the scientific activities; to elaborate research and development activities in the fields of agriculture, horticulture, forestry, ecology and related sciences; to collect new scientific knowledge, systemize it and disseminate to the public; to foster balanced and sustainable agricultural, forestry and rural development.

2. RESEARCH FIELDS

The key research priorities:

- ✓ to carry out long-term basic and applied research, experimental development activities pertinent to the national economy, accrue and disseminate scientific expertise necessary for rational and sustainable use of land, forest and environment resources and high quality production;
- ✓ to ensure international level of scientific competence in agricultural and forest sciences and to work with business, government and members of the public, to render methodological and expert advice, in co-operation with higher education institutions to train scientists, to help them develop specialists in formal and informal training and education.

Strategic objective is to conduct R&D in the fields of agriculture and forestry, as well as related fields of biology, biophysics, ecology and environmental studies, botany and zoology.

3. HUMAN RESOURCES

3.1. Personnel

The quality and results of each institution's activities depend on the potential of human resources. The Centre employs a total staff of about 600, of which research staff accounts for about 32 %.

Table 1. Personnel of the Centre

Darbuotojų grupės	Centre	Institute of Agriculture	Institute of Forestry	Institute of Horticulture	Regional Branches	Total	Workload
Research staff:	**0**	**67**	**37**	**45**	**44**	**193**	127.55
head researchers	0	7	2	7	4	**20**	14.4
senior researchers	0	27	9	20	12	**68**	47.05
researchers	0	10	10	7	15	**42**	27.85
junior researchers	0	23	16	11	13	**63**	38.25
Technicians, laboratory assistants	0	60	12	29	27	**128**	114.95
Administration	13	16	7	12	27	**75**	68.75
Specialists and other personnel	0	46	21	44	94	**205**	191
Total:	13	189	77	130	236	**601**	502.25
PhD students		19	16	6	9	**50**	

3.2. Research Board

The Research Board is the supreme body of the Centre's government. It is comprised of 15 members. The term of service of the Board is 5 years.

The Board sets the key directions for the research activities, approves the long-term activity plan submitted by the director, reports on the annual activities, monitors qualifying analysis of the Centre's activities, sets forth qualification requirements for the research and other staff, as well as procedures for their performance assessment and employment, approves various documents, performs other activities envisaged in the Centre's regulations.

Members of the Research Board

Dr. Virginijus Feiza	Head of Department of Soil and Crop Management, Institute of Agriculture, Chairman of the Research Board
Dr. Audrius Sasnauskas	Director of Institute of Horticulture, Vice Chairman of the Research Board
Dr. Marius Aleinikovas	Director of Institute of Forestry, Vice Chairman of the Research Board
Dr. Sigitas Lazauskas	Head of Department of Plant Nutrition and Agroecology, Institute of Agriculture, Secretary of the Research Board
Dr. Gintaras Brazauskas	Director of Institute of Agriculture
Prof. Dr. Habil. Vidmantas Stanys	Head of Department of Orchard Plants Genetics and Biotechnology, Institute of Horticulture
Dr. Zita Duchovskienė	Deputy Director of Department of Fishery, Ministry of Agriculture of the Republic of Lithuania
Prof. Dr. Habil. Pavelas Duchovskis	Head of Department of Plant Physiology, Institute of Horticulture
Rimantas Krasuckis	Director of Department of Agricultural Production and Food Industry, Ministry of Agriculture of the Republic of Lithuania
Dr. Virgilijus Mikšys	Deputy Director for Research, Institute of Forestry
Dr. Rimantas Prūsaitis	Director of the Directorate General of State Forests
Assoc. Prof. Dr. Steponas Raudonius	Head of Studies Department, Aleksandras Stulginskis University
Dr. Vidas Stakėnas	Head of Department of Ecology, Institute of Forestry
Prof. Dr. Habil. Gediminas Staugaitis	Director of Agrochemical Research Laboratory
Prof. Dr. Habil. Rimantas Velička	Director of Experimental Station, Aleksandras Stulginskis University

3.3. Steering Board

The Steering Board's task is to appraise the Centre's performance and to put forward recommendations for the Centre and Ministry of Education and Science of the Republic of Lithuania regarding improvement of the Centre's activities.

Members of the Steering Board

Dr. Virginija Žoštautienė	Director of Department of Administrative Matters and Assets Management, Ministry of Agriculture of the Republic of Lithuania
Prof. Dr. Dainius Haroldas Pauža	Chairman of Research Council of Lithuania
Assoc. Prof. Dr. Gytis Svirskis	Member of Committee of Natural and Technical Sciences, Research Council of Lithuania
Ginvilė Jekentienė	Chief Specialist of Department of Higher Education, Science and Technology, Ministry of Education and Science of the Republic of Lithuania
Dr. Violeta Juškienė	Director of the Institute of Animal Science, Lithuanian University of Health Sciences
Prof. Dr. Habil. Kęstutis Sasnauskas	Director of the Institute of Animal Science, Lithuanian University of Health Sciences
Assoc. Prof. Dr. Antanas Šarkinas	Director of Food Institute, Kaunas University of Technology

4. DOCTORAL STUDIES

Researchers in the fields of agronomy, forestry, and environmental sciences had already been trained for several decades before the merger of the institutes. After establishment of the Centre, this tradition is being continued.

Based on the order of LR Minister of Education and Science, in 2011 the Centre was newly granted a right for doctoral studies in 4 science fields:

- ✓ **Agronomy** jointly with Aleksandras Stulginskis University
- ✓ **Forestry** jointly with Aleksandras Stulginskis University
- ✓ **Ecology and Environmental Science** jointly with Vytautas Magnus and Aleksandras Stulginskis University
- ✓ **Biochemistry** jointly with Vytautas Magnus and Lithuanian University of Health Sciences and Nencki Experimental Biology Institute (Poland)

4.1. Doctoral students enrolled in 2016

Agricultural Sciences, Agronomy (01 A)

1. **Andrius Šarka**, supervisor Prof. Dr. Habil. Gediminas Staugaitis. Mineral nitrogen variability in organic soils
2. **Donata Drapanauskaitė**, supervisor Dr. Romas Mažeika. Effect of different chemical composition and structure of liming materials on acid soil neutralizing.
3. **Giedrius Petrauskas**, supervisor Dr. Vilma Kemešytė, scientific advisor Dr. Gražina Statkevičiūtė. Genetic diversity of autochthonous red clover (*Trifolium pratense* L.) populations.
4. **Yuliia Kochiieru**, supervisor Dr. Audronė Mankevičienė, scientific advisor Dr. Jurgita Cesevičienė. Research on the quality of raw material and products of bread cereals as influenced by mycotoxin occurrence.
5. **Jurgita Špokaitė**, supervisor Dr. Alvyra Šlepetienė, scientific advisors Dr. Virmantas Povilaitis, Dr. Rasa Tamulienė (KTU). Dynamic of aminoacids biosynthesis in winter wheat (*Triticum aestivum* L.) under intensive growing technology.
6. **Kazimież Duchovski**, supervisor Dr. Alvyra Šlepetienė. Comparison of organic matter and its main components of different soils.
7. **Kristina Cirtautaitė**, supervisor Dr. Romas Mažeika. The influence of the fertilizer products, produced from biofuel ash, on soil and plants.
8. **Mykola Kochiieru**, supervisor Dr. Virginijus Feiza. The effect of crop cover and soil water retention on physico-chemical and biophysical quality of soils of different origin.

Agricultural Sciences, Forestry (04 AB)

1. **Asta Doftartė**, supervisor Dr. Diana Lukminė. An empirical analysis of the factors influencing sustainability of private forest management.
2. **Benas Šilinskas**, supervisor Dr. Iveta Varnagirytė-Kabašinskienė. Norway spruce (*Picea abies* (L.) Karst.) and Scots pine (*Pinus sylvestris* L.) wood properties dependence on growth conditions and stand management.

Biomedical Sciences, Ecology and Environmental Science (03B)

1. **Gintarė Bajarkevičienė**, supervisor Prof. Dr. Alfas Pliūra. Juvenile-stage response and plasticity of different tree species, its populations and simulated forming forest communities under impact of simulated climate change and other environmental stressors.
2. **Sigitas Tamošaitis**, supervisor Dr. Virgilijus Baliuckas. Processes of natural hybridisation in native species of *Alnus*, *Betula* and *Ulmus* genus.

4.2. Doctoral theses defended in 2016

Agricultural Sciences, Agronomy (01 A)

1. **Asta Kazlauskaitė-Jadzevičė** – Changes of *Haplic Luvisol* properties and productivity of phytocenoses with altering land use. Supervisor Dr. Saulius Marcinkonis.
2. **Ieva Jokubauskaitė –** Changes in dissolved and humified carbon in acid soil as influenced by different liming and fertilization systems. Supervisor Dr. Alvyra Šlepetienė.

3. **Jelena Titova –** Influence of fertilization with sewage sludge compost on biomass formation of energy plants and changes of chemical elements. Supervisor Dr. Eugenija Bakšienė.

4. **Jovita Mikaliūnienė** – Resistance of red clover (*Trifolium pratense* L.) to fungal diseases and their qualitative indicators. Supervisor Dr. Skaidrė Supronienė.

5. **Karolina Gvildienė –** The quality of composts, their effect on soil and plants. Supervisor Prof. Dr. Habil. Gediminas Staugaitis.

6. **Kristina Amalevičiūtė** – Changes in the properties of *Pachiterric Histosol* as influenced by management and renaturalization. Supervisor Dr. Alvyra Šlepetienė.

7. **Lina Žičkienė** – Mineral nitrogen fluxes in different soils. Supervisor Prof. Dr. Habil. Gediminas Staugaitis.

8. **Neringa Rasiukevičiūtė** – Genetic and phenotypic diversity of *Botrytis* spp. from strawberry and onion, diseases forecasting and control. Supervisor Dr. Skaidrė Supronienė.

9. **Nijolė Liepienė –** Identification, pathogenicity, harmfulness and control of lupin anthracnose fungus *Colletotrichum* spp. Supervisor Dr. Roma Semaškienė.

Agricultural Sciences, Forestry (04 AB)

1. **Adas Marčiulynas –** Biology and significance of the spruce bud scale (*Physokermes piceae* Shrank.) to sanitary conditions of Norway spruce (*Picea abies* (L.) H. Karst.) in Lithuania. Supervisor Prof. Dr. Habil. Rimantas Rakauskas.

2. **Gediminas Čapkauskas** – Natural disturbances of forest stand development: tree damages and risk of defoliation. Supervisor Dr. Vidas Stakėnas.

Biomedical Sciences, Ecology and Environmental Science (03B)

1. **Valda Araminienė** – Birch sp. health and growth under current and simulated climate condition. Supervisor Dr. Iveta Varnagirytė-Kabašinskienė.

5. SCIENTIFIC OUTPUT

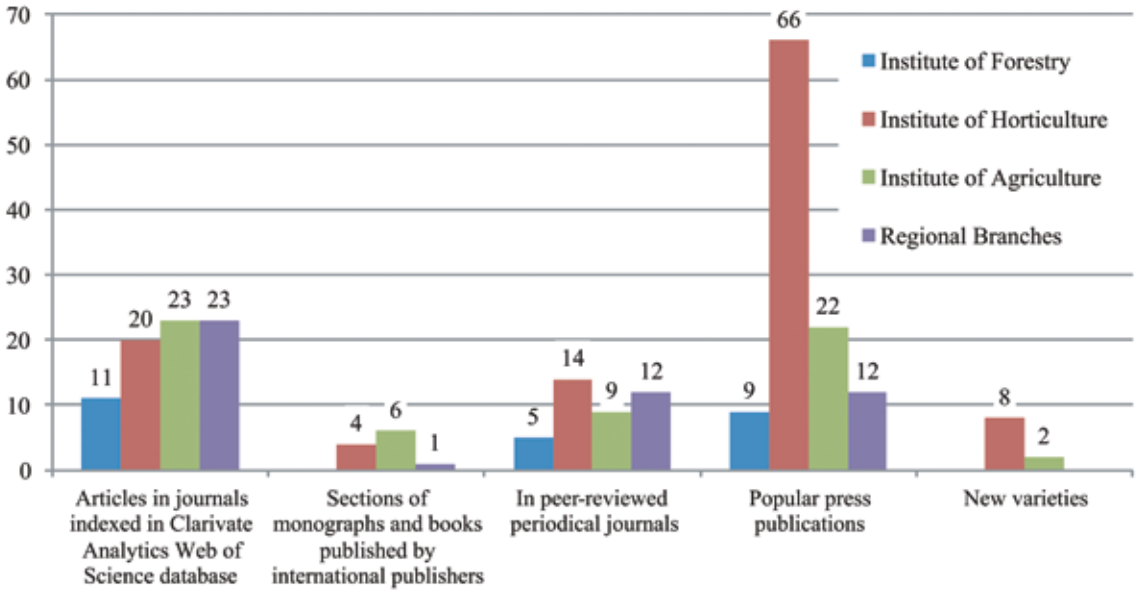

Figure 1. Scientific production of Lithuanian Research Cenre for Agriculture and Forestry in 2016

6. RESEARCH AND DEVELOPMENT

In 2016, there were completed 23 international, 50 national projects, which were supported by Lithuania's Research Council, Ministries of Agriculture, Environment, Education and Science. More than 100 orders were contracted by economic entities of Lithuania and other countries (Table 2). All projects are presented in the appendixes.

Table 2. Projects implemented by the Centre in 2016

Branches	Projects					
	International	Research Council of Lithuania	Ministries of Lithuania	With national economic entities	With foreign economic entities	Total
Institute of Forestry	10	3	15	9	-	**37**
Institute of Horticulture	4	6	4	6	9	**29**
Institute of Agriculture	8	4	12	13	58	**95**
Regional Branches	1	-	6	19	3	**29**
Total:	**23**	**13**	**37**	**47**	**70**	**190**

6.1. Long-term research programmes

In 2012–2016 the Centre conducted six long-term research programmes.

Biopotential and quality of plants for multifunctional use
Leader Dr. Žydrė Kadžulienė
E-mail zkadziul@lzi.lt

The aim was to develop and perfect scientific foundations of crop production, necessary for the development of stable, sustainable and competitive agriculture under changing market and climate conditions, to develop innovative cultivation technologies for various farming systems, allowing preservation of sustainable soil and healthy environment. The programme was implemented by more than 40 researchers from Institute of Agriculture and regional divisions by conducting over 20 thematic studies annually. The use of legumes for nitrogen balance optimization in organic farms was evaluated, cereal and potato productivity in the cropping systems of different intensity on low-productivity soils was assessed, spring oilseed rape productivity on heavy loam *Cambisol* was estimated, the advantages of application of bio-mulches in potato agrocenoses were determined, species composition of segetal plants and their distribution in spring and winter cereals in different regions were evaluated, agrobiological and chemical properties of alternative fibre plants were determined and possibilities of use of their biomass were investigated. The obtained results are published and used for planning new research.

Sustainable forestry and global changes
Leader Dr. Virgilijus Mikšys
E-mail miekolog@mi.lt

Lithuanian forests and the forestry sector experience global and regional changes: climate change, the transition to market economy, the emergence of private forests, increased migration, widespread use of forest biomass in the production of renewable energy, etc. Growing demand for timber raises the need to preserve ecological forest function. The goal of the program was to obtain and organize new scientific knowledge for sustainable forest management, to develop global natural, economic and social change and prepare recommendations. The program ran studies of sustainable forests, forest tree populations' adaptation options, forest productivity, their self-development; assessed the effect of changes in the economic and social development of the forestry sector and the sustainable use of resources.

Harmful organisms in agro- and forest ecosystems

Leader Dr. Roma Semaškienė
E-mail roma@lzi.lt

Plant pathology and protection research was merged in the long term program KOMAS. The aim of the program was to investigate the specificity of the common and emerging pests' populations in Lithuania and create research framework for management strategy by combining profit with safety for environment, human health and biodiversity.

Researchers and PhD students of Institutes of Agriculture, Horticulture and Forestry, also Microbiological Laboratory of Open Access Centre for Agriculture and Forestry work on pest and disease occurrence patterns, population structure of pests, harmfulness and control research and focus on implementation of aim and tasks of the program. The research results are published in scientific journals and are presented in international and local conferences; knowledge is shared in journals and newspapers as well as in workshops and field days for agricultural advisers and farmers.

Horticulture: agrobiological foundations and technologies

Leaders Prof. Dr. Habil. Pavelas Duchovskis, Dr. Giedrė Samuolienė
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The goal of the program is to establish scientific background for the development of novel horticulture in changing climatic and economic conditions, herewith ensuring the cultivation of high-quality, safe and competitive production for domestic market and for export. The research is carried out according to three tasks and eight tools. Over 50 publications in "Clarivate Analytics Web of Science" (formerly "Thomson Reuters Web of Science") data base with impact factor was published during the implementation time of the program. Even more publications were published in other scientific journals. The participants of the program presented the obtained data in over 200 scientific conferences. The results were presented to farmers during other events – seminars, open field days, popular journals, TV and radio.

Productivity and sustainability of agricultural and forest soils

Leader Dr. Virginijus Feiza
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Soil is a slowly renewable natural resource with a high degradation and a very low degree of regeneration. The aim of the program is to investigate agricultural and forest soil resources, to highlight factors determining degradation and to select appropriate means to maintain soil sustainability and optimize carbon cycling, to reduce CO2 emission and nutrient losses in various regions of the country. The programme was implemented by researchers from Institute of Agriculture, Institute of Forestry and regional divisions of the Centre. The findings were published in scientific journals, presented in scientific-practical seminars, field days, agricultural and forestry exhibitions, published in national periodical publications.

Genetics and purposeful change of genotypes of agricultural and forest plants

Leaders Prof. Dr. Habil. Vidmantas Stanys, Assoc. Prof. Dr. Vytautas Ruzgas
E-mail v.stanys@lsdi.lt, ruzgas@lzi.lt

The aim was to establish plant characteristics and properties of the genetic control, to improve the early identification methods of valuable genotypes and to develop new, high-quality breeding material for creation of innovative, competitive and consumer-attractive cultivars; to identify new genotypes of forest plants for the country's economic development.

The research was carried out in these areas: 1) investigations of mechanisms for early diagnostics and screening methods for plant resistance to biotic and abiotic factors; 2) investigation and usage of morphological and molecular markers, identification of genes; 3) investigation of population structure and expression of genes controlling economically important characteristics; 4) the genetic-breeding evaluation of selected tree progeny, formation of breeding populations, evaluation of phenogenetic plasticity and polymosphism of population progeny.

Besides genetic investigations, development of genetic collections of field and horticultural plants, research of genetic resources *ex situ*, accumulation and storage of genetic material for target pre-breeding programs, development of promising breeding material and cultivars were performed.

Table 3. The most important outputs of the long-term research programmes

Title of long-term research programme, leader	Indicators	Plan for 5 years	Results				
			2012	2013	2014	2015	2016
Biopotential and quality of plants for multifunctional use. *Leader Dr. Žydrė Kadžiulienė*	**CA WoS articles**	**20**	**7**	**7**	**11**	**12**	**7**
	Peer-reviewed articles	20	15	11	4	8	8
	Presentations (int. conf.)	20	21	25	7	7	13
	Innovative methods	10	6	5	-	4	7
Sustainable forestry and global changes. *Leader Dr. Virgilijus Mikšys*	**CA WoS articles**	**14**	**7**	**4**	**9**	**7**	**5**
	Peer-reviewed articles	21	7	5	5	9	3
	Presentations (int. conf.)	25	6	11	12	9	9
	Innovative methods	7	1	1	1	3	1
	Popular press articles	16	17	6	12	7	13
Harmful organisms in agro- and forest ecosystems. *Leader Dr. Roma Semaškienė*	**CA WoS articles**	**20**	**6**	**7**	**7**	**7**	**7**
	Peer-reviewed articles	20	12	3	4	3	4
	Presentations (int. conf.)	15	12	10	14	9	13
	Recommendations	10	0	0	-	5	8
Horticulture: agrobiological foundations and technologies. *Leaders Prof. Dr. Habil. Pavelas Duchovskis, Dr. Giedrė Samuolienė*	**CA WoS articles**	**20**	**10**	**13**	**15**	**12**	**11**
	Peer-reviewed articles	20	15	34	15	20	11
	Innovative methods	10	6	2	-	-	2
	Presentations (int. conf.)	20	21	25	42	50	22
	Recommendations	0	5	7	8	7	4
Productivity and sustainability of agricultural and forest soils. *Leader Dr. Virginijus Feiza*	**Sections of books**	**1**	**2**	0	-	**1**	0
	CA WoS articles	**25**	**10**	**12**	**12**	**11**	**16**
	Peer-reviewed articles	25	19	9	14	25	3
	Presentations (int. conf.)	10	8	12	15	33	21
	Popular press articles	75	18	12	17	12	16
	Recommendations	10	3	4	4	4	4
Genetics and purposeful change of genotypes of agricultural and forest plants. *Leaders Prof. Dr. Habil. Vidmantas Stanys, Assoc. Prof. Dr. Vytautas Ruzgas*	**CA WoS articles**	**20**	**8**	**16**	**13**	**18**	**15**
	Patents and varieties	**17**	**9**	**5**	**5**	**7**	**5**
	Other articles	20	8	16	15	14	13
	Presentations (int. conf.)	30	7	11	21	25	18

6.2. National projects

6.2.1. Started in 2016

Projects funded by the Ministry of Agriculture of the Republic of Lithuania

Support for applied research

1. "The state of agricultural crop stands and yield predictions in Lithuania". Project leader Dr. Virginijus Feiza. 2016–2018.
2. "Research into pollen species composition and its content in honey in relation to bee foraging distance". Project leader Dr. Kristina Jonavičienė. 2016–2018.
3. "The study of prevention diseases, pests, and weeds according to sustainable plant protection measures". Project leader Dr. Alma Valiuškaitė. 2016.
4. "Health evaluation of new varieties of orchard plants and development of the highest category of planting material". Project leader Ingrida Mažeikienė. 2016–2018.
5. "Scientific investigation of cereals, legumes and bluegrasses, fruits, vegetables, berries, perennial grasses cultivars for suitability for growing under ecological conditions in Lithuania". Project leader Dr. Rasa Karklelienė. 2016.
6. "Pest risk analysis for *Xylella fastidiosa* (Wwlls et al.)". Project leader Dr. Artūras Gedminas. 2016–2018.

Support for the beekeeping sector in Lithuania

1. "Hygiene behaviour of Carniolan bees, development and establishment of bee lines adapted to Lithuania's honey flow and climate conditions" Project leader Diana Tamašauskienė. 2016.
2. "Efficacy of *MAQs* and *Apivar* preparations against bee mites *Varroa destructo*". Project leader Diana Tamašauskienė. 2016.
3. "Beta-/gamma amylase determination in honey and winter food of bees". Project leader Dr. Violeta Čeksterytė. 2016.

Applied research, funded by the Ministry of Environment of the Republic of Lithuania

1. "Creation of national values for evaluation carbon stocks and the determination of carbon stock values in mineral and organic soils in forest and non-forestland". Project leader Dr. Kęstutis Armolaitis. 2016.
2. "Assessment of carbon stocks in mineral and organic soils, and estimation of national carbon values in the soils after afforestation of abandoned agricultural land/reforestation". Project leader Dr. Iveta Varnagirytė-Kabašinskienė. 2016.
3. "Estimation of carbon values in dead wood of different decay intensity, and determination of national standards on carbon content values in dead wood". Project leader Dr. Vidas Stakėnas. 2016.
4. "Carbon accounting in harvested wood products: recommendations for Lithuania". Project leader Dr. Marius Aleinikovas. 2016.

6.2.2. Conducted in 2016

1. **"*Artemisia dubia* biomass chemical composition and thermochemical conversion studies (ARTBIO)"**, 2014–2016. Project leader Dr. Žydrė Kadžiulienė.
   E-mail zkadziul@lzi.lt

Sustainable use of biomass and provision with herbaceous biomass is a relevant issue of contemporary research. It is important to have a wide range of non-food plants that could be suitable, efficient producers of biomass and therefore it is essential to explore new plants, one of which is *Artemisia dubia* Wall. The objective of the project is to investigate the chemical composition of biomass of the perennial plant *A. dubia* and its suitability for thermochemical conversion.

To achieve the project objective and to accomplish the project tasks, field experiments and laboratory analyses involving perennial plant species *Artemisia dubia* Wall., *Festuca arundinaceae* and *Miscanthus giganteus* are conducted. Field experiments are carried out at Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry, on a moderately heavy *Endocalcari-Endohypogleyic Cambisol* (*CMg-n-w-can)*. Laboratory analyses are done at the Institute of Agriculture and Aleksandras Stulginskis University.

One of the major indicators determining economic benefit of biomass used for energy purpose is the above-ground plant biomass yield. Annual dry matter yield of *A.dubia* was 15–17 t ha^{-1}. The biomass of *A. dubia* was found to have the highest dry matter content, while significant influence of N fertilization was not achieved. It is noteworthy that the biomass of *A. dubia* was characterised by a better chemical composition for combustion. It is important that the biomass of *A. dubia* exhibited a relatively small ash content, which is an advantage when burning the biomass, since one can expect a higher calorific value. Fertilization significantly affected N content in the biomass of *A. dubia*; however, fertilization effect on C and S content was not significant. Summarized results of *A.dubia* potential and quality, particularly available without nitrogen fertilizers, distinguish them as a viable energy crop in the mid-latitudes of the northern part of the temperate zone.

2. **"Physiological background of the crop load and rootstock effect on alternate bearing of apple tree"**, 2014–2016. Project leader Dr. Giedrė Samuolienė.
E-mail g.samuoliene@lsdi.lt

The research is focused on studying of a range of vegetative and reproductive responses to varying crop load, and on the physiological and biochemical approaches underlying the responses to fruit load in apple trees.

In contrast to unthinned trees (12 fruits cm^{-2} TCSA), more intensive thinning resulted in a significant decrease of yield, amount of photosynthesis pigments, but significant increase of fruit weight, leaf area and accumulation of hexoses was observed, and led to more intensive return bloom following year. Heavy crop load resulted in an increase of inhibitor phytohormones and return bloom was suppressed the following year. Thus limited number of inflorescences results in more intensive flowering next year.

Fruit quality did not depend on fruit distribution in the tree and the annual yield of 50 t per ha may be maintained. Higher contents of flowering promoters hormones (JA) and lower contents of inhibitory hormones (GAs) were detected in buds where inflorescences were removed. Strong negative correlation between ABA and sucrose and between IAA and glucose shows that higher levels of flower inhibitors results in decrease of sugars, as signalling molecules, in treatments where inflorescences were unthinned. Thus, flowering induction depends on critical ratio of signalling molecules that is transported to buds. Physiology of photosynthesis depended on fruit distribution in the tree, on which depends light

perception by leaves and fruits. Obtained data shows that apple trees sense mild stress, which is related with absorbed light quantity and results in decrease of pigment content.

Impact of the choice of rootstock and crop-load on apple tree nutritional status and yield relationships between biochemical parameters were analysed. Generally, yield, fruit weight were crop-load, while metabolite changes were rootstock dependent. Mineral sufficiency was dependent on rootstock and crop-load. P 22 rootstock resulted in the smallest yield and fruits. On the average on both cultivars, more regular yield was on Pure 1, P 59 and B.396 rootstocks. A significant higher alternate bearing index was established on P 67, P 62 and M.9 rootstocks.

The developed strategy of crop load and identified optimal crop load for different apple tree cultivars with different rootstocks during different growth periods of orchard could be introduced in commercial orchards in our country and in North eastern region of Europe.

3. **"Estimation of Scots pine ecological plasticity using molecular-genetic methods aimed to improve reforestation strategy in the context of climate change, to preserve forest biodiversity and genetic resources in Belarus and Lithuania"**, 2015–2016.
Project leader Dr. Virgilijus Baliuckas.
E-mail Virgilijus.Baliuckas@mi.lt

The project is aimed to address important strategic task – to create a high productivity and resistance Scots pine stands in rapid climate change conditions by selecting genotypes with high adaptation ability and ecological plasticity. Principles and methods for such selection will be developed. The structural-functional pine genome testing, the determination of genetic characteristics which are important for ecological plasticity and adaptive variability, will lead research fundamentality. Molecular-genetic markers analysis will be carried out in conjunction with the morphological and physiological characteristics. The results will serve as a basis for recommendations guiding forest tree breeding in Belarus and Lithuania.

4. **"Technocogical-technical validation of fiber crops' preparation and use for biofuel and energy-environmental evaluation of the technologies"**, 2015–2016.
Project leader Dr. Algirdas Jasinskas (ASU). Participants: Dr. Zofija Jankauskienė, Dr. Elvyra Gruzdevienė.
E-mail upyte@upyte.lzi.lt

The study was aimed to investigate technologies intended for fibre plants' preparation for pressed biofuels, determine their technological-technical indicators and to conduct energy-environmental assessment of the technologies. Having investigated the biomass of various fibre plants it was found that they contained the highest C content – 45.5–48.0 %, H content – 5.7–5.9 %, nitrogen and sulphur was found at low concentration. Ash content in the tested fibre hemp was low – 3.3–3.9 %. Ash content in the tested fibre nettle was nearly twice as high – 6.57 %. The lower calorific value of fibre nettle was 16.93 MJ kg^{-1} and that of hemp – 17.4 MJ kg^{-1}. The noxious gas emissions from burning various fibre plants suggest that the highest carbon monoxide concentration was produced when burning fibre nettle, i.e. it was approx. 2.5–3.5 times higher than CO emission from burning fibre hemp. Based on analytical and experimental research, it was calculated that the cost of calorific unit of wood pellets is by approx. 30–35 % lower than that of fibre plants and approx. 20–30 % lower compared with other non-traditional herbaceous plants and straw pellets.

5. **"Research into the effects of pelletized manure on crops and soil"**, 2015–2016.
Project leader Prof. Dr. Habil. Gediminas Staugaitis.
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The project was aimed to study the effects of pelletized manure on crops and soil in which theses crops were cultivated. The study involved pelletized organic fertilizers of different origin: poultry manure, cattle manure, organic and organic-mineral fertilizers. The crops under study were spring oilseed rape and potatoes. The study suggested that pelletized organic fertilizers produced from poultry and cattle manure are valuable fertilizers because of their chemical composition. A weakly alkaline medium is specific to these fertilizers which contain 81–84 % organic matter. Pelletized poultry manure contains 3.4–4.4 % nitrogen (N), 2.2–2.3 % phosphorus (P_2O_5), 2.9–3.0 % potassium (K_2O), and pelletized cattle manure 2.0–2.3, 0.9–1.3 and 6.6–7.2 %, respectively. Pelleted poultry manure is richer in nitrogen and phosphorus, while pelletized cattle manure is richer in potassium. Organic-mineral fertilizers are produced from poultry or/and cattle manure by adding mineral fertilizers, and sometimes tree ash. Depending on the

type and amount of components added, the chemical composition of organic-mineral fertilizers varies within a rather wide range. They contain 1.6–6.8 % nitrogen (N), 3.2–7.9 % phosphorus (P_2O_5), 3.1–14.5 % potassium (K_2O).

All the pelletized organic fertilizers tested increased spring rape seed yield and 1000 seed weight. The seeds accumulated slightly less crude protein, but fat yield per ha was calculated to be the highest. Potato tuber yield significantly increased only in response to pelletized poultry manure. All fertilizers tested had little effect on tuber size but were found to reduce dry matter and starch content and increased nitrate accumulation.

The tested pelletized organic fertilizers did not have significant effect on soil pH and negligibly increased organic carbon content. Higher mineral nitrogen contents were established in the soil after harvesting. The content of available potassium in the soil increased, while that of available phosphorus slightly decreased, except for the plots applied with pelletized cattle manure.

6. Research on meristemic seed production of Lithuania-bred potato varieties, 2015-2016.

Project leader Dr. Almantas Ražukas
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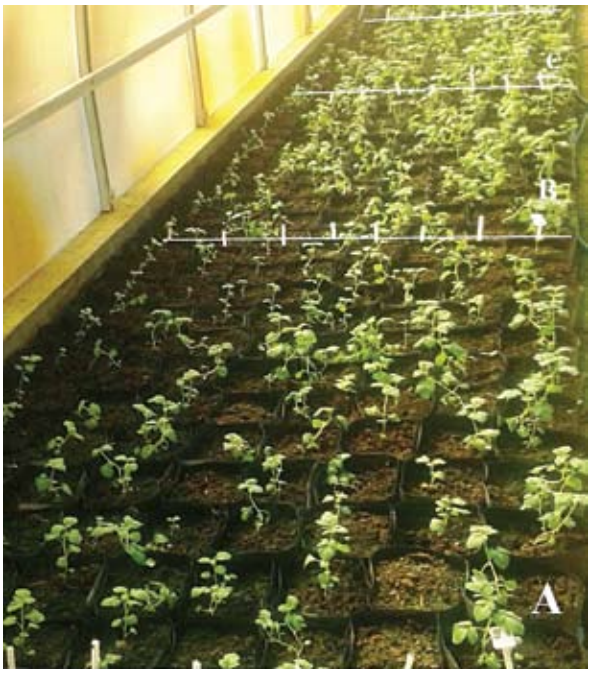
The main aim of this research was to optimize meristemic potato growing technology seeking to produce high quality and quantity in vitro microplants and in vivo minitubers.

During this research work it was determined that the most suitable for in vitro microplant cultivation was 16/8 hours (day/night) light and 24+-2°C temperature. Research of the influence of chemical agents (IAR, NAR, 2,4D, cinetine, BAP, giberaline) on two potato varieties' ('Goda' and 'VB Aista') in vitro potato plant growth determined that the best miniplant development was achieved using IAR (1.0 $mg1^{-1}$) and cinetine (0.04 mg 1^{-1}).

Research of the influence of the biologically active materials on the minitubers of potato cultivar 'Goda' determined that all the preparations had positive influence on the minituber formation in vivo. The best results of potato minitubers formation were obtained when plants were grown in the peat with NPK (NH_4NO_3, Ca $(H_2PO_4)_2$, KCL) + Amino Alexin 0.1 % (3.3 units per plant). Assessment of FERTENAT influence showed that the highest minituber yield was produced by 'VB Liepa' when this compound was used four times: before planting, after planting, foliar-applied at 3–4 leaf stage and beginning of bud formation.

Having performed tuber tests of Lithuania-bred potato varieties ('VB Venta', 'Goda', 'VB Liepa', 'VB Rasa', 'VB Aista') it was found that starch and dry matter content in the tubers grown under organic and intensive production systems was different in all the tested varieties (except 'Goda'): higher amounts were found in the potato tubers grown in the intensive production system ($p<0.05$), tubers were harder in the organic production system ($p<0.05$). Production system had no influence on potato tuber texture, colour and taste. During the storage period, the amount of amino acids and phenolics increased in the potato tubers ($p<0.05$).



7. **"Glyphosate pre harvest management for the grain defoliation purposes and its residues concentration in the grain and their influence on product safety"**, 2015–2016.
Project leader Dr. Gražina Kadžienė.
E-mail grazina.kadziene@lzi.lt

The aim of the study was to clarify whether the residues of glyphosate and its degradation product AMPA residues do not exceed permitted limits in cereal grains, when glyphosate application time is belated from 14 (according to recommendations) up to 2 days before harvest. Evaluation of residues in grain products such as flour, starch, malt were also foreseen in case of glyphosate residues exceeds the limits. The maximum amount of glyphosate at 1440 a.i. per ha dose rate (according to label) was used in winter wheat and spring barley crop stands.

The data from the two-year investigations showed that small amounts of glyphosate and its degradation product AMPA residues were found in wheat and barley grain, when crop stands were applied with glyphosate at 14, 10, 7, 4 and 2 days before harvesting, but these amounts did not exceed the permitted limits. In both years of the study, the use of glyphosate 14–2 days before the harvest, did not impact the yield of winter wheat and spring barley and it had no influence on grain moisture compared to the untreated control. Winter wheat and barley grain quality did not differ between the treatments either. The study repeated over two years showed that glyphosate application time from 14 up to 2 days to harvest did not reduce the seed germination of crops sprayed at full maturity of wheat or barley, when the actual grain moisture was ≤ 24%.

Although the glyphosate residues did not exceed the permitted limits, it does not prove that glyphosate, as well as other chemical substances are completely safe for the environment and consumers of the processed products. Therefore we recommend that the glyphosate must be only used following herbicide label and the safety requirements, at registered rates and at recommended application time.

8. **"The effects of environmental, biological and chemical factors on Lithuania-grown maize grain yield and quality",** 2015–2016. Project leader Dr. Audronė Mankevičienė.
E-mail audre@lzi.lt

The aim was to study the peculiarities of maize cultivation, ascertain its contamination with mycotoxins under Lithuania's conditions in order to secure high-quality and safe production.

Plant protection products used to control maize diseases had effect on maize productivity improvement. The plant protection products applied reduced maize leaf blight severity and incidence on

leaves. Maize hybrids Telesto CS and Schobbi CS were characterised by better biometric indicators (ear development, ear length, ear diameter, row number per ear, grain number per ear row, total grain number per ear, etc.).

Analysis of grain contamination with *Fusarium* fungi showed that maize hybrids differed in grain contamination level but the species composition of the fungi was comparable. In all grain samples the predominant species were *F. poae, F. avenaceum*, *F. sporotrichioides, F. verticillioides.* In 2015, maize grain was found to be free from fumonizin, deoxynivalenol contamination: however, T2 toxin was identified in small concentrations (25–38 µg kg^{-1}) in all samples analysed.

9. **"Determination of resistance of cabbage stem flea beetle (*Psylliodes chrysocephala*) and flea beetle (*Phyllotreta nemorum* and P. *undulata*) populations to pyrethroid group insecticides in Lithuania",** 2015–2016. Project leader Dr. Eglė Petraitienė.
E-mail egle@lzi.lt

Identification of cabbage stem flea beetle resistance to insecticides in Lithuania and the already documented and expected extents would enable estimation of possible losses to the pest and would help envisage resistance management means. The resistances of cabbage stem flea beetle and flea beetle to the two active substances of pyrethroid group insecticides lambda-cyhalothrin and tau-fluvalinate was analysed during the 2015–2016 period.

The populations of cabbage stem flea beetle and flea beetle, collected from the central agro-ecological zone, where cultivation of oilseed rape is concentrated, were exposed to the analysed active substances at label rate doses of 200 % of lambda-cyhalothrin and 100 % of tau-fluvalinate. Average mortality of the individuals of the cabbage stem flea beetle and flea beetle populations was 95 % and 100 %, respectively.

The effective concentration (EC50) of lambda-cyhalothrin, which killed 50 % of the test population of pests, was 0.0074 µg cm^{-2}. The effective concentration (EC50) of tau-fluvalinate, which killed 50% of the test populations of pests, was 0.1014 µg cm^{-2}. In the field conditions, the mortality rate of adults of cabbage stem flea beetle and flea beetle was 9.9 % in the lambda-cyhalothrin (Karate) treatment and 14.1 % in the tau-fluvalinate (Mavrik) treatment.

All the tested populations of cabbage stem flea beetle and flea beetle had developed partial resistance to tau-fluvalinate. However, more than 40 % of the tested populations were moderately resistant to lambda-cyhalothrin.

10. **"Investigation of the effect of fibre hemp grown as a monocrop on soil quality indicators and weed infestation",** 2015–2016. Project leader Dr. Elvyra Gruzdevienė.
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The aim of the project was to study the effect of hemp grown as a monocrop on soil agrochemical indicators, variation of weed seed bank and field weed incidence.

Fibre hemp continuously grown for four years did not significantly deteriorate soil agrochemical indicators, the content of humus increased even in mineral soils. Soil pH in the monoropped hemp was close to neutral and varied very negligibly. Monocropped hemp did not worsen soil bulk density - this indicator tended to get better. In the soil with higher humus status, in rainy years, the content of nitrogen markedly declined, while in the soil with lower humus status it slightly increased. When monocropping hemp for four years, the content of mobile phosphorus in the soil with less organic matter tended to increase, while that of mobile potassium tended to decrease, especially in the treatments with higher humus status. The weeds emerged in the fibre hemp crop in spring most often disappeared when hemp had reached a 1 m height and leaves completely covered the interrows. Only individual plants of goosefoot and barnyard grass survived through hemp vegetation season until harvesting.

In order to grow hemp as a monocrop, one should select a humus-rich soil and have the soil tested in spring before sowing to balance crop fertilization with potassium and nitrogen fertilizers; otherwise the soil properties will start to deteriorate. In less humus-rich soils, in order to increase organic matter content in them one can continuously grow hemp for several years. When continuously growing fibre hemp, it is necessary to monitor soil agrochemical composition with a special emphasis on mobile potassium content.

11. **"Research on disease susceptibility and value of the most common wheat and oilseed rape varieties on different disease control backgrounds"**, 2014–2016.
Project leader Dr. Roma Semaškienė.
E-mail roma@lzi.lt

The project was aimed to determine disease susceptibility of the most common wheat and oilseed rape cultivars grown in the country as well as their response to fungicide use, their agronomic value and to estimate the cultivars from the viewpoint of integrated control of harmful organisms and (ICHO) and to prepare recommendations regarding cultivation of the most suitable varieties under Lithuania's conditions.

Comparative research on winter and spring wheat and winter and spring rape cultivars involved

assessment of the disease incidence and severity, yield potential with a view to selecting the best suited varieties to be grown on farms adhering to ICHO principles. The varieties that stood out by lower disease susceptibility, high yield potential were recommended to be grown adhering to the ICHO rules. These recommendations have to be regularly updated, which warrants continuation of the research.

12. **"The study of prevention diseases, pests, and weeds according to sustainable plant protection measures",** 2016. Project leader Dr. Alma Valiuškaitė.
E-mail a.valiuskaite@lsdi.lt

The aim of the study was to investigate sustainable plant protection possibilities in horticultural farms promoting sustainable farming.

According to the national quality programs, we examined aspects of usage of the plant protection products and evaluated phytosanitary of plants in horticultural farms.

13. **"Scientific investigation of cereals, leguminosae and bluegrasses, fruits, vegetables, berries, perennial grasses varieties for growing suitability under ecological conditions in Lithuania"**, 2016. Project leader Dr. Rasa Karklelienė.
E-mail r.karkleliene@lsdi.lt

The assortment of varieties for the ecological farms is rather small till now. The main reason of this is a low supply of certificated seeds regarding to higher prime cost of growing technologies and low number of suppliers. Potential possibilities of varieties productivity are not achieved often regarding to specific growing conditions in the ecological agro systems. Plant height and architectonics of leaf arrangement have great importance influencing the ability to weed fade, resistance to biotic and abiotic factors, etc.

It is advisable to choose Lithuanian varieties 'Ada' and 'Kena DS' of winter wheat because they are more resistant to diseases instead of widely grown variety ' irvinta'. While choosing a variety of winter spelt wheat, it is important to take account of the soil, meteorological conditions and microclimate. Variety 'Rubra' is resistant to lodging and to winter frost and it is more suitable for growing in the low productivity soil. Moulder soil is more suitable for the variety 'Franchenkorn' that is more sensitive to winter frost

but it is resistant to lodging. A productive wheat variety 'CH Campala' registered in the EU catalogue is resistant to mildew and to other leaf diseases and it is one of the most suitable ones on a heavier-textured soil for organic farms. Barley variety 'Noja DS' is more resistant to leaf diseases especially to the net blotch compared with 'Alisa DS' or 'Aura DS'. Pea varieties 'Ingrid' and 'Ieva DS' can be recommended for ecological farms according to height, resistance to diseases, lodging and productivity. Oats varieties 'Migla DS', 'Viva DS' are more suitable for growing in organic farms.

Investigation of vegetables shows that the best option is to grow local varieties or varieties that are similar according to growing region. The best carrot varieties are : 'Svalia' H, 'Ieva' H, 'Garduolės', 'Noveno' H, 'Bolero' H and red beets: Rikiai', 'Joniai', 'Kamuoliai', 'Boro' H 'Cylindra', etc. Root celery varieties 'Prezident', 'Monarch', 'Giant Praque' are suitable for organic farms. White cabbage is very popular in Lithuania, therefore varieties that are more resistant to diseases are recommended for organic growing: 'Bagočiai', 'Ramco' H, 'Tekila' H and 'Krautman' H. Recommended onion varieties are 'Babtų didieji', 'Czerniakowska', 'Kristine', 'Rawska', 'Sochaczewska', 'Olina', 'Elista', etc. The results of the investigation showed that the majority of garlic varieties are suitable for organic growing. 'Vasariai', 'Jarus', 'Dangiai', 'Žiemiai', 'Therador', 'Unicat' exhibited the best results. Leek varieties 'Bulgina', 'Selina', 'Albos' and 'Kampus' are recommended for organic growing.

Varieties resistant to diseases and pests are very important in the organic horticulture. This is the main factor affecting productivity and quality. The recommended varieties are as follows:

- ✓ Apple tree: 'Orlovim', 'Izbranica', 'Piros', 'Poema', 'Rudenis', 'Vitos', 'Sava', 'Aldas' and etc.,
- ✓ Pear: 'Žiul Giujo', 'Isolda', Lukna', 'Mramornaja', 'Komisinė', 'Konferencinė', 'Beloruskaja pozdniaja',
- ✓ Cherry: 'Safyr', 'Morina', 'Šalunja', 'Pandy 103', slyvos 'Herman', 'Opal', 'Kometa', 'Amitar', 'Oda', 'Štaro vengrinė', etc.,

Berry varieties for organic farms are as follows:

- ✓ Garden strawberry: 'Rumba', 'Darselect', 'Syria', 'Elkat', 'Dangė',
- ✓ Strawberry: 'Dena', 'Meda', 'Redita', 'Elina',
- ✓ Raspberry: 'Polana', 'Polka', 'Polesie', 'Porana rosa',
- ✓ Currant: 'Pilėnai', 'Joniniai', 'Almiai', 'Smaliai', 'Gagatai', 'Dainiai', 'Salviai', 'Ben Alder',
- ✓ Cranberry: 'Bergman', 'Franklin', 'McFarlin', 'Stevens', 'Pilgrim'.

14. **"Evaluation of new strawberry cultivars and their technological assessment"**, 2015–2016. Project leader Dr. Nobertas Uselis.
E-mail n.uselis@lsdi.lt

The aim of the project was to evaluate new strawberry cultivars and to provide their suitability for technological cultivation. In one field experiment, cultivars 'Flair', 'Rumba', 'Daroyal', 'Asia', 'Darselect', 'Elegance' 'Deluxe' 'Vivaldi', 'Sonata' and 'Syria', in the other experiment – 'Salsa', 'Jive', 'Alpha Centauri', 'Florence', 'Pandora' and 'Malvina' were tested. Strawberries were cultivated applying new for Lithuania technology growing them on low plastic-film-mulched beds with fertigation system. Three rows of strawberries were planted on the bed.

After evaluation of strawberry flowering time, beginning of harvesting, percentage and physical

weight of harvested berries during different periods, it can be concluded that the early and medium early cultivars are 'Flair', 'Rumba', 'Daroyal', 'Darselect', 'Asia'; medium late – 'Vivaldi', 'Elegance', 'Deluxe', 'Sonata', 'Syria'; late – 'Salsa', 'Jive', 'Alpha Centauri', 'Florence' and very late – 'Pandora' and 'Malwina'.

In the first year of fruiting, the highest yield of high quality berries from early and medium early cultivar group was recorded for 'Asia' (19.2 t ha^{-1}), 'Sonata' (19.6 t ha^{-1}), 'Flair' (19.9 t ha^{-1}), 'Darselect' (22.8 t ha^{-1}) and 'Vivaldi' (23.8 t ha^{-1}). The lowest yield was of 'Elegance' (12.7 t ha^{-1}) and 'Deluxe' (13.7 t ha^{-1}) strawberries. From late and very late cultivars the most productive were 'Alpha Centauri' (28.3 t ha^{-1}) and 'Salsa' (29.1 t ha^{-1}), productive – 'Florence' and 'Pandora' (22.3–22.4 t ha^{-1}). The lowest yield was recorded for cultivars 'Jive' and 'Malwina'.

According to the data of the first fruiting year, it is recommended to cultivate early and medium early cultivars 'Rumba', 'Darselect' and 'Asia', medium late – 'Syria' and very late – 'Pandora'. Promising cultivars are early 'Flair', late 'Salsa' and very late 'Malwina', but they still require further investigation. Data on medium late variety 'Sonata' are contradictory. It is susceptible to all root diseases, so good results are shown only in the soil free from pathogens and favourable for strawberry development.

15. **"Hygiene behaviour of Carniolan bees, development and establishment of its lines adapted to Lithuania's honey flow and climate conditions"**, 2016.
Project leader Diana Tamašauskienė.
E-mail diana@lzi.lt

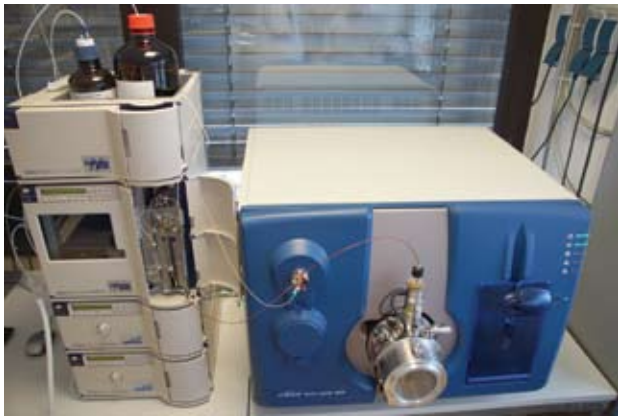
The aim of the research was to develop a new Carniolan bee ecotype, acclimated to Lithuania's honey flow conditions and characterised by high productivity and complying with the requirements of modern beekeepers. The study arrived at the conclusion that in 2016 morphological indicators of Carniolan bees complied with the standard. Analysis of three-year data on the causal agents of *Nosema apis* and *Nosema ceranae* suggested a significant reduction in the colonies infected with viruses and nosema causal agents, which shows improvement in bee healthiness and colony immune system.

16. **"Efficacy of *MAQs* and *Apivar* preparations against bee mites *Varroa destructor*"**, 2016. Project leader Diana Tamašauskienė.
E-mail diana@lzi.lt

The registration of the pyrethroid preparation *Varostop* expires in 2017 in Lithuania, therefore it is planned to distribute a new acaricidal preparation *Apivar* developed by a French company Veto-pharma in 1995 and registered in many European countries and the USA. This product has not been tested in Lithuania yet. The total laboratory efficacy of this product was found to be 96.0 %. Two stripes of Apivar were sufficient as is recommended by the manufacturer. Average efficacy of *Apivar* in a bee colony without brood was 87.8 %. About 12 % of mites survived the treatment; therefore additional treatment with oxalic acid was necessary when there was no brood. The efficacy of *MAQs* preparations without brood was 98.30 %, in the colonies with brood it was 95.8 %. Bee colony infection with varroa mites vary markedly between the experimental sites. Not all bee colonies showed good tolerance of *MAQs* – in some colonies the application of this product resulted in brood and queen death and weakening of colonies.

17. **"Determination of β-/γ amylase in honey and in bee food for the winter",** 2016. Project leader Dr. Violeta Čeksterytė.
E-mail violeta@lzi.lt

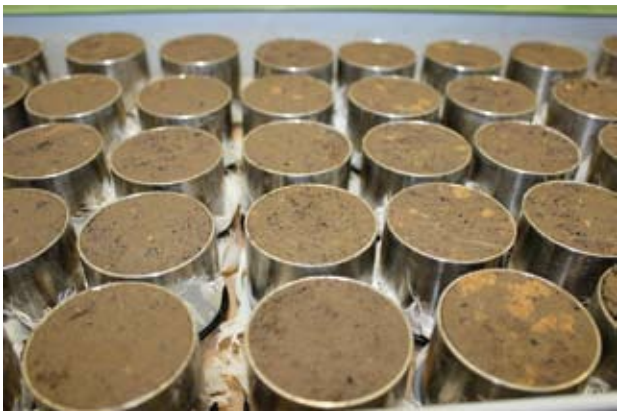
The project was aimed to quantify β-/γ amylase and other non-specific to natural honey compounds in Lithuanian honey and food fed to bees. Neither elevated activity of β-/γ amylase and β-fructofurinodase in spring honey removed from supers nor oligosaccharides, indicating honey adulteration, were identified. Honey removed after straightening of bee nests did not exhibit any signs of adulteration, such as increased activity of β-/γ amylase and β-fructofurinodase or traces of oligosaccharides.



18. **"Creation of national values for evaluation carbon stocks and the determination of carbon stock values in mineral and organic soils in forest and non-forestland",** 2016. Project leader Dr. Kęstutis Armolaitis.
E-mail Kestutis.Armolaitis@mi.lt

The study was essential in order to meet the requirements of the Land Use, Land Use Change and Forestry (LULUCF) reporting under UNFCCC. At the moment Lithuania is using Tier 1 methodology and default values for carbon stock estimations in soil and forest litter (forest floor) in forest and non-forest land. Annual UNFCCC Expert Review Teams revisions encourage countries to follow guidelines of Intergovernmental Panel on Climate Change (IPCC) ant to move to higher Tiers for estimation of carbons stock changes in soils and forest litter.

The aim of study was to estimate soil organic carbon (SOC) stocks in Lithuanian forests, croplands and grasslands. The study was performed on the National Forest Inventory (NFI) permanent sample plots grid (~9x9 km; in total 762 permanent plots – forest land – 289; cropland – 247; grassland – 222; wetland – 4) that covers the whole territory of Lithuania. It was found that mean stocks of soil organic carbon (SOC) in forest floor and surface 0–30 cm mineral or peat layer of some major soil groups (Luvisols + Retisols, Arenosols, Cambisols, Planosols, Podzols and Histosols) are specific in Lithuanian forest and non-forest land. These specific national SOC values for the forests, cropland and grassland could improve Land Use, Land Use Change and Forestry (LULUCF) reporting under UNFCCC.



19. **"Assessment of carbon stocks in mineral and organic soils, and estimation of national carbon values in the soils after afforestation of abandoned agricultural land/ reforestation",** 2016. Project leader Dr. Iveta Varnagirytė-Kabašinskienė.
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The research was implemented under the "Partnership project on greenhouse gas inventory" of the "Programme for Capacity-Building and Institutional Cooperation between Beneficiary State and Norwegian Public Institutions, Local and Regional Authorities" (2009–2014).

The aim of this project was to measure the soil organic carbon (SOC) values in Arenosols, Luvisols and Histosols after afforestation of abandoned agricultural land/reforestation in Lithuania. SOC concentrations and stocks in the coniferous and deciduous forest plantations of different 1–10, 11–20 and 21–30 years of age were analysed. The effect of land-use change was investigated by applying the paired-site design (comparing soil organic carbon in the forest plantation with identical soil type in the control – grassland or cropland) at the same moment in time. The SOC stocks are derived from field measurements up to a depth of 30 cm, totally soil samples were collected from 383 plots. In the field, ground vegetation was assessed – species composition and projection area (%); projection area of forest litter; land-use type was identified – natural or agricultural grasslands, arable land, etc. The litter layer was collected from five places with a frame; mineral soil was sampled with a gauge from 10 places. Subsamples were combined and chemically analysed in the Agrochemical Research laboratory.

The main findings showed that the SOC stocks at 0–30 depths of afforested land compared to the similar grassland soils were higher in the Arenosols and Histosols but not differed in the Luvisols. In the afforested land, the SOC stocks at 0–30 cm soil depth were significantly higher compared to the arable soils. The study showed that organic carbon more intensively accumulated in the deciduous forest compared to the coniferous forest in the Arenosols but no difference was found in the Luvisols and Histosols.

20. **"Estimation of carbon values in dead wood of different decay intensity, and determination of national standards on carbon content values in dead wood"**, 2016. Project leader Dr. Vidas Stakėnas.
E-mail Vidas.Stakenas@mi.lt

The research was implemented under the "Partnership project on greenhouse gas inventory" of the "Programme for Capacity-Building and Institutional Cooperation between Beneficiary State and Norwegian Public Institutions, Local and Regional Authorities" (2009–2014).

The aim of this project was to assess the carbon stocks in dead wood of different decay intensity (wood decay classes), and to estimate the national carbon stock values in dead wood. Dead wood samples of eight dominated Lithuanian forest tree species (Scots pine, Norway spruce, birch, aspen, grey and black alders, oak, and ash) were analysed. Dead wood was divided into five different wood decay classes according to the methodology described by M.L. Hunter (1990). At least 20 samples from each tree species in each wood decay class were collected, and totally it comprised 800 samples. The samples were chemically analysed in the Agrochemical Research Laboratory.

The dead wood fragmentation methods and the experience of dead wood density, carbon concentration and stocks assessment in different wood decay classes in foreign countries were reviewed. The study results showed that the highest density was found in dead wood of ash, oak and birch. The higher decay class showed the lower dead wood density, with exception for the 1st and 2nd decay classes, where the dead wood density was similar. Mean C concentration in dead wood of all tree species and all decay classes was 49%. Mean C concentration increased with the degree of wood decay. The highest C stock was found in ash, oak, birch dead wood of the 1st wood decay class. The lowest C stock was found in the dead wood of conifers. Carbon stock in dead wood significantly decreased with increasing wood decay classes.

21. **"Carbon accounting in harvested wood products: recommendations for Lithuania"**, 2016. Project leader Dr. Marius Aleinikovas.
E-mail m.aleinikovas@mi.lt

Carbon storage in harvested wood products (HWP) is an internationally recognised measure to mitigate climate change.

For the purpose of this study, we reviewed experience gained by several European countries. For this study, we applied two methodological Tiers (Tier 2, Tier 3) proposed by IPCC guidelines in order to compare the results. Historical data on production of HWP were taken from different sources (FAO statistics, national statistics and literature) and for different time series.

Finally, we estimated carbon storage in HWP by applying different methods and compared the results. The presented estimates are in line with internationally agreed (UNFCCC) carbon accounting principles.

The review about carbon accounting and reporting practice in other countries revealed that accounting methods vary and depend on data availability and knowledge. The results of this study showed that carbon stock in HWP differs significantly when different activity data are used, and different accounting methods applied. The highest carbon stock (19.5 Mt) at the end of the study period (year 2015) was observed when FAOSTAT data (1992–2015) were used and the Tier 3 method was applied. The lowest carbon stock in the same period (15.4 Mt) was observed when data from national statists (1940–1991) were used and the Tier 2 method was applied. The carbon inflow into the pool of HWP in all cases was estimated to be 40% higher when applying the material flow analysis compared to the IPCC default (Tier 2) method. To make it clear that carbon accounting methods themselves do not increase carbon stocks in HWP and additional actions will need to be taken if Lithuania decides to contribute more to climate change mitigation by storing carbon in HWP.

22. **"The quality investigation and determination of quality requirements for the different age bare-root nursery stock, for the rare native tree species seedlings, and for the seedlings used for transplanting in the forest nurseries",** 2015–2016.
Project leader Dr. Vytautas Suchockas.
E-mail Vytautas.Suchockas@mi.lt

The research objectives: 1) to investigate and to determine the lowest quality requirements for different age bare-root tree seedlings, to determinate quality requirements for rarely used tree species seedlings, or to equate them to those tree species whose quality requirements are very similar; 2) to determine the quality requirements of seedlings used for transplanting in the nurseries; 3) to compare the results with the seedlings quality requirements of at least 3 of the European Union countries

The quality of bare-root tree seedlings and rare native tree species seedlings is determined visually by assessment of the physiological status, and by measurement of the seedlings average height and diameter. Visually we evaluated stem and root vitality, development of the root system, damages, stem shape and branchiness. We defined custom properties for low-quality seedlings, and for the seedlings which do not meet the requirements as a standard nursery stock.

23. **"New stumpage price determination methodology by different tree species and asortiments clause to real stumpage price value in the market"**, 2015–2016.
Project leader Dr. Diana Lukminė.
E-mail ekonsk@mi.lt

The state stumpage pricelist was developed and approved after Lithuanian independence declaration in 1990. However, it does not fully meet the changes in forest sector. The biggest portion of stumpage is sold in private forests while the pricelist is valid for stumpage, which is sold in state forests and comprises only few percent of total amount. The improvement of stumpage pricelist is relevant because the assortment and classification of purchasing stumpage has been changed.

The aim of research is to evaluate the stumpage pricing in Lithuania. We evaluated the existing stumpage prices in compliance with the roundwood market prices in Lithuania, estimated availability of information of real stumpage transactions, described theoretical potential stumpage price calculation models and assessed their practical application in Lithuanian forestry, described the factors influencing stumpage price.

Feasible stumpage pricing improvement directions have been determined in Lithuania: 1) stumpage pricing based on roundwood assortment structure; 2) statistics of aggregated stumpage price and the main influencing factors; 3) creation of registration system of stumpage transactions; 4) application of the stumpage transactions analysis method.

24. **"Evaluation of interspecific hybrids between black and grey alder perspectives for forestry",** 2015–2016. Project leader Dr. Virgilijus Baliuckas.
E-mail Virgilijus.Baliuckas@mi.lt

The project aims to obtain the new scientific information about black alder, grey alder and their hybrid plus tree suitability for mixed seed orchard.

Plus trees of alder species and interspecific hybrids were studied using bark and leaf morphological traits and molecular markers. Differences between species in phenology of plus trees and their grafted copies in seed orchard were assessed. Morphological description of interspecific hybrids was made according to the results of identification using molecular markers. Wood ring width and density was determined by analysing core samples. In order to determine hybrid spread in Lithuanian forests and their phenological distinctness, the clones in the first black alder seed orchard and the plants of halfsib families in the field trials were investigated.

Taxonomic inventory of alder stands was done in several forest districts. For that temporary sample plots of 0.05 ha were set in young naturally regenerated stands. Selection of sample plots was done in mature mixed black and grey alder stands. It was found that 8.8 % of the total numbers of trees in the sample plots were of hybrid origin. Much less proportion of hybrids was detected in black alder field trials (2.6 %). Perspectives of mixed black and grey alder seed orchards are discussed in the report.

25. **"Estimation of breeding value and selection of hybrid aspen and hybrid poplar clones for vegetative propagation and crossing"**, 2015–2016. Project leader Prof. Dr. Alfas Pliūra.
E-mail Alfas.Pliura@mi.lt

We started the third stage of hybrid aspen and hybrid poplar breeding which aims at selecting bred material of high breeding value based on testing of clones in clonal trials for assignment the highest category of reproductive material – 'Tested' which will facilitate use of regionalized reproductive material of high breeding value for vegetative mass propagation for establishing of very productive short rotation forest plantations as well as for initiating new breeding/crossing program aiming at creation of Lithuania-bred varieties of hybrid poplars.

Based on testing of 37 clones of hybrid aspen and 75 clones and commercial varieties of hybrid poplars in Dubrava and Anykščiai experimental clonal plantations and estimation of complex indices composed of BLUP breeding values of most important traits: growth rate, wood production, adaptation, biomass distribution (Harvest index), quality of stem and wood, three sets of best clones and varieties were selected for three provenance regions of common aspen being delineated in Lithuania. For establishing of short rotation plantations in each provenance region, there were selected 11–12 best hybrid aspen clones: 51DhPL003, 51DhPL005, 51DhPL008, 51DhPL009, 51DhPL010, 51DhPL011, DH13, 51DhPL0019 and 51DhPL0020 (*P. tremuloides x P. tremula)*, 51DhPL022 and DH30 (*P. alba x P. tremula*) and 8–9 hybrid poplar clones and varieties: Isl-15 and UK-Donk (*P. deltoides x P. trichocarpa*), SvSFPopel1 (*P. balsamifera x*), SvSFPopel2, SvSFPopel6 and UK-Androscoggin (*P. maximowiczii x P. trichocarpa*), SvSFPopel4 (*P. balsamifera x P. trichocarpa*), UK-Boelare (*P. trichocarpa x P. deltoides*) and UK-Fritzi Pauley ex France (*P. x canadensis*) which shoved themselves as most suitable for Lithuanian environmental

conditions (at Northern limit of *Populus nigra* natural distribution range). Thirty clones were selected for each region to compose breeding populations for crossing programme. Complex breeding value ranks of the same clones varied substantially by provenance regions although the composition of sets of best 20 clones each differed from each other by 6 clones only: 51DhPL025, SvSFPopel2, SvSFPopel4, SvSFPopel9, SvSFPopel15 and UK- Fritzi Pauley ex France. Some clones of high specific adaptation which were very productive in one clonal trial but showed poor results in another clonal trial had too low complex indices and were not selected to the sets. Realized genetic gain in selection of 20 % intensity reached 26.1–29.7 % for tree height, 27.7–37.2 % for stem diameter, 9.9–19.8 % for tree survival, 4.0–4.4 % for tree condition, 1.4–12.5 % for Harvest index, stem straightness did not deteriorate, and decrease of wood hardiness was minimized.

26. **"Improvement of forest fire risk forecasting system"**, 2014–2016.
Project leader Dr. Vidas Stakėnas.
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The aim of the project was to improve the methodology for forest fire risk index calculation, including wind speed and litter moisture indicators, and to develop improved forest fire risk forecasting system model. One of the project objectives was to review the experience on fire risk forecast, including wind speed and humidity indicators of flammable materials, in foreign countries.

The data analysis showed that only the amount of precipitation per decade significantly correlated with the number of fire cases ($r = -0.83$), while the correlation coefficients with mean air temperature, wind speed and air humidity deficit were not high. The mean correlation coefficient between the amount of daily precipitation, fixed at 12 meteorological stations, and the amount obtained from the weather radar information was 0.81 (varying from 0.66 to 0.93). The data showed a relatively high overlapping between the daily precipitation amount obtained from the radar information and meteorological stations, therefore, radar information can be used for the determination of both precipitation spatial dispersion and forest fire indicators in Lithuania. The analysis showed a strong correlation (logarithmic dependence) between the moisture category of upper litter (moss) layer, assessed according to the perceptible properties of litter sample humidity, and moisture content in the litter sample ($R^2 = 0.88$). The mean moisture content of litter in different moisture categories varies from 8.31 % (category 1) to 204.8 % (category 8). Because mean moisture differs statistically significantly between the adjacent litter moisture categories, therefore, this distribution describing the litter moisture perceptible properties could be recommended for a practical use in forest enterprises.

27. **"The first stage of silver birch and Norway spruce high intensity breeding (the 3rd breeding cycle), based on cross-pollination and progeny testing - the selection of genotypes in the field trials, grafting (cloning), clone cultivation, preparation of projects for crossing combinations and grafted plantations"**, 2014–2016.
Project leader Dr. Virgilijus Baliuckas.
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The project aim was to adopt methods for silver birch and Norway spruce crossings, to select the best genotypes in the progeny field trials, to prepare grafted material and project for crossing based breeding.

Norway spruce parent trees for breeding population were selected in the halfsib progeny field trials established in 1983, plus tree clonal archives, Baltic region provenance tests. Selection of Lithuanian origin parent trees was done by provenance regions for Norway spruce. Only one founder was selected per family or provenance for each of five breeding populations. The best by productivity and stem quality founders were selected at each field trial. Stem diameter consisted of 60 % in the selection index and stem quality including spike knots – 40 %. 250 parent trees were selected for 5 breeding populations in 2015–2016, 50 trees for each population. 30 scions of each parent tree were grafted in Dubrava Forest Enterprise greenhouse in 2016.

The same principles as for Norway spruce breeding metapopulation were applied for silver birch. 50 genotypes were selected for each of two breeding zones. The rank of complex selection index for silver birch halfsib family had to be among top 50 % of all tested families. Each breeding population consists of 70 % Lithuanian, 12 % Latvian, 10 % Polish, 6 % Finish and 2 % Swedish origin grafted parent trees. 3 ramets of each genotype are necessary for the breeding populations. Sexual asymmetry in silver birch is not so pronounced as in Norway spruce, therefore preliminary division into female and male trees is not necessary. The first field trials with silver birch fullsib families are planned starting from 2017. Tested material from these trials will be included into breeding populations in the future.

28. **"Revision of silver birch provenance regions and possibilities of forest reproductive material transfer using DNA markers and data from field trials"**, 2014–2016. Project leader Dr. Virgilijus Baliuckas.
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The project aims to revise silver birch provenance regions based on molecular markers and results from progeny field trials. The project also includes recommendations for forest reproductive material transfer.

The results are based on data from 1999 and 2008 series of field trials. 196 halfsib families from 31 Lithuanian populations, 95 halfsib families from 10 Polish populations, progenies from 4 Latvian provenances were analysed. Study of maternally

inherited chloroplast DNA was done on 133 trees from 22 populations.

5 microsatellite loci were used in DNA study: Ccmp2, Ccmp4, Ccmp5, Ccmp7, Ccmp10. By the aid of DNA markers genetic structure of silver birch in Lithuania was revealed. The results from field trials and DNA study allowed decreasing provenance region number (Fig. 2). The conclusions on forest reproductive material transfer from Poland and Latvia were presented.

Figure 2. Revised silver birch provenance regions

29. **"Evaluation of the possibilities of extensive, long term selective target stem diameter cuttings in Lithuanian forests"**, 2014–2016. Project leader Dr. Virgilijus Mikšys.
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In many European countries the scope of clear cutting of main forest areas has been reduced, selective cutting practices are becoming increasingly popular and new selective forestry methods are being created and developed. There is a lack of knowledge of the possibilities of selective forestry and the methods of selective cutting in Lithuania.

After conducting an analysis of the systems of selective forestry practices and their application in other European countries, it has been concluded that the essential understanding and methods (also known as types, systems) of selective cuttings are mostly analogous to the methods being applied in Lithuania. The most important indicators used for regulating or recommending selective cutting are the ages of the stands (trees) or their measurements – most commonly the diameter of the tree stem.

The practice of selective cutting is being developed and implemented in many European countries. Selective cuttings in uneven-aged stands are being implemented using regulations that are essentially identical to those used in Lithuania. However, the selection of trees to be cut is usually made using the target stem diameter, not age. The most important advantages of using target stem diameter are a simpler selection of trees for selective cutting and the possibility to grow more large-dimension wood. Selective cutting in even-aged stands based on target stem diameter are only done when the stands are prepared for them by structural thinning.

Under conditions present in Lithuania, selective cutting based on target stem diameter could be done in uneven-aged stands especially those where the species composition and site allows formation of stands composed of less light-demanding tree species. There are no simple and unambiguous criteria for selecting stands where this type of cutting is applicable. Selective cuttings of this type cannot be used when seeking to transform even-aged stands into uneven-aged stands, or to use the wood of mature trees in them at proper times, when cutting trees of which the determining factor is qualitative maturity, and are only partially usable when doing group selection cutting. Since a large wood industry has not formed, there is no significant need to start using target stem diameter as key indicator for selective cutting.

The proportion of uneven-aged stands among mature stands in Lithuanian forests is quite significant, among III-IV group of forests they make up 33 and 37 %, respectively, and their mean area in forests of all groups is about 140 thousand hectares. After additional calculations and applying methods of expert evaluation it has been preliminarily determined, that selective cuttings can be done in about 30 thousand hectares of uneven-aged stands over the next decade. If the amount of selective cuttings in the country are to be increased, it would be purposeful to start experiments of transforming even-aged stands into uneven-aged stands by using structural thinning and to consider the legitimization of the of these thinnings in II group forests.

30. **"Preparation of requirements (criteria) for products manufactured from biodegradable waste"**, 2015–2016. Project leader Prof. Dr. Habil. Gediminas Staugaitis.
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The project was designed to assess the quality of composts and anaerobic digestate produced from various biodegradable wastes and to develop quality criteria for these products. Samples for laboratory analyses were taken from various places of Lithuania from waste composting and decomposing sites and facilities.

The findings suggest that composts and anaerobic digestates differed in quality and pollution rate, therefore their use as fertilizer also differs. In the sewage sludge composts and anaerobic digestates the concentrations of diclofenac, 17-beta-estradiol (E2), 17-alfa-ethynylestradiol (EE2), macrolid antibiotics did not exceed the method's determination and detection limit.

6.3. International projects

6.3.1. Started in 2016

1. **"European Fruit Network"** (EUFRUIT), 2016–2019. Coordinator in the Institute of Horticulture Dr. Audrius Sasnauskas.

The European Fruit Network includes 12 countries focussed on 4 thematic areas of critical for the competiveness and innovation potential of the European Fruit sector: 1) new cultivar development and evaluation; 2) minimise residues on fruit and the environment; 3) optimising storage and fruit quality; 4) 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 systematic approach includes: 1) scanning & synthesis via 4 expert groups who scan state-of-art knowledge, practises and technologies and synthesise

the material to identify key areas of learning and best practise approaches at a European level. 2) showing & sharing will deliver outreach/dialogue at a national level through establishment of local 'operational groups'. An online Knowledge Platform will hold all outreach material, outreach activities include; 100 industry publications, 90 technical bulletins, 25 flyers/newsletters, 60 seminars, 160 field based meetings, 25 conference plus 12 events aimed at the general public. 3) sustaining the network will occur through long-term integration of the assembled EUFRUIT network in future actions. The overall outcome of EUFRUIT will be establishment of a framework and a systematic approach that together builds a bridge across the 'valley of death'. This bridge will secure a direct path for new knowledge in the future and reduce the likelihood of repetition of research at a national level.

The European fruit sector will have ready access to up-to-date information to implement and value will be created 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.

2. **InnoFruit R004 "Advancement of non-technological innovation performance and innovation capacity in fruit growing and processing sector in selected Baltic Sea Region countries"**, 2016–2019. Coordinator in the Institute of Horticulture Dr. Darius Kviklys.

The InnoFruit project aims at developing the fruit-growing potential in the Baltic Sea Region to secure the availability of healthy, high quality fruit and fruit products through research-driven innovations, thereby increasing the competitiveness and sustainability of the fruit chain in Latvia, Lithuania, Poland, and Sweden. Despite the fact that high-level research in the field of fruit-growing and processing has been developed in Latvia and Lithuania, the transfer of knowledge and innovation in these countries is limited due to the lack of appropriate advisory systems, slow development of fruit-growing cooperatives, and low absorptive capacity of SMEs.

The mutual exchange of knowledge and learning among the project partners will thus aim to address the specific objective of the Project to increase the number of successful SMEs in the fruit-growing sector through the use and implementation of technological and non-technological innovations via a newly created demo-farm network. The complementary competencies of research organisations, non-governmental organisations, producers' cooperatives, and SMEs constituting the project consortium will facilitate efficient development and use of the demonstration base offered by the open network. The activities to be performed as part of the Project will also lead to the elaboration of guidelines for the establishment of similar demo-farms in other countries, more efficient communication tools for diverse stakeholder groups, increased accessibility of new demonstration objects for fruit-growing and fruit-processing companies, as well as development of policy recommendations on knowledge and technology transfer in the fruit-growing and food sector.

The project is expected to boost the innovation capacity of companies in the Baltic Sea Region, especially in the area of process, organisation, and marketing innovations, enabling them to open up new markets or re-position their products. It will also enhance the profile of the research organisations in providing relevant extension services along with boosting their research capacity and technological base. The Project will contribute to the advancement and sustainable development of the knowledge-based bio-economy sector, int. al. contributing to the mitigation of regional disparities in the macro region.

3. **"Water Management in Baltic Forests" (WAMBAF)**, 2016–2019. Coordinators in the Institute of Forestry: Dr. Marius Aleinikovas and Dr. Olgirda Belova.

The aim of the WAMBAF project is to reduce the export of nutrient and dangerous compounds (e. g. mercury) from forestry sites to streams, lakes and the Baltic Sea. The project focuses on three topics: riparian forests, drainage issues and beaver dams. The project involves nine partners: Swedish Forest Agency (lead partner); Institute Natural Resources Finland, Luke; Metsähallitus, Finland; Latvian State Forest Research Institute Silava; Lithuanian Research Centre for Agriculture and Forestry; Ministry of Environment of the Republic of Lithuania; Forest Research Institute IBL, Poland; Forestry Research Institute of Sweden; Swedish University of Agricultural Sciences.

WAMBAF is supported by 17 organisation including forest companies, NGO's, authorities and forestry schools. Additionally, Estonia and Russia are represented among these organisations.

WAMBAF will deliver a number of outputs as a new digital wet area maps; guidelines for drainage and riparian forests, including best practises from countries in the Baltic Sea Region; a classification tool for beaver dams; an app for Smartphones concerning drainage; an adaptation of the tool "Blue targeting"; films; a beaver handbook and an action plan.

4. **SNS (Nordic Forest Research Co-operation Committee) project "Centre of Advanced Research on Environmental Services from Nordic Forest Ecosystems, CAR-ES III"**, 2016–2020. Coordinator in the Institute of Forestry Dr. Iveta Varnagirytė-Kabašinskienė.

The partner institutions involved in the project are the University of Copenhagen, Dept of Geosciences and Natural Resource Management; NIBIO, Norwegian Institute of Bioeconomy Research and Norwegian Forest and Landscape Institute (Skog & Landskab); Natural Resources Institute Finland (Luke) in cooperation with University of Helsinki; Agricultural University of Iceland in cooperation with University of Akureyri and Icelandic Forest Research; Latvian Forest Research Institute "Silava"; University of Tartu, Institute of Ecology and Earth Sciences in cooperation with Estonian University of Life Sciences, Institute of Forestry and Rural Engineering; Forestry Research Institute of Sweden (SkogForsk); Institute of Forestry, Lithuanian Research Centre for Agriculture and Forestry. Project-leader – Prof. Raija Laiho from Natural Resources Institute Finland.

The overall aim of CAR-ES is to provide the best knowledge for informed decision-making on forest management concerning continued provision of ES in the Nordic-Baltic area, aiming to reach this objective through strengthened collaboration between Nordic and Baltic forest researchers and stakeholders working on sustainable forestry and the ES from forests. Operational aims for the networking are: to provide the basis for interdisciplinary communication in Nordic and Baltic countries, to integrate and share knowledge on ES, to coordinate research, i. e. to reduce overlap, improve the comparability of complementary national research, to share scientific tools, methodologies and data and, finally, to initiate new research projects at the Nordic-Baltic scale, and/or at the European scale with a strong Nordic-Baltic component.

6.3.2. Conducted in 2016

1. FP7-ERANET-2013-RTD **"Coordinated integrated pest management in Europe"** (C-IPM), 2014–2016. Coordinator in the Institute of Agriculture Dr. Roma Semaškienė.

Europe faces the challenge of responding to the mandatory implementation of the principles of Integrated Pest Management (IPM) as called for by Directive 2009/128/EC on the sustainable use of pesticides. Most European countries are investing in research and extension to face this challenge, reduce reliance on pesticides, and reduce risks associated with their use. Added value and synergies can be

created by coordinating such national research and extension efforts and by pooling existing resources. C-IPM create a forum for exchange and identification of IPM research and development priorities, provide recommendations on national and European research, connect existing initiatives, and coordinate joint transnational research calls. With stakeholders and researchers, C-IPM will position IPM in the future European innovation landscape. C-IPM realises that innovation and sustainability in crop protection can only come about if funders, researchers and farm advisers are closely associated, if multiple sectors are taken into account, and if all available control tactics and strategies are integrated. This approach is key to enriching the suite of IPM techniques and ensuring a high level of implementation of IPM among European farmers.

2. IEE project **"Optimizing pathways and market systems for enhanced competitiveness of sustainable bioenergy and technologies in Europe"** (IEE/12/842/SI2.645699–BIOTEAM), 2013–2016. Coordinator in the Institute of Agriculture Dr. Žydrė Kadžiulienė.

The aim of BIOTEAM was to ascertain how the bioenergy market works and how private business decisions and EU and national policy instruments affect bioenergy pathway competitiveness and sustainability (i. e. environmental, economic and social). BIOTEAM project was aimed to assess the market forces and policies on sustainable biomass resources and create a new balance between the social and environmental aspects in order to optimize the use of biomass systems sustainability characteristics. For that objective united the Netherlands, Poland, Finland, Italy, German and Lithuanian researchers and the coordinator of Project was Joint Implementation Network (JIN) from the Netherlands. The project focussed on the questions:

- Development of harmonized sustainability assessment framework for assessing bioenergy pathways; sustainability impact assessment of prioritized bio-energy pathways for each country involved;
- Performing an inventory assessment of the impact of social, economic and environmental policy instruments on the sustainable use of biomass for energy purposes;
- Market mapping tool to assess the impact competitive market forces on the behaviour and actions of bio-energy pathway stakeholders;
- Multi-criteria assessment that aims to strike a balance between the social, economic and environmental impacts.

We, as partners focused on biogas and solid biofuels production process, on its environmental, economic and social aspects. The main legal acts regulating the biogas and solid biofuels production processes were analysed and the most relevant ones were identified. The project identified what legal basis Lithuania is still missing, so we can expect more rapid development of biogas and solid biofuels production sector. The project identified that there is no regulation on biogas digestate use as a suitable fertilizer. It was proposed to prepare the rules for use of biogas digestate as a fertilizer for crops.

6.3.3. Continuous projects

1. **"Research on winter wheat winterhardiness and diseases".**
Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas.

The project is implemented jointly with the Danish Sejet breeding station, which is part of DLG breeding and seed production group. Compared to Denmark, Lithuania's climate is drier and colder. There are more days in winter with low temperatures, irregular snow cover prevails. This allows us under field conditions to select winter wheat genotypes, adapted to harsher climate conditions. In summer, Lithuania's conditions are much more varied – with droughty and rainy periods, compared to West Denmark's where Sejet station is based. Due to this fact, winter wheat and triticale, grown in the field experiments, are more susceptible to diseases. To select genotypes according to disease resistance is an important stage in plant breeding. In 2016, in the fields of Institute of Agriculture there were sown 282 lines of winter wheat and triticale and assessed for winterhardiness, height and infection with foliar diseases. Thirty six promising triticale lines were sown following the design of competitive variety trials with 3 replications. In addition to the above described traits, in this trial we also estimated grain yield. The Danish project partners visited the site and the results were positively assessed. In the autumn 2016, the project partners from Denmark Sejet breeding station decided to continue the research and submitted a new lot of breeding material, which was successfully sown. The cooperation with Sejet has been continued for more than 20 years.

2. **"Research on facultative and winter wheat".**
Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas.

Facultative and winter wheat research is organized by the International Wheat and Maize Improvement Centre CIMMYT, which has divisions in all continents. Facultative and winter wheat research is annually done in 60–70 points of the world. Winter wheat genotypes for research are sent by several tens of breeding institutes, including Institute of Agriculture, which has been involved in this research network since 1993. Over the 23 years of cooperation, the Institute of Agriculture has researched over 3000 winter wheat varieties and lines. It was found that 53 % of the tested varieties exhibit good winterhardiness equal to that of the Lithuanian variety 'Ada'. A total of 10.5 % varieties were higher yielding than the local reference varieties, 78 % of the varieties were earlier-maturing and had shorter stems, 6 % – were more resistant to mildew, 15 % – to septoria. 25 % of the varieties were characterised by very good grain quality. Varieties from droughty regions are a valuable material to improve quality and earliness of the varieties grown in cool climate. In the context of climate warming, it is important to develop

varieties more resistant to midsummer droughts and CIMMYT wheat genetic material will be of great benefit. In 2016, this programme researched 160 breeding lines and varieties. The varieties developed in Romania and the USA exhibited the most valuable indicators. The Institute's working winter wheat collection was supplemented with these varieties.

3. **"European plant genetic resources conservation programme".**
Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas.

European agricultural research and education institutions, including Institute of Agriculture have joined the common genetic resources conservation programme, which was initiated by the International Plant Genetic Resources Institute IPGRI. In 2016, there were established new and maintained the existing collections of cereals and legumes: oat (*Avena* L.), barley (*Hordeum* L.), spring and winter wheat (*Triticum* L.), winter rye (*Secale* L.) and pea (*Pisum* L.). The following number of accessions was sown: oats – 279, barley – 388, spring wheat – 236, winter wheat – 230, winter rye – 16 and pea – 117. The national genetic resources of cereals and legumes accumulated in field collections were renewed and propagated taking into account biological properties of plants. The collection accessions that are in poor state can outcross or disappear due to adverse agoclimatic conditions, or due to lost germination. Adequate phytosanitary condition of the collections was maintained to ensure their further use in breeding, genetic and other research and as a teaching aid or seed production source. In the field collections, the most valuable crop varieties and forms were selected and their seeds were transferred to the Plant Genebank for long-term storage.

4. **SNS (the Nordic Forest Research Co-operation Committee) project "Northern European Database of Long-Term Forest Experiments".**
Coordinator on the Institute of Forestry Dr. Virgilijus Baliuckas.

SNS had for some years noticed that long-term field experiments in forest faced many of the same challenges in all Nordic countries. This was mainly a problem in raising sufficient financial support for maintaining high quality experiments and thereby to assure collection of data and achieve valuable scientific results also in the future. It was supposed that possible benefits for the maintenance of existing and the establishment of new high quality experiments could be achieved by a closer Nordic co-operation within this field. One important prerequisite and the first step for increased scientific co-operation is to have a common database showing all experiments in the Nordic countries with a common classification standard. NOLTFOX is the result of the attempt to make such a database, easily accessible for everybody.

In 2001, the first version of NOLTFOX was launched to the public. Two years later, in 2003, NOLTFOX was evaluated by an international group and they recommended SNS to continue the development of NOLTFOX. In accordance with the evaluation outcome the work on including the Baltic countries (Estonia, Latvia and Lithuania) in NOLTFOX was initiated in 2004. A further development of NOLTFOX was also proposed with expansion of the database with references to published literature relevant to the long term field experiments. The new version of NOLTFOX including literature and the Baltic countries was launched in 2005. United Kingdom joined the co-operation in 2006 and will present their data on the web-site in 2007.

The aim with the database is to stimulate to an increased Nordic, Baltic and international co-operation within forest research, to increase the scientific quality of field research and to avoid expensive duplication of new experiments in the countries. Increased use of existing data and results are also expected to be a result of NOLTFOX.

The project group consisted of researchers from all Nordic countries. The database is constructed by Jukka Pöntinen (Metla, Finland) and the visual layout is designed by Jouni Hyvärinen (Metla, Finland).

More information:
http://www.nordicforestresearch.org/sns-research/networks/noltfox/

5. **"Winter wheat breeding, variety testing and marketing in Estonia"**
Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas.

Lithuanian and Estonian climatic and crop growing conditions differ. The same crop varieties grown in these countries differ in their morphological and physiological characteristics and value for cultivation and use. As a result, in 2000 it was decided to test Lithuania-bred winter wheat genotypes in Estonia in Jogeva Plant Breeding Institute (currently Estonian Crop Production Institute). The testing was continued in 2016. The plants were found to be 10–15 cm shorter under Estonian conditions, therefore genotypes not fit according to stem height and lodging for Lithuania's conditions, can be successfully grown in Estonia. Estonia's winters are more severe and there is more snow there. Due to this, varieties have to be more resistant to colder winters and spring mould. Lithuanian variety 'Ada' was registered in Estonia and is successfully multiplied there. The two varieties from the joint breeding programme 'Kallas' and 'Nemunas' were registered in Estonia. Variety crossing and genome stabilization work was done at the Institute of Agriculture. Research on adaptation characteristics was done at Jogeva. In 2016, plant breeding research and work was continued in both institutes. The crossing combinations were conducted in Lithuania, plants of segregating populations and in stabilized genome nurseries were selected. In 2017, 5–6 promising lines will be passed on to Estonian colleagues.

6.4. Plant breeding

Performance of breeding programmes on major field crops, vegetables and pomefruits, stonefruits and berries. A total of 470 varieties of outdoor, garden and vegetable plants have been developed since the beginning of plant breeding in Lithuania (1922). Ten varieties of agricultural and horticultural plants were included in the National Plant Variety List and in the EU Common Catalogue of Agricultural Plant and Vegetable Varieties in 2016:

- **Winter wheat 'Herkus DS'**
- **Spring barley 'Rusnė DS'**
- **Jerusalem Artichoke 'Sauliai'**
- **Winter garlic 'Dangiai'**
- **Tomato 'Adas', 'Ainiai'**
- **Wild Strawberry 'Dena', 'Elina', 'Meda', 'Redita'**

- Winter wheat variety **'Herkus DS'** was tested at the Plant Variety Testing Centre in 2012–2015. Breeders: Assoc. Prof. Dr. V. Ruzgas, Dr. Ž. Liatukas, K. Razbadauskienė, Dr. G. Brazauskas.

'Herkus DS' outyielded 4 reference varieties by 0.6 % (9.9 t ha^{-1}). According to grain quality parameters, the variety is attributed to group (A), characterised by good baking qualities. The highest grain yield 13.3 t ha^{-1} was recorded at Pasvalys Plant Variety Testing Station in 2015. 'Herkus DS' is characterised by large grain, average 1000 grain weight of 47.5 g and high test weight (≥800 g l^{-1}). The variety is of medium maturity; its winterhardiness (6.4 points) is close to that of reference varieties (6.5 points). It is of medium height 92.5 cm (ref. var. 89 cm), its lodging resistance is 7.9 points, close to that of reference varieties (8.1 points).

- Spring barley **'Rusnė DS'** was tested at the Plant Variety Testing Centre in 2013–2015. Breders: Dr. A. Leistrumaitė, K. Razbadauskienė, Dr. Ž. Liatukas, Dr. G. Statkevičiūtė.

The variety is high-yielding, in the variety testing trials of Institute of Agriculture in 2011–2015 'Rusnė DS' surpassed the average of the reference varieties by 7–10 %. In 2013–2015, the average yield produced at the State Crop Production Service was 8.16 t ha^{-1}. Maximal yield 11.05 t ha^{-1} was achieved at Pasvalys Plant Variety Testing Station in 2015. The plants are characterised by short straw (68 cm), resistance to lodging (9 points), and good tillering capacity. The grain is medium in size, 1000 grain weight is 48.0–51.0 g.

'Rusnė DS' is a medium early, forage-type variety. Grain protein content is 12.0–12.3 %, starch – 62.0–64.0 %. The variety exhibited elevated contents of K and Mg in grain. It is resistant to powdery mildew, loose smut, net blotch, leaf blotch, and ramularia leaf spot.

- Tomatoes **'Ainiai'** is deterministic type, medium early hybrid variety. Breder: Dr. A. Radzevičius.

The first cluster is formed over the 7–8 leaf. Fruits are medium size with 70–80 g of weight. The fruits are red, cyllindric with 3–4 correctly spaced seed-beds with the green shoulder on the base. Fruit are resistant to the transportation. Average yield reached to 16 kg/m^2.

- Tomatoes **'Adas'** is indeterministic type, medium early hybrid variety. Breder: Dr. A. Radzevičius.

The first cluster is formed over the 6–7 leaf. Fruits are small size with 30–40 g of weight. Ripen fruits are red coloured, round with 2–3 seed-beds. Tomatoes are good and pleasant taste. Average yield reached to 17 kg/m^2.

- Garlic (*Allium sativum* L.) variety **'Dangiai'** is suitable for planting in autumn and formatting of flower stem. Breders: Dr. D. Juškevičienė, Dr. R. Karklelienė.

Length of leaf reached to 1.2 m. Approximately 187 bulbils form up in a flower head. The shape of bulb is transverse elliptic, colour of external scales is white with purple stripes on it and number is 7–8. A bulb is composed from 5–7 uniform cloves. The colour of cloves scale is brownish purple. Averaged yield reached 16 t ha^{-1} and marketability is 99 %.

- Jerusalem artichoke variety **'Sauliai'** (*Helianthus tuberosus* L.) is perennial, herbaceous, flowering plant.
  Breders: N. Maročkienė, Dr. R. Karklelienė, P. Gumbelevičius.

The length of stem is 1.7–1.9 m and diameter 1.8–2.4 cm. Leaf is medium size and the colour of flowers is yellow. Size and shape of tuber is various. The colour of tuber skin is white. Weight of tubers reached 90–185 g and productivity to 86 t ha^{-1}. Tubers accumulated 15.6 % of total sugar and 4.6 % of ascorbic acid approximately.

- Wild strawberry **'Dena'**.
  Breder: Dr. R. Rugienius.

A variety developed by crossing *F. vesca* **'**Rugen**'** x *F. nipponica*. Variety has the typical features of cultivated alpine strawberry: plants vigorous, dense or medium density, do not have runners (stolons), the leaves are small, bright green above, shiny. Inflorescence above the leaves, berries relatively big size – at the beginning of up to 3 g, then 1.7 g (other cultivated alpine strawberries 1 to 1.7 g), at the beginning round, then oval, red, very attractive, the flesh is white. Berries are delicious, fragrant. Early season variety, in Babtai was 10–30 % more productive than cultivars 'Rugen', 'Regina', 'Rojan'.

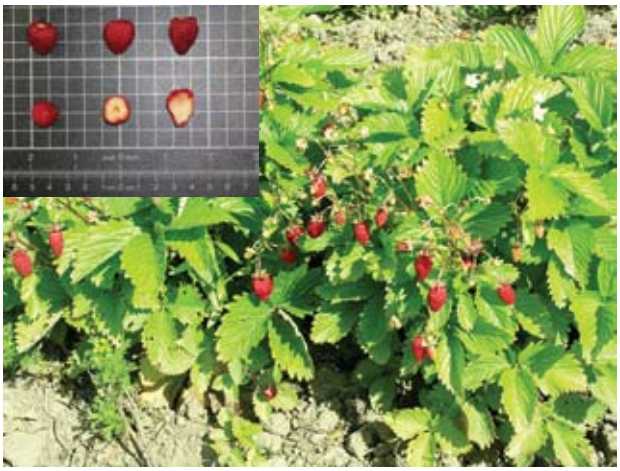
- Wild strawberry **'Elina'**.
  Breder: Dr. R. Rugienius.

Variety developed from open pollinated *F. vesca* seedling of unknown origin. The plants have intermediate vigor and dense. Number of runners (stolons) high or average, leaves small or medium-sized, oblong, with yellowish-green up, rough, shiny. Inflorescences above the leaves, berries relatively large, cone-shaped, very attractive, yellowish-white, white flesh. Berries are delicious, aromatic, easily harvested. It blooms medium early, bears early in season, remontant, very productive – in Babtai was obtained 20–30 % more yield than from the other cultivar 'Yellow Wonder'.

- Wild strawberry **'Meda'**.
  Breder: Dr. R. Rugienius.

Variety developed from *F. vesca* 'Rugen' open pollinated seedlings. Like the parental form, it has the typical features of remontant alpine strawberry: plant vigorous, dense or medium density, do not have runners (stolons), the leaves are small or medium-sized, light green at the up side, uneven surface, gloss. Inflorescences at leaf level, berries relatively big size, at the beginning up to 3.3 g, then 1.9 g (average size of other alpine strawberries varies from 1 to 1.7 g), at the beginning oval shape, later elongated heart-shaped, relatively uniform, attractive, red, flesh is white. Berries are delicious, fragrant. It blooms medium early, bears early, very productive – in Babtai yield 20–40 % higher than of other cultivars 'Rugen', 'Regina', 'Rojan'.

- Wild strawberry **'Redita'.**
  Breder: Dr. R. Rugienius.



Variety developed from *F. vesca* 'Rugen' open pollinated seedlings. Typical remontant alpine strawberry: plants vigorous, dense or medium density, do not have runners (stolons), the leaves are small or medium-sized, up side light green, shiny, leaf stalks often red. Inflorescences at leaf level, berries relatively big, at the beginning up to 3.3 g, then 1.7 g (berries of other cultural strawberries form 1 to 1.7 g in size), shape elongated, very attractive, red, flesh is white. Berries are delicious, aromatic, easily harvested. It blooms medium early, bears early, high yielding – in Babtai were 10–20 % more productive than cultivars 'Rugen', 'Regina', 'Rojan'.

6.5. Healthy and high-quality food products

Scientific research as well as (product development) experimental production is carried out in the Institute of Horticulture. The experimental basis of the Institute encompasses gardens, nursery gardens, orchards and greenhouses where fruits and vegetables are grown for the production of healthy and natural food products of exceptional quality. The quality control test results of the production meets quality standards established by European Union – the quality of the products is confirmed by issued certificates. Whereas, the national product quality certificate confirms that products meets specifications of the national agricultural and food quality system and gives a right to mark such products with a national product quality mark "KOKYBĖ".

Products developed in 2016

- Freeze-dried raspberries. The berries are dehydrated, hold their shape and retain vitamins – 10g of freeze-dried raspberries is the equivalent of 100 grams of fresh raspberries.

- Sea buckthorn and pumpkin jam "Gardumėlis" – the product is made from 100 % sea buckthorn juice with pulp enriched with freeze-dried pumpkin pieces.

- Apple and carrot; apple and black currant; plum, apple and carrot; dried fruit strips made from fruits, berries and vegetables – unique, natural and a low-calorie dried product made from the fruit and vegetable puree.The dried fruit strips with plums and blackcurrant developed in Lithuanian Research Centre for Agriculture and Forestry Institute of Horticulture (sold under the brand name MB LABU), were awarded with the gold medal during the exhibition "Made in Lithuania 2016" (7–9 October 2016).

- During the exhibition "BABY LAND" (specialized exhibition for young parents and future parents where new products for children are presented) two new products, dried rhubarb and freeze-dried pumpkin with rhubarb syrup, developed in LAMMC were presented under the brand name LABU (Vilnius, Litexpo Exhibition Center, 25–27 November 2016).

- During the competition held by the Kaunas Chamber of Commerce Industry the dried fruits, berries and vegetables strips "LABU" developed in Institute of Horticulture were awarded IIIrd place.

Production outlets

- Shop in Babtai on the highway Kaunas–Klaipėda (Vėrupės str. 11);
- Shop in Kaunas, in the building of Agrochemical Research Laboratory (Savanorių pr. 287);
- Store of Experimental Base in Babtai (Sodų str. 5).
- All products can be ordered on-line: http://www.kaimasinamus.lt/ukininkas/.192/.

7. INTERNATIONAL ACTIVITIES

7.1. Research Fellowships

Dr. Kristina Jonavičienė's internship at the Swiss Federal Institute of Technologies (ETH Zürich)

During the study visit (June 1–August 30) Dr. Kristina Jonavičienė, head of the Genetics and Physiology Laboratory, Institute of Agriculture, continued research on perennial ryegrass phenotyping leaf growth under drought, conducted in 2014–2015, in cooperation with plant molecular breeding researchers led by Prof. B. Studer. This research was aimed to identify candidate gene sequences regulating leaf growth under adverse conditions. The latest PacBio RS II platform was used for gene sequencing. This third-generation single molecule real time sequencing technology (SMRT), enables sequencing long DNA sequences (up to 10 kb) and covers well the GC rich regions. Five candidate genes were sequenced using this PacBio RS II SMRT technology, and the obtained sequences will be used in association study seeking to identify changes in gene sequence determining leaf growth under adverse conditions.

Dr. Vaida Šėžienė's internship at Forest Reasearch Institute in Poland

During the research visit in Forest Research Institute in Poland (period from 20 June to 19 August, 2016) junior researcher of the Institute of Forestry Dr. Vaida Šėžienė was working on the project entitled "The possibility of utilisation non-wood forest products (NWFPs) as a source of antioxidants in beneficial for health supplements". The following tasks were developed under that project: sample collection of non-wood forest products (berries and barks), preparation of reagents for chemical analysis, preparation of the extracts (ethyl acetate, water, ethanol and its mixtures) of non-wood forest products.

Determination of some micro- and macro-elements in the extracts of berries and barks using ICP-MS. Preparation of extracts were done in chemistry laboratory of University of Warsaw. Determination of the content of flavonoids and the antioxidant activity of prepared extracts were done using chelating properties, Folin-Ciocalteu, CUPRAC and DPPH methods. Determination of pH of Prepared extracts.

During the research visit contacts were established with other departments in the Forest Research Institute in Poland. They will be useful for further collaboration and projects.

Dr. Rita Armonienė's post-doctoral internship in Sweden

Dr. Rita Armonienė, a research worker from Institute of Agriculture, Laboratory of Genetics and Physiology, has won a scholarship for post-doctoral internship funded by the Swedish Institute's *Visby* programme. Since September 1 she has been doing research on "Identifying novel sources of *Septoriatritici* blotch (STB) resistance in winter wheat landraces of Nordic and Baltic origin" at Swedish University of Agricultural Sciences, Plant Breeding Department under the supervision of Dr. Aakash Chawade.

The main research objectives are to conduct phenotypic assessment of winter wheat varieties and breeding lines for resistance to Septoria leaf blotch, leaf rust and cold tolerance, to develop SNP markers, using genotyping by sequencing and identify SNP markers for the tested phenotypic traits using association mapping.

Dr. Jurata Buchovska's and PhD student Aušra Juškauskaitė's internship in Institute of Forest of the National Academy of Sciences of Belarus

Forest Genetics and Tree Breeding Department researcher Jurata Buchovska of the Institute of Forestry and PhD student Aušra Juškauskaitė attended the internship in Institute of Forest of the National Academy of Sciences of Belarus from 26 of November to 10 of December. During internship they were introduced to the Institute's scientific research directions, laboratories and facilities equipment. Old wood and dried leaf samples were analysed using molecular genetic methods in the Molecular Genetic Laboratory. Research methodology and obtain data will be used in publications and in the dissertation of Aušra Juškauskaitė.

7.2. Cooperation

The Centre's scientists joined the Global Research Alliance on Agricultural Greenhouse Gases.

On February 1, the first meeting of EUVRIN (European Vegetable Research Institute Network) was held in Brussels. Representatives from "Flanders – State of the Art", "Agrolink Flanders", "FRESHFEL" and "AREFLH" organizations and from the research institutions of EU countries, Norway and Switszerland took part. The Centre was represented by the director of Institute of Horticulture Dr. Audrius Sasnauskas. The activities of EUFRIN were presented there. Members of European Commission introduced the guidelines of "Horizon 2020" project. Six working groups were set up: integrated pest management, fertilization and irrigation, greenhouses, genetic resources and breeding, quality of garden plants, organic gardening.

On April 12, an agreement for scientific co-operation between the Centre and Institute of Ecology of the Carpathians, National Academy of Science of Ukraine was signed.

On April 19, Institute of Forestry became a member of European Forest Institute.

On May 31, a framework agreement between the Centre and the University of Santiago de Compostela was signed. The goal of this agreement is to set up collaboration in cultural, scientific, pedagogical and research activities.

On June 2, an agreement of scientific co-operation between the Centre and Plant Breeding and Genetics Institute, National Centre of Seed and Cultivar Investigation of the Ukrainian National Academy of Agrarian Science was signed.

In order to strengthen the cooperation and promote exchange in agriculture between Shandong province of the People's Republic of China and the Republic of Lithuania, Shandong Provincial Department of Agriculture and the Centre concluded an initial cooperation agreement as follows: maintain frequent contact and conduct personnel exchange and visits; deepen exchange and cooperation in agricultural technology; strengthen cooperation in agricultural trade and investment; jointly attend and co-host activities such as agricultural exhibitions and seminars; promote sharing of agricultural development policies and information.

8. PUBLISHING

The Centre is a co-publisher of the scientific journals "Baltic Forestry" (IF 2015 / 2016 – 0,530), "Zemdirbyste-Agriculture" (IF 2015 / 2016 – 0.579), "Sodininkystė ir daržininkystė", "Miškininkystė", "Agronomy Research". Other publications released in the year 2016:

✓ Abstracts of presentations of the scientific conference "Agrariniai ir miškininkystės mokslai: naujausi tyrimų rezultatai ir inovatyvūs sprendimai" / "Agricultural and Forestry Sciences: the Latest Research Results and Innovative Solutions"

✓ "Naujausios rekomendacijos žemės ir miškų ūkiui" / "The Latest Recommendations for Agriculture and Forestry "

✓ "Sodiname mišką" / "Plant Forest".

✓ "Lietuvos agrarinių ir miškų mokslų centro veikla 2015 metais" / "Activities of Lithuanian Research Centre for Agriculture and Forestry in 2015"

✓ "Žemdirbystės institutas mokslo keliu" / "Institute of Agriculture on the Road of Science" – a book dedicated to 60 years' anniversary of the Institute of Agriculture.

9. PUBLICITY ACTIVITY

The Centre organizes 10–15 scientific conferences, seminars annually and invites specialists from national research and educational institutions, representatives from governmental and economic entities of agriculture, specialists from state and private forest enterprises, farmers, and foreign researchers.

9.1. Scientific conferences, seminars

9.1.1. International events

The International Conference on the Scientific Actualities and Innovations in Horticulture (SAIH2016) took place from 2nd to 3rd of June in Kaunas. Organizers: the Centre, Lithuanian Academia Scientiarum, the Association of Agricultural and Forestry Research Institutes. Sponsors: Ministry of Agriculture of the Republic of Lithuania, National Paying Agency under the Ministry of Agriculture, "Analytical Solutions", "Thermo Fisher Scientific", "Armgate".

To establish new links and collaborations among participants, the conference brought together researchers from diverse fields of study who share a common interest in Horticulture. Oral and poster presentations were made by the representatives from various countries: Italy, Lithuania, Estonia, Latvia, and Thailand. The participants had an opportunity to discuss the latest developments, ideas, changes and solutions in Horticultural science.

International conference "Novel Methods for Circulating Plant Nutrients – Consequences for Fertiliser Value and Soil Fertility" took place on 15–16 September in Akademija. It was organized by Institute of Agriculture. The conference was funded by the Ministry of Agriculture of the Republic of Lithuania.

Oral presentations were made by the representatives from Lithuania, Estonia, Latvia, Sweden, and Norway. The topics presented encompassed methodological aspects of nutrient balance assessment, effects of new and innovative fertilizers on plants and soil, variety of organic fertilizers, compost, use and range of fertilizers in different regions of the world and the peculiarities of the industrial development prospects, etc.

On December 8, an **international conference "Evolution of innovations in horticulture"** took place at Institute of Horticulture. It was devoted to the commemoration of the initiator of modern horticulture in Lithuania Algimantas Kviklys' (1936–1992) 80th birth anniversary.

His research topics encompassed cultivation of high quality planting material of horticultural plants, intensive technologies of horticultural and berry plants and strategies of horticultural development.

The event was attended by his former Lithuanian and foreign colleagues, family members and others.

9.1.2. National events

The most important research results of the Centre were presented at an annual conference **"Agricultural and Forestry Science: the Latest Research Results and Innovative Solutions"**, which took place on January 27–29.

The Centre's results for the year 2015 were reviewed, the activities of long-term institutional research, development programmes were presented, and the outputs of the research projects funded by the Lithuanian Science Board, Ministry of Agriculture,

Ministry of the Environment, European Social Foundation Agency were introduced. Great attention was devoted to soil quality, plant genetics and breeding, plant pathology, prevention and control of harmful organisms, development of innovative products and quality, relevant problems of forestry. In the presentations, great emphasis was placed on healthy, safe and biologically valuable food, ecological sustainability, and environmental issues. The conference presentations were summarised in the publication "Agricultural and Forestry Sciences: the Latest Research Results and Innovative Solutions".

A conference entitled **"Genetically modified organisms. Why?"** devoted to the Earth Day, was arranged on March 17 at Institute of Agriculture. The event was supported by the Lithuanian Ministry of Agriculture. A lot of questions arise: why do we need genetically modified organisms, why is there a paucity of information on this topic, why does negative opinion towards them prevail?

An invited speaker from Vilnius University's Institute of Biotechnology – professor Dr. Virginijus Šikšnys, winner of the Warren Alpert foundation prize for the remarkable contributions to the understanding of the CRISPR bacterial defense system and the revolutionary discovery that it can be adapted for genome editing delivered a lecture on this subject.

The subtleties of legal regulation of genetically modified organisms were discussed by Dr. Odeta Pivorienė – the head of Genetically Modified Organisms Division of Nature Protection Department of Lithuanian Ministry of Environment.

Dr. Jurga Turčinavičienė (Vilnius University, Department of Zoology) delivered a lecture on the response of pests to genetically modified organisms.

A scientific conference "**Innovations in Crop Production and technological development",** devoted to the commemoration of Prof. Leonas Kadžiulis 90th birth anniversary, took place on June 16. The conference attracted interest of farmers, business representatives, and agricultural advisors. The event was supported by the Lithuanian Ministry of Agriculture.

The conference presentations dealt with the issues of soil tillage and organic fertilizer effects on soil; crop productivity, soil quality in agricultural and forest ecosystems, importance of swards, major diseases of oilseed rape, the latest plant varieties developed at the Institute of Agriculture.

A scientific conference "Beginnings and evolution of agricultural research in South Lithuania" took place on June 17 at Perloja Experimental Station of the Centre, devoted to the 85th anniversary of Varėna Experimental Station. The event was supported by the Lithuanian Ministry of Agriculture.

Presentations were followed by a discussion on whether further development of GMO was necessary, what the future prospects were. It was decided that consumers should be informed concerning GM food, research into GMO should be continued to gain a better understanding of them and keep up with the modern science innovations.

Agricultural research in South Lithuania was started well before Perloja Experimental Station had been set up (1959). Varėna Experimental Station was established in 1931 with a prime objective to tame low-fertility soils of Dzūkija region.

A conference **"On the path of agronomy science",** devoted to the commemoration of Prof. Dr. Habil. Leonas Kadžiulis 90th birth anniversary, took place on June 28 at the Lithuanian Academy of Sciences. It was arranged by the Lithuanian Academy of Sciences' Department of Agricultural and Forestry and Department of "Scientists' Chamber", Lithuanian Research Centre for Agriculture and Forestry.

Everyone who knew profesor Leonas Kadžiulis was fascinated by his firm attitudes to life, unquenchable optimism, a wide variety of interests, intellect and erudition. The commemorative event was attended by his colleagues, relatives, disciples and friends who shared warm memories of the outstanding professor and his legacy of solid scientific achievements.

A conference **"Agricultural research experience at the Institute of Agriculture",** devoted to the 60th anniversary of the Institute took place on October 20. The event was supported by the Lithuanian Ministry of Agriculture.

An overview of the Institute's history, activities and future prospects was delivered by the current director Dr. Gintaras Brazauskas and former directors Prof. Dr. Habil. Zenonas Dabkevičius and Assoc. Prof. Dr. Vytautas Ruzgas. Despite the various difficulties encountered in the course of its existence, the Institute of Agriculture has been successfully operating for 60 years, which signifies its importance and sustainability. The event was attended by the staff of the Institute, representatives from the Academy of Sciences, colleagues from other research institutions and universities, politicians, representatives from business entities.

A seminar **"Plant biotechnologies and crop production"** and an **"Orchard Blossom Festival"** took place on May 12 at Institute of Horticulture. The event was organized by the Lithuanian Academy of Sciences' Department of Agricultural and Forestry Sciences and Institute of Horticulture.

The conference was aimed to publicise the Centre's activities and present research results and their practical application to the academic community and public at large.

A seminar "Climate change and Lithuania's ecosystems", devoted to the 60th birth anniversary of the academician, Prof. Dr. Habil. Remigijus Ozolinčius, took place on November 17. The event was supported by the Lithuanian Ministry of Agriculture.

The conference presentations dealt with the multifaceted activities of the former director, professor Remigijus Ozolinčius, who was a researcher, lecturer, scientific supervisor, project leader, editor of various journals and a poet.

The emphasis was placed on his contribution to the research into climate change effects and ecosystem. His research fields – climate warming, intensifying forest use and threats posed by these processes are still relevant today in Lithuania and beyond.

9.2. Activities in popular science

9.2.1. Events

On March 31–May 2, the Centre took part in the **international agricultural exhibition "Ką pasėsi…"** held at Aleksandras Stulginskis University.

The Centre's focus in the exhibition was soil topics. The branches of the Centre displayed their exhibits: Institute of Horticulture Agriculture – raw and processed horticultural products, seeds germinated in different soils; Institute of Agriculture – soil fractions, crop roots as affected by different soil tillage methods; Institute of Forestry – diameters of trees of various ages; Vėžaičiai Branch – plant differences from the treatments with rhizogene (designed to improve nitrogen fixation of legumes from the atmosphere) and without its application. Consultations were provided to farmers, business representatives and all those interested in agricultural issues.

An event devoted to the international Fascination of Plants Day was organized on May 18. Its objective is to encourage children to admire nature and to get them interested in it.

The nature-loving pupils visited the Institute of Agriculture's Apiary, where they got acquainted with beekeeper's activities and learned a lot about honey and its products.

Children not only listened to the nature-related stories but also joined the cheerful march in the park, guessed the riddles and brainteasers and tried to identify seeds of different trees. After completing the tasks in the park, pre-schoolers were involved in modelling from natural plasticine; elementary school pupils were acquainted with different tree species and were taught how to determine their age.

An event **"The night of scents"** was arranged on July 22 at Vytautas Magnus University's Kaunas Botanical Garden. Researchers from various Lithuanian research institutions shared the secrets of the plant world and their working experience. The event was attended by Dr. Vilma Kemešytė, head of Grass Breeding Department, Institute of Agriculture, and a doctoral student Eglė Norkevičienė who introduced the alternative uses of perennial plants.

9.2.2. Practices, tours

The Centre admits university and college students of various specialities from Lithuania and abroad for work-based apprenticeships. Trainees get acquainted with the activities of a specific department and gain knowledge and skills in the field of their interest.

The Centre annually receives groups of visitors from Kėdainiai secondary schools and from Lithuanian universities and colleges and familiarizes them with researchers' work, laboratory facilities and doctoral studies.

Institute of Agriculture signed agreements of cooperation with Akademija gymnasium and Kėdainiai "Atžalynas" gymnasium. School children are given an opportunity to jointly conduct research with the Institute's researchers.

Institute of Horticulture maintains close cooperation with Panevėžiukas comprehensive school, Babtai nursery school-kindergarten and Babtai gymnasium. The Institute is involved in educational activities with schoolchildren, involve them in practical activities in laboratories and fields. In the future, the institute intends to establish cooperation with pre-school and school educational institutions of Kaunas city. The development project "Agrobiological Educational Centre" which is currently being implemented would expand the cooperation between researchers and schoolchildren.

10. EVALUATION OF RESEARCH ACTIVITIES

Vytautas Vazalinskas prize

Prof. Dr. Habil. Gediminas Staugaitis and Prof. Dr. Habil. Zigmas Jonas Vaišvila were presented with Vytautas Vazalinskas prize for the series of works "Assessment of Lithuania's Land Productivity and Optimization of Plant Optimization" (2010–2014) on January 27 during Centre's Conference "Agricultural and Forestry Sciences: the Latest Research results and Innovative Solutions"

LSB scholarships for academic achievements

In 2016, a total of 655 applications for Lithuanian Science Board's scholarship for academic achievements were submitted. Scholarships were awarded to 243 applicants. The Center's doctoral students who received the scholarships are Andrius Aleliūnas, Kristina Amalevičiūtė, Agnė Veršulienė, Viktorija Vaštakaitė, Karolina Barčauskaitė, Evaldas Lelešius, Jonas Viškelis.

Medal of Merit for Lithuanian Village

On March 17, Prof. Dr. Habil. Zenonas Dabkevičius – Director of the Centre was decorated with a medal of Merit for Lithuanian Village for significant contribution to the country's agricultural science and its development, promotion of innovation, dissemination of scientific innovation

Awards, certificates of merit presented to doctoral students and young researchers

On April 26, awards, diplomas of contests, certificates of merit were presented to doctoral students and young researchers at the General Accounting Meeting of Members of Lithuanian Academy of Sciences (LAS). The LAS award for the best project of young researchers and doctoral students was presented to Dr. Jurga Miliauskienė senior research worker of Plant Physiology Laboratory, Institute of Horticulture for the work "Complex effects of climate and anthropogenic factors on the photosynthetic system of *Raphanus sativus* L." LAS certificate of merit was presented to Dr. Ramunė Bobinaitė senior research worker of Biochemistry and Technology Laboratory, Institute of Horticulture, for the work "Phytochemical, biological and technological assessment of Lithuania-grown raspberry cultivars" Among the students of higher education institutions, a doctoral student Olakunle Kelvin Akinroluyo from the Laboratory of Genetics and Physiology, Institute of Agriculture was awarded for his work "Factors influencing hemp morphogenesis *in vitro*".

Membership in Lithuanian Academy of Sciences and Latvian Academy of Sciences

On April 26, Assoc. Prof. Dr. Vytautas Ruzgas head researcher of Institute of Agriculture, Cereal Breeding Department and Prof. Dr. Alfas Pliūra head researcher of Institute of Horticulture, Forest Genetics and Breeding Department were approved as members of Lithuanian Academy of Sciences at the general reporting meeting of Lithuanian Academy of Sciences, Department of Agricultural Sciences.

On November 24, director of the Centre Prof. Dr. Habil. Zenonas Dabkevičius was elected foreign member of Latvian Academy of Sciences.

Lithuanian Academy of Sciences' Scholarships for young researchers

The scholarships are designed to encourage scientific creative activities, support research of the most talented young researchers and to promote creative competition among young researchers. In 2016–2017, the Presidium of the Academy awarded the scholarships to Centre's scientific secretary, senior researcher Dr. Vita Tilvikienė and research worker Dr. Birutė Frercks. Certificates were awarded on September 20.

Other awards

On October 23–26, at the international conference "18th International Conference on Land Degradation and Sustainable Soil Management" in Paris (France) the Centre's doctoral student Kristina Amalevičiūtė was awarded for the best presentation "Labile and humified carbon storage in natural and anthropogenically affected Luvisols", prepared with the co-authors Dr. Ieva Jokubauskaitė, Dr. Alvyra Šlepetienė, Assoc. Prof. Dr. Jonas Volungevičius, Dr. Inga Liaudanskienė.

Institute of Agriculture was awarded for the best-kempt environment of the budget-funded institution.

On November 24 2016, Vilius Tinteris from Joniškėlis Experimental Station became the winner of the National Autumn Ploughing Contest.

11. FUNDING

The Centre's budget is composed of state budget appropriations, funds from national and international projects and funds from contract work for Lithuanian and foreign economic entities. In 2016, the Centre's income amounted to 9 million EUR. The main costs are for salaries and wages (60 %), purchasing of goods and services, doctoral studies, public utility services, etc.

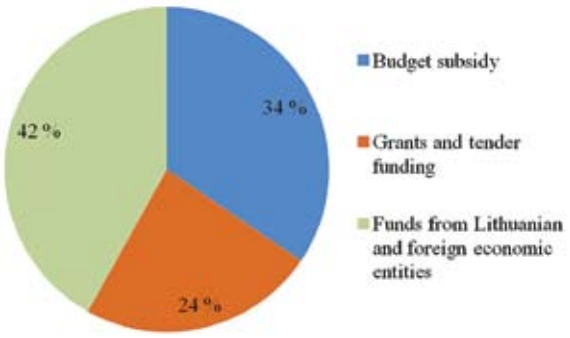


Figure 3. Funding of Lithuanian Research Centre for Agriculture and Forestry for 2016

12. APPENDIXES

12.1. Projects

Projects funded by the Lithuanian Research Council

Projects of the national research programme "Sustainability of agro-, forest and water ecosystems"

1. "The influence of long-term contrasting intensity resources management on genesis of different soils and on other agro-ecosystems components" (AGROTVARA). Partners: LAMMC, ASU, VU. Project leader Dr. Virginijus Feiza. 2015–2018.

2. "Establishment and diversity of a newly emerging cereal pathogen in the agroecosystem due to changing climate and farming practices". Partners: LAMMC, GTC. Project leader Dr. Gražina Kadžienė. 2015–2018.

3. "Response and plasticity of different tree species & juvenile-stage forest communities under impact of climate change and other environmental stressors" (MIŠKOEKOKAITA). Partners: LAMMC, GTC. Project leader Prof. Dr. Alfas Pliūra. 2015–2018.

4. "Study of impact of clear cuttings on biodiversity dynamics in forest ecosystems" (No. SIT-1/2015). Partners: LAMMC, VDU. Project leaders Dr. Remigijus Daubaras (VDU), Dr. Vidas Stakėnas. 2015–2018.

5. "Integrated impact of climate and environmental changes on the productivity, biodiversity and sustainability of agro-ecosystems" (KLIMAGRO). Partners: LAMMC (Dr. Sandra Sakalauskienė, Dr. Jurga Miliauskienė), VDU. Project leader Prof. Dr. Habil. Romualdas Juknys (VDU). 2015–2018.

6 "Anthropogenic influence on vegetation as component of Lithuania river ecosystem stability" (No. SIT-2/2015). Partners: LAMMC (Dr. Laisvūnė Duchovskienė), VDU. Project leader Prof. Dr. Habil. Eugenija Kupčinskienė (VDU). 2015–2017.

Projects of researcher teams

1. "Control of nitrate reduction in green vegetables: metabolic effects of light and other environmental factors". Project leader Dr. Akvilė Viršilė. 2015–2018.

2. "Development of molecular markers for genomic selection of adaptation in perennial ryegrass". Project leader Dr. Gintaras Brazauskas. 2015–2018.

3. "Role of lipids in low-temperature adaptation of apple". Project leader Dr. Perttu Haimi. 2015–2018.

4 "Supercritical fluid extraction of lycopene and the application of its extracts in development of innovative products". Project leader Prof. Dr. Pranas Viškelis. 2015–2018.

5. "*Artemisia dubia* biomass chemical composition and thermochemical conversion studies (ARTBIO)". Partners: LAMMC ir ASU. Project leader Dr. Žydrė Kadžiulienė. 2014–2016.

6. "Physiological background of the crop load and rootstock effect on alternate bearing of apple tree". Project leader Dr. Giedrė Samuolienė. 2014–2016.

Project of the Ministry of Education and Science of the Republic of Lithuania and Belarus State Science and Technology Committee on scientific and technological cooperation programme

"Estimation of Scots pine ecological plasticity using molecular-genetic methods aimed to improve reforestation strategy in the context of climate change, to preserve forest biodiversity and genetic resources in Belarus and Lithuania". Project leader Dr. Virgilijus Baliuckas. 2015–2016.

Students' scientific practice

1. "Lighting effects on nitrate metabolism in green vegetables". Student I. Odminytė (VDU). Supervisor Dr. Akvilė Viršilė. 2016.

2. "The effects of light spectra, minerals and substrate on nutritional quality of *Brassicaceae* microgreens". Student M. Valaitytė (VDU). Supervisor Viktorija Vaštakaitė. 2016.

Projects funded by the Ministry of Agriculture of the Republic of Lithuania

Support for applied research

1. "Long-term monitoring of soil agrochemical properties". Project leader Prof. Dr. Habil. Gediminas Staugaitis. 2016–2020.

2. "Pest risk analysis for Xylella fastidiosa (Wwlls et al.)". Project leader Dr. Artūras Gedminas. 2016–2018.

3. "The state of agricultural crops and productivity predictions in Lithuania". Project leader Dr. Virginijus Feiza. 2016–2018.

4. "Determination of pollen species composition and its content in honey in relation to bee foraging distance". Project leader Dr. Kristina Jonavičienė. 2016–2018.

5. "The study of prevention diseases, pests, and weeds according to sustainable plant protection measures". Project leader Dr. Alma Valiuškaitė. 2016.

6. "Health evaluation of new varieties of orchard plants and development of the highest category of planting material". Project leader Ingrida Mažeikienė. 2016–2018.

7. "Scientific investigation of cereals, leguminosae and bluegrasses, fruits, vegetables, berries, perennial grasses varieties for growing suitability under ecological conditions in Lithuania". Project leader Dr. Rasa Karklelienė. 2016.

8. "Selection of lupine cultivars suitable for cultivation under Lithuania's climate conditions". Project leader Dr. Zita Maknickienė. 2015–2017.

9. "Cultivation technologies of soy". Project leader Dr. Žydrė Kadžiulienė. 2015–2017.

10. "Winter wheat crop stand formation for good overwinter survival and yield". Project leader Dr. Sigitas Lazauskas. 2015–2017.

11. "Technological-technical validation of fibre plants preparation and use for biofuel and energy-environmental assessment of the technologies". Project leader Dr. Algirdas Jasinskas (ASU). 2015–2016.

12. "Effects of pelletized manure on plants and soil". Project leader Prof. Dr. Habil. Gediminas Staugaitis. 2015–2016.

13. "Meristemic seed production of Lithuania-bred potato varieties". Project leader Dr. Almantas Ražukas. 2015–2016.

14. "Glyphosate pre-harvest management for the grain defoliation purposes and its residues concentration in the grain and their influence on product safety". Project leader Dr. Gražina Kadžienė. 2015–2016.

15. "Effects of environmental, biological and chemical factors on Lithuania-grown maize grain yield and quality". Project leader Dr. Audronė Mankevičienė. 2015–2016.

16. "Determination of resistance to pyrethroid group insecticides of the populations of cabbage stem flea beetles (*Psylliodes chrysocephala*, *Phyllotreta nemorum* ir *P. undulata*) in Lithuania. Project leader Dr. Eglė Petraitienė. 2015–2016.

17. "Investigation of the effect of fibre hemp grown as a monocrop on soil quality indicators and weed infestation". Project leader Dr. Elvyra Gruzdevienė. 2015–2016.

18. "Evaluation of new strawberry cultivars and their technological assessment". Project leader Dr. Nobertas Uselis. 2015–2016.

19. "Research into the disease susceptibility of the most popular wheat and oilseedrape cultivars and value for cultivation and use on different disease control backgrounds". Project leader Dr. Roma Semaškienė. 2014–2016.

Support for international research and technology development projects

"Fertility building management measures in organic cropping systems" (FertilCrop). Project leader Dr. Žydrė Kadžiulienė. 2015–2017.

Projects financed by the Ministry of Environment of the Republic of Lithuania

1. "Creation of national values for evaluation carbon stocks and the determination of carbon stock values in mineral and organic soils in forest and non-forestland". Project leader Dr. Kęstutis Armolaitis. 2016.

2. "Assessment of carbon stocks in mineral and organic soils, and estimation of national carbon values in the soils after afforestation of abandoned agricultural land/reforestation". Project leader Dr. Iveta Varnagirytė-Kabašinskienė. 2016.

3. "Estimation of carbon values in dead wood of different decay intensity, and determination of national standards on carbon content values in dead wood". Project leader Dr. Vidas Stakėnas. 2016.

4. "Carbon accounting in harvested wood products: recommendations for Lithuania". Project leader Dr. Marius Aleinikovas. 2016.

5. "Guidelines for breeding of spruce, larch, birch and black alder plantations". Project leader Dr. Gintautas Urbaitis. 2015–2017.

6. "The quality investigation and determination of quality requirements for the different age bare-root nursery stock, for the rare native tree species seedlings, and for the seedlings used for transplanting in the forest nurseries". Project leader Dr. Vytautas Suchockas. 2015–2016.

7. "Development of requirements (criteria) for products produced from biologically degradable waste materials". Project leader Prof. Dr. Habil. Gediminas Staugaitis. 2015–2016.

8. "New stumpage price determination methodology by different tree species and assortment clause to real stumpage price value in the market". Project leader Dr. Diana Lukminė. 2015–2016.

9. "Evaluation of interspecific hybrids between black and grey alder perspectives for forestry". Project leader Dr. Virgilijus Baliuckas. 2015–2016.

10. "Estimation of breeding value and selection of hybrid aspen and hybrid poplar clones for vegetative propagation and crossing". Project leader Prof. Dr. Alfas Pliūra. 2015–2016.

11. "Improvement of forest fire risk forecasting system". Project leader Dr. Vidas Stakėnas. 2014–2016.

12. "The first stage of silver birch and Norway spruce high intensity breeding (the 3rd breeding cycle), based on cross-pollination and progeny testing – the selection of genotypes in the field trials, grafting (cloning), clone cultivation, preparation of projects for crossing combinations and grafted plantations". Project leader Dr. Virgilijus Baliuckas. 2014–2016.

13. "Revision of silver birch provenance regions and possibilities of forest reproductive material transfer using DNA markers and data from field trials". Project leader Dr. Virgilijus Baliuckas. 2014–2016.

14. "Evaluation of the possibilities of extensive, long term selective target stem diameter cuttings in Lithuanian forests". Project leader Dr. Virgilijus Mikšys. 2014–2016.

HORIZON 2020 Projects

"European Fruitnetwork" (EUFRUIT). Coordinator in the Institute of Horticulture Dr. Audrius Sasnauskas. 2016–2019.

INTERREG Programme Projects

1. InnoFruit R004 "Advancement of non-technological innovation performance and innovation capacity in fruit growing and processing sector in selected Baltic Sea Region countries". Coordinator in the Institute of Horticulture Dr. Darius Kviklys. 2016–2019.

2. Water Management in Baltic Forests (WAMBAF). Coordinators in the Institute of Forestry: Dr. Marius Aleinikovas and Dr. Olgirda Belova. 2016–2019.

European Territorial Cooperation Projects

"Optimizing pathways and market systems for enhanced competitiveness of sustainable bioenergy and technologies in Europe" (IEE/12/842/SI2.645699–BIOTEAM). Coordinator in the Institute of Agriculture Dr. Žydrė Kadžiulienė. 2013–2016.

The 7th Framework Programme Projects

1. FP7-ERANET-CORE Organic "Plus fertility building management measures in organic cropping systems". Coordinator in the Institute of Agriculture Dr. Žydrė Kadžiulienė. 2015–2017.

2. FP7-ERANET-2013-RTD "Coordinated integrated pest management in Europe". Coordinator in the Institute of Agriculture Dr. Roma Semaškienė. 2014–2016.

Other projects

1. "Perennial ryegrass breeding research in Nordic and Baltic countries". Coordinator in the Institute of Agriculture Dr. Gintaras Brazauskas. 2014–2018.

2. "EUFORGEN – The European Forest Genetic Resources Programme – IV". Coordinator in the Institute of Forestry Dr. Virgilijus Baliuckas. From 2010.

3. SNS (the Nordic Forest Research Cooperation Committee) project "Northern European Database of Long-Term Forest Experiments". Coordinator in the Institute of Forestry Dr. Virgilijus Baliuckas. 2016.

4. SNS (Nordic Forest Research Co-operation Committee) project "Centre of Advanced Research on Environmental Services from Nordic Forest Ecosystems, CAR-ES III". Coordinator in the Institute of Forestry Dr. Iveta Varnagirytė-Kabašinskienė. 2016–2020.

5. "Research on winter wheat winterhardiness and diseases". Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. 2016.

6. "Research on facultative and winter wheat". Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. 2016.

7. "European plant genetic resources conservation programme". Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. 2016.

8. "Winter wheat breeding, variety testing and marketing in Estonia". Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. 2000–2016.

COST Programme

1. FP1406 "Pine pitch canker – strategies for management of *Gibberella Circinata* in greenhouses and forests". Coordinator of Action in the Vokė Branch Dr. Audrius Kačergius. 2015–2019.

2. FA1306 "The quest for tolerant varieties – phenotyping at plant and cellular level". Coordinator of Action in the Institute of Horticulture Dr. Rytis Rugienius. 2014–2018.

3. FP1303 "Performance of biobased building materials". Coordinator of Action in the Institute of Forestry Dr. Mindaugas Škėma. 2013–2017.

4. FP1301 "Innovative management and multifunctional utilization of traditional coppice forests – an answer to future ecological, economic and social challenges in the European forestry sector" (EuroCoppice). Coordinator of Action in the Institute of Forestry Dr. Marius Aleinikovas. 2013–2017.

5. FP1203 "European non-wood forest products network" (NWFPs). Coordinator of Action in the Institute of Forestry Dr. Olgirda Belova. 2012–2017.

6. FA1104 "Sustainable production of high-quality cherries for the European market". Coordinator of Action in the Institute of Horticulture Dr. Vidmantas Bendokas. 2012–2016.

7. FP1201 "Forest land ownership change in Europe: significance for management and policy" (FACESMAP). Coordinator of Action in the Institute of Forestry Dr. Diana Lukminė. 2012–2016.

8. FP1202 "Strengthening conservation: a key issue for adaptation of marginal/peripheral populations of forest trees to climate change in Europe" (MaP-MGI). Coordinator of Action in the Institute of Forestry Dr. Virgilijus Baliuckas. 2012–2016.

9. FP1103 "Fraxinus dieback in Europe: elaborating guidelines and strategies for sustainable management" (FRAXBCK). Coordinator of Action in the Institute of Forestry Prof. Dr. Alfas Pliūra. 2011–2016.

12.2. Scientific Papers

Articles in journals indexed in Clarivate Analytics Web of Science database

1. **Arlauskienė A., Velykis A., Šlepetienė A., Janušauskaitė Dalia.** 2016. Comparison of postharvest practices used for cereal straw decomposition in a clay loam soil. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (6): 523–533.

2. **Avižienytė D., Brazienė Z**., Romaneckas K., **Marcinkevičius A.** 2016. Efficacy of fungicides in sugar beet crops. Zemdirbyste-Agriculture, 103 (2): 16–174.

3. Bartkienė E., Bartkevics V., Starkutė V., Krunglevičiūtė V., Čižeikienė D., Žadeikė D., Juodeikienė G., **Maknickienė Z.** 2016. Chemical composition and nutritional value of seeds of *Lupinus luteus*, *L. angustifolius* and new hybrid lines of *L. angustifolius*. Zemdirbyste-Agriculture, 103 (1): 107–114.

4. **Bobinaitė R., Viskelis P., Bobinas Č**., Mieželienė A., Alenčikienė G., Venskutonis P. R. 2016. Raspberry marc extracts increase antioxidative potential, ellagic acid, ellagitannin and anthocyanin

concentrations in fruit purees. LWT – Food Science and Technology, 66: 460–467.

5. **Brazienė Z**., Vasinauskienė R. 2016. Damp water steam influence on weeds and foliar fungal diseases in sugar beet crop. Fresenius Environmental Bulletin, 25 (7): 2654–2661.

6. **Butkutė B., Lemežienė N.,** Dagilytė A., **Cesevičienė J.,** Benetis R., **Mikaliūnienė J.,** Rodovičius H. 2016. Mineral element and total phenolic composition and antioxidant capacity of seeds and aerial plant parts of perennial legumes. Communications in Soil Science and Plant Analysis, 47 (1): 36–45.

7. Cleary M., Nguyen D., **Marčiulynienė D.,** Berlin A., Vasaitis R., Stenlid J. 2016. Friend or foe? Biological and ecological traits of the European ash dieback pathogen *Hymenoscyphus fraxineus* in its native environment. Scientific Reports, 6: 21985.

8. **Cepauskas D., Miliute I., Staniene G., Gelvonauskiene D., Stanys V.,** Jesaitis A. J., **Baniulis D.** 2016. Characterization of apple NADPH oxidase genes and their expression associated with oxidative stress in shoot culture *in vitro*. Plant Cell Tissue and Organ Culture, 124 (3): 621–633.

9. **Čeksterytė V.**, Kurtinaitienė B., Venskutonis P. R., Pukalskas A., Kazernavičiūtė R., **Balžekas J**. 2016. Evaluation of antioxidant activity and flavonoid composition in differently preserved bee products. Czech Journal of Food Sciences, 34 (2): 133–142.

10. **Čeksterytė V.,** Navakauskienė R., Treigytė G., Jansen E., Kurtinaitienė B., **Dabkevičienė G., Balžekas J.** 2016. Fatty acid profiles of monofloral clover beebread and pollen and proteomics of red clover (*Trifolium pratense*) pollen. Bioscience, Biotechnology, and Biochemistry, 80 (11): 2100–2108.

11. **Dabkevičienė G., Statkevičiūtė G., Mikaliūnienė J., Norkevičienė E., Kemešytė V.** 2016. Production of *Trifolium pratense* L. and *T. hybridum* L. tetraploid populations and assessment of their agrobiological characteristics. Zemdirbyste-Agriculture, 103 (4): 377–384.

12. Danilcenko H., Gajewski M., Jariene E., Paulauskas V., **Mažeika R.** 2016. Effect of compost on the accumulation of heavy metals in fruit of oilseed pumpkin *Cucurbita pepo* L. var. *Styriaca*. Journal of Elementology, 21 (1): 21–31.

13. Danusevičius D., **Kavaliauskas D.,** Fuss B. 2016. Optimum Sample Size for SSR-based Estimation of Representative allele frequencies and genetic diversity in scots pine populations. Baltic Forestry, 22 (2): 194–202.

14. **Danusevicius D**., Kerpauskaite V., Kavaliauskas D., Fussi B., Konnert M., **Baliuckas V.** 2016. The effect of tending and commercial thinning on the genetic diversity of Scots pine stands. European Journal of Forest Research, 135 (6): 1159–1174.

15. Drenkhan R., Tomešová-Haataja V., Fraser S., Bradshaw R. E.,Vahalík P., Mullett M. S., Martín-García J., Bulman, L. S., Wingfield M. J., Kirisits T., Cech T. L., Schmitz S., Baden R., Tubby K., Brown A., Georgieva M., Woods A., Ahumada R., Jankovský L., Thomsen I. M., Adamson K., Marçais B., Vuorinen M., Tsopelas P., Koltay A., Halasz A., La Porta N., Anselmi N., Kiesnere R., Markovskaja S., **Kačergius A.**, Papazova-Anakieva I., Risteski M., Sotirovski K., Lazarević J., Solheim H., Boroń P., BragançaH.,ChiraD.,MusolinD.L.,Selikhovkin A. V., Bulgakov T. S., Keča N., Karadžić D., Galovic V., Pap P., Markovic M., Poljakovic Pajnik L., Vasic V., Ondrušková E., Piškur B., Sadiković D., Diez J. J., Solla A., Millberg H., Stenlid J., Angst A., Queloz V., Lehtijärvi A., Doğmuş-Lehtijärvi H. T., Oskay F., Davydenko K., Meshkova V., Craig D., Woodward S., Barnes I. 2016. Global geographic distribution and host range of Dothistroma: a comprehensive review. Forest Pathology, 46 (5): 408–442.

16. **Feiziene D., Feiza V., Povilaitis V., Putramentaite A., Janusauskaite D., Seibutis V., Slepetys J**. 2016. Soil sustainability changes in organic crop rotations with diverse crop species and the share of legumes. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (1): 36–51.

17. Follo G., Lidestav G., Lugvig A., Vilkriste L., Hujala T., Karppinen H., Didolot F., **Mizaraite D.** 2016. Gender in european forest ownership and management – reflections on women as "new forest owners". Scandinavian Journal of Forest Research, *In Press*.

18. **Jarašiūnas G., Kinderienė I.** 2016. Impact of agro-environmental systems on soil erosion processes and soil properties on hilly landscape in Western Lithuania. Journal of Environmental Engineering and Landscape Management, 24 (1): 60–69.

19. Jauregui I., Aparico-Tejo P. M., Avila C., Carias R., **Sakalauskiene S.,** Aranjuelo I. 2016. Root-shoot interactions explain the reduction of leaf mineral content in *Arabidopsis* plants grown under elevated [CO_2] conditions. Physiologia Plantarum, 158 (1): 65–79.

20. **Jokubauskaite I., Karčauskienė D., Slepetiene A., Repsiene R., Amaleviciute K.** 2016. Effect of different fertilization modes on soil organic carbon sequestration in acid soils. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (8): 647–652.

21. Jakubauskaite V., Zukauskaite A., **Kryzevicius Z., Ambrazaitiene D., Vilkiene M., Karcauskiene D**. 2016. Bioremediation of the soil contaminated with petroleum oil products using sewage sludge. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (8): 664–670.

22. **Jonavičienė A., Supronienė S., Semaškienė R.** 2016. *Microdochium nivale* and *M. majus* as seedling blight causative agents in spring cereals. Zemdirbyste-Agriculture, 103 (4): 363–368.

23. **Karčauskiene D., Ciuberkis S.,** Raudonius S. 2016. Changes of weed infestation under long-term effect of different soil pH levels and amount

of phosphorus: potassium. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (8): 688–697.

24. **Kazlauskaitė-Jadzevičė A.,** Marcinkonis S., **Bakšienė E.** 2016. Energy value of biomass produced on various land uses in a sandy loam *Haplic Luvisol*. Zemdirbyste-Agriculture, 103 (2): 143–150.

25. **Keriene I., Mankeviciene A.,** Bliznikas S., **Cesnuleviciene R., Janaviciene S., Jablonskyte-Rasce D., Maiksteniene S.** 2016. The effect of buckwheat groats processing on the content of mycotoxins and phenolic compounds. CYTA-Journal of Food, 14 (4): 565–571.

26. **Kinderienė I., Karčauskienė D.** 2016. Assessment of soil erosion processes as influenced by different land-use systems on hilly rolling landscape of Western Lithuania. Zemdirbyste-Agriculture, 103 (4): 339–346.

27. **Kviklys D., Čeidaitė A., Lanauskas J., Uselis N., Samuolienė G.** 2016. The effect of rootstock on apple tree bearing stability in a cooler climate. Agricultural and Food Science, 25 (1): 81–88.

28. **Lamanauskas N.,** Pataro G., **Bobinas Č.,** Šatkauskas S., **Viškelis P., Bobinaitė R.,** Ferrari G. 2016. Impact of pulsed electric field treatment on juice yield and recovery of bioactive compounds from raspberries and their by-products. Zemdirbyste-Agriculture, 103 (1): 83–90.

29. Lygis V., Prospero S., Burokiene D., Schoebel C. N., **Marciulyniene D**., Norkute G., Rigling D. 2016. Virulence of the invasive ash pathogen *Hymenoscyphus fraxineus* in old and recently established populations. Plant Pathology, *In Press*.

30. Lujaniene G., Levinskaite L., **Kačergius A.,** Gavutis M. 2016. Sorption of plutonium to bacteria and fungi isolated from groundwater and clay samples. Journal of Radioanalytical and Nuclear Chemistry, *In Press.*

31. Markovskaja S., **Kačergius A.,** Davydenko K., Fraser S. 2016. First record of *Neocatenulostroma germanicum* on pines in Lithuania and Ukraine and its co-occurrence with *Dothistroma* spp. and other pathogens. Forest Pathology, 45 (5): 522–533.

32. **Masilionytė L., Maikštėnienė S.** 2016. The effect of alternative cropping systems on the changes of the main nutritional elements in the soil. Zemdirbyste-Agriculture, 103 (1): 3–10.

33. Matušinsky P., Svačinová I., **Jonavičienė A.,** Tvarůžek L. 2016. Long-term dynamics of causative agents of stem base diseases in winter wheat and reaction of Czech *Oculimacula* and *Microdochium* spp. populations to prochloraz. European Journal of Plant Pathology, *In Press*.

34. **Mazeika R.,** Dambrauskas T., Baltakys K., Mikolajunas M., **Staugaitis G.,** Virzonis D., Baltrusaitis J. 2016. Molecular and morphological structure of poultry manure derived organo-mineral fertilizers (OMFs). ACS Sustainable Chemistry & Engineering, 4 (9): 4788–4796.

35. **Mazeika R., Staugaitis G**., Baltrušaitis J. 2016. Engineered pelletized organo-mineral fertilizers (OMF) from poultry manure, diammonium phosphate and potassium chloride. ACS Sustainable Chemistry and Engineering, 4 (4): 2279–2285.

36. Menkis A., **Lynikienė J., Marčiulynas A., Gedminas A., Povilaitienė A.** 2016. The great spruce bark beetle (*Dendroctonus micans* Kug.) (Coleoptera: Scolytidae) in Lithuania: occurrence, phenology, morphology and communities of associated fungi. Bulletin of Entomological Research, *In Press*.

37. **Miliauskienė J., Sakalauskienė S., Lazauskas S., Povilaitis V., Brazaitytė A., Duchovskis P.** 2016. The competition between winter rape (C_3) and maize (C_4) plants in response to elevated carbon dioxide and temperature, and drought stress. Zemdirbyste-Agriculture, 103 (1): 21–28.

38. **Miliūtė I.,** Buzaitė O., **Gelvonauskienė D., Sasnauskas A., Stanys V., Baniulis D.** 2016. Plant growth promoting and antagonistic properties of endophytic bacteria isolated from domestic apple. Zemdirbyste-Agriculture, 103 (1): 77–82.

39. **Norkevičienė E., Lemežienė N., Cesevičienė J., Butkutė B.** 2016. Switchgrass (*Panicum virgatum* L.) from North Dakota – a new bioenergy crop for the Nemoral zone of Europe. Communications in Soil Science and Plant Analysis, 47 (1): 64–74.

40. Nugis E., **Velykis A., Satkus A.** 2016. Estimation of soil structure and physical state in the seedbed under different tillage and environmental conditions. Zemdirbyste-Agriculture, 103 (3): 243–250.

41. Olšauskaitė V., Padarauskas A., **Cesevičienė J., Lemežienė N., Butkutė B.** 2016. Hydrophilic interaction chromatography–tandem mass spectrometry for the determination of swainsonine in plants. Chemija, 27 (4): 208–212.

42. **Ozolinčius R., Bareika V., Rubinskienė M., Viškelis P., Mažeika R., Staugaitis G.** 2016. Chemical Composition of Silver Birch (*Betula pendula* Roth.) and Downy Birch (*Betula pubescens* Ehrh.) Sap. Baltic Forestry, 22 (2): 222–229.

43. Petrauskaite O., Juodzbalys G., **Viskelis P**., Liesiene J. 2016. Control of a porous structure of cellulose-based tissue engineering scaffolds by means of lyophilization. Cellulose Chemistry and Technology, 50 (1): 23–30.

44. **Petrokas R.** 2016. Appropriate Measures for Retention Forestry. Baltic Forestry, 22 (2): 382–389.

45. **Pliūra A.,** Lygis V., **Marčiulynienė, Suchockas V., Bakys R.** 2016. Genetic variation of *Fraxinus excelsior* half-sib families in response to ash dieback disease following simulated spring frost and summer drought treatments. iForest – Biogeosciences and Forestry, 9: 12–22.

46. **Pocienė L., Kadžiulienė Ž.** 2016. Biomass yield and fibre components in reed canary grass and tall fescue grown as feedstock for combustion. Zemdirbyste-Agriculture, 103 (3): 297–304.

47. **Povilaitis V., Šlepetienė A., Šlepetys J., Lazauskas S., Tilvikienė V., Amalevičiūtė K., Feizienė D., Feiza V., Liaudanskienė I., Cesevičienė J., Kadžiulienė Ž., Kukujevas A.** 2016. The productivity and energy potential of alfalfa, fodder galega and maize plants under the conditions of the nemoral zone. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (3): 259–266.

48. **Radzevičius A., Viškelis J., Karklelienė R., Juškevičienė D., Viškelis P.** 2016. Determination of tomato quality attributes using near infrared spectroscopy and reference analysis. Zemdirbyste-Agriculture, 103 (1): 91–98.

49. **Radzevičius A., Viškelis P., Viškelis J., Karklelienė R., Juškevičienė D., Duchovskis P**. 2016. Tomato biochemical composition and quality attributes in different maturity fruits. Acta Scientiarum Polonorum. Hortorum Cultus (Ogrodnictwo), 15 (6): 221–231.

50. **Ramanauskienė J., Gaurilčikienė J., Supronienė S.** 2016. Effects of fungicides on the occurrence of winter wheat eyespot caused by fungi *Oculimacula acuformis* and *O. yallundae*. Crop Protection, 90: 90–95.

51. **Ramanauskiene J., Gaurilčikiene I.** 2016. Incidence of eyespot in winter wheat and quantification of the fungi *Oculimaculaacuformis* and *O. yallundae* in Lithuania. Journal of Plant Diseases and Protection, 123 (2): 75–81.

52. **Rasiukeviciute N., Suproniene S., Valiuškaite A.** 2016. Effective onion leaf fleck management and variability of storage pathogens. Open Life Sciences formerly Central European Journal of Biology, 11 (1): 259–269.

53. **Rasiukevičiūtė N., Valiuškaitė A., Uselis N., Viškelis J.,** Lukšienė Ž. 2016. Attempts to use photosensitization for preservation of strawberry cultivar 'Darselect': effects on shelf-life, nutritional and organoleptic properties excluding Photosensitization for preservation of strawberry. Journal of Plant Diseases and Protection, 123 (3): 125–131.

54. Raudone L., Burdulis D., **Raudonis R.**, Janulis V., Jankauskiene L., **Viskelis P.,** Trumbeckaite S. 2016. Effect of *Perilla frutescens* extracts and rosmatinic acid on rat heart mitochondrial. Acta Polonae Pharmaceutica, 73 (1): 135–145.

55. Raudone L., Raudonis R., Liaudanskas M., **Viškelis P.,** Pukalskas A., Janulis V. 2016. Phenolic profiles and contribution of individual compounds to antioxidant activity of apple powders. Journal of Food Science, 81 (5): C1055–C1061.

56. **Repšiene R., Karčauskiene D**. 2016. Changes in the chemical properties of acid soil and aggregate stability in the whole profile under long-term management history. Acta Agriculturae Scandinavica, Section B – Soil & Plant Science, 66 (8): 671–676.

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