

**LITHUANIAN
RESEARCH CENTRE
FOR AGRICULTURE
AND FORESTRY**



**ANNUAL REPORT
2019**



MAJOR FACTS

- In 2019, the Lithuanian Research Centre for Agriculture and Forestry (hereinafter LAMMC): employed a total staff of **545**, including **185** research workers, and had **61** doctoral students.
- Carried out **32** international, **37** national research projects funded by the Research Council of Lithuania, Ministry of Agriculture, Ministry of Environment, fulfilled over **100** contract orders for national and foreign economic entities.
- Implemented **6** long-term institutional research programmes.
- **5** agricultural crop varieties were included in the EU Common Catalogue of Varieties of Agricultural Plant and Vegetable Species and in the Lithuanian National List of Plant Varieties, **3** varieties were included only in the Lithuanian National List of Plant Varieties.
- LAMMC researchers published **85** scientific publications in the journals indexed in the *Clarivate Analytics Web of Science* (hereinafter *CA WoS*), **4** chapters in the books published by the internationally acclaimed publishing houses, **30** publications in *Q1* journals and **17** in *Q2* journals;
- **9** LAMMC doctoral students defended dissertations.
- Arranged **2** international, **8** national conferences, more than **80** workshops, discussions, field days, experience sharing group meetings, exhibition of agricultural machinery and technologies “Agrovizija 2019”.
- LAMMC, the Center for Physical Sciences and Technology (FTMC), the Lithuanian Energy Institute (LEI) and the Science and Technology Park of Institute of Physics established the Research and Technology Organization – **RTO Lithuania**.
- LAMMC joined the European Plant Science Organization (EPSO).
- LAMMC programme for support for academic visits was approved.

CONTENT

DIRECTOR'S FOREWORD.....	4
1. LAMMC VISION, MISSION AND VALUES	6
2. STRATEGIC DIRECTIONS	6
3. ESTABLISHMENT OF RESEARCH AND TECHNOLOGY ORGANIZATION – RTO LITHUANIA	6
4. HUMAN RESOURCES	7
4.1. Research board	7
4.2. Works council	8
4.3. Employees	8
5. DOCTORAL STUDIES.....	10
5.1. Doctoral students enrolled in 2019 and research topics	10
5.2. Doctoral dissertations defended in 2019	11
6. RESEARCH AND DEVELOPMENT.....	11
6.1. Scientific publications published in 2019.....	11
6.2. Long-term research programmes	12
6.3. Projects	16
6.3.1. National projects started in 2019	16
6.3.2. Ongoing national projects.....	17
6.3.3. National projects completed in 2019	22
6.3.4. International projects started in 2019	34
6.3.5. Ongoing international projects	39
6.3.6. International projects completed in 2019	41
6.3.7. Results of ongoing projects for 2019.....	48
6.4. Plant breeding	51
6.5. Food produce of exceptional quality	54
7. RESEARCH INTERNSHIPS	56
8. DISSEMINATION OF SCIENTIFIC KNOWLEDGE	64
8.1. Scientific conferences, seminars.....	64
8.1.1. International conferences, seminars	64
8.1.2. National conferences, seminars, discussions.....	65
8.2. Science promotion activities.....	69
8.3. Publishing	70
8.4. Cooperation with international organisations, science and studies institutions	71
9. AWARDS.....	72
10. FUNDING	74
11. APPENDICES	76
11.1. All projects.....	76
11.1.1. National.....	76
11.1.2. International	79
11.2. Major scientific publications.....	82

DIRECTOR'S FOREWORD



The year 2019 is an anniversary year, marking 10 years of Lithuanian Research Centre for Agriculture and Forestry's (LAMMC) activities. Since its establishment on December 23, 2009, LAMMC has been striving to become a united and community-driven institution with a thriving spirit of ideas and knowledge that encourages creativity and search for solutions. Having completed the first decade of operation, it is natural to look back at the road we have covered and appreciate the achievements of all of us.

Over the past decade, LAMMC scientists have proved through their achievements that they are able to work and compete in the Lithuanian and international scientific community. During this period, the number of doctoral students and scientific publications has almost doubled. In the tenth year of its operation, 61 doctoral students studied at LAMMC, including 8 from foreign countries (Syria, Egypt, Ukraine, Nigeria, Pakistan). In Lithuania, LAMMC ranks among the leading institutions according to internationalisation level of doctoral studies. In 2019, LAMMC researchers published their research results in 85 publications in international scientific journals (47 in 2010), indexed in the "*Clarivate Analytics Web of Science*" database. We are really glad that not only is the number of publications increasing, but the quality is improving as well (more than half of them have been published in *Q1* and *Q2* journals).

During the 2010–2019 period, 73 varieties of agricultural crops were included in the EU Common Catalogue of Varieties of Agricultural Plant and Vegetable Species and in the Lithuanian National List of Plant Varieties (of which five in 2019 – winter wheat (2 varieties), tall fescue, perennial ryegrass, ware potatoes, also in 2019 two apple varieties and one cherry variety were included in the National List of Plant Varieties. It is gratifying to note that varieties developed by LAMMC are increasingly grown not only in Lithuania but also abroad – Latvia, Estonia, Belarus, as well as in Germany or even in Canada and the USA.

Research and experimental development work is also gaining momentum – projects of national high level R&D (SMART), international "Horizon 2020", "INTERREG", "LIFE" programmes are being implemented, services are being provided to national and international economic entities. The increasing number of international project applications shows that we are actively preparing for the new "European Horizon" programme.

This year, LAMMC researchers and doctoral students have been particularly active in increasing professional knowledge through involvement in internships in various countries: the USA, Switzerland, Germany, Ireland, Denmark, Sweden, Finland, Italy, France, Spain, Greece and other countries. We hope that the experience gained will allow us to work more closely with our foreign colleagues.

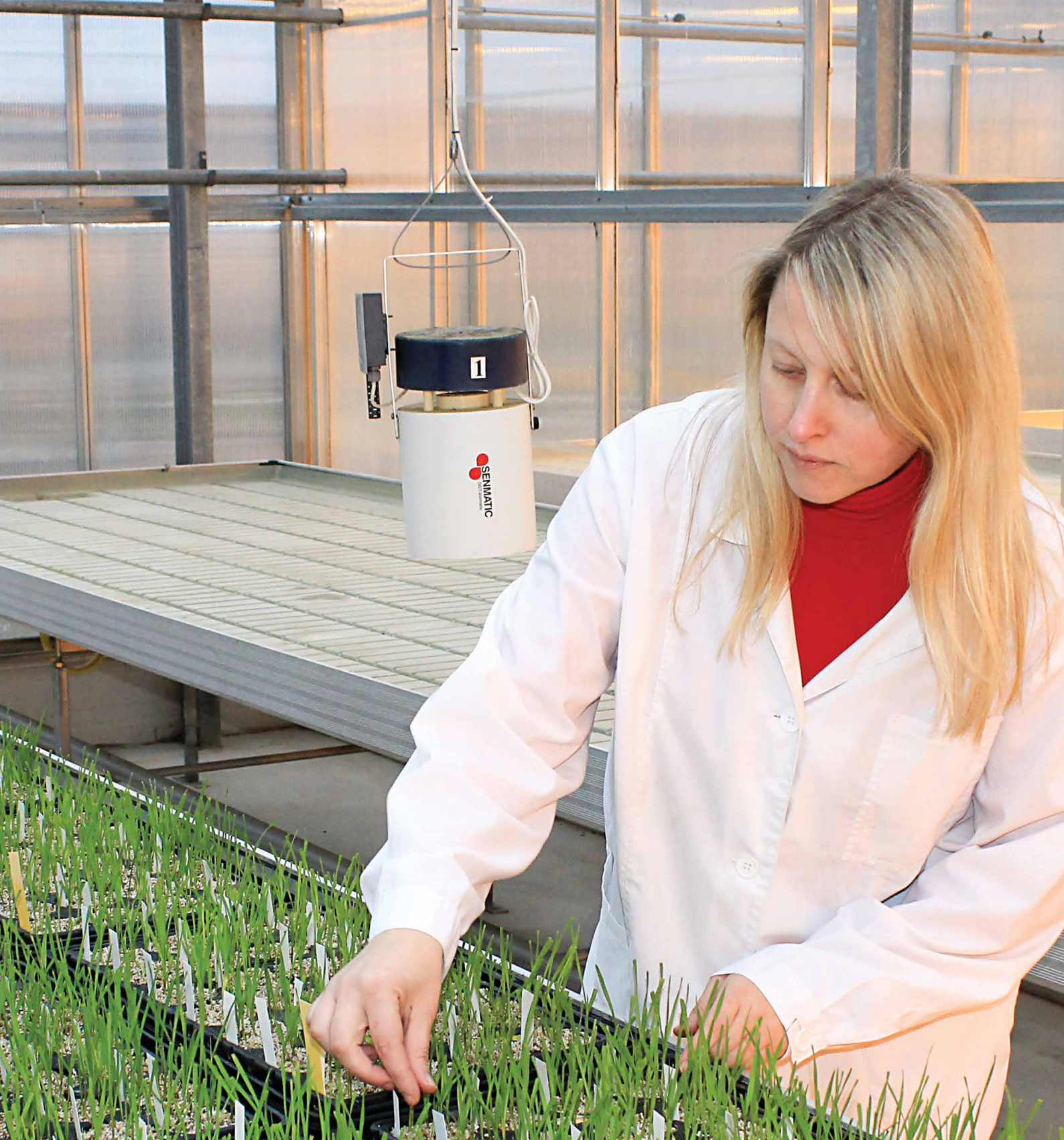
In 2019, 2 international and 8 national conferences were held, workshops, discussions, and field days were arranged. It is noteworthy that one of the largest exhibitions of agricultural machinery and technologies in Lithuania "Agrovizija" was organized for the 12th time. The events attracted considerable attention of many state institutions, business partners and the public. During 2019, over 8 thousand participants attended LAMMC events.

This year has been special for LAMMC because of the new opportunities for collaboration. We have become an official member of the European Plant Science Organisation (EPSO). In 2019, LAMMC, the Center for Physical Sciences and Technology (FTMC), the Lithuanian Energy Institute (LEI) and the Science and Technology Park of Institute of Physics have established the Association of the Research and Technology Organisations (RTO Lithuania). This decision has been aimed at fostering innovation-based interdisciplinary research.

I believe that in the 11th year of its operation, LAMMC community will remain focused and committed to the implementation of innovative ideas.

Director Dr. Gintaras Brazauskas

A handwritten signature in blue ink, appearing to be 'Gintaras Brazauskas'.



LAMMC VISION, MISSION AND VALUES
STRATEGIC DIRECTIONS
RTO LITHUANIA
HUMAN RESOURCES

1. LAMMC VISION, MISSION AND VALUES

VISION

The leading state research institute in Lithuania and North European region whose activities are based on high-level basic and applied research, acquisition of novel scientific knowledge, development of technologies and innovations, their transfer and efficient experimental development. An advanced Centre of excellence and competence in agricultural, forestry, and food sciences.

MISSION

Generate, garner and disseminate new scientific know-how geared to awareness of sustainable land, forest and environment resources, their competitive development and use, elaboration of innovative technologies and products to meet the needs of the society.

VALUES

- The spirit of the scientific institution, long-standing traditions and accountability to the society;
- Competence, honesty and transparency of activities;
- Proactiveness, creativity and continuous improvement;
- Community-driven open-mindedness.

2. STRATEGIC DIRECTIONS

LAMMC priorities:

- 1) development of high-level research;
- 2) enhancement of internationalization;
- 3) development of doctoral studies;
- 4) cooperation between science and business;
- 5) community mobilization;
- 6) expansion of public services.

3. RESEARCH AND TECHNOLOGY ORGANISATION – RTO LITHUANIA

On May 30, 2019 the country's leading research centres: Lithuanian Research Centre for Agriculture (LAMMC), the Center for Physical Sciences and Technology (FTMC), the Lithuanian Energy Institute (LEI) and the Science and Technology Park of Institute of Physics established a Research and Technology Organisation.

This organisation acts as an association with the aim of consolidating the country's potential in applied research by expanding the high value-added industrial sector while maintaining the organizational flexibility of the centres.

Research and Technology Organizations (RTOs) are institutions coordinating the activities of non-university research institutes or centres that support development of high-tech industries and other sectors of economy as well as promote innovation. RTO seeks to transfer scientific knowledge to business, transform it into new products or high value-added technologies and services.



Photo by D. Jakubauskis (from left to right):
Director of Science and Technology Park of Institute of Physics Julius Paužolis, Director of Lithuanian Research Centre for Agriculture and Forestry Dr. Gintaras Brazauskas, Director of Lithuanian Energy Institute Dr. Sigitas Rimkevičius, Director of the Center for Physical Sciences and Technology Prof. Dr. habil. Gintaras Valušis.

4. HUMAN RESOURCES

4.1. Mokslo taryba

The Research Board is a collegial management body of LAMMC. The Board consists of 15 members with a term of service of 5 years.

The Board sets the key directions for the research activities, approves activity plan of LAMMC submitted by the director, annual reports, sets forth qualification requirements for researchers and other employees, as well as procedures for their performance assessment and employment, approves various documents related to research activities, and performs other activities laid out in the statute of LAMMC.



Members of the Research Board

Members of the Research Board

Dr. Virginijus Feiza	Head of Soil and Crop Management Department, Institute of Agriculture, Chairperson of Research Board	 Chairperson of the Research Board Dr. Virginijus Feiza
Dr. Marius Aleinikovas	Director of Institute of Forestry, Deputy Chairperson of Research Board	
Dr. Audrius Sasnauskas	Director of Institute of Horticulture, Deputy Chairperson of Research Board	
Dr. Žydrė Kadžiulienė	Director of Institute of Agriculture, Secretary of Research Board	
Dr. Gintaras Brazauskas	Director of Lithuanian Research Centre for Agriculture and Forestry	
Dr. Zita Duchovskienė	Head of Technology and Innovation Division, Ministry of Education Science and Sport	
Prof. Dr. habil. Pavelas Duchovskis	Head researcher of Plant Physiology Laboratory, Institute of Horticulture	
Rimantas Krasuckis	Chief advisor of Ministry of Agriculture	
Dr. Virgilijus Mikšys	Senior researcher of Department of Forestry, Institute of Forestry	
Dr. Nerijus Kupstaitis	Chief advisor of Nature Protection and Forest Policy Group of Ministry of Environment	
Assoc. Prof. Dr. Steponas Raudonius	Associate professor of Institute of Agroecosystems and soil Sciences, Department of Agronomy, Vytautas Magnus University Agriculture Academy	
Dr. Vidas Stakėnas	Head of Ecology Department, Institute of Forestry	
Prof. Dr. habil. Vidmantas Stanys	Head of Orchard Plants Genetics and Biotechnology Department, Institute of Horticulture	
Prof. Dr. habil. Gediminas Staugaitis	Director of Agrochemical Research Laboratory	
Prof. Dr. habil. Rimantas Velička	Professor of Institute of Agroecosystems and Soil Sciences, Department of Agronomy, Vytautas Magnus University Agriculture Academy	

4.2. Works Council

The Works Council of LAMMC is a collegial body representing employees, which defends the professional, labour, economic and social rights of the employees of LAMMC and its branches and represents their interests.

The works council consists of 9 members, whose term of office is 3 years.

Members of Works Council

Dr. Rasa Karklelienė	Head of Sector of Vegetable Breeding, Institute of Horticulture, Chairperson of Works Council	Dr. Rasa Karklelienė
Dr. Antanas Ronis	Senior Researcher of Plant Pathology and Protection Department, Institute of Agriculture, Deputy Chairperson of Works Council	
Aušra Vabalienė	Personnel Inspector-Secretary, Agrochemical Research Laboratory. Secretary of Works Council	
Dr. Rita Asakavičiūtė	Senior Researcher of Department of Light Soils and Crop Production Sciences, Vokė Branch	
Agnė Jankauskienė	Head of Communication and Project Administration Group, Institute of Agriculture	
Dr. Darius Kviklys	Head of Department of Horticulture Technologies	
Giedrė Šeškauskaitė	Chief economist of LAMMC	
Dr. Rita Verbylaitė	Researcher of Forest Genetics and Breeding Department, Institute of Forestry	

4.3. Personnel

As of December 31, 2019, LAMMC employed a total staff of 545 of which researchers accounted for 34 %, specialists and other employees – 34 %, laboratory assistants, technicians – 22 %, administration – 10 % (Figure 1).

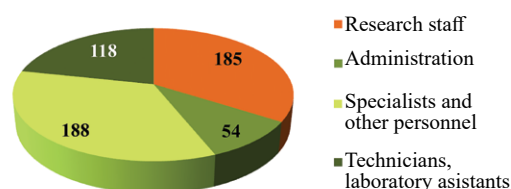


Figure 1. Number of employees by position in LAMMC

Head researchers – 20 %, senior researchers – 34 %, researchers – 22 %, junior researchers – 24 % (Figure 2).

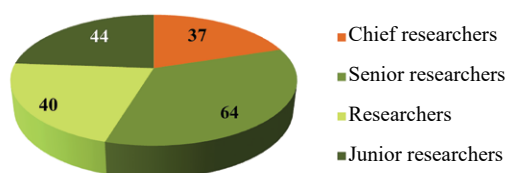


Figure 2. Distribution of researchers according to position

In 2019, LAMMC had a total of 61 doctoral students in the fields of agronomy, forestry, ecology and environment, and biochemistry sciences (Figure 3).

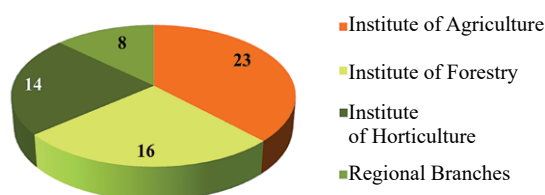


Figure 3. Distribution of doctoral students in LAMMC Branch Divisions



DOCTORAL STUDIES

RESEARCH AND DEVELOPMENT

5. DOCTORAL STUDIES

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

- **Agronomy** (jointly with Vytautas Magnus University),
- **Forestry** (jointly with Vytautas Magnus University),
- **Ecology and environmental science** (jointly with Vytautas Magnus University),
- **Biochemistry** (jointly with Vytautas Magnus University and Lithuanian University of Health Sciences).

The four-year PhD programs provided by LAMMC conform to the problematics of the contemporary agriculture and forestry, the latest methods are used in research, studies and research activities are led and supervised by experienced scientists.

5.1. Students enrolled in the PhD programmes in 2019 and their research topics

Agricultural Sciences, Agronomy (A 001)

1. **Muhammad Ayaz.** “The influence of biochar on *Cambisol* quality and mitigation of GHG emissions”. Supervisor Dr. Dalia Feizienė, scientific advisor Dr. Vita Tilvikienė.
2. **Mindaugas Budvytis.** “Bioactive compounds in multispecies swards and implication on dairy cow health and productivity”. Supervisor Dr. Žydrė Kadžiulienė, scientific advisor Assoc. Prof. Dr. Rolandas Stankevičius.
3. **Audronė Ispiryan.** “Research on biologically active materials of raspberry (*Rubus idaeus*) and development of waste recycling technologies”. Supervisor Dr. Jonas Viškelis, scientific advisor Prof. Dr. Petras Rimantas Venskutonis.
4. **Gediminas Kudirka.** “The efficiency of plant mineral nutrition and determinant factors in hydroponic systems”. Supervisor Dr. Akvilė Viršilė, scientific advisor Assoc. Prof. Dr. Lina Ragelienė.
5. **Agnė Lukošūtė.** “The influence of agronomic factors on the occurrence of diseases in winter and spring wheat in the context of climate change”. Supervisor Dr. Roma Semaškienė.
6. **Simona Lukošūtė.** “The prevalence and development *Rhexocercosporidium carotae* (Ärsvoll) U. Braun in field and occurrence on stored carrot roots”. Supervisor Dr. Neringa Rasiukevičiūtė, scientific advisor Dr. Daiva Burokienė.
7. **Vilija Matyžiūtė.** “Soil seed bank dynamics in different agroecosystems”. Supervisor Dr. Regina Skuodienė, scientific advisor Dr. Regina Repšienė.
8. **Lauksmė Merkevičiūtė-Venslovė.** “Quality of conserved forage and factors influencing its changes”. Supervisor Dr. Alvyra Šlepetienė, scientific advisors Dr. Audronė Mankevičienė, Dr. Jurgita Cesevičienė.
9. **Edvinas Misiukevičius.** “Adaptability of daylily (*Hemerocallis* L.) in ploidy level changes”. Supervisor Prof. Dr. habil. Vidmantas Stanys.
10. **Eimantas Venslovas.** “Nutritional value of forage crops, mycotoxin risks and relationships with natural and anthropogenic factors”. Supervisor Dr. Audronė Mankevičienė, scientific advisor Prof. Dr. habil. Zenonas Dabkevičius.
11. **Samar Swify.** “Effect of urea compounds as fertilizer on different soil types”. Supervisor Dr. Romas Mažeika, scientific advisor Dr. Dalia Feizienė.

Agricultural Sciences, Forestry (A 004)

1. **Skirmantas Kadziauskas.** “The analysis of use of wood for climate change mitigation and promoting bio-economy in the Lithuania”. Supervisor Dr. Marius Aleinikovas.
2. **Valeriia Mishcherikova.** “Functional diversity of microbial communities in Scots pine (*Pinus sylvestris* L.) and Norway spruce (*Picea abies* L.) forests in the process of climate change”. Supervisor Dr. Diana Marčiulygienė.
3. **Gediminas Survila.** “Peculiarities of growth of forest plantations planted on agricultural land using deep ploughing”. Supervisor Dr. Iveta Varnagirytė-Kabašinskienė, scientific advisor Dr. Kęstutis Armolaitis.

Biomedical Sciences, Ecology and Environmental Science (N 012)

Diana Sivojienė. “Successions of soil microbial communities in light soil using various organic fertilizers”. Supervisor Dr. Audrius Kačergius.

5.2. Doctoral dissertations defended in 2019

Agricultural Sciences, Agronomy (A 001)

1. **Olakunle Kelvin Akinroluyo.** “Effect of ploidy level on plant abiotic stress response in westerwolths ryegrass”. Supervisor Dr. Gražina Statkevičiūtė, scientific advisor Dr. Vilma Kemešytė.
2. **Sigita Janavičienė.** “Changes in type A and B trichothecenes, important grain quality factors, during cultivation of spring cereals and grain storage”. Supervisor Dr. Audronė Mankevičienė.
3. **Žilvinas Kryževičius.** “Effect of long-term liming and organic fertilization on aluminium compounds changes in acid soils”. Supervisor Dr. Danutė Karčauskienė, scientific advisors Prof. Dr. Audronė Žukauskienė, Prof. Dr. Esperanza Alvarez Rodriguez.
4. **Monika Toleikienė.** “The nitrogen use of diversified legumes in the organic stockless farming ecosystem”. Supervisor Dr. Žydrė Kadžiulienė, scientific advisor Dr. Aušra Arlauskienė.
5. **Ieva Urbanavičiūtė.** “Japanese quince (*Chaenomeles japonica* sp.) biologically active substances and waste free processing technology development”. Supervisor Prof. Dr. Pranas Viškelis, scientific advisor Dr. Darius Kviklys.
6. **Mindaugas Visockis.** “Application of pulsed electric fields to improve the extraction of biomolecules from vegetable raw material”. Supervisor Prof. Dr. Pranas Viškelis, scientific advisor Prof. Dr. Saulius Šatkauskas.
7. **Indrė Višniauskė.** “Organic matter of composts, its transformation in soil and influence on plant growth”. Supervisor Dr. Eugenija Bakšienė.

Agricultural Sciences, Forestry (A 004)

1. **Adomas Stoncelis.** “Dependence of the wood properties of the main forest tree species on environment and genotype”. Supervisor Dr. Virgilijus Baliuckas.
2. **Miglė Vaičiukynė.** “Hormonal regulation of root development in *in vitro* cultures of *Populus tremula* L. and its hybrids and *Betula pendula* Roth”. Supervisor Dr. Sigutė Kuusienė.

6. RESEARCH AND DEVELOPMENT

6.1. Scientific publications published in 2019

The year 2019 was the most productive in the history of LAMMC: a total of 85 scientific articles were published in the journals with an impact factor (IF) indexed in *CA WoS* database, the highest citation index of the journal in which LAMMC researchers with colleagues from foreign institutions published their research findings is 6.704. In 2019, about 100 popular science articles were written. The main scientific publications of LAMMC are presented in Figure 4.



Figure 4. m. LAMMC scientific publications published in 2019

6.2. Long-term research programmes

LAMMC is involved in six long-term R&D programmes (2017–2021). The results for the year 2019 of the ongoing long-term research programmes are presented below.

“Biopotential and quality of plants for multifunctional use”

Leader Dr. Žydrė Kadžiulienė

The effects of climate change, environmental requirements, agronomic expectations and consumer demands are increasingly driving the focus on innovative crop production technologies, beneficial agro-ecosystem services, and the search for new solutions for more efficient use of renewable resources. Research within the scope of the program is underway and addressed in that direction.

In 2019, the results of the research on the efficiency of nitrogen utilization of legume plants in the organic farming systems and the influence of symbiotic nitrogen on nitrogen leaching in a sandy loam *Luvisol* were summarized. Results of non-traditional energy perennial grasses and willows grown for biofuel and re-fertilization with sewage sludge compost were systematized and technological proposals were prepared. In recent years, studies on the productivity, qualitative and quantitative changes of fibre hemp (*Cannabis sativa* L.), phytocannabinoids and other active substances using different agrotechnologies, experiments on the chemical composition, technological properties of winter wheat grains and soil quality using the liquid organic fertilizers have been started. Research is being continued on enhancement of the multifunctionality of agroecosystems which address the aspects of productivity potential and stability of the crop rotation in the systems of varying intensity under changing climate conditions. Other research examines the interaction among the sward productivity-environment-sward management factors; the effects of digestate, by-product of biogas production, used as an organic fertilizer on plants, soil and micro-organisms.

The research results of the programme topics are published in various scientific publications. The latest research results have been published in more



Experiment on fibre hemp cultivation agrotechnologies



Experiment on pea cultivation agrotechnologies

than 10 articles in the journals indexed in the database *CA WoS*, 13 oral and poster presentations have been made at international conferences, practical aspects of research have been presented in workshops and popular science articles.

“Sustainable forestry and global changes”

Leader Dr. Virgilijus Mikšys

The aim of the program is to obtain and systematize the new scientific knowledge necessary for the development of sustainable forest management in the context of global natural, economic and social changes and to prepare recommendations for applying this knowledge in practice.

The investigations of organic carbon deposits in mineral and organic soils were carried out. The regularities of plant nutrient metabolism processes in forest ecosystems in model ecosystems were analysed. The influence of the extent and intensity of degradation of forest organic residues on forest ecosystems was investigated. Taxonomic differences of morphological characters of *Alnus* ssp. leaves according to molecular markers were determined. Epigenetic phenomena initiated in 23 hybrid poplar clones were further investigated by transplanting them to field trial. The effect of the stress hormone abscisic acid on various poplar hybrids was investigated in an in vitro system.

The influence of the location of the donor tree shoots in the canopy of 4 poplar hybrids on the



Experiments on the response of different clones of poplar hybrids at the phytotrone of Institute of Forestry, LAMMC

morphogenesis of the cuttings was investigated. The establishment of container-grown silver birch plantations was investigated. The bareroot seedlings establish better during the dry season.

“Harmful organisms in agro- and forest ecosystems”

Leader Dr. Roma Semaškienė

The aim of the programme is to investigate the peculiarities of behaviour of dominant and newly-emerging pests in the agro-forest ecosystems and to develop the scientific basis for managing their destructive effects in a manner that maintains economic benefits without compromising environmental and human safety, biodiversity conservation. To achieve the objective of the programme, the following three tasks have been set:

1) to study the crop-destroying phytopathogens and phytophagous populations and to determine the peculiarities of their behaviour (interaction between host plants and pathogens or pests and the environment, factors affecting the spread of harmful organisms and outbreaks) in various agro-forest ecosystems of Lithuania;

2) to investigate and assess the occurrence of pathogenic and toxic fungi, pest insects in arable, garden and orchard crops and the abundance and spread of soil microbiota as influenced by natural and anthropogenic factors;

3) to examine and evaluate the effect of harmful organisms on crop productivity and quality and to identify measures for their prevention and control.



Research on soil pathogens in controlled conditions

The program implementation encompasses research within the framework of 4 thematic topics.

In 2019, 13 research studies were carried out, 12 articles were published in the journals with an impact factor indexed in the *CA WoS*, database, 14 publications in conference proceedings, 1 recommendation for production was prepared. In 2019, one doctoral dissertation was defended, 7 doctoral students were involved in research.

“Horticulture: agrobiological foundations and technologies”

Leader Dr. Giedrė Samuolienė

The research in horticulture is carried out in various aspects – fundamental and applied – in Lithuania. Developing the principles of horticulture, in order to ensure the safe and competitive production, taking into account changing climatic and market conditions, it is important to develop and improve ecological, integrated and intensive horticultural technologies; to carry out the breeding, physiological, genetic and biochemical aspects. In order to achieve competitive horticultural production, which would be important for growers and manufacturers, a special attention is paid to yield, diversity of horticultural products, chemical composition and technological properties. It is necessary to create and optimize storage processes, which would allow preservation of natural biochemical composition. **The purpose of the programme** is to create scientific basics for the development of modern horticulture in changing climatic and economic conditions; ensuring qualitative, safe and competitive production for the local market and exports. Results achieved in



Presentation of research results at a scientific-reporting conference

2019: 20 articles in the journals indexed in *CA WoS* database, 9 publications in peer-reviewed periodical publications, 3 sections of textbooks, published by international publishers, 5 recommendations and popular science articles.

“Productivity and sustainability of agricultural and forest soils”

Leader Dr. Virginijus Feiza

Relevance of the Programme – EC Directive (COM(2006) 232) sets out common principles for Soil Thematic Strategy to protect soils across the EU. The document sets out that the EU Member State will be in a position to decide how best to protect soil and how to use it in a sustainable way on their own territory. **The goal of the program** is to evaluate soil fertility potential in agricultural and forest ecosystems, to highlight the factors which affect their degradation and to choose the measures to maintain soil sustainability, to optimize carbon cycle in the soil, to reduce greenhouse gas emission and plant nutrient losses from the soil in different regions of the country.

The research is focused on three basic directions:

1) Productivity improvement and reduction of degradation processes in soils of morainic and limnoglacial origin;

2) Rational use of natural soil resources, organic and mineral materials of local origin;



Small plot experiments

3) Evaluation of the productivity potential of agricultural and forest soils.

To gain a deeper understanding of the processes taking place in the soil, the scientists of different scientific branches (agriculture, biomedicine, physical science) are involved.

In 2019, the participants of the programme published 10 papers in journals having IF, 4 papers are under revision, 12 articles were published in popular press, 6 recommendations for practical

farming were published, 44 seminars / lectures for agricultural producers, 16 oral presentations and 3 poster presentations were made in national and international conferences.

“Genetic determination of the traits of agricultural and forest plants, development of modern cultivars”

Leaders: Prof. Dr. habil. Vidmantas Stanys, Assoc. Prof. Dr. Vytautas Ruzgas

The objectives of the program: to develop molecular markers for abiotic and biotic stress resistance, plant productivity and quality parameters; to create new breeding material for the development of new commercially successful plant varieties; to identify genotypes of forest plants beneficial for the development of the national economy.

Agricultural and forest plants can provide economic revenue only if competitive lines, varieties or populations are being used. Natural and agricultural ecosystems are in perpetual fluctuations because of various environmental factors, such as climate change, hydrological regime, pest and pathogen infestation. New techniques and products are constantly being developed for the plant cultivation; quality parameters for the plant production are constantly changing in the processing industry. Therefore the genotypes and population structures of agricultural and forest plants have to be continuously improved and adapted to meet current economic and environmental needs.

In 2019, the programme was further carried out by the departments of Cereal and Grass Breeding, Laboratory of Genetics and Physiology of Institute of Agriculture, Department of Orchard Plant Genetics and Biotechnology of Institute of Horticulture and Institute of Forestry.

Genetic factors governing plant phenotype and stress response were investigated; new breeding material superior in productivity and quality was created and new varieties were developed, evaluation of progeny of selected trees, development

and assessment of breeding populations were carried out.

In 2019, the results were published: 13 articles in the journals indexed in *Clarivate Analytics Web of Science* database; 4 articles in other scientific journals; 90 new breeding lines were developed; 7 new varieties were submitted for registration; 8 varieties were registered. The results were presented in 25 scientific conferences.



Barley hybridisation nursery



Lupine collection research



Yield assessment in field experiments with peas

6.3. Projects

In 2019, LAMMC implemented 32 international, 37 national research projects, funded by the Research Council of Lithuania, Ministry of Agriculture, Ministry of Environment, and fulfilled over 100 contract orders for Lithuanian and foreign economic entities (Table 2). A list of the national and international research projects conducted in 2019 is presented in the appendices.

1 lentelė. Projects implemented by LAMMC in 2019

	International	Research Council of Lithuania	Ministry of Agriculture, Ministry of Environment, etc.	Lithuanian economic entities	Foreign economic entities	Total
Institute of Forestry	12	3	7	10	-	32
Institute of Horticulture	5	6	-	10	5	26
Institute of Agriculture	12	4	16	25	29	86
Regional Branches	3	-	1	30	2	36
Total:	32	13	24	75	36	180

6.3.1. National projects started in 2019

Projects funded by the Research Council of Lithuania

Projects implemented by the researchers' groups

1. "Light as a tool of biofortification: photophysiological aspects of essential trace elements management in leafy vegetables". Project leader Dr. Aušra Brazaitytė. 2019–2022

Other projects funded by the Research Council of Lithuania

Sub-activity "Developing students' skills in conducting research during the semester"

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. "Optimisation of expression of recombinant peptides in tobacco plants and purification". Leader Prof. Dr. habil. Vidmantas Stanys. October 18, 2019 – April 30, 2020. 2. "The use of biogas production waste substrate for crop fertilisation – its effect on the soil, | <ol style="list-style-type: none"> GHG emission and crop quality". Leader Dr. Vita Tilvikienė. October 18, 2019 – April 30, 2020. 3. "The effect of biochar on soil water retention and plants". Leader Dr. Dalia Feizienė. October 18, 2019 – April 30, 2020. |
|---|--|

Research funded by the Ministry of Agriculture

Research and applied activities projects in agriculture, food and fisheries

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. "Glyphosate and AMPA residues and its degradation time in soil and grain". Project leader Dr. Gražina Kadžienė. 2019–2021. | <ol style="list-style-type: none"> 2. "Impact of growing system on the quality and safety of fruit and vegetable production". Project leader Dr. Darius Kviklys. 2019–2020. |
|---|--|

Support for projects of the measure “Knowledge transfer and information activities” (Program for the Lithuanian rural development 2014–2020)

1. “Implementation and spread of innovative technologies in growing of clonal stands of *Populus* hybrids in the areas that are not suitable for agriculture”. Project leader Dr. Sigutė Kuusienė. 2019–2020.

Applied research projects funded by the Ministry of Environment of the Republic of Lithuania and its subordinate state institutions

1. “Flow analysis of industrial wood to determine cumulative changes in carbon stocks in wood products”. Project leader Dr. Marius Aleinikovas. 2019–2020.
2. “Preparation of genetic monitoring methodology for Scots pine, Norway spruce, pedunculate oak and silver birch”. Project leader Dr. Virgilijus Baliuckas. 2019–2021.
3. “A study of environmental risk assessment of GMO”. Project leader Dr. Algimantas Paulauskas (VDU), coordinator of LAMMC Dr. Kristina Jaškūnė. 2019–2020

Technological development project funded by the Agency for Science, Innovation and Technology (MITA)

1. “Creation prototypes of technology of birch juice industrial extraction and innovative biologically valuable products”. Project leader Prof. Dr. Pranas Viškelis. 2019–2020.

6.3.2. National projects ongoing in 2019

This section provides major ongoing national projects (high level R&D (SMART) projects).

Research funded by the Research Council of Lithuania

High level R&D (SMART) projects

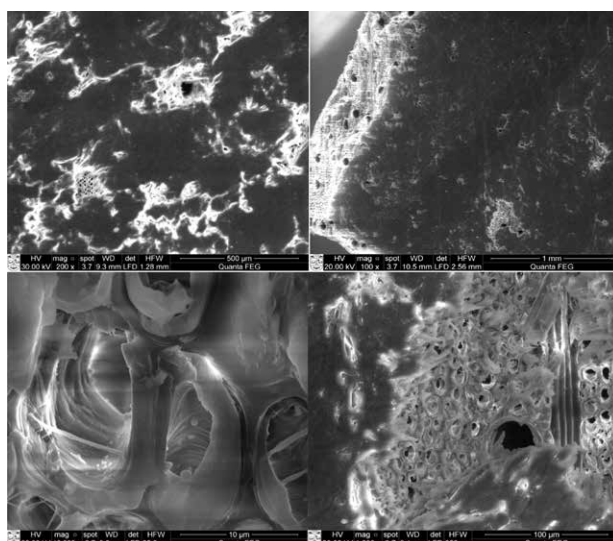
1. “Development of wood modifying eco-friendly technology for higher value products”. Project leader Dr. Marius Aleinikovas. 2017–2021.

The aim of the project is to create an environmentally friendly technology for the modification of wood properties, based on the reaction of wood bioactive compounds with the modification reagent, and ensuring the rational use of ligno-cellulosic material and giving higher added value to the products.

In 2019, the development of modifier, on a basis of iron oxide, or iron salt solution, and technological parameters for impregnation applied for different tree species (*Picea abies*, *Pinus sylvestris*, *Pseudotsuga menziesii*, *Juglans Regia*, *Acer platanoides*) was continued.

The mass loss after thermal processing was obtained in all treatments, including the control treatment, for all species, except *Pinus sylvestris* and *Picea Abies* wood in the treatment with additive FeO_3 together with tannins.

Among all species, *Pinus sylvestris* and *Picea Abies* wood density after thermal processing also responded differently than other species, i.e. the



The microstructure of thermally processed samples of maple wood analysed by a scanning electron microscope (SEM)

wood density of these conifers increased after the thermal processing. However, wood density of other species – *Pseudotsuga menziesii*, *Juglans Regia* and *Acer platanoides* evidently increased in the control and FeCl_3 with tannins treatments or slightly decreased in Fe_2O_3 with tannins treatment.

Generally, different treatments of pure Fe_2O_3 and FeCl_3 or Fe_2O_3 and FeCl_3 applied together with

commercial tannins decreased the content of total phenolic compounds compared with the control treatment in the wood of *Pinus sylvestris*, *Picea Abies* and *Acer platanoides*. More contradictory values were obtained for the wood of *Pseudotsuga menziesii* and *Juglans Regia*.

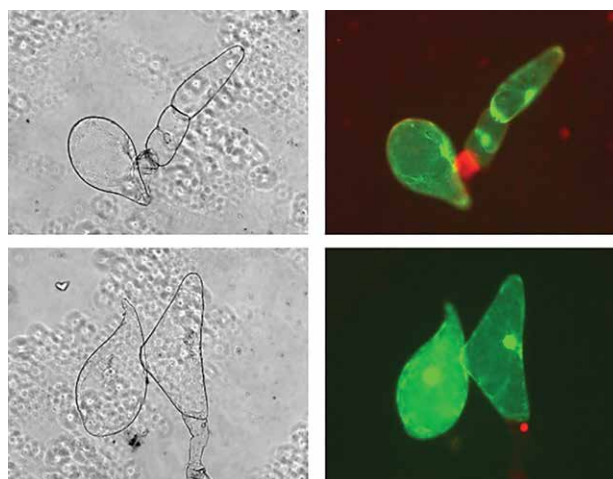
2. “Closed plant cultivation system for production of raw materials for peptide nanoengineering applications”. Project leader Dr. Danas Baniulis. 2017–2021.

The aim of the project is to develop a technology based on closed type plant tissue cultivation system that is dedicated for production of raw materials for preparation of peptides mimicking the extracellular matrix proteins (PMEM). Four new constructs of peptides mimicking functional domains of fibronectin and laminin were developed.

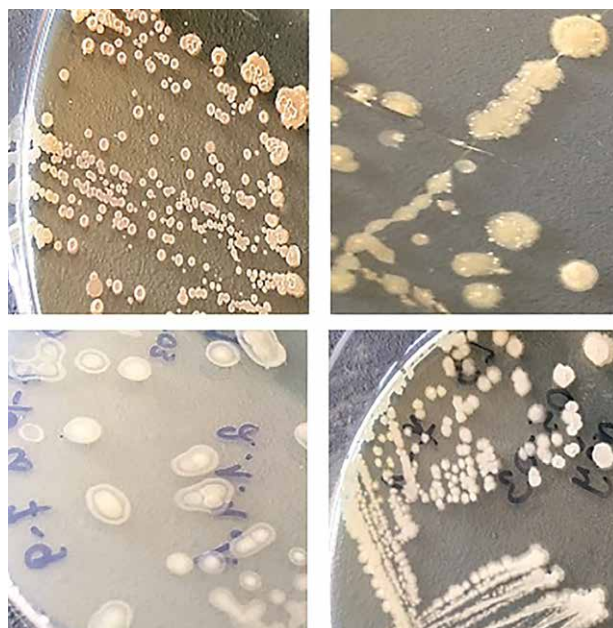
During period of the year 2019, PMEM constructs were prepared using bacterial expression system and structural and surface preparation aspects were assessed using purified peptides.

For plant transformation, PMEM constructs with constitutive promoters p32S and pNos or inducible promoter pHsp18.2 were developed. Tobacco plant transformants were selected and PMEM expression was assessed using specific antibodies and/or fluorescence analysis of the GFP-tag used in the constructs. Peptide purification experiments were carried out and efficiency of purification was assessed using polyhistidine tag and different matrices of metal affinity chromatography.

Tobacco undifferentiated tissue lines were developed and optimization of experiments of the tissue cultivation in bioreactor system were initiated. Further research on plant stress under *in vitro* conditions was carried out, and the effect of antibiotics on tobacco shoot development was assessed. Fifty-two tobacco endophytic bacteria isolates were prepared and identified using 16S RNA sequencing. Effect of the selected isolates on tobacco shoot growth *in vitro* was assessed. Co-cultivation experiments were carried out to classify plant-endophyte interactions and gene expression analysis was initiated.



Expression of extracellular matrix mimicking peptides in tobacco cell suspension (cells visualized with bright field microscopy (left) and based on GFP fluorescence (right))



Growth of endophytic bacteria isolated from tobacco *Nicotiana tabacum*

3. “UV-A lighting strategies for controlled environment horticulture: upgrade to sustainable, high-value production”. Project leader Dr. Akvilė Viršilė. 2017–2021.

The project aims to create the research result based UV-A lighting application strategy for the improvement of phytochemical value and taste properties in different green vegetables, herbs for high value production in closed environment horticulture systems. In 2019, research tasks were aimed to evaluate the effects of UV-A (~315~400 nm) light parameters (in the background of the optimized main artificial lighting characteristics) on different leafy vegetables and herbs: their phytochemical contents, sensory properties, productivity etc. The main results show distinct effects of UV-A LED light parameters on the investigated plants. The effects are dependent on plant species and main lighting source characteristics; as well as the combinations of UV-A wavelength, intensity and duration have unequal impact. The obtained results will be employed for further steps in the development of lighting technology.



Additional UV-A lighting is potentially useful in increasing the yield of medicinal components from vegetable raw material

4. „Quality diagnostics of biogas production by-product (digestate) for innovative use as a biofertilizer“. Project leader Dr. Alvyra Šlepetienė. 2017–2021.

Anaerobic digestion of plant-origin biomass in biogas plants produces not only the energy-efficient product – biogas, but also a by-product – bio-fertilizer, which is potentially useful for soils and crop production. At the same time, there is a need for fast but accurate quality diagnostic methods for such bio-fertilizers. However, few suitable methods have been developed and little research has been done, this leads to problems in the analysis of the composition of the bio-products. **The main idea of this project** is to develop a new method that allows for rapid but very accurate bio-fertilizer analyses. One of the possible methods is the planned spectrometry method, which will allow the assessment of the specific instantaneous chemical composition of the bio-product. Based on these indicators, it will be possible to predict the impact on plants and the environment. The aim of the project is to evaluate and compare the quality of various agro-raw materials available in the country on the basis of scientific knowledge; to reveal their potential for use, considering their suitability for industrial processing into biogas; to promote the use of residual biomass from biogas plants as bio-fertilizer in agriculture and to improve its quality diagnostics by developing an innovative and accurate NIR spectrometry method.



Experiment on fertilization with liquid and dry fraction of digestate in cereals



Experiment on fertilization with liquid and dry fraction of digestate in grassland

In 2019, residual biomass and raw-material samples (100 in total) were taken from nine biogas plants for chemical and instrumental evaluation of their quality, and the absorption spectra of the samples were recorded using NIR spectrometry. Mathematical modelling using PLS (Partial Least Square), MPLS (Modified Partial Least Square) regression analysis, PCR (Principal Components Regression) was applied to develop the relationship between spectral and chemical analyses of dry and liquid bio-fertilizers. The suitability of raw materials for biogas production was assessed, and the amount and composition of biogas formed from different phyto-raw materials was determined. Two field experiments were carried out on soils of different genesis, using residual biomass of biogas plants as bio-fertilizer and soil improver; the influence of



Assessment of organic carbon changes in a laboratory

different types of bio-fertilizers on soil chemical parameters and organic matter qualitative parameters was determined.

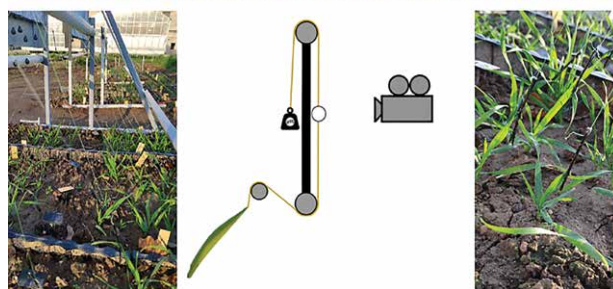
5. “Development of winter wheat varieties for amylose-free starch and vital gluten processing”. Project leader Dr. Gintaras Brazauskas. 2017–2021.

Autumn growth rate and de-hardening in early spring for eighteen winter wheat breeding lines and varieties are evaluated using largely automated, non-destructive and precise phenotyping system. The experiment under field conditions is ongoing and the data is being collected.

Thirteen winter wheat cultivars of contrasting autumn growth rate were chosen for evaluation of LT50 determining freezing tolerance. 360 seeds were sown for each of genotype for 6 different temperature points at the artificial freezing tests. Wheat plants were cold acclimated in natural and artificial conditions for 8 weeks. The freezing experiments results showed very broad LT 50 values ranging from -8 °C to -16 °C, and the most freezing tolerant genotypes could not be evaluated, because even at very low temperatures, more than half of plant survived the freezing test. New freezing experiments are set it up for plants which were acclimated for 4 weeks at the moment.

In order to identify novel alleles in *GBSSI* genes *Wx-D1* and *Wx-B1* sampling of DNA from plants of TILLING population was performed. In total 37 mutant DNA samples were amplified and sequenced of which 23 of *Wx-B1* and 14 of *Wx-D1* genes. Two point mutations were identified. Both mutations are missense type and located in the coding sequence in the 7th exon of *Wx-B1* and *Wx-D1* genes.

The leave samples of 19 F4 waxy wheat lines were collected and genomic DNA was extracted



Phenotyping panel for chronological profiling of the leaf elongation rate

for high molecular weight glutenin analysis using allele-specific PCR. Nine lines were homozygous in GluA1 and GluD1 loci, 6 of them contained GluA1c and GluD1a alleles, the remaining 3 GluA1c-GluD1a, GluA1a-GluD1d and GluA1a-GluD1a. Six lines were heterozygous in GluA1 locus, 3 were heterozygous in GluD1 locus and 1 was heterozygous in both loci.

6. “Enhancement of the multifunctional properties of legumes in feed and food value chain” (SmartLegume). Project leader Dr. Žydrė Kadžiulienė. 2017–2021.



In the context of climate change and the environment, the contribution of legume crops to sustainable agriculture is increasingly important. **The aim of the**

project is to develop innovative legume-growing systems based on their multifunctional value and to enhance their use as more environment- friendly plant-derived raw materials in feed and food chains. One of the activities of the project is conducting field experiments, which will result in offering pea cultivar-specific cultivation technologies and to design tentative soil and crop management schemes for lentil and chickpea cultivation.

During the initial period of the project, genotypic and phenotypic diversity of the local population of pea nodulating bacteria was investigated. On the bases of obtained results were identified three local *Rhizobium leguminosarum* symb. *viciae* strains able to increase pea productivity and survive at different pH. The 49 new lines of peas were tested in the cultivars trial in 2019. The most perspective lines were DS 3637-2 and DS 3795-3. The seeds of lines were sent for testing the value for cultivation and use in Lithuania as well as for distinctness, uniformity and stability (DUS) testing.

In conventional farming conditions, the legumes were investigated. According to the ability to suppress weeds, the legumes are arranged as follows: peas> beans> chickpeas> lentils. Lentils are 4.5 times weaker in weeds than peas. The chemical measures used for weed control did not damage peas and beans, however chickpeas and lentils were sensitive to the action of those measures.

Chickpea and lentil cultivation technologies were studied in conventional and organic farming systems. Seeding time of lentils and chickpeas, seed rate, row widths, weed control measures, nitrogen fixation capacity, cultivar potential and yield were studied. In 2019, the yield of lentils was 1280 to 2430 kg ha⁻¹, depending on the growing means used, and the yield of chickpeas was slightly higher - 1550 to 2830 kg ha⁻¹. Preliminary results show that new varieties of lentils and chickpeas have the potential to grow in our climate.



Technological experiments of legumes in conventional farming systems



Demonstration of legumes growing technologies in exposition of Institute of Agriculture in the Exhibition “Agrovizija 2019”



Demonstration of legumes growing technologies in exposition of Institute of Agriculture in the Exhibition “Agrovizija 2019”

Postdoctoral fellowship promotion projects funded by the European Union's funds

1. **“The resistance of different Scots pine (*Pinus sylvestris* L.) genotypes against root rot (*Heterobasidion annosum* (Fr.) Bref.)”.** Fellowship supervisor Dr. Virgilijus Baliuckas, research fellow Dr. Adas Marčiulynas. 2017–2019.

Scots pine (*Pinus sylvestris*) is the most common conifer tree species in Lithuania. A considerable part of the mature pine stands are suffering from one of the most dangerous pathogens in the Northern Hemisphere - root rot (*Heterobasidion annosum*). The root rot damages pine stands in Lithuanian, which affects not only tree health, but also influence the functioning of the forest ecosystems as well as affect the economic processes of the wood industry.

The general aim of the research is to prepare methodology for the selection of genotypes resistant to root rot and perform genetic-breeding assessment of selected and representative trees in population by the results of their progeny testing as well as select the best genotypes (selected trees and individuals from progeny families) for the breeding of forest seed plantations. The selection and breeding will be carried out to achieve the resistance of Scots pine to root rot.

The genotypic variation among Scots pine half-sib families' susceptibility to a pathogen was observed in the first project activity. Seedling mortality due to *H. annosum* significantly differed among half-sib families; however, other susceptibility indicators (incidence rate and pathogen spread) did not show any significant differences. It is likely that the lower susceptibility of Scots pine half-sib families is based on a combination of enhanced constitutive and inducible phenolic defense mechanisms.

In the second project activity it was found that taking smaller numbers but larger areas of root rot results in improved genetic parameters for resistance assessment, while genotype selection for resistance enhancement does not reduce the selectivity effect of other traits. As the age of pine trial plantations increases, the efficiency of selection of resistant genotypes increases.

The purpose of the third activity was to determine the mycobiota of soil and roots in the Scots pine stands damaged by root rot. During the study, Scots pine root and soil samples were collected from different habitats affected by root-rot. The obtained results will allow us to evaluate the diversity of mycobiota and to identify the potential species of fungi that increase resistance to *H. annosum*.



Heterobasidion annosum isolates from living Scots pine trees in southern Lithuania



Damaged areas in Scots pine progeny field trials

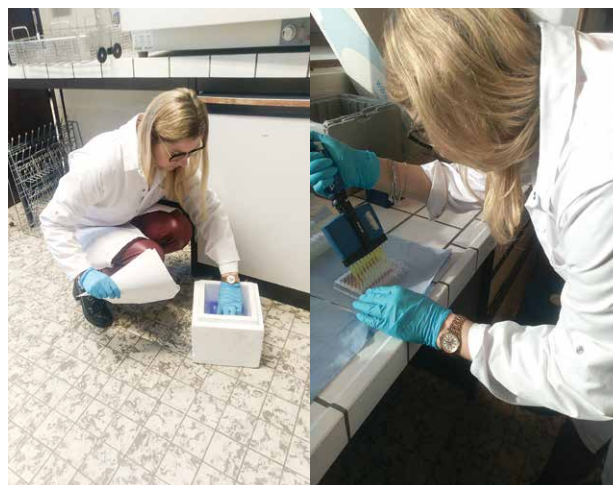


Heterobasidion annosum inoculation experiment

2. “The metabolic response of spring oilseed rape (*Brassica napus* L.) to the negative effects of climate change”.

Fellowship supervisor Dr. Akvilė Viršilė, research fellow Dr. Aušra Dikšaitytė. 2017–2019.

The aim of this project is to investigate the metabolic response of spring oilseed rape under different mineral nutrition conditions to the adverse effects of climate change (heatwaves, drought) and the relationship of metabolic parameters with rape resistance and post-stress regeneration potential. The results of the study showed that the photosynthetic rate and growth of well-watered rape grown under adequate nutrient conditions (N-A) in heatwave (HW) treatment increased. However, under the combined effect of HW and drought, both photosynthesis and growth were strongly inhibited and, regardless mitigating the effect of elevated concentrations of atmospheric CO₂, did not return to control plant levels after the regeneration period. The main mechanism by which the elevated CO₂ diminished the adverse effects of combined heat and drought stress on photosynthetic rate was attributed to the improved leaf water potential due to increased water use efficiency. Compared to N-A plants, the growth responses of nutrient deprived (N-D) plants to single HW treatment were weaker and, in most cases, insignificant. Meanwhile, photosynthesis and growth were further inhibited by the combined effect of HW and drought. The more impaired photosynthesis under the combination of HW and drought, compared to single drought treatment, was



Preparation of samples and standard solutions for biochemical analyses of plants

attributed mainly to the faster soil drying induced by higher evapotranspiration through higher leaf-to-air vapour pressure deficit and because of this sharper decrease in stomatal conductance. However, other mechanisms than those related to stomatal conductance were also evident. Some of these include diminished photochemistry of photosystem II and disturbed C/N balance in shoots and roots, more pronounced in N-D conditions.

3. “The impact of light quantity and quality parameters on the changes of bioecological properties of *Fragaria x ananassa* pathogens”.

Fellowship supervisor Dr. Aušra Brazaitytė, research fellow Dr. Neringa Rasiukevičiūtė. 2017–2019.

The aim of this project was to investigate the influence of the light quantity and quality on the *Fragaria x ananassa* pathogens' bioecological properties *in vitro* and *in vivo*. The task of the project is to investigate the impact of light quantity and quality on *Botrytis* spp. and *Colletotrichum* spp. pathogens potential, their biometric and biological symptoms interaction, to determine pathogens response to light *in vivo* and to evaluate the opportunity of research data application in strawberry growing under LED lights in a controlled environment.

The project results gave new scientific knowledge on LED light effect on *Botrytis* spp. and *Colletotrichum* spp. bioecological properties.



The impact of light on the biological features of pathogens



The effect of different light on *Colletotrichum* spp. pathogenesis



The effect of different light on *Botrytis* spp. pathogenesis

4. “Assessment of different perennial herbaceous plant species as potential feedstocks for conversion into bioenergy products”. Fellowship supervisor Dr. Bronislava Butkutė, research fellow Dr. Kristina Amalevičiūtė-Volungė. 2017–2019.

The aim of this research project was to give a complex evaluation and scientific validation of the feasibility of use of perennial herbaceous plants for the production of bioproducts using innovative technologies, to estimate biomass yield in relation to harvesting time as well as chemical composition and energy value and to study biomass methanation process and its control. The following plants were studied: cocksfoot (*Dactylis glomerata* L.), reed canary grass (*Phalaris arundinacea* L.), tall fescue (*Festuca arundinacea* Schreb.), ryegrass (*Lolium perenne* L.), lucerne (*Medicago sativa* L.), sainfoin (*Onobrychis viciifolia* L.), and switchgrass (*Panicum virgatum* L.) Plant biomass for chemical composition analyses was taken at 4 different growth stages (heading, flowering, re-growing and after winter) with three field replicates. Oxitop system was used for biogas production. The method is based on the control and management of pressure changes during the anaerobic processes. The qualitative composition of the biogas (methane content) was determined by a mobile biogas analyser. In addition, in order to identify energy plants and estimate their suitability for solid fuel, assessment of their calorific/energy value was carried out by a direct combustion method using the IKA C200 calorimeter.

The studies showed that the highest methane yield was obtained from the biomass of ryegrass, sainfoin and cocksfoot. It is recommended to use biomass of perennial ryegrass, switchgrass, tall fescue or cocksfoot for direct combustion after winter.



Experiment on the biogas production from the biomass of perennial grasses using the *OxiTop* system and the biogas quality analyser

Applied research funded by the Ministry of Agriculture

Research and applied activities projects in agriculture, food and fisheries

1. “Research on the suitability of different varieties of cereals for integrated pest management (IPM)”. Leader Dr. Jūratė Ramanauskienė. 2017–2019.

The aim of the project was to determine the susceptibility of cereal varieties to diseases, yield response to disease control, and their agronomic value and to evaluate the varieties in terms of integrated pest management (IPM) and to make the recommendations regarding cultivation of the most suitable cereal varieties under Lithuania's conditions.

Results: 1) Winter wheat varieties ‘Hondia’, ‘Kena DS’ and ‘Skagen’ showed lower susceptibility to diseases and good yield potential. To fulfil the varietal yield potential, more intensive disease control is required for winter wheat varieties ‘Artist’, ‘Etana’, ‘Patras’ and ‘Tobak’ 2) Spring wheat varieties ‘KWS Akvilon’ and ‘Quintus’ showed lower susceptibility to diseases and good yield potential. More intensive disease control is required for the spring wheat varieties ‘KWS Chamsin’, ‘KWS Collada’ ‘Triso’, ‘Vanek’ and ‘Wicki’. 3) Spring barley varieties ‘Laureate’, ‘Quench’ and ‘Rusnė DS’ showed lower susceptibility to diseases and good yield potential. More intensive disease control is required for the spring barley varieties ‘Avalon’, ‘Ema DS’, ‘Propino’ and ‘RGT Planet’, although ‘RGT Planet’ showed the highest yield potential. 4) Research on the suitability of cereal varieties for IPM on the background of elevated infection level showed that it had a significant effect on tan spot severity increase in spring wheat. On the background of elevated infection level, the severity of tan spot was 78.0–85.0 % higher. 5) Comparison of the effects of different infection levels on yield indicators in spring barley did not show any significant differences; however, fungicide application gave positive results. The grain yield of spring barley in the crops not applied with fungicides was 1.3–1.5 t ha⁻¹ lower. 6) The results of 3-year experiments showed that the following cereal varieties were the highest yielding: winter wheat ‘Artist’, ‘Etana’ and ‘Skagen’, spring wheat ‘KWS Akvilon’, ‘Wicki’, ‘KWS Collada’ and ‘Quintus’, and spring barley ‘RGT Planet’, ‘Laureate’, ‘Quench’ and ‘Rusnė DS’.



Winter wheat varieties at tillering stage



Winter wheat varieties at stem elongation



Spring wheat varieties at milk maturity stage

2. “The use of degassed bio-substrate for fertilization of agricultural crops”.

Leader Dr. Vita Tilvikienė. 2017–2019.

Biogas production is anaerobic digestion of biomass resulting in biogas and a by-product – digestate. Research and evaluation of digestate made from different raw materials showed that in all cases it lowers the total (direct and indirect) energy consumption for agricultural management and improves environmental parameters (data on direct emissions are not provided).

The use of digestate for fertilization of agricultural crops requires an evaluation of its quality before each application. The chemical composition of the biosubstrate varies greatly depending on the raw material used and the efficiency of the biogas production process. Digestate requires detailed chemical analysis to ensure proper plant nutrition. It is particularly important to determine the amount of heavy metals in the biosubstrate to prevent soil contamination.

Considering that the 120 kg ha⁻¹ nitrogen rate in the biosubstrate used did not always ensure sufficient protein content in the grain or even grain yield, it is recommended to increase the biosubstrate rate to 170 kg ha⁻¹ nitrogen or to use mineral nitrogen fertilizer for additional fertilization.



Workshop at the exhibition of agricultural technologies “Agrovizija 2019”

Due to the high content of organic matter in the digestate, especially in separated one, it is recommended to apply it before planting or during plant vegetation. The fertilization with digestate should be repeated over several years in order to get positive results. The effect is not instantaneous as most nutrients are in organic form but can have long-term beneficial effects on soil and plants in the long-term perspective.

3. “Inventory of greenhouse gas emissions in the national crop sector”.

Leader Dr. Jūratė Aleinikovienė (ASU, currently – Vytautas Magnus University Academy of Agriculture), Dr. Vita Tilvikienė. 2017–2019.

Agricultural activity (tillage, fertilization, soil and vegetation damage) directly contributes to the release of atmospheric greenhouse gases (GHG), which directly affect climate change. As is known, every country in the European Union reports annually on GHG emissions according to the common methodology. In view of the fact that the methodology applies to countries with different climates, it is necessary to revise national indicators that can reflect the situation in the country as closely as possible.

The aim of the project was to base research on GHG (CO₂ and CH₄ and N₂O) emissions at regional (e.g. Baltic countries) or even national values, which would replace the overall values.

The research was conducted to evaluate the GHG in different agricultural systems, use of mineral and organic fertilizers, land use change, ect. A detailed analysis of previous studies was performed. For more



Experiments on GHG emissions demonstrated at a scientific conference

information about the project and final report, please visit: <http://zum.lrv.lt/lt/veiklos-sritys/mokslas-mokymas-ir-konsultavimas/mokslas/moksliniu-tyrimu-ir-taikomoji-veikla>

4. “Analysis of epidemiological and laboratory research of African swine fever (ASF), prognosis of disease transmission, risk analysis and disease management strategy in wildlife and pig farming localities in the Republic of Lithuania”.

Project leader Dr. Olgirda Belova. 2017–2019.

We aimed to determine ASF transmission in wildlife and pig farming localities using epidemiological, serological, virological and molecular biology research data as well as to ascertain distances of wild boars seasonal moving seeking to predict ASF spread and create ASF management strategy. After analysis of ASF transmission routes in wildlife, to suggest surveillance tools preventing the spread of ASF virus into health territories and create ASF management strategy in wildlife. We determined natural and human conditions in the different natural regions of Lithuania, ways of wild boar management. We performed the analysis of local conditions of the natural regions and ascertained habitat suitability for wild boar. The monitoring of animal moving and their individual and group behaviour was performed in the two model territories using GPS tracking and thermal imaging cameras. The data on ASF spread over the country are considered. The final report was prepared.



For the first time, the new technology of passive capturing for wild boar GPS tracking was adapted

5. “Development of the Code for Good Agricultural Practice, whose application would mitigate negative effects of agriculture on soil, water, air and climate”.

Project leader Dr. Virginijus Feiza. 2018–2019.

The goal of the Code of Good Agricultural Practice for Prevention of Pollution of Water, Air and Soil is to prepare the set of recommendations based on Nitrate and Air Directive requirements as well as on the new research findings including modern practical experience regarding provision of practical advice on management practices that can be implemented on farms to reduce environment pollution from agriculture.

In 2000, Code for Good Agricultural Practices was published. Eighteen years have passed since that date. Many important research data and a lot of positive farming experience were accumulated. The possibility to publish new know-how experience became viable. The government of the Republic of Lithuania and also different EU directives pay a lot of attention to measures to reduce environment pollution and GHG emission. In this Code, economic and juridical measures will be provided, whose implementation would significantly reduce



Productive soil – high crop yield

the negative influence originating from agriculture on soil water bodies, air and climate.

6. “Evaluation of the most harmful seed borne diseases of cereals and fodder legume crops and the establishment of their thresholds in certified seed of cereals and fodder crops”.

Project leader Dr. Roma Semaškienė. 2017–2019.

The aim of the project is to identify the most harmful seed borne diseases of cereals and fodder crops and the highest allowable thresholds (in percent) in certified seed of cereals and fodder crops. According to historic and project’s research data, the most harmful seed borne diseases of cereals were: common bunt (*Tilletia caries*) in winter wheat, snow mould (*Microdochium* spp.) in winter cereals, *Fusarium* and *Microdochium* root rots in all cereals, net blotch (*Pyrenophora teres*), *Bipolaris sorokiniana* root rots and loose smut (*Ustilago nuda*) in barley.

Pathogens of the genus *Fusarium*, which are the main causal agents of root rots and fusarium head blight, predominated on the seed of cereals throughout the three experimental years. Higher infection level of these pathogens was identified on the farm-saved seed than on certified seed.

The most harmful seed borne diseases of legumes were found to be ascochyta blight of peas and anthracnose of beans (*Ascochyta* complex), *Botrytis* spp. and *Fusarium* crown and root rots. The infection of beans with the pathogens was significantly higher than that of peas.

Upon completion of the study, a recommendation was prepared on the thresholds of seed infection



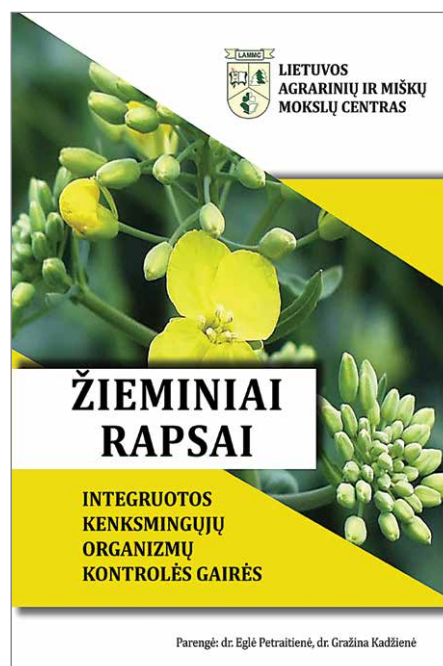
Spring barley seed infected with seed-borne pathogens

with the most harmful pathogens in certified seed of cereals. It is recommended that the infection level of *Fusarium* genus on the seeds of winter and spring cereals should not exceed 15 %. This threshold should include *F. graminearum* and *Microdochium* pathogens. The level of infection for each individual pathogen should not exceed 5 %. The seed should be treated when the specified threshold is exceeded.

7. “Preparation of Guidance Notes on Integrated Pest Management (IPM) for the main field and horticultural crops in Lithuania”. Project leader Dr. Roma Semaškienė. 2018–2019.

In accordance with Directive 2009/128/EC of the European Parliament and Council, all professional users of plant protection products shall be required to apply the principles of integrated pest management (IPM) in agricultural activities since 2014. Adherence to these principles is an essential indicator ensuring the sustainable use of plant protection products, preservation of the environment and improvement of human health. The application of these principles in agricultural activities is also set forth in the Law on Plant Protection. In order to ensure that plant protection products are used in agriculture in a responsible, sustainable and targeted way, it is necessary to adopt IPM approach and guidelines.

The aim of the project is to implement the provisions of Directive 2009/128/EC and to properly apply the principles of integrated pest management (IPM) in agriculture. This would provide agricultural producers with more knowledge and information on how to prevent the spread of diseases, pests and weeds



Guidelines for integrated pest management (IPM) for winter oilseed rape

in horticultural and agricultural crops. Therefore, it is necessary to develop scientifically validated IPM guidelines for agricultural and horticultural crops.

During the project implementation period, 20 IPM guidelines were developed for agricultural crops (spring and winter wheat, spring barley, peas, spring and winter oilseed rape, winter triticale, winter rye, oats, beans, maize, vetch), garden crops (potatoes, carrots, cabbage, onions, beetroot) and horticultural

crops (apples, blackcurrants, strawberries). All guidelines reflect the 8 core principles of IPM: prevention, monitoring, decision-making, non-chemical methods, pesticide selection, reduced pesticide use, anti-resistance strategies, evaluation.

The guidelines are presented in the Integrated Plant Protection Information, Consultation and Training information system at: www.ikmis.lt

8. “Assessment of carbon sequestration potential in agriculture”.

Leader Dr. Žydrė Kadžiulienė. 2017–2019.

Soil carbon stock is an important environmental factor. It plays an important role in ecosystems and performs many direct and indirect functions. Increasing soil carbon storage (i.e. carbon sequestration) can enhance ecosystem's sustainability. Through good carbon management practices the soil has significant potential to accumulate atmospheric CO₂ (carbon dioxide). Rational land use and management provide the opportunity to reduce greenhouse gas emissions from the agricultural sector and mitigate the negative effects of climate change. The purpose of the latter project was to assess carbon sequestration potential in the crop production sector. Field experiments and laboratory investigations were carried out at the Lithuanian Institute of Agriculture and Forestry (LAMMC) and the Vytautas Magnus University Agriculture Academy. The study sites were chosen taking into account the prevailing soil and contrasting agro-meteorological conditions. The potential for carbon sequestration in the crop production sector depends on the soil genesis, the intensity of the technologies and their influence on the physical and chemical changes and on the meteorological conditions. After the implementation of the project, a general conclusion was drawn that the intensification of economic activities, caused negative physical changes in the soils in the following sequence: Luvisol (Central Lithuania, Dotnuva, loam and sandy loam) → Planosol (Central Lithuania, Kaunas, loam), → Cambisol (Northern Lithuania, Joniškėlis, clay loam) → Retisol (Western Lithuania, loam). Negative agrochemical changes, including SOC, are heightening in the following direction: Cambisol (Northern Lithuania) → Luvisol (Central Lithuania, Dotnuva) → Planosol (Central Lithuania, Kaunas) → Retisol (Western Lithuania). A suitable crop rotation in modern agriculture is one of the main tools for soil carbon sequestration. Long-term proper crop rotation in combination with the regular use of straw, catch crops or manure as fertilizers and the incorporation of perennial grasses into crop rotations are effective means for soil



Estimation of changes in carbon sequestration in a field experiment of tillage-fertilization-straw application



Investigation of carbon sequestration potential in different organic crop rotations

organic carbon accumulation. It is advisable to apply the Code of Good Agricultural Practice to efficiently increase the carbon sequestration potential in agriculture. Application of the Code's requirements would reduce the negative impact of agriculture on soil, water bodies, air and climate. As a result of the project, other recommended measures have been developed for better management of the carbon sequestration process as well as recommendations for land users.

EIP activity group project

1. “Innovation Gateway” – a Centre for knowledge collection and transfer, development and demonstration of agricultural technologies.

Leaders Rimtautas Petraitis (LAAS), Dr. Roma Semaškienė. 2017–2019.

The project involved 18 partners: Lithuanian Agricultural Advisory Service (LAAS), research institutions and experimental farms. In terms of areas of activities, the project covers topics and sectors of animal husbandry, crop production, horticulture, environmental protection and other areas related to agricultural production.

The aim of the project is to ensure the smooth operation of the farm-consulting-science chain for the creation, introduction and dissemination of agricultural innovations as well as the development of the system of knowledge accumulation and transfer.

The Centre “Innovation Gateway” is composed of the Precision Farming Services and Expertise Centre with a technology demonstration pavilion, the Applied Innovation Research Results Information System (TITRIS) and the Innovation Support Service (IPT). The TITRIS action plan envisages that the system will continuously provide agriculture-relevant information on research conducted in the country and innovation in a user-friendly way. IPT (LAAS structural unit) will collect, compile and systematise information on the needs of users (farmers), already existing innovations, will initiate and organise various activities between partners by using the interactive system created.

Project outcome is establishment of the Centre “Innovation Gateway”, which is a stable,



Opening of the Technology Demonstration Pavilion.

From left: Dr. Artūras Šiukščius deputy director of Institute of Animal Science, Veterinary Academy, LUHS, Dr. Gintaras Brazauskas director of LAMMC, Jurgita Stakėnienė senior advisor of MA, Jurgita Baranauskienė vice-chancellor of VMU AA and Dr. Edvardas Makelis director of LAAS

continuously operating, coordinated system with modern infrastructure and competent employees, which will contribute to the solution of the issues arising on the farms and will facilitate introduction of innovative technologies.

Support for the Lithuanian Beekeeping Sector

1. “Investigation, consolidation and preservation of beneficial properties of *Apis mellifera Carnica* existing and newly developed strains, adapted to Lithuanian climate and honey flow”. Leader Dr. Violeta Čeksterytė. 2019.

The aim is to preserve the gene pool of *Apis mellifera carnica* by expanding the population of this race in Lithuania.

Results. Bee colonies of the *carnica* race were assessed for morphological characters, biological, and productivity traits. The results of the study suggest that all colonies tested conform to the *Apis mellifera carnica* bee standard. Seven bee colonies died in the 2018–2019 winter, others overwintered well. L5 – Ctrojc bee colonies consumed the least amount of food 5.75 kg/bee colony over winter. L1 – Cvig, L2 – Cct19 bee lines were stronger and had about 106.3 and 112.1 brood cells respectively in spring. L1 – Cvig bee lines were most productive in terms of spring honey collection on average 37.13 kg bee/colony.



Nucleuses with indigenous bee queens deployed in Pervalka bee queen isolation point

The hygienic behaviour of bees was investigated in 52 bee colonies in the summer of 2019 and it was found that 8 colonies did not possess this property. Very high hygienic behaviour was noted for 22 colonies that cleared from 96 % to 100 % cells in their families. Those colonies were used to raise bee queens and form parent families. To evaluate the health of bee colonies, four viral tests were performed in 50 colonies. The black queen cell virus (BQCV) was found in 24, Sacbrood virus (SBV) in 17 and deformed wing virus (DWV) in 4 colonies. Clinical signs of the disease did show up in the colonies, the bees were only carriers of the virus.



Parental colonies delivered to Pervalka bee queen isolation point for insemnation of bee queens

Applied research funded by the Ministry of Agriculture and its subordinate institutions

1. “Selection of Scots pine genotypes resistant to root rot”.

Project leader Dr. Virgilijus Baliuckas. 2017–2019.

The aim of the study is to evaluate the breeding value for resistance to root rot of Scots pine half-sib families in the field trials for second generation forest seed orchards and to compare the benefit of the breeding for resistance with the routine breeding in Lithuania.

It was determined that: 1) by taking into account the smaller number and larger damage plots better genetic parameters of resistance evaluation are obtained; (2) in the selection of genotypes to increase resistance, breeding values of other traits shall not be reduced; 3) as the age of pine stands increase, the efficiency of selection of resistant genotypes increases.

There was a correlation between the resistance to root rot and the concentration of phenolic compounds in wood. The most appropriate time for sampling wood for phenolic compounds is the end of the growing season. Concentrations of phenolic compounds of pine families differ in different sites. The effect of the family on the concentration of phenolic compounds is significantly greater compared to population. Reliable changes in the concentration of phenolic compounds in needles of seedlings infected with pathogen were found during the summer-autumn period, whereas greater changes were observed in the wood and roots during the winter-summer period.

The response of Scots pine seedlings to pathogen infection resulted in changes in the concentration of phenolic compounds, as well as in pathogen spread and mortality rate in half-sib families. The selection of genotypes that survived in Scots pine stands in root rot damage plots is ineffective.



Inoculation of Scots pine seedlings with pathogen in the greenhouse of Dubrava SFE



Collection of *Heterobasidion annosum* samples in 40 year old pine stand

A methodology for breeding has been developed outlining how to select genotypes more resistant to root rot. Recommendations for selection of

genotypes of Scots pine resistant to root rot were prepared. Proposals are made for breeding in the genetic objects.

2. “The services for level II forest monitoring”.

Project leader Dr. Vidas Stakėnas. Customer – State Forest Service. 2019.

The ICP Forests is an international forest monitoring and research network established in 1985. International Program for the Cooperation in Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests), established by the United Nations Economic Commission Convention on Long-range Transboundary Air Pollution (CLRTAP). The main objective of the program is to collect and summarize data on the state of forest ecosystems across Europe and to monitor changes in the state over time. Information on the state and trends of forest ecosystems and their response to environmental change in Europe and beyond has been collected for more than 30 years under the ICP Forests program and methodology.

In 2019, the tasks of Intensive Forest Monitoring (Level II) were carried out in accordance with the planned and successfully functioning scheme for many years, in line with the requirements and methodology of the ICP-Forests program. In 9 observation plots, the following parameters were assessed: the tree crown condition was evaluated according to the morphological parameters; air pollution, soil solution quality, amount of pollutants (deposition) open field and under tree crown, mass of litterfall; intensity of ozone-induced damage. Investigation of forest litter and mineral soil chemical composition was carried out in Forest monitoring Level II plots. According to the long-term data of the Forest monitoring (Level II) program, the average atmospheric deposition amounts found annually (2000–2017) are as follows: 4.7 kg / ha of S; 8.5 kg / ha of N; 3.7 kg / ha of K.



Soil sampling



Forest monitoring plot

Other projects funded by the Research Council of Lithuania

Development of students' scientific competence through practical research activities

Sub-activity “Research done by students during the non-study time”

1. “Bioresponse based cultivation of green leafy vegetables in closed environment agriculture”. Project leader Dr. Giedrė Samuolienė. 2018 October 1st – 2019 April 30th.
2. “Improvement of student's competence in conducting research in the field of efficient use of biomass for bioenergy”. Project leader Dr. Vita Tilvikienė. 2018 October 1st – 2019 April 30th.
3. “The photosynthetic and antioxidant response of horticultural plants to the pathogenesis of *Botrytis* spp. under the lighting”. Project leader Dr. Viktorija Vaštakaitė-Kairienė. 2018 October 1st – 2019 April 30th.

Sub-activity “Development of students’ competences through participation in scientific summer practice”

1. “The effect of different concentration of CO₂ in the air on plant development at the initial growth stages”. Leader Dr. Vita Tilvikienė. July 1 – August 31, 2019.
2. “Quality of non-food plants and evaluation of their potential applications”. Leader Dr. Žydrė Kadžiulienė. July 1 – August 31, 2019.
3. “Investigation of the influence of biochar on soil GHG emissions and water holding capacity”. Leader Dr. Dalia Feizienė. July 1 – August 31, 2019.
4. “The impact of physical methods on the changes in secondary metabolites and photosynthetic indicators in different half-sib families of *Picea abies*”. Leader Dr. Vaida Šežienė. July 1 – August 31, 2019.

6.3.4. International projects started in 2019

Projects of the “Horizon 2020” program

1. “Stepping-up IPM decision support for crop protection” (IPM Decisions).

Coordinator in the Institute of Agriculture Dr. Roma Semaškienė. 2019–2024.



The IPM Decisions project consortium is formed from 27 organizations working in partnership from across Europe

Project aim – increase the impact of on-farm DSS for IPM

Implementing Integrated Pest Management (IPM) practices to tackle pests, weeds and diseases can be a real challenge for farmers and advisors. Decision Support Systems (DSS) can assist on-farm decisions to implement IPM.

The IPM Decisions project will create a user-friendly online platform for the monitoring and

management of pests. The platform will be available across the EU with DSS, data, tools and resources tailored to individual regions.

A pan-European collective of farmers, advisors, DSS providers and researchers will design and develop the platform so it meets the needs of different types of users. This community will be called the IPM Decisions Network.

For more information, visit the project website www.IPMDecisions.net



Institutions involved in the project

2. “Best4Soil”. Coordinator in the Institute of Agriculture Dr. Antanas Ronis. 2019–2021.



Healthy soils are of major importance for the future of the European horticultural and agricultural crop production.

Especially in intensive production systems, soil borne diseases are a major factor with a negative impact on soil health. Newly developed best practices and sound crop rotations permit to maintain, improve or

re-establish soil health in Europe. With Best4Soil we are building a community of practice network across Europe by inter-connecting growers, advisers, educators and researchers. This network promotes knowledge ready for practice on 4 best practices (compost, green manure, anaerobic disinfestation, (bio) solarisation) for the control of soil borne diseases. Therefore we build a website and organize

meetings and events in 20 European countries where we exchange knowledge on soil health with our communities of practice. The main objective of the Best4Soil thematic network is to maintain, improve or re-establish soil health in Europe. We provide open-access databases with information on the range of pathogens and nematodes that affect vegetable, arable and cover crops to help practitioners to build appropriate crop rotations and innovative control strategies.



Meeting of the project participants in Malaga (Spain)

Projects of the “INTERREG” program

1. “Market driven authentic Non-Timber Forest Products from the Baltic region – focus on wild and semi cultivated species with business potential” (NovelBaltic).

Coordinator in the Institute of Horticulture Dr. Ramunė Bobinaitė. 2019–2021.



The NovelBaltic project aims to increase the awareness and competitive value of forest products (berries, mushrooms and other biologically valuable products) from the Baltic Sea region in the world and especially Asian regions by applying the existing and developing new methods to ensure the authenticity and geographical origin of the forest products.

The main goals of the project:

1. To survey the market demand in the Beijing region and certain regions of Southeast Asia.
2. To develop a digital platform designed to ensure product authenticity and quality.
3. To develop a digital platform designed to ensure product authenticity and quality.
4. To evaluate the suitability (validity) of the selected raw materials and production processes.

In 2019, bilberry and lingonberry samples were collected from different locations of Lithuania. The chemical composition and antioxidant activity of bilberries and lingonberries from Norway, Finland, Latvia and Lithuania were investigated. The FT-NIR methodology for berry authentication research is being developed.

When conducting market analysis in the Baltic Sea Region, a survey of Lithuanian companies and farmers growing and/or processing berries, was conducted.

A chapter on chromatographic methods for testing the authenticity of berries was prepared for the review article “*Tools for validating authenticity – focus on berry-based products*”.



Prof. Dr. Pranas Viškelis is introducing the “NovelBaltic” project



The meeting of the participants of the “NovelBaltic” project at University of Latvia in Riga

2. “Water Management in Baltic Forests Tool Box” (WAMBAF).

Coordinator in Lithuania Dr. Olgirda Belova. 2019–2021.

The results of good water protection practices for maintenance of drainage systems, management of riparian forests and beaver populations are improving the sustainability of forestry and the water quality in the BSR. Experience from WAMBAF and feedback from target groups show a need for additional work and further implementation. The aims are as follows: upscale and adapt the tools, developed in WAMBAF; implement the tools to a wider target group. Five main outputs will be upscaled and adapted: machine learning wet area maps, avoiding negative impact on water quality and unacceptable driving in forests; beaver impact maps at catchment scale will serve for decision support due to beaver ponds on landscape level in the context of water quality and climate change. Blue Targeting tool will be adapted to wider territory in NW Russia, and made into a digital version for easier implementation; translation of films on forestry operations for water consideration,



Participants of the WAMBAF Tool Box kick-off meeting at the Tobo demonstration territory of a sustainable forest experiment (Sweden)

to local languages to make them easier to understand; manual for forest drainage as practical help for the machine operators to perform drainage operations.

3. “Baltic Phytoremediation” (BAPR).

Coordinator in the Vėžaičiai branch Dr. Danutė Karčauskienė. 2019–2022.

Objective: increased use of green technologies in order to decrease the pollution discharges in the South Baltic area

Tasks:

1) to create the innovative plant based phytoremediation technologies and methods for cleaning polluted soil;

2) to create Baltic Phytoremediation Standard describing the phytoremediation process and develop the means for its implementation.



The first meeting of project partners in Kalmar (Sweden)



Presentation of the project partner – LAMMC

Project of the “LIFE” program

1. “Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland” (LIFE OrgBalt).

Coordinator in the Institute of Forestry Dr. Kęstutis Armolaitis. 2019–2023.

The aim of the project is implementation of innovative Climate Change Mitigation (CCM) measures in nutrient-rich organic soils in Temperate Cool Moist (TCM) climate region to contribute to the United Nations Framework Convention of Climate Change (UNFCCC) Paris agreement, EU policies (Regulation (EU) 2018/841, LULUCF regulation) and national climate policy targets in post-2020 period by reduction of greenhouse gas (GHG) emissions from cropland, grassland and forest land on nutrient-rich organic soils.

The main objectives are:

1) to improve the GHG accounting methods and activity data for nutrient-rich organic soils under conventional management conditions;

2) to identify and demonstrate sustainable, resilient and cost-effective CCM measures applicable in nutrient-rich organic soils;

3) to provide tools and guidance for elaboration, implementation and verification of impact of the CCM.



Project's team

COST actions

1. “Knowledge for Resilient Ecosystems” (G-BIKE). Coordinators in the Institute of Forestry Dr. Olgirda Belova, Prof. Dr. habil. Alfars Pliūra. 2019–2023.

In the changeable environment, the ecosystem resiliency depends on the adaptability of organisms. G-BIKE will enable standard and routine tools for assessing, monitoring and managing the genetic resilience and related adaptive potential of wild and captive populations. G-BIKE will assist scientists and practitioners across the EU to integrate genetic and evolutionary knowledge into conservation planning policies, and to promote cross-border management and long term monitoring programmes of evolutionary potential in order to ensure persistence of populations and species. Considering the drastic impacts of climate change during the coming decades, G-BIKE is especially urgent. The following aims will be accomplished by involving a balanced representation of scientists and practitioners from a diversity of countries: clearly articulating for managers how genetic diversity can support ecosystems; developing and testing best practice protocols for monitoring genetic diversity in time and space; providing an online forum on



Project participants meeting in Serbia

emerging tools; connecting all stakeholders through networking and training opportunities; building a network of conservation genetics labs; building a foundation for long term impact. Results will be disseminated in easy-to-read summaries for practitioners and outreach to the public at Natura 2000 sites, botanic gardens and zoos as well as in scientific publications.

Projects of other EU programmes supporting research

1. SNS project “Conservation of resistant ash (*Fraxinus excelsior*) genotypes in Nordic and Baltic regions to maintain the full range of ecosystem-services provided by this keystone species”. Coordinators at the Institute of Forestry Dr. Diana Marčiulynienė, Prof. Dr. habil. Alfás Pliūra. 2019–2022.

The general aim of the project is to continue the efforts started in collaborating Nordic and Baltic countries leading to restoration of ash trees in the region. The specific objective is to develop and establish a set of 2nd generation genetic test trials that can be crucial for ash conservation. This joint Nordic-Baltic project will combine efforts focused on genetic selection in the partner countries to start up a second-generation selection program. The healthy individuals already identified will continue to be used in the program, as well as newly selected trees. In



Seed samples of resistant ash genotypes



Prof. Dr. habil. Alfás Pliūra is collecting seed samples in Telšiai RAP experiments

2019, in two experimental plantations of the European RAP series in Telšiai and Kėdainiai, samples of seeds were collected from the healthiest trees and planted at the State Enterprise Forest Enterprise nursery to grow seedlings and planting of experimental plantations. Seed samples of all genotypes will also be stored in the Lithuanian Gene Bank.

2. Inter-institutional collaboration project “Ash-Adapt – Evolutionary potential of natural *Fraxinus excelsior* populations challenged by novel pests and pathogens”. Coordinators at the Institute of Forestry Dr. Rita Verbylaitė, Prof. Dr. habil. Alfás Pliūra. 2019–2021.

Objective: to identify SNP markers that are associated with ash dieback resistance and other fitness related characters including gender and phenology.

Activities: The identification of SNPs will be based on existing clonal trials where the ash dieback disease has been assessed during several years. The assessment will follow a joint protocol and is planned to include assessments of trials in Denmark, Sweden, Germany, Austria, and Lithuania. Several traits will be assessed according to the joint protocol (spring flushing (2 times), ash dieback susceptibility, and autumn senescence. Results will be shared and a publication on SNP identification (Genome-wide Association Study) will be developed and co-authored together with other European collaborators.



Fraxinus excelsior stand devastated by ash dieback disease

6.3.5. International projects ongoing in 2019

This section presents the main international projects currently being implemented (programs “Horizon 2020” and LIFE).

Projects of the “Horizon 2020” program

1. “A thematic network to design the penetration path of non-food agricultural crops into European agriculture” (PANACEA).

Coordinator in the Institute of Agriculture Dr. Vita Tilvikienė. 2017–2020.



The PANACEA project aims to create a thematic network to promote effective knowledge exchange between research, industry and the farming community to map the integration of non-food crops into European agriculture. After extensive research analysis, the main plants that could be grown in the project countries were selected. Potential non-food crops in Lithuania have been identified as: hemp, willow, poplar, wheat (for bioethanol production), miscanthus. Training is planned for the next year to help farmers and others interested in getting to know these plants and learn about their growing aspects.

In 2019, seminars were organized for farmers, scientists, and consultants to introduce the potential of non-food crops. Events focusing on the cultivation and use of hemp received particular attention.



Workshop “Fibre hemp – prospects for cultivation and processing in Lithuania”

For more information about the project, visit <http://www.panacea-h2020.eu/>

2. “Fostering sustainable legume-based farming systems and agri-feed and food chains in the EU” (LEGVALUE).

Coordinator in the Institute of Agriculture Dr. Žydrė Kadžiulienė. 2017–2021.



The goal of LEGVALUE is to pave the way for the development of sustainable and competitive legume-based farming systems and agrifood and food chains in the EU. In recent years, project researchers have been developing legume crop development assessments, examining legume practices and ecosystem services. Initial analysis of data collected from farmers in different countries reveal that farmers generally value, pay attention to services provided by legumes such as yield, quality, income and less notice (or understand) energy, environmental services. An analysis of the ecosystem services discussed in the scientific papers found that the focus is on yield, food / feed quality, nutrients, mainly green manure and bean compound services. The project participants evaluated the technological, organizational and institutional levers for promoting the development of the legume feed and food value chains, taking into account the different flows of the supply chain from yields to consumer. An analysis



Experiments on the yield potential of peas

of 29 value chains and 120 stakeholder value chain participants revealed a tendency for new legume crop value chains, driven by participants from different countries (farmers, consultants, etc.), to be more food chain oriented. Meanwhile, the former value chains, encouraged by legume crop processors, are more focused on feed value chains.

The LAMMC team involved in the project conducted field experiments on peas, beans and soy. In the early years of the project, two networks of cooperation between farmers growing beans and peas in conventional and organic farming systems were established. For participants in these networks, as well as others interested in growing legumes, LAMMC team organized two seminars to share knowledge and experience on what legumes need to exploit the multifunctional values of those unique

plants for both feed and food, and for the needs of the agroecosystem itself. The latest results from legume research have been presented. For the greater benefit of legumes, it is still important to increase the gross margin, which requires better and more stable yields and for this we need better control of weeds and employment of other best practices in legume cultivation.

Projects of LIFE program

1. **“Nutrient recycling circular economy model for large cities – water treatment sludge and ashes to biomass to bio-energy”**. Coordinator of the LAMMC Agrochemical Research Laboratory Dr. Lina Žičkienė. 2018–2022.

A model of the utilisation of integrated circular economy wastes containing nutrients – the final use of sewage sludge and the corresponding amount of biomass ash for biomass production has not yet been developed and implemented in the countries of the European Union. So far, the use of sewage sludge in the EU countries for the cultivation of plantations has been limited to research and episodic pilot/demonstration trials. The project is also innovative, since dried anaerobically treated sewage sludge will be used for the fertilisation of energy plants, which is more environmentally friendly than sewage sludge treated in other ways.

The aim of the project: to create and demonstrate the first of its kind on the EU level full scale sustainable closed loop circular economy model for large cities nutrient from nutrient rich waste – municipal water treatment sludge and biomass ashes – recycling into renewable energy for city's needs via environment friendly biomass plantation phytoremediation filter.

Results of this year:

1. 900 ha of existing woody biomass plantations will be mobilized for nutrient rich waste reuse municipal wastewater sludge digestate (*already done in full in 2019*). 900 ha of new woody biomass plantations will be established (*60 ha established in 2019*).

2. 27000 dmt of pelleted municipal wastewater sludge digestate and 1500 t of biomass ashes will be reused for biomass yield improvement within CE model (*5200 dmt of sludge and 500 t of biomass ashes reused in 2019*).

3. The project will reuse 1350 t total N (*210 t reused in 2019*), 675 t of total P (*135 t reused in 2019*) and 60 t of K (*40 t reused in 2019*).

4. The soil quality, in particular carbon and nutrient balance, will be improved on 1800 ha area within the project area (*330 ha improved in 2019*).



Meeting of the project partners



Establishment of soil monitoring sites

5. 24 special soil monitoring sites will be established in 2019 to ensure, to analyse impact on different types of soils, represented in targeted area (*8 special soil monitoring sites established in 2019*).

6. 24 lysimeters will be installed. Comprehensive water monitoring is done by taking and analysing water from lysimeters to assess nutrient leaching from waste. (*8 lysimeters established in 2019*).



Installation of lysimeters

6.3.6. International projects completed in 2019

Projects of the “Horizon 2020” program

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

Through a multi-actor approach, it aims to improve the implementation of research outcomes into practical and applicable knowledge that will directly benefit the European fruit sector. The EUFRUIT consortium consists of 21 partners, including research institutes, universities, and industrial partners who represent key parts of the fruit supply chain, from 12 European countries. EUFRUIT aims to synthesize the national and regional best-practices within the four thematic areas and to share this knowledge through the EUFRUIT network: 1) performance of new fruit varieties, 2) reduction in pesticide residues, 3) fruit quality - improvement of fruit handling/storage, 4) secure sustainable fruit production. Within each of the above-mentioned thematic areas, EUFRUIT has established an ‘international expert group’ (IEG) comprised of fruit research experts, SMEs and representatives from existing national fruit-oriented networks and clusters. These four IEGs meet annually to review and report on the state-of-the-art knowledge, existing practices and novel technologies and then synthesize this material to identify key areas of learning, new knowledge and possible best practice approaches at a European level. All the knowledge arising from EUFRUIT is held in English on an open access Knowledge Platform <http://kp.eufrin.org>. At the end of the project period, in month 36, the monthly unique visits to the Knowledge Platform had reached an average of 141 unique visitors per month, 1041 activities are uploaded on the Knowledge Platform with 193 industry publications, 36 scientific articles, 41 technical bulletins/ guidelines, online videos or similar, 60 seminars and lecture-based, field-based workshops, 24 conferences and other activities. The project also presents an overview of dissemination and communication activities within growers and public in European countries.



Scientists of Institute of horticulture introduce new apple varieties and hybrids at the traditional autumn festival “Obuolinės” in Babtai

Projects of the “INTERREG” program

1. “Revival of old traditional fruit, vegetable and ornament plants and their products: Heritage Gardens Tour”.

Coordinator in the Institute of Horticulture Dr. Darius Kviklys. 2017–2019.

There is an increasing interest in old horticultural plant cultivars and their products as natural and cultural heritage objects across Europe as well in Latvia and Lithuania. The overall objective of the project is to assess heritage objects of horticultural plants, identify old cultivars, to increase attractiveness and accessibility of old horticultural plant collections. The main tasks are: 1) to assess most valuable heritage objects during the

expeditions; 2) to identify old plant cultivars using genetic investigations; 3) to prepare technologies in order to preserve heritage sites; 4) to propagate endangered cultivars and establish collections of gene resources; 5) together with tourism associations to develop a new tourism product - Heritage Garden Tour aiming at awareness of preservation of natural heritage horticultural plants.



Heritage Orchard established at Rundale palace

2. “Advancement of non-technological innovation performance and innovation capacity in fruit growing and processing sector in selected Baltic Sea Region countries” (InnoFruit).

Coordinator in the Institute of Horticulture Dr. Darius Kviklys. 2016–2019.

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. The specific

objective of the project is 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.



New type of intensive orchards



New type of intensive orchards

3. “Water Management in Baltic Forests (WAMBAF) of Interreg Baltic Sea Region”.

Coordinators in the Institute of Forestry Dr. Marius Aleinikovas, Dr. Olgirda Belova. 2016–2019.

A special emphasis is put on clear water and forestry activities, seeking to increase efficiency of water management reducing nutrient inflows and decrease discharges of hazardous substances to the regional waters and the Baltic Sea. **The main tasks** are based on three priorities: forest drainage system; riparian forests /buffer zones, and beaver building activity in forests. The outputs are the basis for wider cooperation and for harmonization of water management in forests of Baltic Sea Region. The guidelines on beaver dam management and Beaver tool, riparian forests and forest drainage system, the Handbook “Beaver as renewable resource” were prepared, the tools for assessing necessity of drainage systems and riparian forests maintenance were developed; Beaver dam tool, Blue targeting tool, Drainage system management and Riparian forests management guidelines and tools were prepared and assessed during training courses at the established Demo areas.



Project training courses

COST action programs

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

The main goal of the Action was to establish a European-focused network to improve the knowledge of the biology, ecology and spread pathways of *Fusarium circinatum*, to examine the potential for developing effective and environmentally-friendly prevention and mitigation strategies and to deliver these outcomes to stakeholders and policy makers. The outbreaks of this disease are currently only observed in a few European countries (Portugal, Spain, Italy and France), but the potential risk of further spread is quite high. In Italy and France, the pathogen was successfully eradicated (in 2008 and 2011). The action has involved 36 countries within a working group of 175 researchers and has organised four training schools and eight working group meetings and four MC meetings. The main success of the Action is the establishment of a strong collaboration network between researchers that fostered the accumulation of knowledge about *F. circinatum* to mitigate the spread of the pathogen in Europe. Working group 1 (WG1) aimed at harmonizing a common methodology to monitor the presence of *G. circinata* in Europe (involving LAMMC), illustrated pamphlets on pitch canker



Pine pitch canker symptoms on *Pinus radiata*

disease showing symptoms on different pine species are currently available in 14 European languages (including Lithuanian). WG2 aimed at gathering information concerning potential synergic effects with other organisms. WG3 aimed at shedding light on factors determining the epidemiology and spread of PPC, reviewing the importance of environmental factors and forest management on disease spread, and preparing a pamphlet that synthesize disease spread pathways and preventive measures to be adopted. WG4 aimed at assessing the current and potential European risk for *G. circinata* based on future climate change scenarios. WG5 aimed at synthesizing information concerning host resistance and the use of biological control methods as alternatives to chemical treatments. WG6 aimed to provide timely dissemination of information from PINESTRENGTH, with emphasis on stakeholders and other target audiences beyond COST participants. The PINESTRENGTH website was established for this purpose and is regularly updated. As a direct result of the action, 34 articles have been published so far, some of them gathered in a special issue of the SCI journal “Forests”. Additionally, several dissemination articles were published in 11 European languages (in Lithuanian – “Mūsų girios”).



Action partners visiting contaminated site in Spain



Action partners in conference held in Warsaw (Poland)

Projects of the EU Framework Programme 7 (FP7)

1. FP7 ERA-NET SUMFOREST. “Benchmarking sustainability performance of value chains using ToSIA, the Tool for Sustainability Impact Assessment”.

Coordinator in the Institute of Forestry Dr. Marius Aleinikovas. 2017–2019.

The construction sector is one of the leading sectors of the European economy and vital to the bio-economy. **The aim of the project** is to develop a versatile benchmarking method to quantify and to compare sustainability impacts of different material use in the European construction sector. Further, we aim to show the usability of the benchmarking method to quantify the impacts and potentials of substituting non-renewable with renewable materials in the construction sector. The production of glue laminated timber (GLT) is rapidly growing in Lithuania. Lithuanian case study compares sustainability impacts of local producers made GLT and reinforced concrete constructions throughout value chains.

The results show that when comparing GLT (Glue laminated timber) and RC (Reinforced concrete) frame buildings environmental values are in favour of GLT frame buildings. Economic values show that production price of m³ of GLT is higher compared to RC price; however, price of one produced m² of GLT frame buildings is lower compared to RC frame buildings. Social values indicate that employment is significantly higher when RC frame buildings are build.



Graphic view of a two-storey wooden building



Graphic view of a five-storey wooden building

2. FP7-ERANET-2013-RTD. “IT-solutions for user friendly IPM-tools in management of leaf spot diseases in cereals (SpotIT)”.

Coordinator in the Institute of Agriculture Dr. Antanas Ronis. 2017–2019.

Leaf spot diseases are the major diseases in the Nordic-Baltic region in cereals. The main tool for controlling these diseases is the use of fungicides. The application of innovative plant protection tools would reduce fungicide application rates and optimize spray times. This means higher production, higher incomes for farmers and less pollution by pesticides. SpotIT aims to provide a locally adopted disease prediction model to complement the Integrated Pest Management (IPM) tools.

According to the results of our study, a single fungicide application when applied at BBCH 51-55 gave an average profit of 23EUR in winter wheat. Spraying in accordance with the recommendations of disease prediction models also gave profits from 11 to 20 EUR. In the case of spring barley, a single application by fungicides at BBCH 37-39 gave an average profit of 6 EUR. However, single application of fungicide at later stages (BBCH 51-55) and particularly two applications of fungicides (at BBCH 37-39 and BBCH 51-55) were unprofitable. Predictive models did not recommend fungicide spraying in either 2018 or 2019.

The project application committed to select appropriate disease prediction models and make



Meeting of “SpotIT” project participants in Vilnius

them available to Lithuanian consumers (farmers and consultants). Lithuanian Agricultural Advisory Service is a partner in this project therefore at the end of this project, the “Septoria humidity model” for the detection of Septoria leaf blotch in winter wheat will be placed on the IKMIS website. The model will be available for the users for at least five years after the end of this project. From the 2020 season, the disease prediction model will be linked to at least five meteorological stations. To facilitate the use of the disease prediction model, it will be translated into Lithuanian.

Projects of other EU programmes supporting research

1. Swedish Institute Baltic Sea Cooperation project “Cooperation in the Baltics on the development of strategies to foresee outbreaks of Fusarium damage”. Coordinator in the Institute of Agriculture Dr. Skaidrė Supronienė. 2017–2019.

The aim of the project was to disseminate information among the project partners on problems with Fusarium contamination and on the current status of the development of alert systems to secure that cereal crops are not damaged by Fusarium or other pests that can endanger crop quality. Three activities were planned in the application: 1) information dissemination; 2) pilot project on combining data/experiences from the different participating countries; 3) preparation of project application to Interred Baltics or to Horizon program. During the project period, five meetings in Sweden, Poland, Lithuania, Latvia and Denmark were organised with a total of 60 unique participants - researches, entrepreneurs, consultants and farmers. Due to the extended project period, the results from the project were also presented at



Meeting of the project participants in Denmark

the Nordic Baltic Fusarium Seminar in Esbjerg, Denmark, on 3–4 April 2019. During the project meetings, the experience on the problems caused by Fusarium fungi was shared among partners. The main risk factors were discussed, issues of concern for different interest groups and possible solutions were analysed. Results from the pilot study showed that there are some mutual experience from the different countries such as that spring cereals are more affected than winter cereals, that there are large differences between years and locations and that weather is the most important factor. Three of four of the project partners took part in a Horizon

application to the call “Stepping up integrated pest management” that was submitted in September 2018. The consortium got good ratings; however, the proposal was not approved. In conclusion, the creation of a consortium working on the same topic in the same region has been very valuable. Exchange of knowledge, learning the techniques and working habits, ways of collecting the data to comply with each other standards have been very interesting. For a future application we plan to continue cooperation and include the participants that were not included in the original project group.

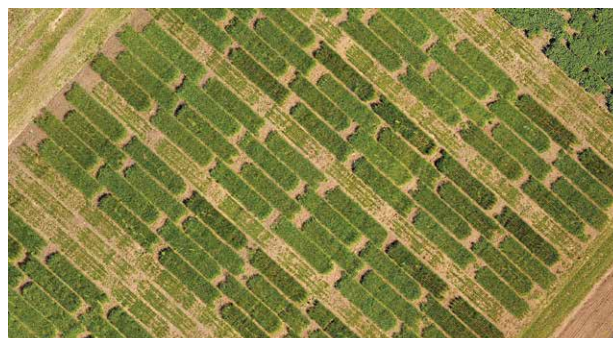
2. “Perennial ryegrass breeding research in Nordic and Baltic countries”.

Coordinator in the Institute of Agriculture Dr. Gintaras Brazauskas. 2014–2019.

This project aims at improving the winter hardiness, persistence and other important perennial ryegrass traits for northern Europe. It will also make plant breeding in northern Europe more prepared to meet new demands due to climate change, political decisions or consumer demand. In 2018 established field trials were scored for agronomically important traits: winter survival, spring regrowth, plant height, heading date, tolerance to drought and diseases, DM yield and regrowth after cut. Five hundred perennial ryegrass genotypes were genotyped by means of GBS (Genotyping by Sequencing) in 2019. A total of 265,821,9 high-confidence polymorphic markers were used in genome-wide association studies (GWAS) in conjunction with previously phenotyped traits. A number of GWAS markers were associated with plant size in autumn, heading date, regrowth in autumn, rust resistance, and winter survival. Genetic markers and phenotypic data will be used to develop a model for genomic selection.



The collection of promising diploid population of the perennial ryegrass



The field test of tetraploid perennial ryegrass varieties and populations

3. Long-term research program CoFoRD 14C/846: FORM “Forest Management – Research required to investigate genetic resistance to ash dieback disease *Hymenoscyphus pseudoalbidus* (anamorph *Chalara fraxinea*) and the development of disease resistant ash planting stock”.

Coordinator in the Institute of Forestry Prof. Dr. habil Alfās Pliūra. 2016–2019.

The aim of the project is to investigate genetic resistance of ash to ash dieback disease caused by *Chalara fraxinea* (*Hymenoscyphus fraxineus*) and to develop a disease resistant ash planting stock. The research tasks are: (1) To establish clonal field

trials of ash material (derived from selected trees in Ireland) in Lithuania for exposure to *H. fraxineus* and to identify and select putatively tolerant/resistant genotypes to *H. fraxineus* in these sources and also in existing 9 yr. old RAP provenance trials

in Lithuania which contain Irish & UK provenances; (2) To estimate genetic variation and heritability of damage/ resistance traits in a potential breeding population (i.e. genotypes in the clonal trials); (3) To estimate temporal changes in damage due to *H. fraxineus* and changes in genetic variability and heritability in the tested clones over three years of exposure and to identify and select highly resistant clones while testing under high infection pressure; (4) To collate information on the availability of Irish and other suitable genotypes which may display tolerance to *H. fraxineus* within existing graft trials and in 3 provenance trials (RAP) in Lithuania.

In 2019, a clonal trial of Irish plus trees clones (5000 ramets) was established in Dubrava division of the State Forest Company. Periodic inventory of tree condition and disease damage was made in clonal trials established in 2018 and 2019, data were analysed and presented to partners and in seminar in Teagasc, Ireland. In Telšiai and Kėdainiai RAP trials of the 2005-year series most resistant genotypes of Irish origin were selected, their cuttings were sampled and sent to Irish partners for further studies.



Clonal trial of common ash plus trees 900 clones for testing for resistance to ash dieback caused by invasive pathogen *Hymenoscyphus fraxineus*



Trials for rejuvenation and preparation for vegetative propagation of common ash genotypes selected for resistance to ash dieback caused by invasive pathogen *Hymenoscyphus fraxineus*

4. EFINORD-SNS (Forest Bioeconomy Network and Nordic Forest Research) network “Integrating knowledge on nutrient cycling and organismal responses for sustainable use wood ash in Nordic forests – NORDASH”.

Coordinator in the Institute of Forestry Dr. Iveta Varnagirytė-Kabašinskienė. 2019.

The long-term goal is to build a network for knowledge sharing between Nordic research groups working with wood ash, forest ecology, and key forest processes and soil organisms. The network will bridge research groups in Nordic and Baltic countries and link recent wood ash research projects. The knowledge gained will, in the longer term, secure a safe and knowledge-based use of biomass harvesting and wood ash recycling in Nordic and Baltic forests and plantations.

During the scientific meeting on 13–15 November, 2019, the most important findings for each country as well as for the Nordic-Baltic region were discussed; a report listing the current available research sites in each country was compiled. Based on the list of common research themes and knowledge gaps across the Nordic-Baltic area, joint articles in peer-reviewed, popular journals and newsletters in the field of energy and forestry, as well as future research applications were discussed.



Meeting of the project participants in Denmark

6.3.7. Results of ongoing projects and programmes obtained in 2019

1. “EUFORGEN – The European forest genetic resources programme – IV”.

Coordinator in the Institute of Forestry Dr. Virgilijus Baliuckas. Since 2010.



European Forest Genetic Resources Programme is an international cooperation programme that promotes the conservation and sustainable use of forest genetic resources in Europe as an integral part of sustainable forest management.

In April 2019, the EUFORGEN Steering Committee finalized the strategic objectives and the implementation plan for 2020-2024, setting out proposed activities, results and the budget. The document also provides information on the added value of the programme and an implementation, monitoring and evaluation plan to measure the impact and success of EUFORGEN in this next phase. The three strategic objectives for EUFORGEN Phase VI were approved.

1. Facilitate knowledge sharing and communicate with key stakeholders: facilitate knowledge sharing and learning among relevant actors (e.g. scientists, national competent authorities, practitioners and policymakers); communicate the importance of genetic diversity and outputs of EUFORGEN to policymakers, forestry professionals and practitioners on the ground, wider scientific community and society; maintain and further develop the o European Information System on Forest Genetic Resources (EUFGIS) 11 and contribute to the further development of the distribution maps of European forest trees; contribute to relevant international reporting efforts, such as the State of Europe's Forests reports.



EUFGIS Database of genetic conservation units in Lithuania

2. Coordinate the implementation of the conservation of forest genetic resources in Europe: update and promote the pan-European conservation strategy, including responses to large scale risks; implement the conservation strategy; contribute to the implementation of regional-level priorities of FAO Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources.

3. Promote the appropriate use of forest genetic resources: prepare science-based recommendations and tools for better incorporating genetic aspects into Sustainable Forest Management practices; analyse policy issues and recommend changes when they conflict with the appropriate use of forest genetic resources.

2. SNS (the Nordic Forest Research Cooperation Committee) project “Northern European database of long-term forest experiments”.

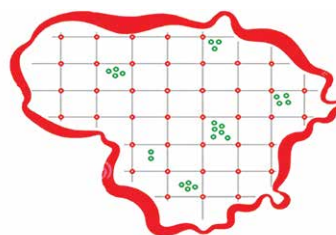
Coordinator in the Institute of Forestry Dr. Marius Aleinikovas. Since 2008.

The aim of the database is to stimulate Nordic, Baltic and international cooperation 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. 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



Forest experimental plot

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. NOLTOX is the result of the attempt to make such a database, easily accessible for everybody.



Simplified scheme of forest experimental plots established by Institute of Forestry

3. “Research on winter wheat winterhardiness and diseases”.

Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 1994.

The main task was to evaluate the winter hardiness and resistance to plant diseases of varieties of winter wheat and triticale, developed in the mild maritime climate conditions.

The long term project conducted together with Danish Sejet plant breeding station has been continued since 1994.

The main objective of these investigations is to study and evaluate the winter wheat and triticale breeding lines and varieties, developed in mild maritime weather conditions, under Lithuanian conditions. In Denmark, the winters are mild and it is not possible to evaluate the winter hardiness of lines developed.

In 2019, there were investigated 316 lines of winter wheat and triticale from Sejet breeding programs. A total of 25 lines of winter triticale were investigated in replicated yield trials. The plant



Winter wheat varieties developed in Western European conditions are characterised by a high yield potential

breeders evaluated the testing results and decided to continue this project in 2020.

4. “Research on facultative and winter wheat”.

Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 1993.

The main task was to investigate the facultative and winter wheat, developed at distant regions and select the promising genotypes for local genetic collections and submit the data for global investigations network.

The investigations program is organized and coordinated by International Centre for Improvement of Wheat and Maize CIMMYT. It is a global investigations network, and wheat varieties for these investigations are collected from the USA, West, Central and East Europe, Far East countries. Institute of Agriculture has been involved in these investigations since 1993.

In 2019, a total of 208 lines and varieties, developed in distant regions and received from CIMMYT wheat improvement program, were evaluated for winter hardiness, grain yield, 1000 grain weight, susceptibility to plant diseases and agronomic traits at Institute of Agriculture. The variety ‘Ada’ was used as a check.

As result of this program, there were developed some lines, whose pedigree included varieties form CIMMYT project. A promising line 7183-1, developed from this program, was tested in the



Awned facultative and winter wheat varieties are more suitable for hot climate conditions

replicated yield trials and State Variety Testing. In control nurseries, 15 lines developed using germplasm from CIMMYT, were investigated in non-replicated yield trails. In the germplasm collection block, 5 varieties, selected for future crosses, were investigated.

5. “European plant genetic resources conservation programme”.

Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 1998.

The main task was to collect and investigate plant genetic resources for the development of varieties with high competitive ability.

In 2019, we continued the activity under “European plant genetic resources conservation program“. We collected and investigated the plant genetic resources of all plant species, which are included in the institute’s approved plant breeding programs. This will be useful genetic material for further breeding program.

In the nurseries of winter wheat breeding, there were grown and investigated 412 varieties and lines. Two varieties are planned to be transferred to the Gene bank for long-term conservation.

In the group of spring cereals, there were grown and investigated: 417 varieties of spring barley from which 4 varieties were transferred for long-term conservation, 300 varieties and breeding lines of spring wheat, 2 varieties are planned to be transferred to the Gene bank for long-term storage.

In oats gene resources collection, there were investigated 233 varieties, for the most valuable traits. Three varieties were transferred to the Gene bank for long-term storage.

In the field pea collection, there were investigated 125 varieties for resistance to lodging, grain yield



Assessment of the genotypes in the spring barley collection

and resistance to plant diseases. Two varieties will be transferred to the Gene bank.

In 2019, a large collection of perennial grasses was investigated. In the collection of forage grasses, there were collected and investigated 3153 varieties and lines of ryegrass and festulolium, meadow fescue, cocksfoot, Kentucky blue grass, clovers, Lucerne, of which 15 most valuable varieties and lines of perennial grasses were transferred for long-term storage in the Gene bank.

6. “Winter wheat breeding, variety testing and marketing in Estonia”.

Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 2000.

The main task is to develop winter wheat varieties suitable for growing in Estonian conditions

In 2019, we continued the winter wheat breeding program conducted together with Estonian Crop Research Institute. The program started in 2000. According to the targets of this program, the winter wheat lines developed in Lithuania are transferred to Estonian Crop Research Institute in Jõgeva.

In 2019, 10 breeding lines were selected for investigation in Estonian Crop Research Centre. Twenty six lines, developed at Institute of Agriculture and selected under Estonian growing conditions in 2010–2018, were investigated in Estonian wheat breeding program in 2019.



The highest-yielding and disease-resistant varieties are selected at Institute of Agriculture and transferred to Estonia for further testing

6.4. Plant breeding

LAMMC conducts breeding programs for the major field crops, vegetables and pomefruits, stonefruits and berries. In 2019, the following varieties were included in the EU Common Catalogue of Varieties of Agricultural Plant and Vegetable Species and in the Lithuanian National list of Plant Varieties: winter wheat ‘Suleva DS’, ‘Lakaja DS’, tall fescue ‘Medainis’, perennial ryegrass ‘Cirvija’, table potatoes ‘VB Meda’. The following varieties were included in the National list of Plant Varieties: apple varieties ‘Bosanova’, ‘Lauda’, cherry variety ‘Verknė’.

❶ Winter wheat variety ‘Suleva DS’

Breeders: Assoc. Prof. Dr. Vytautas Ruzgas, Dr. Žilvinas Liatukas, Kristyna Razbadauskienė.

The variety was developed at Lithuanian Research Centre for Agriculture and Forestry. By grain quality traits, it belongs to E quality group. The mean grain yield was 9.65 t ha⁻¹ in the official state variety testing during 2016- 2018. Grain quality traits under intensive cultivation correspond to E or 1st grain quality class standards. The mean protein content was 11.9 %, sedimentation 38.5 ml, gluten 23.1 %, 1000 kernel weight 43.6 g, and hectolitre weight 808 g l⁻¹.

The variety is characterized by high tolerance to cold, short plant height, high resistance to lodging, medium resistance to grain pre-harvest sprouting. The variety is medium susceptible to leaf spot diseases but resistant to powdery mildew and leaf rust. The recommended sowing time is the second half of September. Intensive fertilization and pesticides application is recommended when the variety is cultivated on fertile soils.



Winter wheat variety ‘Suleva DS’

❷ Winter wheat variety ‘Lakaja DS’

Breeders: Assoc. Prof. Dr. Vytautas Ruzgas, Dr. Žilvinas Liatukas, Kristyna Razbadauskienė.

The variety was developed at Lithuanian Research Centre for Agriculture and Forestry. By grain quality traits, it belongs to A quality group. The mean grain yield was 9.7 t ha⁻¹ in the official state variety testing during 2016- 2018. Grain quality traits under intensive cultivation correspond to 1st or 2nd grain quality class standards. The mean protein content was 11.2 %, sedimentation 33.7 ml, gluten content 21.4 %, 1000 kernel weight 43 g, and hectolitre weight 782 g l⁻¹.

The variety is characterized by very high tolerance to cold and drought, short plant height, high resistance to lodging, medium resistance to grain pre-harvest sprouting. The variety is medium susceptible to leaf spot diseases but resistant to powdery mildew and leaf rust. The recommended sowing time is all September month. Intensive fertilization and pesticides application is recommended when the variety is cultivated in fertile soils.



Winter wheat variety ‘Lakaja DS’

● **Tall fescue variety ‘Medainis’**

Breeder Dr. Vaclovas Stukonis.

The variety was developed at Lithuanian Research Centre for Agriculture and Forestry. It produced a dry matter yield of on average 15.88 t ha⁻¹. The average plant height is 116.4 cm, winterhardiness score 8.7, lodging score 8.7, plant leafiness 48.5 %c. Protein content in dry matter 12.6 %, fibre content 31.18 %. Vegetation period until the first cut 459 days. It is a very late-maturing variety, suitable for growing as an energy crop. When cut late, it has relatively high lignin content. The variety is suitable for grassland establishment. When cut at the same time as medium-early varieties, it has good forage value. It is resistant to adverse climate factors, moderately resistant to fungal diseases and produces a high seed yield.



Tall fescue variety ‘Medainis’

● **Perennial ryegrass variety ‘Cirvija’**

Breeders: Dr. Vaclovas Stukonis, Dr. Vilma Kemešytė, Dr. Juozas Kanapeckas.

The variety was developed at Lithuanian Research Centre for Agriculture and Forestry. It forms not very dense but rather ornamental turf and shows good weed smothering ability, high winterhardiness, drought and disease resistance. The variety is resistant to treading, regrows fast after mowing, is most suitable for use in mixtures for lawns, can also be use in mixtures for grasslands. It is the first lawn-type perennial ryegrass variety developed by Lithuanian plant breeders.



Perennial ryegrass variety ‘Cirvija’

● **Table potato variety ‘VB Meda’**

Breeders: Dr. Rita Asakavičiūtė, Dr. Almantas Ražukas.

It is a medium-early potato variety. Tubers are smooth, compact, medium-sized. Blooming is short and sparse. The colour of flowers is white. The tubers are oval, the eyes are shallow, the skin of the tubers is yellow and rough. Slicing, cooking and production of semi-finished products do not change colour. Nutritional and culinary qualities are good. Tuber yield is 43.7–54.7 t ha⁻¹, starch content 14.6–16.6%. The variety is resistant to cancer, potato cyst nematodes, does not tolerate viruses. Tubers are resistant to phytophthoras, very good for overwinter storage. The variety grows in all types of soils, is resistant to drought. Due to its high resistance to diseases and its good appearance, it is suitable for organic farms.



Table potato variety ‘VB Meda’

☉ **Apple variety 'Bosanova'**

Breeders: Dr. Dalia Gelvonauskienė, Dr. Audrius Sasnauskas,
Dr. Bronislovas Gelvonauskis, Dr. Juozas Lanauskas.

The variety was developed at Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2019. It is an early winter apple variety. Origin: 'Auksis' × 'Prima'. Trees are medium strong vigorous. Late flowering (15th–21st of May). Average fruit weight is 160 g. The apples are crispy and juicy with a well-balanced sour-sweet taste and a nice flavour. This apple variety has storability until January and good shelf life. Trees are winter hardy, resistant to scab (Vf gene) and apple blotch. Recommended to grow with small and medium full dwarf rootstocks.



Apple variety 'Bosanova'

☉ **Apple variety 'Lauda'**

Breeders: Dr. Dalia Gelvonauskienė, Dr. Audrius Sasnauskas, Dr. Bronislovas Gelvonauskis.

The variety was developed at Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2019. It is a winter apple variety. Origin: 'Tellissaare' × 'Prima'. Trees are medium strong vigorous. Medium early flowering (9th–19th of May). Average fruit weight is 150 g. 'Lauda' is an attractive, middle large-fruited apple variety with sour-sweet taste, crispy and juicy flesh. This apple variety has storability until April and good shelf life. Trees are winter hardy, relatively resistant to scab and apple blotch. Recommended to grow with small and medium full dwarf rootstocks.



Apple variety 'Lauda'

☉ **Sour cherry variety 'Verknė'**

Breeder: Prof. Dr. habil. Vidmantas Stanys.

Sour cherry variety developed at Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2019. Origin: 'Dolgoždanaja' × 'Drogano geltonoji'. Trees are winter hardy, medium strong vigorous. Flowering from 25th of April to 11th of May. Cherry size is medium to large, average fruit weight is 4.9 g. The stone can be easily separated from the flesh. The flesh is medium firm, juicy, sweet and sour, tasty. Disease resistance is good.



Sour cherry variety 'Verknė'

6.5. Food produce of exceptional quality

LAMMC is involved not only in the research activities but also in the experimental product development activities. The experimental basis of the Institute of Horticulture 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”.

In 2019, innovative “Ribes Alibi” sources were developed at the Laboratory of Biochemistry and Technology.

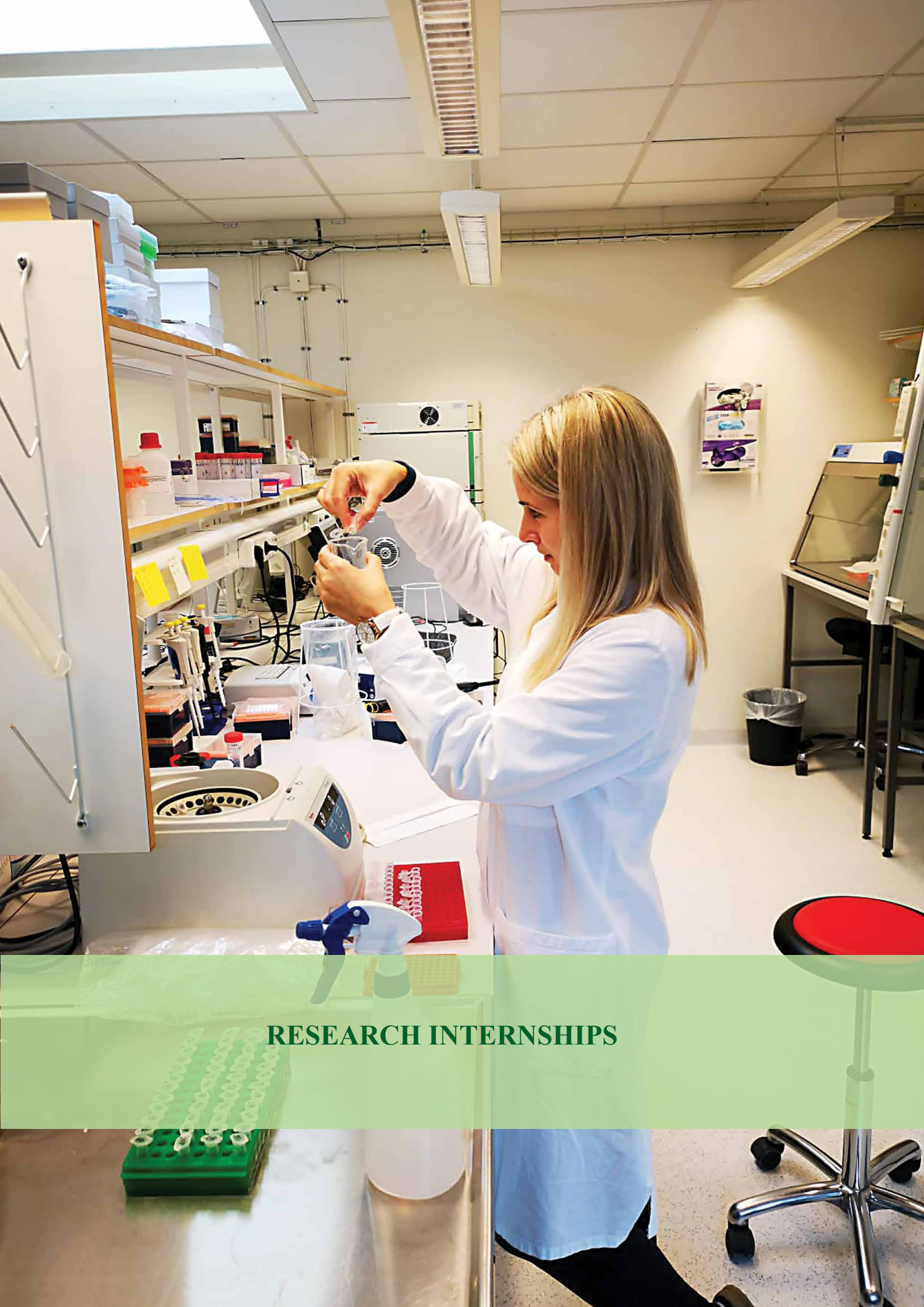


LAMMC Institute of Horticulture Laboratory of Biochemistry and Technology and UAB “Dangaus pupos” are implementing R&D by launching sauce under the trademark Ribes Alibi. The use of local, less common raw materials for this type of product, such as black and red currant, and the use of innovative technologies and technological solutions have led to the creation of sauces of exceptional taste and quality. The aim is to produce a product with reduced added sugars while also preserving the maximum amount of biologically valuable components of raw materials (using innovative extraction and pasteurization technologies) and possibly increasing the biological value of the final product using the latest scientific knowledge and developments (including fermentation technology).

Ribes Alibi sauces are marketed in niche products trade places: gourmet food stores (By Food, Rūta, Bakalėja, etc.), specialized meat food stores (Viking the Chef, The Farm, Steak Supply, etc.), stores focused on the sale of made-in-Lithuania products (Gurkė, Ūkininkų pastogė, Vaišė, etc.), healthy food stores (Namai be gliuteno), Rimi supermarket chain’s local products shelves “Vikis”. Export is also in the focus: the first export consignment reached Ireland, relations in Taiwan market are developing. The sauces are presented to end users in various fairs and healthy food festivals (Vegfest) in Lithuania and Latvia, where customers may taste them and get more knowledge about this new product.



“Ribes Alibi” sources developed in collaboration between Institute of Horticulture’s Laboratory of Biochemistry and technology and UAB “Dangaus pupos” (Photos by J. Pridotkienė)



RESEARCH INTERNSHIPS

7. RESEARCH INTERNSHIPS

On January 18, 2019 the procedure for granting support for academic visits was approved at the Lithuanian Research Centre for Agriculture and Forestry.

The aim of the support for academic visits is to increase internationalisation, encourage researchers and doctoral students' in-service training at foreign science and research institutions, strengthen cooperation with foreign researchers, and increase the number and quality of international scientific publications.

In 2019, LAMMC support for academic visits was granted to 6 persons.

Long-term internships conducted in 2019:

Internship of Dr. Karolina Barčauskaitė at Lehigh University, USA

On February 1 – March 16, researcher of Institute of Agriculture, Laboratory of Agrobiolgy Dr. Karolina Barčauskaitė did internship at Lehigh University (USA).

The aim of an internship was to study the interaction between urea and model humic acid compounds in order to reduce ammonia gas emissions to the atmosphere.

During the internship, researcher deepened her theoretical and practical knowledge of Raman spectroscopy, became familiar with research carried out by Assoc. Prof. Dr. Jonas Baltrušaitis research team. New nitrogen fertilizers are under development on urea basis to reduce the ammonia gas emission to the atmosphere and to improve plant nutrient uptake. Research of urea single crystal and salicylic acid was carried out using a large area scan by means of Raman spectrometer which has two type wavelength



Dr. Karolina Barčauskaitė at Lehigh university (USA)

lasers (532 nm and 785 nm) coupled with confocal microscope. It is expected to continue collaboration with US scientists in the future as well.

Internship of doctoral student Kristina Bunevičienė at Lehigh University, USA

On October 18 – December 13, a doctoral student, junior researcher of Institute of Agriculture, Laboratory of Agrobiolgy Kristina Bunevičienė did internship at Lehigh University (USA).

Aim – to analyse the biofuel ash structure (both ash and granular) and to study the interaction of the main ash component (CaCO_3) with organic acids using modern instrumental analysis methods.

During the internship, experiments were carried out with biofuel ash and lime dust. In particular, microelements and their distribution using SEM analysis were determined for bulk and granular biofuel ash and lime dust. This was followed by absorption studies with monoammonium phosphate (MAP). The MAP was observed to absorb selected test samples (at varying concentrations). The kinetics over time was performed after the absorption and the best concentration for MAP absorption. The same research was done with the addition of organic acids (acetic, oxalic, citric and glycolic). Everything was done using Ion exchange chromatography. The obtained powder was analysed by Raman



Kristina Bunevičienė at Lehigh University (USA)

spectroscopy and SEM. Biofuel ash was found to be less able to absorb than lime dust. However, they could also be used as absorbents.

Internship of Dr. Austra Dikšaitytė at University of Antwerp, Belgium

On October 27 – November 27, researcher of Institute of Horticulture, Laboratory of Plant protection Dr. Austra Dikšaitytė did internship at Department of Biology, University of Antwerp (Belgium).

The goal of the internship was to master the methodology for the determination of hydrogen peroxide (H_2O_2), one of the most important and most harmful forms of reactive oxygen species (ROS), in plant tissues. ROS are by-products of photosynthesis and respiration in plant tissues. Abiotic stressors such as drought and heatwaves also induce the production and temporary accumulation of ROS in plants, including H_2O_2 , whereby they can act as secondary messengers/chemical mediators in plant defence signalling and lead to programmed cell death. Among all ROS, H_2O_2 plays a crucial role in key cellular processes by acting as a signalling molecule in response to external stimuli and as a key component of growth and developmental processes. However, due to the instability of H_2O_2 , it is difficult to reliably determine its level in plant tissues under stressful growth conditions. Proper selection of extraction buffer is essential for reliable determination of H_2O_2 concentration



Dr. Austra Dikšaitytė at Department of Biology, University of Antwerp (Belgium)

in plant tissues to avoid interfering substances. During the internship, H_2O_2 was extracted from plant tissues spectrophotometrically using different extraction buffers to compare their influence on H_2O_2 concentration change, and analyses were performed on fresh, frozen ($-80\text{ }^{\circ}\text{C}$) and lyophilized plant tissues to evaluate reproducibility.

Internship of doctoral student Donata Drapanauskaitė at Lehigh University, USA

On February 1 – March 15, junior researcher, doctoral student of Analytical Department of Agrochemical Research Laboratory Donata Drapanauskaitė did internship at Lehigh University (USA):

● The objective of the internship was to study the interaction between urea and model humic acid compounds in order to reduce ammonia gas emissions to the atmosphere. New nitrogen fertilizers are under development on urea basis to reduce the ammonia gas emission to the atmosphere and to improve plant nutrient uptake. Research of urea single crystal and salicylic acid was carried out using a large area scan and true component analysis with Raman spectrometer with confocal microscope, which has two type wavelength lasers (532 nm and 785 nm). The single experiment was done changing humidity and time. Also, ammonia gas from soil fertilized with newly developed fertilizers was determined using an ion selective electrode.

● August 1 – December 13. The purpose of the internship was to synthesize slow-release fertilizers (Struvite) from low soluble magnesium minerals using simulated anthropogenic wastewater containing nitrogen and phosphorus and investigate their formation conditions by changing the pH and Mg / wastewater ratio of the solution.



Donata Drapanauskaitė at Lehigh University (USA)

During the internship, there were carried out *ex situ* and *in situ* struvite studies using magnesium oxide crystal as a low soluble source of magnesium, and struvite crystals from different concentrations

of model wastewater solutions were grown. Subsequently, the grown struvite crystals were exposed to formic acid in an in situ experiment. Also, another experiment was carried out by adding different concentrations of organic acids and observing the growth rate of the crystal and crystal shape changes depending on the type and concentration of organic acid added. The best pH of

the solution for struvite formation was 8.5 and above, and the concentration of magnesium in the solution was 1000ppm, nitrogen and phosphorus 600 ppm. On September 8–11, a visit was arranged to meet Professor Juan Navea's research group at Skidmore College, Saratoga Springs. SEM-EDS analysis of synthesized struvite samples was performed during the visit.

Internship of Dr. Kristina Jaškūnė at ETH Zurich, Switzerland

On December 1–23, senior researcher of Institute of Agriculture, Laboratory of Genetics and Physiology Dr. Kristina Jaškūnė did internship at ETH Zurich (Switzerland).

The aim of the internship was to prepare DNA libraries for PacBio RS II SMRT sequencing.

Candidate genes for leaf growth under stress conditions were identified by GWAS during the previous project stages. The genes controlling growth traits under drought will be further evaluated for their functional role in the tolerance to changing environment process using a reverse genetic tool – TILLING approach. Perennial ryegrass TILLING population has been developed by the project partners from ETH Zurich and allows us to identify mutant alleles for any target gene, and to test the corresponding phenotypes. Project partners' know-how as well as the infrastructure allowed them to prepare PacBio SR II libraries for two candidate



Preparation of libraries of candidate genes at ETH Zurich (Switzerland)

genes. The results of the sequenced genes will be used in next project implementation stages in order to prove the function of the candidate genes controlling leaf growth under drought conditions.

Internship of Dr. Adas Marčiulynas at Swedish University of Agricultural Sciences

On May 1–31, researcher of Institute of Forestry, Department of Forest Protection and Game Management Dr. Adas Marčiulynas did internship at Southern Swedish Forest Research Centre (SSFRC) at the Swedish University of Agricultural Sciences (SLU).

Scots pine (*Pinus sylvestris*) is the most common conifer tree species in Lithuania. A considerable part of the mature pine stands is suffering from one of the most dangerous pathogens in the Northern Hemisphere - root rot (*Heterobasidion annosum*). In Lithuania, this root rot damages pine stands, which affects not only tree health, but also influences the functioning of the forest ecosystems as well as affects the economic processes of the wood industry.

The main purpose of this internship was to use the DNA metabarcoding method to evaluate the diversity of fungal species associated with *Heterobasidion annosum* damaged pines in different parts of Lithuania, specifically: 1) to determine the fungal species diversity of the damaged pine roots; 2) to determine the diversity of fungal species in the soil, in the damaged stands.



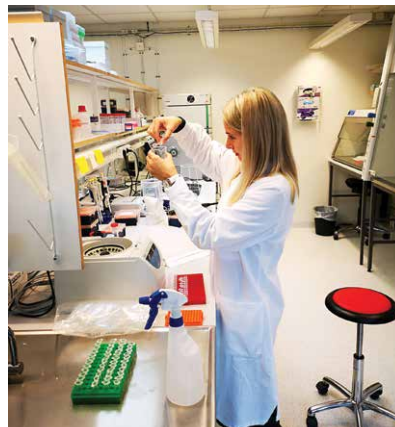
Dr. Adas Marčiulynas at Southern Swedish Forest Research Centre, Swedish University of Agricultural Sciences

Internship of Dr. Diana Marčiulynienė at Southern Swedish Forest Research Centre (SSFRC) at the Swedish University of Agricultural Sciences (SLU).

On October 2– 31, senior researcher of Institute of Forestry, Department of Forest Protection and Game Management dr. Diana Marčiulynienė did internship at Southern Swedish Forest Research Centre (SSFRC) at the Swedish University of Agricultural Sciences (SLU).

The NordGen scholarship allowed to participate in the fieldwork where the main aim was assessment and analysis of existing trials and survey of stands to identify truly superior 1st generation genotypes.

Based on 2018 surveys and personal contacts with stakeholders, all ash sites (126 in total) have been divided into five main areas across Sweden. Senior researcher was participated in the field trip in the 1st area between the 2nd – 13th of July, 2019. A total of 53 sites were inventoried in the south-west part of Sweden, 10 of which were selected additionally during the trip. Over 150 ash trees were inventoried and assessed. Senior researcher believe this study



Dr. Diana Marčiulynienė at Southern Swedish Forest Research Centre (SSFRC) at the Swedish University of Agricultural Sciences (SLU).

trip was highly successful because all selected trees will be used for the establishment of a new ash trial.

Internship of Dr. Jurga Miliauskienė at Rensselaer Polytechnic Institute, USA

On September 9 – November 1, chief researcher of Institute of Horticulture, Laboratory of Plant Physiology Dr. Jurga Miliauskienė did internship at Rensselaer Polytechnic Institute (RPI), Lighting Enabled Systems and Application Center (LESA), USA.

The aim of the visit was to investigate the impact of the next generation of pulsed LED fixture on the productivity, photosynthesis and antioxidant potential of leafy vegetables, to plan and manage photophysiological research. In horticulture, the main objective of applying pulsed LED lighting is to save energy without crop growth inhibition. During the visit, the effects of pulsed LED light individual colour channels with different frequencies, also multiple colour channels with different frequencies on lettuce cv. Defender biomass, photosynthesis, and antioxidative potential were evaluated. The research results indicate that pulsed light has a significant



Research on the effects of LED lighting on leafy vegetables (USA)

positive effect on the growth and internal quality of investigated lettuce, and suggests that pulsed lighting techniques are an innovative technology and high-speed pulsing capabilities should be included in the development of artificial horticulture lighting systems.

Internship of doctoral student Rūta Paulauskaitė at University of Agriculture, Poland

On September 11 – October 16, doctoral student of Institute of Horticulture, Laboratory of Plant Physiology Rūta Paulauskaitė did internship at University of Agriculture (Poland).

A program of internship funded within the project: “Light as a Tool of Biofortification: Photophysiological Aspects of Essential Trace Elements Management in Leafy Vegetables”.

The objective of the internship was to learn how to perform elemental analysis using green pea samples from my PhD thesis entitled “Environmental factors inducing oxidative stress in green pea (*Pisum sativum*) and tools for its management”. The green peas were grown under



Equipment of University of Agriculture (Poland)

different conditions (meteorological drought/normal watering) and using different nanoparticles

at different concentrations. Samples were collected and dried at 70 °C for 48 hours.

During laboratory work, doctoral student gained knowledge about preparation of plant, organic matter, water and soil samples for analytical analysis and determination of micro and macro elements in them using Microwave Digestion System (MARS,

CEM Corporation) and elemental analyser TruMac CNS. She prepared 200 samples for analysis and performed analyses of C, N, S. Moreover, during the internship attended a 4-day science camp at Świętokrzyski National Park, collecting spring water samples. Furthermore, attended the 70th anniversary of the forest department conference.

Internship of Dr. Neringa Rasiukevičiūtė at National Institute for Agriculture and Food Research and Technology (INIA) (Spain)

On February 23 – April 30, senior researcher of Institute of Horticulture, Laboratory of Plant Protection Dr. Neringa Rasiukevičiūtė did internship at National Institute for Agriculture and Food Research and Technology (INIA) (Spain).

The aim of the internship was to gain knowledge of new pathogen diagnostic methods and to establish closer contacts with the scientists of the INIA Plant Pathology Group of the Department of Plant Protection INIA (Madrid, Spain).

The internship was focused on the pathogen identification thought fluorescent microscopy. I carried out *Monilinia laxa*, the brown rot of stone fruit, gene expression studies and detected latent cherry *M. laxa* infection by real-time PCR. I gained knowledge in *M. laxa* cultivation and propagation techniques, evaluated the effect of *M. laxa* phytotoxins on nectarines, studies possibilities for developing and using biological plant protection products, evaluated the effect of olive oil extracts



Dr. Neringa Rasiukevičiūtė (in the middle)
at National Institute for Agriculture and
Food Research and Technology (INIA) (Spain)

on tomato soil pathogen *Fusarium oxysporum* f.sp. *lycopersici*.

The data obtained during the internship will be used for the preparation of scientific publications. It is expected to continue collaboration with Spanish scientists in the future.

Internship of Dr. Sidona Sikorskaitė-Gudžiūnienė at Helsinki University, Finland

On October 1 – November 16, researcher of Institute of Horticulture, Department of Orchard Plant Genetics and Biotechnology Dr. Sidona Sikorskaitė-Gudžiūnienė did internship at Helsinki University, Department of Agricultural Sciences, Plant Pathology and Virology Group (Finland).

The aim of the internship was to construct an effective vector for virus-induced gene suppression, to master the methods of vector construction and the virus-induced gene suppression system. The viral vector constructed during the internship will be used in laboratory studies aimed at ascertainment of gene functions of plants and better understanding of mechanisms of response of garden plants to biotic and abiotic factors.

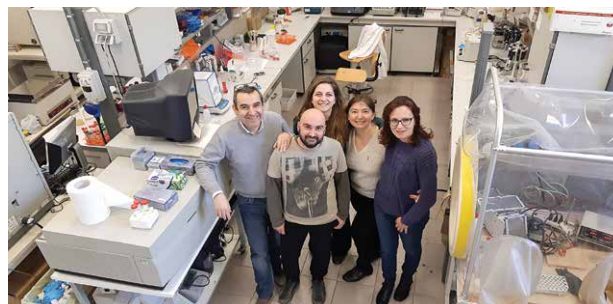


Dr. Sidona Sikorskaitė-Gudžiūnienė
at Helsinki University (Finland)

Internship of Dr. Skaidrė Supronienė at University of Florence, Italy

On January 7 – April 6, head of Microbiology Laboratory, Institute of Agriculture, chief researcher Dr. Skaidrė Supronienė did internship at University of Florence (Italy).

The aim was to establish closer contacts with the scientists of the University working in the field of agricultural microorganisms, to familiarize with their experience in commercialization of scientific production and services, and to gain knowledge about the application of the Phenotype MicroArray (PM) technology for microorganism research. In PM studies, different phenotypes of microorganisms are



Dr. Skaidrė Supronienė (second from the right)
University of Florence (Italy)

determined by differences in their ability to absorb various sources of carbon, nitrogen, phosphorus and sulphur, their sensitivity to the medium pH and chemicals of different classes (heavy metals, antibiotics, etc., estimated at around 2000 different sources). The open access “Biolog” system, available at the Microbiology Laboratory of the Institute

Agriculture LAMMC, has so far been used only for physiological profiling of soil microorganism communities. The knowledge and experience gained during the internship on the application of PM technology will contribute to increasing the scientific, practical and commercial competence of the laboratory staff.

Internship of Dr. Monika Toleikienė at Maynooth University, Ireland

On December 3, 2018 – January 28, 2019, junior researcher of Institute of Agriculture, Department of Plant Nutrition and Agroecology (during the internship – doctoral student) Dr. Monika Toleikienė did internship at Maynooth University (Ireland).

The aim of the internship was to acquire practical skills in working with statistical data analysis programs (software), which will help to identify and commercialize the most advanced growing technologies of legumes in an organic production system in Lithuania. The SAS statistical program was used to process the research data, which will help to identify the potentially most valuable legume species to be commercialized on Lithuanian organic farms



Maynooth University (Ireland)

by optimising the implementation of the national greening program and economic benefit of farms.

Internship of Dr. Viktorija Vaštakaitė-Kairienė at Michigan State University, USA

From May 2019 to April 30, 2020, senior researcher of Institute of Horticulture, Laboratory of Plant Physiology Dr. Viktorija Vaštakaitė-Kairienė is doing internship (implementing research project “Technological and photophysiological aspects of leafy greens growing indoors under LED lighting”) at Michigan State University, College of Agriculture & Natural Resources, Department of Horticulture (USA), which is financed by Baltic-American Freedom Foundation (BAFF).

The aim of this research project is to utilize narrow- and broad-band LEDs to produce high-quality leafy greens (lettuce, spinach, etc.) indoors, in a productive, predictable, and efficient manner. The objectives are to evaluate the plant growth parameters, nutritional value and overall quality changes during the postharvest storage as well as electric energy consumption of different light strategies.

Dr. Viktorija Vaštakaitė-Kairienė participates in workshops and scientific conferences and works



Dr. Viktorija Vaštakaitė-Kairienė at Michigan State University (USA)

closely with the scientists from USA on preparing projects and publications.

Internship of Dr. Rita Verbylaitė at Aristotle University of Thessaloniki (Greece) and University of Copenhagen (Denmark)

- On May 6 – June 14, researcher of Institute of Horticulture, Department of Forest Genetics and Tree Breeding Dr. Rita Verbylaitė did internship at Aristotle University of Thessaloniki, Faculty of Agriculture, Forestry and Natural Environment, Laboratory of Forest Genetics & Tree Breeding.

The aim of this internship was to strengthen the capacity to carry out high-level R&D activities through an internship at the Aristotle University of Thessaloniki, develop a methodology for forest genetic monitoring for Norway spruce. To achieve



Dr. Rita Verbylaitė (third from the left) with colleagues from Aristotle University of Thessaloniki (Greece)

this aim, the microsatellite method was used for two Lithuanian and two Greek spruce populations during the internship.

- On November 4–29, researcher of Institute of Horticulture, Department of Forest Genetics and Tree Breeding Dr. Rita Verbylaitė did internship at University of Copenhagen, Department of Geosciences and Natural Resource Management (Denmark).

The main aim of the internship was to gain new knowledge and expertise in conducting phenotypic trait analysis of *Fraxinus excelsior* clones, to be included in the International Ash Resistance Breeding Program. To achieve the aim, phenological observations and health condition assessment of three clonal experimental trials of common ash (Kaišiadorys, Marijampolė and Kėdainiai) were performed. Phenological observations were conducted in spring and autumn, while samples of the most resistant and least resistant clone trees were collected in the summer of 2019. During the internship, the phenotypic data of clonal trials were analysed using SAS and ASReml computer software.

The collected data will allow us to assess the changes in genetic diversity in these spruce populations that will occur over the next ten years.



Dr. Rita Verbylaitė (in the centre)
University of Copenhagen (Denmark)

Spatial analysis of clonal trials was evaluated as well, which reduced the influence of environmental factors on heritability coefficients. The phenotypic stability of the clones in the trials was calculated on the basis of phenotypic data, and the clones with the highest resistance to *Hymenoscyphus fraxineus* were selected for the breeding program.

Internship of Dr. Renaldas Žydelis at Agrifood Research and Technology Centre of Aragon (Spain) and Agrosphere Institute (IBG-3), Forschungszentrum Jülich GmbH (Germany)

- On January 27 – March 16, researcher of Institute of Agriculture, Department of Plant Nutrition and Agroecology Dr. Renaldas Žydelis did internship at Agrifood Research and Technology Centre of Aragon (Spain).

The aim of the internship was to familiarize with and transfer the most advanced crop modelling practice to the agribusiness and to use the gained knowledge to commercialize varieties and cultivation technologies under Lithuanian conditions. In order to achieve this goal, the possibilities of DSSAT model (Decision Support System for Agrotechnology Transfer) were assessed. The model was designed to simulate the yield of various agricultural crops and the possibilities to adapt them under Lithuanian conditions.

The model which was optimized during the internship according to the specific area of research and experimental variety was used to evaluate maize nutrition and the losses of nitrate leaching during vegetation. A reduction in grain yield due to water and nitrogen stress was also calculated. This model can be useful when solving the problems of farmers.

- On November 2 – December 4, researcher of Institute of Agriculture, Department of Plant Nutrition and Agroecology dr. Renaldas Žydelis did internship at Agrosphere Institute (IBG-3), Forschungszentrum Jülich GmbH (Germany).

The aim of the internship was to determine the applicability of the AgroC model for modelling hemp growing processes under Lithuanian environmental conditions.

The first results obtained showed that the AgroC model reproduced well the significant stages of



Dr. Renaldas Žydelis (second from the left) at Agrifood
Research and Technology Centre of Aragon (Spain)

fibre hemp growth and development, the yield of biomass and individual organs, but at least two years' experimental data are required for accurate application of the model. Hemp field experiments are planned to be continued until 2023, and this data will be used to improve the algorithms of the model.



Renaldas Žydelis at Agrosphere Institute (IBG-3),
Forschungszentrum Jülich GmbH (Germany)



**DISSEMINATION OF SCIENTIFIC KNOWLEDGE
EVALUATION OF RESEARCH ACTIVITIES
FUNDING**



8. DISSEMINATION OF SCIENTIFIC KNOWLEDGE

In 2019, national and international events were organized: conferences, workshops, exhibition of agricultural technologies “Agrovizija”. The congress of the International Union of Game Biologists (IUGB) attracted considerable attention of a large international scientific community. Not only events were organized but also publications for science and the general public were prepared. In 2019, the citation index of the scientific journal “Zemdirbyste-Agriculture” increased in the *CA WoS* database, new informational publications were published. Cooperation agreements with Lithuanian and foreign research and study institutions were signed. On March 1, LAMMC became an official member of the European Plant Science Organisation (EPSO).

8.1. Scientific conferences, seminars

8.1.1. International conferences, seminars

August 26–30. The **34th congress of International Union of Game Biologists (IUGB)** was organised in Kaunas. Organisers: Institute of Forestry, LAMMC. Research presented at the congress dealt with forestry, agriculture, hunting, recreation, urbanization, climate change, ecosystems and economic development, and the coexistence of humans and wildlife. The Congress attracted participants from all over the world: USA, Brazil, Australia, France, Italy, Portugal, Germany, Switzerland, Belgium, United Kingdom, Norway, Finland, Denmark and other countries. In total, about 200 participants attended the event.



November 14. **An international conference “Young Scientists for the Advancement of Agriculture”** was organised at the Lithuanian Academy of Sciences (LAS) in Vilnius. Organisers: LMA Department of Agricultural and Forestry Sciences, Lithuanian Research Centre for Agriculture and Forestry. The aim of the event was to bring together young scientists conducting research in the fields of agronomy, agrobiological and agroecology, soil and agrochemistry, horticulture, forestry, zoo-technics and veterinary medicine, agricultural engineering, food safety and quality, agricultural economics and rural sociology and to encourage cooperation and dissemination of research results.



(photo by V. Valuckienė)

February 8. **International seminar “Strawberry growing technologies”**. The seminar was organised by Institute of Horticulture, Kaack Pflanzenvermehrung GmbH u. Co. KG and A. Ragaišis farm. Topics discussed at the event: trends in contemporary strawberry breeding, strawberry cultivation, weed and pest control in strawberry crops, irrigation systems in strawberry fields, strawberry fertilizers, repelling birds and wild animals in strawberries, greenhouses, etc.



March 14. **International seminar “Peculiarities of *Camelina sativa* L. growing, utilization of production and market search”** held at Vėžaičiai Branch. Topics discussed at the event: “Cultivation peculiarities of *Camelina sativa* L.: overview of research”, “Fertilization and seed cleaning of *Camelina sativa* L.: overview of production results 2008–2018”, “Energy and economic efficiency of *Camelina sativa* L.”, etc. Roundtable discussion “Is *Camelina sativa* L. a promising plant?” was focussed on the problems related to its cultivation.



8.1.2. National conferences, seminars, discussions

January 23–25. **Scientific conference “Agrarian and Forestry Sciences: the Latest Research Results and Innovative Solutions”**. On the first day of the events, results of the research activities of Institute of Agriculture and regional Branches were presented. Discussions dealt with plant diseases, plant breeding, energy plants, crop rotation effects on crop yield and soil, various organic fertilizers, environmental pollution and other relevant topics. The second day of the conference was focussed on the research activities of Institute of Horticulture. Discussions encompassed the following relevant horticultural research topics: plant physiology, genetics, diseases, varietal productivity, effects of biological stimulants on plants, yield, soil, etc. The third day of the event was devoted to the research activities of Institute of Forestry. The following was discussed: the response of 7 forest tree species to climate change-related factors (cold, heat, drought, etc.), genetic diversity and its spatial distribution during reforestation, the distribution of wild boars in a specific territory, their social behaviour, etc.



March 20. **Conference “Globalization – Ecology – Future”** at Institute of Agriculture. The event was dedicated to the World’s Earth Day. The following topics were presented at the event: “The beginning of food globalization and its ecological consequences as seen by archaeologists“, “Circular economy model for big cities: sewage sludge and biomass ash into biomass – biomass into renewable energy (NutriBiomass4LIFE)“, “LIFE projects in Lithuania: prospects and challenges“. Worldwide debates held on the Earth Day focus on environmental topics, environment-friendly solutions, threats to our planet, necessity for sustainable development of the society and care for the future generations.



April 25. **Conference-discussion “Genome Editing: Opportunities and Challenges”** held at the Lithuanian Academy of Sciences (LAS). The event, relevant for Lithuania’s science and progress, was arranged by the LAS Departments of Biology, Medicine and Geosciences and Agricultural and Forestry Sciences, Lithuanian Research Centre for Agriculture and Forestry and Vilnius University. Nearly a year ago (on July 25, 2018), the European Court of Justice ruled that genome editing products, derived through the use of new methods, should be regulated under the EU GMO Directive 2001/18/EC. Lithuanian researchers are among the creators of gene editing technology, and believe that this constraint contradicts the technological progress. The Directive was adopted back in 2000, when the genome editing technology had not yet been



(V. Valuckienės fotografija)

developed. This technology was discussed at the conference.

May 14. **Scientific conference “Processing of Crop Produce. Innovations and Challenges” and festival “Flowering Orchards”** held at Institute of Horticulture. The event was organized by Institute of Horticulture and Lithuanian Academy of Sciences’ Department of Agricultural and Forestry Sciences. The topics discussed during the event: “Challenges of vegetable production, trends in the EU and Lithuania“, “Innovative fruit and vegetable processing technologies“, “Plant raw materials and preparations for the development of functional nutraceuticals“, “Valorisation of berries and their by-products”. The second part the event included a visit to the flowering orchards of the Institute of Horticulture.



May 15. **LAMMC conference of doctoral students “Science Behind Plant Wellbeing”** (the event devoted to “Fascination of Plants Day”). Nearly 50 doctoral students of LAMMC presented their research results in the English language. The best presentations were selected by voting. This conference of doctoral students is not only a great way to demonstrate their research results, familiarize with their colleagues’ work, gain valuable knowledge but also is a step towards defending their dissertations. After the event, LAMMC doctoral students discussed the impressions of the day in the nature.



June 20. **Conference “Sustainable and Profitable Management of Straw in Farming Based on the Principles of Circular Economy”** held at Institute of Agriculture. The event brought together scientists and business representatives to find the best solutions for sustainable and profitable utilization of straw for biofuel production. The highlight of the event is orientation towards sustainable, green solutions and their application in regional conditions. In the second part of the event, a visit to the experimental fields of Institute of Agriculture was arranged.



June 20. **Scientific-practical conference “Possibilities and Measures for Soil and Crop Productivity Improvement”** held at Joniškėlis Experimental Station. The information provided during the conference was aimed at encouraging farmers to reduce the impact of farming on climate change, apply the latest crop production technologies, reduce tillage intensity and use of chemical plant protection products, apply crop rotations with a greater diversity of crops and include catch crops.



September 18. **Conference-discussion “The Origins and Evolution of Weed Research in Lithuania”** dedicated to 100th birth anniversary of prof. Jadvyga Monstvilaitė (1919–2004). The event was held at the Lithuanian Academy of Sciences (LAS) and organized by LAS Department of Agricultural and Forestry Sciences and Lithuanian Research Centre for Agriculture and Forestry. The conference was attended by the researchers working in the field of herbology, prof. Jadvyga Monstvilaitė’s disciples and fellows as well as doctoral students. The daughter of prof. Jadvyga Monstvilaitė, prof. of Lithuanian Academy of Music and Theatre Giedrė Kaukaitė honoured the event with her presence.



(photo by V. Valuckienė)

February 6. **Seminar “Topicalities of Fibre Hemp Cultivation and Presentation of the Concept of Cooperation between UAB AGROPRO and Growers in 2019”** held at Institute of Agriculture. Topics covered during the event: fibre hemp in crop production; research on the dependence of fibre hemp seed yield and quantitative factors determining it on legumes and other soil-improving crops as pre-crops and undersown crops; practices that could ensure maximum fibre hemp yield in the organic production system, etc.



February 21. **Seminar “Fibre Hemp – Prospects for Cultivation and Processing in Lithuania”** held at Institute of Agriculture. Topics covered during the event: non-food crops and their prospects in agriculture; peculiarities of fibre hemp cultivation and potential applications; peculiarities of hemp drying; biocomposites from fibre hemp boon and bast: prospects and risks; possibilities of incorporation of hemp fibre into chipboards; phytocannabinoids – their importance and peculiarities of their accumulation in hemp, etc. The event was attended by nearly 150 participants. Active discussions, experience sharing on hemp cultivation took place in the event. The seminar was funded by the PANACEA project.



June 20. **Seminar “Agricultural Sciences in Southeast Lithuania: History and Innovation”** held at the Vokė Branch. The participants of the event were familiarized with the history of agricultural sciences in Southeast Lithuania region and with soil and crop production research and other activities conducted at the Vokė Branch and Perloja Experimental Station.



September 12. **Seminar “Research Internships – Experience and Challenges”** held at Institute of Agriculture. During the event, five researchers from Institute of Agriculture, Institute of Horticulture and Institute of Forestry shared their experience and presented research results obtained during their internships abroad. The chairperson of committee for assessment of applications for support for academic visits Dr. Kristina Jaškūnė told the participants about the support for academic visits provided by LAMMC.



October 4. **Public seminar, in which applicants for the position of Head Researcher presented the ongoing and planned research activities, research results and prospects** held at Institute of Agriculture. Presentations delivered at the seminar: “Aspects of composition of grain and other plant-derived raw materials and prospects for research”, “Soil quality and its potential variation in the farming systems differing in intensity”, “Investigation of the effects of fertilization products on soil and development of a system for the evaluation of their efficacy”, “Integrated pest management (IPM): maintenance of sustainable ecosystem and healthy environment by reducing pesticide use”, “Science and technological advancement in commercial horticulture”.



October 24. **Scientific-practical discussion “The State of Lithuania’s Soils: the Present and Prospects”** held at Institute of Agriculture. The topic discussed during the event: “Soil agrochemical properties and their change”, “Sustainable use of soils”, “Erosion of Lithuania’s soils: problem of its evaluation, insights into regional policy solutions”. The presentations were followed by a discussion which revealed the need for closer cooperation among farmers, agricultural policy makers, government officials and agricultural scientists and soil experts in addressing the challenge of ensuring sustainable use of soil.



November 8. **Discussion “Risk of Glyphosate Background Contamination”** held at Institute of Agriculture. During the event, senior researcher of Department of Soil and Crop production of Institute of Agriculture Dr. Gražina Kadžienė delivered a presentation on “Glyphosate residues in soil and grain, risk assessment of background contamination”. The presentation was followed by a discussion joined by the representatives of various institutions, farmers and researchers. The event was attended by nearly a hundred participants.



8.2. Science popularization activities

April 10. The event **“Promotion of International Cooperation”** (measure funded by the Research Council of Lithuania) was held at Institute of Agriculture. Organizers: Research Council of Lithuania and Institute of Agriculture. The event was attended by a representative of Research Council of Lithuania Sonata Juciūtė who introduced the LINO LT project intended for the development of international relations of Lithuanian science. The aim of the project is to promote the internationalization of Lithuanian science by strengthening the capacities of the country’s researchers and science managers to participate in international research and development (R&D) and innovation programs.

June 26–28. An exhibition of agricultural technologies **“Agrovizija 2019”** was organized in Akademija, Kėdainiai distr. Organizers: Institute of agriculture and Lithuanian Plant Protection Association. The exhibitors included companies presenting innovations in agricultural machinery, plant varieties, fertilizers as well as organizations involved in agricultural research and consulting.

For the first time in the history of the exhibition, a discussion forum **“Challenges, Experience, Solutions – for Future Agriculture”** was organized, which was attended by Arnoldas Pranckevičius Head of European Commission Representation in Lithuania.

Demonstration of plant protection technologies, plant variety and fertilization field trials, agricultural machinery, sprayer and stubble cultivator show were arranged at the event. Workshops and consultations on various topics took place throughout the three days. On the second day of the exhibition, a discussion forum **“Challenges, Experience, Solutions – for Future Agriculture”** took place. Consultations were provided on plant and technical innovations, financial solutions for farms, etc.

During the exhibition, LAMMC researchers organized more than 10 workshops on plant diseases and pests, climate change, cultivation of legumes, sustainable use of soil and other relevant issues. LAMMC stand exhibited the Centre’s achievements, projects, and Lithuanian varieties..

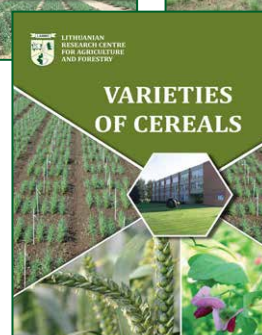
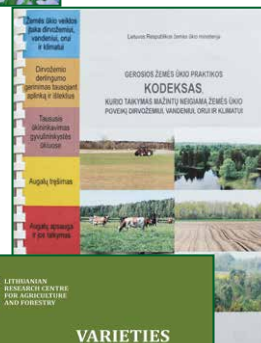
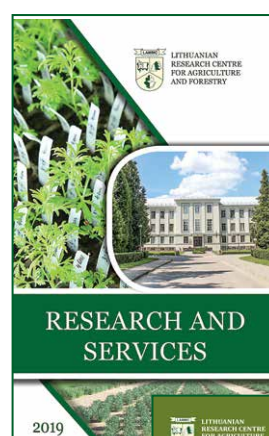
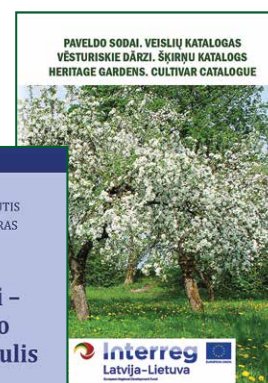
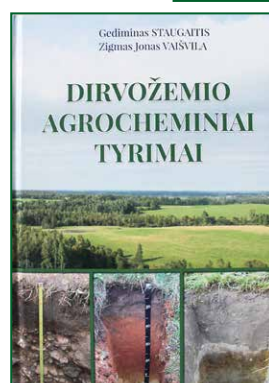
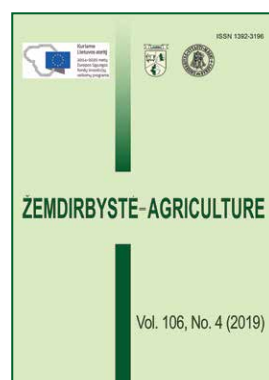
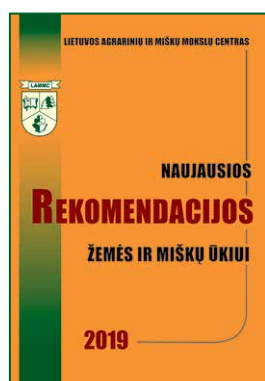


8.3. Publishing

LAMMC is a co-publisher of the scientific journals “Baltic Forestry” (IF 2018 / 2019 – 0.754), “Zemdirbystė-Agriculture” (IF 2018 – 1.020), “Sodininkystė ir daržininkystė”, “Miškininkystė”, “Agronomy Research”.

Other publications released in 2019:

- Prof. Dr. habil. G. Staugaitis and Prof. Dr. habil. Z. J. Vaišvila. Scientific-methodological material “Soil Agrochemical Research”;
- Publication intended for the Ministry of Agriculture “Code of Good Agricultural Practice, Application of which would Mitigate the Negative Impact of Agriculture on Soil, Water, Air and Climate”;
- Book “Heritage Gardens. Catalogue of Varieties”;
- Proceedings of the scientific conference “Agricultural and Forestry Sciences: the Latest Research Results and Innovative Solutions”;
- “The Latest Recommendations for Agriculture and Forestry 2019”;
- Informational pamphlet “Research and Services 2019”;
- Bibliography of Dr. K. K. Bačelis “Flax is my World”;
- Booklets “Varieties of Legumes and Grasses”, “Varieties of Cereals”.



8.4. Cooperation with international organizations, research and studies institutions

Every year, pupils from different schools of the country and students from higher education institutions visit LAMMC in order to get acquainted with the research activities carried out there and with the PhD programs offered by the Centre.

In 2019, LAMMC became a member of the European Plant Science Organization (EPSO), new contacts were established with science and studies institutions.

Membership in EPSO

As of March 1 2019, LAMMC became an official member of European Plant Science Organization (EPSO).

EPSO is an independent academic organization (established in 2000), which currently represents 69 institutional members from more than 220 research institutes, divisions and universities from 31 countries in Europe and beyond. This organization discusses European and global science policies with the European Commission, members of the European Parliament and national politicians.

The mission of EPSO is to increase the influence and visibility of plant science in Europe.

The organization's best-known event is the annual "Fascination of Plants Day" celebrated worldwide.



Cooperation agreements signed in 2019

- A cooperation agreement between LAMMC and **Vilnius Gediminas Technical University**. The agreement provides for the promotion of mutual cooperation in the field of research, experimental development, innovation, and teaching activities, development of interdisciplinary links between different research/studies institutions on the issues of science of national and international relevance.
- A cooperation agreement between Institute of Horticulture and **Kaunas Aleksandras Stulginskis School-Multifunctional Centre**. The agreement provides for the exchange of experience, with an emphasis on the exchange of good practices between researchers and educators, and the organization of joint methodological, cultural, educational and other events.
- A cooperation agreement between Institute of Horticulture and **Pasvalys Petras Vileišis Gymnasium**. The agreement provides for the exchange of experience, with an emphasis on the exchange of good practices between researchers and educators, and the organization of joint methodological, cultural, educational and other events.
- A cooperation agreement between LAMMC and **University of Florence, Department of Science and Technology of Agriculture, Food, Environment and Forestry (Italy)**. The cooperation is in the field of phenotyping of microorganisms.
- A cooperation agreement between LAMMC and **International Sakharov Environmental Institute of Belarusian State University**. The key objectives of the cooperation: to conduct joint research, produce joint publications, participate in scientific workshops, conferences and other events.

9. EVALUATION OF RESEARCH ACTIVITIES

Bonuses, certificates of merit for students, doctoral students and young scientists

The Winners of the Young Scientists and Doctoral Students' Research Work Contest arranged by the Lithuanian Academy of Sciences (LAS) in 2019, LAMMC researchers: Dr. **Jonas Viškelis**

for the research work "Influence of technological measures and biological factors on fruit quality in intensively managed apple (*malus x domestica* Borkh.) orchards" and Dr. **Valda Araminienė** for



Dr. Valda Araminienė winner of Young Scientists and Doctoral Students' Research Work Contest arranged by the Lithuanian Academy of Sciences
(Photo by V. Valuckienė)



Dr. Jonas Viškelis winner of Young Scientists and Doctoral Students' Research Work Contest arranged by the Lithuanian Academy of Sciences
(Photo by V. Valuckienė)

the research work "State and growth of birch trees under the present and modelled climate conditions". The winners were awarded bonuses.

A certificate of merit was awarded to the senior research worker of LAMMC Institute of Horticulture, Laboratory of Plant Physiology Dr. **Viktorija Vaštakaitė-Kairienė** for the research work "Physiological aspects of management of metabolites and mineral elements in *Brassicaceae* sprouts".



A certificate of merit awarded to dr. Viktorija Vaštakaitė-Kairienė
(Photo by V. Valuckienė)

Lithuanian Academy of Sciences' scholarships for young scientists

The Presidium of the Lithuanian Academy of Sciences awarded a scholarship (2019–2020), intended for young scientists, to the senior research worker of LAMMC Institute of Forestry, Department of Ecology Dr. **Povilas Žemaitis** for the research work "The effect of stump rot on the sustainability of spruce forests".

The scholarships for young scientists assigned by the Lithuanian Academy of Sciences are aimed at promoting scientific creative activities, supporting the research work of the most talented ones and promoting creative competition between young scientists.



Dr. Povilas Žemaitis (in the centre of the second row)
(Photo by V. Valuckienė)

Members of the Lithuanian Academy of Sciences

On February 12, 2019, the general meeting of the members of the Lithuanian Academy of Sciences (LAS) took place, during which new full members of LAS were elected: director of Institute of Agriculture, LAMMC, head researcher

Dr. Žydrė Kadžiulienė (agroecology) and director of Agrochemical Research Laboratory, LAMMC, head researcher Prof. Dr. habil. **Gediminas Staugaitis** (agronomy).



Dr. Žydrė Kadžiulienė has become a member of the Lithuanian Academy of Science
(Photo by V. Valuckienė)



Prof. Dr. habil. Gediminas Staugaitis has become a member of the Lithuanian Academy of Sciences
(Photo by V. Valuckienė)

Members of the Young Academy of the Lithuanian Academy of Sciences

By the Resolution of the Presidium of Lithuanian Academy of Sciences No. 37 of November 14, 2019 research worker of the Laboratory of Genetics and Physiology, Institute of Agriculture, LAMMC Dr. **Rita Armonienė** (agronomy) was approved as a new member of LAS Young Academy.

Members of the Lithuanian Academy of Sciences' Young Academy are elected by means of a competition. The eligible candidates are those who have achieved significant scientific results and are active in professional activities, obtained a doctoral degree not more than 10 years ago and are not more than 40 years of age before the election day.



Dr. Rita Armonienė and President of the Lithuanian Academy of Sciences academician Jūras Banys
(Photo by V. Valuckienė)

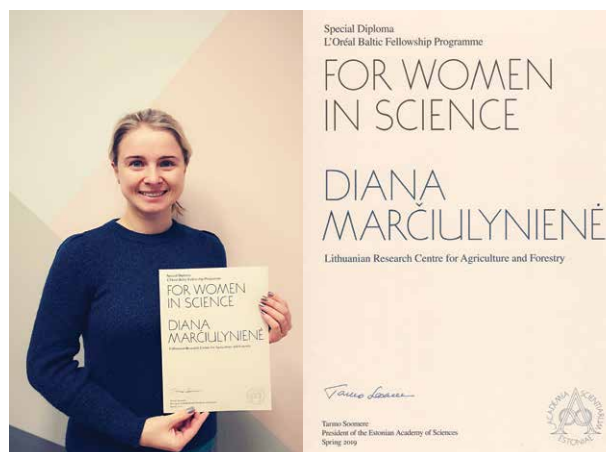
Other awards

The Kaunas District Municipality awarded the head of the Laboratory of Biochemistry and Technology, Institute of Horticulture, LAMMC prof. Dr. **Pranas Viškelis** with the First Level Badge of Honour. His research topics include quality, storage and processing of agricultural produce. Prof. Dr. Pranas Viškelis has authored more than 400 scientific articles, has bred 11 varieties of horticultural plants.



Prof. Dr. Pranas Viškelis was awarded the First Level Badge of Honour

A senior research worker of the Department of Forest Protection and Game Management, Institute of Forestry, LAMMC Dr. **Diana Marčiulynienė** was awarded a special international diploma “*L’Oreal Baltic Fellowship Programme for Women in Science*” for her scientific achievements.



Dr. Diana Marčiulynienė was awarded a special international diploma “*L’Oreal Baltic Fellowship Programme for Women in Science*” for her scientific achievements

10. FUNDING

LAMMC budget is composed of state budget appropriations, funds from national and international projects, funds from contract work for Lithuanian and foreign economic entities and other income (sales of agricultural produce, lease of premises, etc.) (Figure 5). In 2019, LAMMC revenue amounted to 12.4 million Eur.

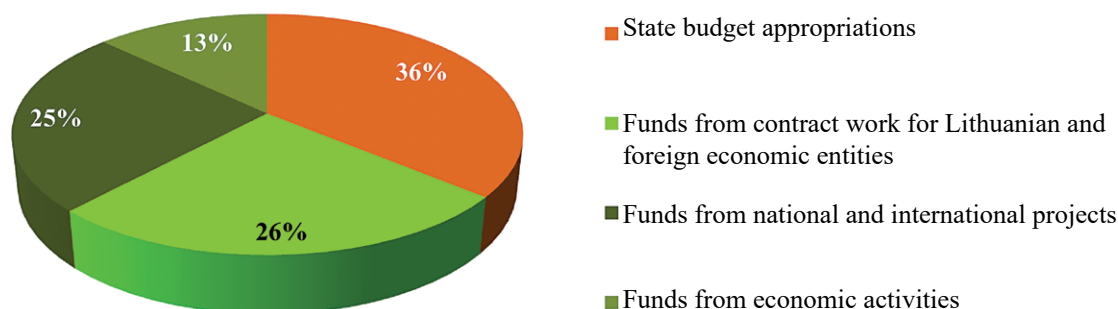


Figure 5. Funding sources

Major expenditure in 2019: salaries/wages and social insurance (69 %), goods and services (15 %). Other expenditure: public utility services and communications, business trips, maintenance of transport means/vehicles, doctoral scholarships, royalties, etc.



APPENDICES

11. APPENDICES

11.1. All projects

11.1.1. National projects

Research funded by the Research Council of Lithuania

Projects of researchers' teams

1. "Light as a tool of biofortification: photophysiological aspects of essential trace elements management in leafy vegetables". Project leader Dr. Aušra Brazaitytė. 2019–2022.
2. "Biogeography and spread of local and invasive tree pathogens: focus on climate, tree species and intensity of forest management". Project leader Dr. Audrius Menkis. 2017–2020.
3. "GrowGene – Genome-wide functional analysis of perennial ryegrass for improved growth under water limiting conditions". Project leader Dr. Kristina Jonavičienė. 2017–2020.
4. "Dynamic light spectrum and intensity modelling and photoresponse in different vegetable morphogenesis stages". Project leader Dr. Giedrė Samuolienė. 2017–2020.
5. "Improvement of apple fruit quality by application of innovative horticultural technologies". Project leader Dr. Darius Kviklys. 2017–2020.
6. "Involvement of oxidative stress in molecular mechanism of seed response to cold plasma treatment". Project leader Dr. Danas Baniulis. 2017–2019.

High level R&D projects (SMART)

1. "Development of wood modifying eco-friendly technology for higher value products". Project leader Dr. Marius Aleinikovas. 2017–2021.
2. "Closed plant cultivation system for production of raw materials for peptide nanoengineering applications". Project leader Dr. Danas Baniulis. 2017–2021.
3. "UV-A lighting strategies for controlled environment horticulture: upgrade to sustainable, high-value production". Project leader Dr. Akvilė Viršilė. 2017–2021.
4. "Quality diagnostics of biogas production by-product (digestate) for innovative use as a biofertilizer". Project leader Dr. Alvyra Šlepetienė. 2017–2021.
5. "Development of winter wheat varieties for amylose-free starch and vital gluten processing". Project leader Dr. Gintaras Brazauskas. 2017–2021.
6. "Enhancement of the multifunctional properties of legumes in feed and food value chains" (SmartLegume). Project leader Dr. Žydrė Kadžiulienė. 2017–2021.

Grant for high-level researchers' group project

"Insights into future forests: challenges of climate change and diseases, and possible measures for saving biodiversity and ecosystem functioning". Project leader Dr. Audrius Menkis. 2017–2021.

Post-doctoral internships in Lithuania

1. “The resistance of different Scots pine (*Pinus sylvestris* L.) genotypes against root rot (*heterobasidion annosum* (Fr.) Bref.)”. Post-doc Dr. Adas Marčiulynas. Research supervisor Dr. Virgilijus Baliuckas. 2017–2019.
2. “The metabolic response of summer rape (*Brassica napus* L.) to negative effects of climate change”. Post-doc Dr. Aušra Dikšaitytė. Research supervisor Dr. Akvilė Viršilė. 2017–2019.
3. “The impact of light quantity and quality parameters on changes of the *fragaria* x *ananassa* pathogens bioecological properties”. Post-doc Dr. Neringa Rasiukevičiūtė. Research supervisor Dr. Aušra Brazaitytė. 2017–2019.
4. “Assessment of different perennial herbaceous plant species as potential feedstocks for conversion into bioenergy products”. Post-doc Dr. Kristina Amalevičiūtė-Volungė. Research supervisor Dr. Bronislava Butkutė. 2017–2019.

Other projects of the Research Council of Lithuania

Sub-activity “Development of students’ competences through participation in scientific summer practice”

1. “The effect of different concentration of CO₂ in the air on plant development at the initial growth stages”. Leader Dr. Vita Tilvikienė. July 1 – August 31, 2019.
2. “Quality of non-food plants and evaluation of their potential applications”. Leader Dr. Žydrė Kadžiulienė. July 1 – August 31, 2019.
3. “Investigation of the influence of biochar on soil GHG emissions and water holding capacity”. Leader Dr. Dalia Feizienė. July 1 – August 31, 2019.
4. “The impact of physical methods on the changes in secondary metabolites and photosynthetic indicators in different half-sib families of *Picea abies*”. Leader Dr. Vaida Šėžienė. July 1 – August 31, 2019.

Sub-activity “Developing students’ skills in conducting research during the semester”

1. “Optimisation of expression of recombinant peptides in tobacco plants and purification”. Leader Prof. Dr. habil. Vidmantas Stanys. October 18, 2019 – April 30, 2020.
2. “The use of biogas production waste substrate for crop fertilisation – its effect on the soil, GHG emission and crop quality”. Leader Dr. Vita Tilvikienė. October 18, 2019 – April 30, 2020.
3. “The effect of biochar on soil water retention and plants”. Leader Dr. Dalia Feizienė. October 18, 2019 – April 30, 2020.

Sub-activity “Research done by students during the non-study time”

1. “Bioresponse based cultivation of green leafy vegetables in closed environment agriculture”. Project leader Dr. Giedrė Samuolienė. 2018 October 1st – 2019 April 30th.
2. “Improvement of student’s competence in conducting research in the field of efficient use of biomass for bioenergy”. Project leader Dr. Vita Tilvikienė. 2018 October 1st – 2019 April 30th.
3. “The photosynthetic and antioxidant response of horticultural plants to the pathogenesis of *Botrytis* spp. under the lighting”. Project leader Dr. Viktorija Vaštakaitė-Kairienė. 2018 October 1st – 2019 April 30th.

Applied research funded by the Ministry of Agriculture of the Republic of Lithuania

The agriculture, food and fisheries research and development projects

1. “Residues of glyphosate and its breakdown product AMPA in the soil and duration of their degradation”. Project leader Dr. Gražina Kadžienė. 2019–2021.
2. “Safety and quality of fruit and vegetable produce as influenced by different cultivation technologies”. Project leader Dr. Darius Kviklys. 2019–2020.
3. “Development of guidelines of integrated pest management (IPM) for agricultural and horticultural crops”. Project leader Dr. Roma Semaškienė. 2018–2019.
4. “Development of the Code for Good Agricultural Practice, whose application would mitigate negative effects of agriculture on soil, water, air and climate”. Project leader Dr. Virginijus Feiza. 2018–2019.
5. “Evaluation of the most harmful seed borne diseases of cereals and fodder legume crops, and the establishment of their thresholds in certified seed of cereals and fodder crops”. Project leader Dr. Roma Semaškienė. 2017–2019.
6. “Assessment of the potential of carbon sequestration in agriculture”. Project leader Dr. Žydrė Kadžiulienė. 2017–2019.
7. “Evaluation of cereal varieties susceptibility for integrated pest management (IPM)”. Project leader Dr. Jūratė Ramanauskienė. 2017–2019.
8. “The use of digestate for the fertilization of agricultural crops”. Project leader Dr. Vita Tilvikienė. 2017–2019.
9. “The inventory of greenhouse gas emissions in crop production”. Project leaders Dr. Jūratė Aleinikovienė (ASU), Dr. Vita Tilvikienė. 2017–2019.
10. “Analysis of epidemiological and laboratory research of ASF (African swine fever), prognosis of disease transmission, risk analysis and disease management strategy in wildlife and pig farming localities in the Republic of Lithuania”. Project leader Dr. Olgirda Belova. 2017–2019.
11. “Long-term monitoring of soil agrochemical properties”. Project leader Prof. Dr. habil. Gediminas Staugaitis. 2016–2020.

Support for Lithuanian beekeeping sector

“Investigation, consolidation and preservation of beneficial properties of *Apis mellifera Carnica* existing and newly developed strains, adapted to Lithuanian climate and honey flow”. Leader Dr. Violeta Čeksterytė. 2019.

Support for projects of the measure “Knowledge transfer and information activities” (Program for the Lithuanian rural development 2014–2020)

1. “Implementation and spread of innovative technologies in growing of clonal stands of *Populus* hybrids in the areas that are not suitable for agriculture”. Project leader Dr. Sigutė Kuusienė. 2019–2020.
2. “Quality and risk assessment of conserved forages aimed at ensuring high feeding-value forage and well-being for dairy cattle”. Project leader Dr. Audronė Mankevičienė. 2017–2020.
3. “Crop rotation diversification and agro-technology optimization for the restoration of biodiversity and agro-ecosystem functions”. Project leader Dr. Lina Šarūnaitė. 2017–2020.

EIP activity group project (Program for the Lithuanian rural development 2014–2020)

1. “Targeted introduction of integrated pest control under intensive farming conditions”. Project leader Dr. Antanas Ronis. 2018–2020.
2. “Improvement and dissemination of innovative technologies for larch, spruce, birch and alder tree species plantation forestry breeding and maintenance”. Project leader Dr. Gediminas Čapkauskas. 2018–2020.
3. The “Innovation gateway” centre for knowledge gathering and transfer, development and demonstration of agricultural technologies”. Project leaders Rimtautas Petraitis (LAAS), Dr. Roma Semaškienė. 2017–2019.

Applied research projects funded by the Ministry of environment of the Republic of Lithuania and its subordinate state institutions

1. “The services for level II forest monitoring”. Project leader Dr. Vidas Stakėnas. Customer – State Forest Service. 2019.
2. Flow analysis of industrial wood to determine cumulative changes in carbon stocks in wood products”. Project leader Dr. Marius Aleinikovas. 2019–2020.
3. “A study of environmental risk assessment of GMO”. Project leader Dr. Algimantas Paulauskas (VDU), coordinator LAMMC Dr. Kristina Jaškūnė. 2019–2020.
4. “Preparation of genetic monitoring methodology for Scots pine, Norway spruce, pedunculate oak”. Project leader dr. Virgilijus Baliuckas. 2019–2021 m.
5. “Sustainable forests for the future society”. Project leader Dr. Marius Aleinikovas. 2017–2019.
6. “Selection of Scots pine genotypes resistant to root rot”. Project leader Dr. Virgilijus Baliuckas. 2017–2019.

Technological development project funded by the Agency for Science, Innovation and Technology (MITA)

“Creation of prototypes of technology of birch juice industrial extraction and innovative biologically valuable products”. Project leader Prof. Dr. Pranas Viškelis. 2019–2020.

Support of the Ministry of Transport and Communications of the Republic of Lithuania**Support for the project 2014-2020 EU Fund Investment Program Priority 2 “Promotion of Information Society” 02.3.1-CPVA-V-529 Measure “Development of Advanced Electronic Services”**

“Modernization and Development of Informational, Advisory and Training Electronic Services for Integrated Plant Protection”. No.02.3.1-CPVA-V-529-01-0003. Leaders Ilma Rimkevičienė (Lithuanian Agricultural Advisory Service), Dr. Alma Valiuškaitė. 2017–2020.

11.1.2. International projects**“Horizon 2020” projects**

1. “Stepping-up IPM decision support for crop protection” (IPM Decisions). Coordinator in the Institute of Agriculture Dr. Roma Semaškienė. 2019–2024.
2. “Best4Soil”. Coordinator in the Institute of Agriculture Dr. Antanas Ronis. 2019–2021.

3. “Fostering sustainable legume-based farming systems and agri-feed and food chains in the EU” (LEGVALUE). Coordinator at the Institute of Agriculture Dr. Žydrė Kadžiulienė. 2017–2021
4. “Thematic network to design the penetration path of non-food agricultural crops into European agriculture” (PANACEA). Coordinator at the Institute of Agriculture Dr. Vita Tilvikienė. 2017–2020.
5. “European Fruit Network” (EUFRUIT). Coordinator at the Institute of Horticulture Dr. Audrius Sasnauskas. 2016–2019.

Projects of “Interreg” program

1. “Baltic Phytoremediation” (BAPR). Coordinator in the Vėžaičiai branch Dr. Danutė Karčauskienė. 2019–2022.
2. “Market driven authentic Non-Timber Forest Products from the Baltic region – focus on wild and semi cultivated species with business potential” (NovelBaltic). Coordinator at Institute of Horticulture Dr. Ramunė Bobinaitė. 2019–2021.
3. “Water Management in Baltic Forests Tool Box” (WAMBAF). Coordinator in Lithuania Dr. Olgirda Belova. 2019–2021.
4. “Revival of old traditional fruit, vegetable and ornament plants and their products: Heritage Gardens Tour”. Coordinator at the Institute of Horticulture Dr. Darius Kviklys. 2017–2019.
5. R004 “Advancement of nontechnological innovation performance and innovation capacity in fruit growing and processing sector in selected Baltic Sea Region countries” (InnoFruit). Coordinator at the Institute of Horticulture Dr. Darius Kviklys. 2016–2019.
6. “Water Management in Baltic Forests (WAMBAF)”. Coordinators at the Institute of Forestry: Dr. Marius Aleinikovas and Dr. Olgirda Belova. 2016–2019.

LIFE projects

1. “Demonstration of climate change mitigation potential of nutrients rich organic soils in Baltic States and Finland” (LIFE OrgBalt). Coordinator in the Institute of Forestry Dr. Kęstutis Armolaitis. 2019–2023.
2. “NutriBiomass4LIFE – Nutrient recycling circular economy model for large cities – water treatment sludge and ashes to biomass to bio-energy”. Coordinator at LAMMC Agrochemical Research Laboratory Dr. Lina Žičkienė. 2018–2022.

Projects of Research Framework Programme FP 7

1. FP7 ERA-NET SUMFOREST. “Benchmarking sustainability performance of value chains using ToSIA, the Tool for Sustainability Impact Assessment”. Coordinator in the Institute of Forestry Dr. Marius Aleinikovas. 2017–2019.
2. FP7-ERANET-2013-RTD. “IT-solutions for user friendly IPM-tools in management of leaf spot diseases in cereals (SpotIT)”. Coordinator in the Institute of Agriculture Dr. Antanas Ronis. 2017–2019.

Projects of other EU programmes supporting research

1. SNS project “Conservation of resistant ash (*Fraxinus excelsior*) genotypes in Nordic and Baltic regions to maintain the full range of ecosystem-services provided by this keystone species”. Coordinators at the Institute of Forestry Dr. Diana Marčiulynienė, Prof. Dr. habil. Alfas Pliūra. 2019–2022.
2. Inter-institutional collaboration project “Ash-Adapt – Evolutionary potential of natural *Fraxinus excelsior* populations challenged by novel pests and pathogens”. Coordinators at the Institute of Forestry Dr. Rita Verbylaitė, Prof. Dr. habil. Alfas Pliūra. 2019–2021.

3. EFINORD-SNS (Forest Bioeconomy Network and Nordic Forest Research) network “Integrating knowledge on nutrient cycling and organismal responses for sustainable use wood ash in Nordic forests – NORDASH”. Coordinator in the Institute of Forestry Dr. Iveta Varnagirytė-Kabašinskienė. 2019.
4. “Baltic Sea Region network for sustainable wheat production” (BALTICWHEAT). Coordinator at the Institute of Agriculture Dr. Rita Armonienė. 2019–2020.
5. Swedish Institute Baltic Sea Cooperation project “Cooperation in the Baltics on the development of strategies to foresee outbreaks of *Fusarium* damage”. Coordinator in the Institute of Agriculture Dr. Skaidrė Supronienė. 2017–2019.
6. Long-term research program CoFoRD 14C/846: FORM “Forest Management – Research required to investigate genetic resistance to ash dieback disease *Hymenoscyphus pseudoalbidus* (anamorph *Chalara fraxinea*) and the development of disease resistant ash planting stock”. Coordinator in the Institute of Forestry Prof. Dr. habil. Alfas Pliūra. 2016–2019.
7. “Perennial ryegrass breeding research in Nordic and Baltic countries”. Coordinator in the Institute of Agriculture Dr. Gintaras Brazauskas. 2014–2019.
8. SNS (Nordic Forest Research Co-operation Committee) project “CAR-ES III Centre of advanced research on environmental services from Nordic forest ecosystems”. Coordinator in the Institute of Forestry Dr. Iveta Varnagirytė-Kabašinskienė. 2016–2020.
9. The European Cooperative Programme for Plant Genetic Resources project “Facilitating use on the European perennial ryegrass collection: improving access to genetic resources and C&E data (ImprovLoliumCol)”. Coordinators at the Institute of Agriculture Dr. Eglė Norkevičienė, Dr. Vilma Kemešytė. 2018–2021.
10. Nordfruit: “Pre-breeding for future challenges in Nordic fruits and berries” partly supported by the Nordic Council of Ministers. Coordinator at the Institute of Horticulture Dr. Audrius Sasnauskas. 2018–2020.

COST actions

1. CA18134 – “Knowledge for Resilient Ecosystems” (G-BIKE). Coordinators in the Institute of Forestry Dr. Olgirda Belova, Prof. Dr. habil. Alfas Pliūra. 2019–2023.
2. FP1406 – “Pine pitch canker – strategies for management of *Gibberella Circinata* in greenhouses and forests” (PINESTRENGTH). Management committee member at Vokė Branch Dr. Audrius Kačergius. 2015–2019.

Ongoing projects

1. “EUFORGEN – The European forest genetic resources programme – IV”. Coordinator in the Institute of Forestry Dr. Virgilijus Baliuckas. Since 2010.
2. SNS (the Nordic Forest Research Cooperation Committee) project “Northern European database of long-term forest experiments”. Coordinator in the Institute of Forestry Dr. Marius Aleinikovas. Since 2008.
3. “Winter wheat breeding, variety testing and marketing in Estonia”. Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 2000.
4. “European plant genetic resources conservation programme”. Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 1998.
5. “Research on winter wheat winterhardiness and diseases”. Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 1994.
6. “Research on facultative and winter wheat”. Coordinator in the Institute of Agriculture Assoc. Prof. Dr. Vytautas Ruzgas. Since 1993.

11.2. Major scientific publications

Articles in the journals indexed in *Clarivate Analytics Web of Science* database (impact factors for 2018)

1. **Bendokas V.**, Skemiene K., Trumbeckaitė S., **Stanys V.**, Passamonti S., Borutaite V., Liobikas J. 2019. Anthocyanins: From plant pigments to health benefits at mitochondrial level. *Critical Reviews in Food Science and Nutrition*. *In Press*. **IF – 6.704**
2. Agathokleous E., Anav A., **Araminienė V.**, De Marco A., Domingos M., Kitao M., Koike T., Manning W. J., Paoletti E., Saitanis C. J., Sicard P., Vitale M., Wang W., Calabrese E. J. 2019. Commentary: EPA's proposed expansion of dose-response analysis is a positive step towards improving its ecological risk assessment. *Environmental Pollution*, 146: 566–570. **IF – 5.714**
3. **Araminienė V.**, Sicard P., Anav A., Agathokleous E., **Stakėnas V.**, De Marco A., **Varnagirytė-Kabašinskiene I.**, Paoletti E., Girgždienė R. 2019. Trends and inter-relationships of ground-level ozone metrics and forest health in Lithuania. *Science of the Total Environment*, 658: 1265–1277. **IF – 5.589**
4. Buragienė S., Šarauskis E., Romaneckas K., Adamavičienė A., Kriauciūnienė Z., **Avižienytė D.**, Marozas V., Naujokienė V. 2019. Relationship between CO₂ emissions and soil properties of differently tilled soils. *Science of the Total Environment*, 662 (20): 786–795. **IF – 5.589**
5. **Šarauskis E.**, **Masilionytė L.**, Juknevičius D., Buragienė S., Kriauciūnienė Z. 2019. Energy use efficiency, GHG emissions, and cost-effectiveness of organic and sustainable fertilisation. *Energy*, 172: 1151–11690. **IF – 5.537**
6. **Tilvikienė V.**, **Kadziulienė Z.**, **Liaudanskienė I.**, Zvicevicius E., Cerniauskienė Z., Ciplienė A., Raila A. J., Baltrusaitis J. 2019. The quality and energy potential of introduced energy crops in Northern part of temperate climate zone. *Renewable Energy*, 9 November. *In Press*. **IF – 5.439**
7. Agathokleous E., **Araminiene V.**, Belz R. G., Calatayud V., De Marco A., Domingos M., Feng Z. Z., Hoshika Y., Kitao M., Koike T., Paoletti E., Saitanis C. J., Sicard P., Calabrese E. J. 2019. A quantitative assessment of hormetic responses of plants to ozone. *Environmental Research*, 176, September 2019, 108527. **IF – 5.026**
8. **Adaškevičiūtė V.**, **Kaškonienė V.**, **Kaškonas P.**, **Barčauskaitė K.**, Maruška A. 2019. Comparison of Physicochemical Properties of Bee Pollen with other Bee Products. *Biomolecules*, 9: 819. **IF – 4.694**
9. **Damanauskas V.**, **Velykis A.**, **Satkus A.** 2019. Efficiency of disc harrow adjustment for stubble tillage quality and fuel consumption. *Soil and Tillage Research*, 194:104311. **IF – 4.675**
10. Callesen I., Clarke N., Lazdinš A., **Varnagiryte-Kabasinskiene I.**, Raulund-Rasmussen K. 2019. Nutrient release capability in Nordic and Baltic forest soils determined by dilute nitric acid extraction–Relationships with indicators for soil quality, pH and sustainable forest management. *Ecological Indicators*, 96 (1): 540–547. **IF – 4.490**
11. **Brazaitytė A.**, **Viršilė A.**, **Samuolienė G.**, **Vaštakaitė-Kairienė V.**, **Jankauskienė J.**, **Miliauskienė J.**, **Novičkovas A.**, **Duchovskis P.** 2019. Response of mustard microgreens to different wavelengths and durations of UV-A LEDs. *Frontiers in Plant Science*, 17 October 2019. **IF – 4.106**
12. Yates S., **Jaškūnė K.**, Liebisch F., Nagelmüller S., Kirchgessner N., Kölliker R., Walter A., **Brazauskas G.**, Studer B. 2019. Phenotyping a dynamic trait: leaf growth of perennial ryegrass under water limiting conditions. *Frontiers in Plant Science*, 22 March 2019. **IF – 4.106**
13. **Samuolienė G.**, **Brazaitytė A.**, **Viršilė A.**, **Miliauskienė J.**, **Vaštakaitė-Kairienė V.**, **Duchovskis P.** 2019. Nutrient Levels in Brassicaceae Microgreens Increase Under Tailored Light-Emitting Diode Spectra. *Frontiers in Plant Science*, 14 Nov 2019. **IF – 4.106**
14. Luksienė Z., **Rasiukeviciute N.**, Zudyte B., **Uselis N.** 2019. Innovative approach to sunlight activated biofungicides for strawberry crop protection: ZnO nanoparticles. *Journal of Photochemistry and Photobiology B: Biology*, Available online 23 October 2019, 111656. **IF – 4.067**
15. Ios R., Aloï F., Piškur, B., Guinet C., Mullett M., Berbegal M., Bragança H., Cacciola S.O., Oskay F., Cornejo C., Adamson K., Douanla-Meli C., **Kačergius A.**, Martínez-Álvarez P., Nowakowska J. A., Luchi N., Vettraino A. M., Ahumada R., Pasquali M., Fourie G., Kanetis L., Alves A., Ghelardini L., Dvořák M., Sanz-Ros A., Diez J. J., Baskarathevan J., Aguayo J. 2019. Transferability of PCR-based diagnostic protocols: An international collaborative case study assessing protocols targeting the quarantine pine pathogen *Fusarium circinatum*. *Scientific Reports*, 9, Article number: 8195 (2019). **IF – 4.011**

16. Mildažienė V., Aleknavičiūtė V., Žūkienė R., Paužaitė G., Naučienė Z., Filatova I., Lyushkevich V., **Haimi P., Tamošiūnė I., Baniulis D.** 2019. Treatment of Common Sunflower (*Helianthus annuus* L.) Seeds with Radio-frequency Electromagnetic Field and Cold Plasma Induces Changes in Seed Phytohormone Balance, Seedling Development and Leaf Protein Expression. Scientific Report, 9: article number 6437 (2019). **IF – 4.011**
17. **Supronienė S., Kadziene G.,** Irzykowski W., Sneideris D., Ivanauskas A., **Sakalauskas S., Serbiak P., Svedzda P., Auskalniene O., Jedryczka M.** 2019. Weed species within cereal crop rotations can serve as alternative hosts for *Fusarium graminearum* causing Fusarium head blight of wheat. Fungal Ecology, 37: 30–37. **IF – 3.990**
18. Odilbekov F., **Armonienė R.,** Koc A., Svensson J., Chawade A. 2019. GWAS assisted genomic prediction to predict resistance to Septoria tritici blotch in Nordic winter wheat at seedling stage. Frontiers in Genetics. **IF – 3.517**
19. **Dikšaitytė A., Viršilė A.,** Žaltauskaitė A., Januškaitienė I., Juozapaitienė G. 2019. Growth and photosynthetic responses in Brassica napus differ during stress and recovery periods when exposed to combined heat, drought and elevated CO₂. Plant Physiology and Biochemistry, 142: 59–72. **IF – 3.404**
20. **Žemaitis P.,** Gil W., Borowski Z. 2019. Importance of stand structure and neighborhood in European beech regeneration. Forest Ecology and Management, 448: 57–66. **IF – 3.126**
21. **Morkūnaitė-Haimi Š., Vinskiene J., Stanienė G., Haimi P.** 2019. Differential Chloroplast Proteomics of Temperature Adaptation in Apple (*Malus x domestica* Borkh.) Microshoots. Proteomics, 19 (19): 1800142. **IF – 3.106**
22. Sarvašová Z., Ali T., Dorđević I., **Lukmine D.,** Quiroga S., Suárez C., Hrib M., Rondeux J., Mantzanas K. T., Franz K. 2019. Natura 2000 payments for private forest owners in Rural Development Programmes 2007–2013-a comparative view. Forest Policy and Economics, 99: 123–135. **IF – 3.099**
23. **Butkutė B.,** Taujenis L., Norkevičienė E. 2019. Small-Seeded Legumes as a Novel Food Source. Variation of Nutritional, Mineral and Phytochemical Profiles in the Chain: Raw Seeds-Sprouted Seeds-Microgreens. Molecules, 24 (1): 133. **IF – 3.060**
24. Vilkiškytė G., Raudonis R., Motiekaitytė V., Vainorienė R., Burdulis D., **Viškelis J.,** Raudonė L. 2019. Composition of Sugars in Wild and Cultivated Lingonberries (*Vaccinium vitis-idaea*). Molecules 2019, 24 (23): 4225. **IF – 3.060**
25. **Vaičiukynė M., Žiauka J.,** Žūkienė R., **Vertelkaitė L., Kuusienė S.** 2019. Absciscic acid promotes root system development in birch tissue culture: a comparison to aspen culture and conventional rooting-related growth regulators. Physiologia Plantarum, 165 (1): 114–122. **IF – 3.000**
26. **Čiplienė A., Gurevičius P., Janulevičius A., Damanauskas V.** 2019. Experimental validation of tyre inflation pressure model to reduce fuel consumption during soil tillage. Biosystems Engineering. 186: 45–59. **IF – 2.983**
27. **Žaltauskaitė J., Dikšaitytė A., Miškelytė D., Kacienė G., Sujetovienė G., Januškaitienė I., Sakalauskienė S., Miliauskienė J., Juknys R.** 2019. Does interspecific competition change the barley's response and recovery from heat wave? Journal of Agronomy and Crop Science, 205 (4): 401–413. **IF – 2.960**
28. Kiiker R., Skrabule I., **Ronis A.,** Cooke D. E. L., Hansen J. G., Williams I. H., Mänd M., Runno-Paurson E. 2019. Diversity of populations of *Phytophthora infestans* in relation to patterns of potato crop management in Latvia and Lithuania. Plant Pathology, 68 (6): 1207–1214. **IF – 2.493**
29. Bartkiene E., Lele V., Sakiene V., Zavistanaviciute P., Ruzauskas M., Bernatoniene J., Jakstas V., **Viskelis P.,** Zadeike D., Juodeikiene G. 2019. Improvement of the antimicrobial activity of lactic acid bacteria in combination with berries/fruits and dairy industry by-products. Journal of the Science of Food and Agriculture, 99 (8): 3992–4002. **IF – 2.422**
30. **Viršilė A., Brazaitytė A., Vaštakaitė-Kairienė V., Miliauskienė J., Jankauskienė J.,** Novičkovas A., **Samuolienė G.** 2019. Lighting intensity and photoperiod serves tailoring nitrate assimilation indices in red and green baby leaf lettuce. Journal of the Science of Food and Agriculture, 99 (14): 6608–6619. **IF – 2.422**
31. **Kochiieru Y., Mankeviciene A., Janaviciene S., Jonaviciene A., Ceseviciene J.** 2019. The influence of milling and sifting processes on deoxynivalenol distribution in whole-wheat flour and its products. World Mycotoxin Journal, 12 (2): 133–140. **IF – 2.406**
32. Makrickiene E., **Danusevičius D.,** Brazaitis G., Manton M. 2019. Morphological and genetic differentiation of wolf trees in Scots pine stands based on chloroplast microsatellite markers. European Journal of Forest Research, 138 (3): 527–537. **IF – 2.354**
33. Odilbekov F., He X., **Armonienė R.,** Saripella G. V., Henriksson T., Singh P. K., Chawade A. 2019. QTL Mapping and Transcriptome Analysis to Identify Differentially Expressed Genes Induced by Septoria Tritici Blotch Disease of Wheat. Agronomy, 9 (9): 510. **IF – 2.259**

34. Marčiulynas A., Sirgedaitė-Šežienė V., Žemaitis P., Baliuckas V. 2019. The Resistance of Scots Pine (*Pinus sylvestris* L.) Half-sib Families to Heterobasidion annosum. *Forests*, 10 (3): 287. IF – 2.166
35. Pliūra A., Jankauskienė J., Bajerkevičienė G., Lygis V., Suchockas V., Labokas J., Verbylaitė R. 2019. Response of juveniles of seven forest tree species and their populations to different combinations of simulated climate change-related stressors: spring-frost, heat, drought, increased UV radiation and ozone concentration under elevated CO₂ level. *Journal of Plant Research*, 132 (6): 789–811. IF – 2.082
36. Barčauskaitė K. 2019. Gas chromatographic analysis of polychlorinated biphenyls in compost samples from different origin. *Waste Management & Research*, 37 (5): 556–562. IF – 2.015
37. Stanys V., Bendokas V., Rugienius R., Sasnauskas A., Frercks B., Mažeikienė I., Šikšnianas T. 2019. Management of anthocyanin amount and composition in genus *Ribes* using interspecific hybridisation. *Scientia Horticulturae*, 247: 123–129. IF – 1.961
38. Viršilė A., Brazaitytė A., Vaštakaitė-Kairienė A., Jankauskienė J., Miliauskienė J., Samuolienė G., Novičkovas A., Duchovskis P. 2019. Nitrate, nitrite, protein, amino acid contents, and photosynthetic and growth characteristics of tatsoi cultivated under various photon flux densities and spectral light compositions. *Scientia Horticulturae*, 258, 108781. IF – 1.961
39. Varnagiryte-Kabašinskienė I., Lukminė D., Mizaras S., Beniušienė L., Armolaitis K. 2019. Lithuanian forest biomass resources: legal, economic and ecological aspects of their use and potential. *Energy, Sustainability and Society*, 9: 41. IF – 1.901
40. Supronienė S., Kadziene G., Irzykowski W., Sneideris D., Ivanauskas A., Sakalauskas S., Serbiak P., Svezda P., Kelpsiene J., Pranaitiene S., Jedryczka M. 2019. Asymptomatic weeds are frequently colonized by pathogenic species of *Fusarium* in cereal-based crop rotations. *Weed research*, 59: 312–323. IF – 1.857
41. Paulikienė S., Raila A., Žvirdauskienė R., Zvicevičius E. 2019. Application of an environmentally friendly preventive measure for the preservation of fresh vegetables. *Journal of Food Science and Technology*, 56 (4): 2147–2157. IF – 1.850
42. Boussora F., Allam M., Guasmi F., Ferchichi A., Rutten T., Hansson M., Youssef H. M., Börner A. 2019. Spike developmental stages and ABA role in spikelet primordia abortion contribute to the final yield in barley (*Hordeum vulgare* L.). *Botanical Studies*, 60 (1): *In Press*. IF – 1.796
43. Šneideris D., Ivanauskas A., Supronienė S., Kadžienė G., Sakalauskas S. 2019. Genetic diversity of *Fusarium graminearum* isolated from weeds. *European Journal of Plant Pathology*, 153 (2): 639–643. IF – 1.744
44. Arlauskienė A., Jablonskyte-Rasce D., Slepeticene A. 2019. Effect of legume and legume-festulolium mixture and their mulches on cereal yield and soil quality in organic farming. *Archives of Agronomy and Soil Science, In Press*. IF – 1.681
45. Menkis A., Povilaitienė A., Marčiulynas A., Lynikienė J., Gedminas A., Marčiulytė D. 2019. Occurrence of common phyllosphere fungi of horse-chestnut (*Aesculus hippocastanum*) is unrelated to degree of damage by leafminer (*Cameraria ohridella*). *Scandinavian Journal of Forest Research*, 34 (1): 26–32. IF – 1.667
46. Tarasevičienė Ž., Viršilė A., Danilchenko H., Duchovskis P., Paulauskienė A., Gajewski M. 2019. Effects of Germination Time on the Antioxidant Properties of Edible Seeds. *CyTA – Journal of Food*, 17: 447–454. IF – 1.605
47. Vaitkūnienė V., Šiukšta R., Leistrumaitė A., Rančelis V. 2019. Prospective use of barley spike/flower homeotic single and double mutants for ornamental purposes. *Euphytica*, 215: 127. IF – 1.527
48. Survilienė E., Kazlauskaitė S. 2019. First report of *Dasineura oxycoccana* in Lithuania – Short Communication. *Plant Protection Science*, 55 (3): 218–221. IF – 1.464
49. Urbanavičiūtė I., Rubinskienė M., Viškelis P. 2019. The Fatty Acid Composition and Quality of Oils From Post-Industrial Waste of Quince *Chaenomeles japonica*. *Chemistry & Biodiversity*, 16 (9): e1900352. IF – 1.449
50. Sirgedaitė-Šežienė V., Baležentienė L., Varnagiryte-Kabašinskienė I., Stakenas V., Baliuckas V. 2019. Allelopathic effects of dominant ground vegetation species on initial growth of *Pinus sylvestris* L. seedlings in response to different temperature scenarios. *iForest – Biogeosciences and Forestry*, 12: 132–140. IF – 1.419
51. Urbanaviciute I., Liaudanskas M., Seglina D., Viskelis P. 2019. Japanese Quince *Chaenomeles Japonica* (Thunb.) Lindl. ex Spach Leaves a New Source of Antioxidants for Food. *International Journal of Food Properties*, 22 (1): 795–803. IF – 1.398
52. Tripolskaja L., Asakaviciute R. 2019. Effects of fertilizers on pulse crop productivity and nitrogen assimilation on acid soil. *Plant, Soil and Environment*, 65 (11): 536–540. IF – 1.337

53. Kryzevicius Z., Karcauskiene D., Álvarez-Rodríguez E., Zukauskaitė A., Slepėtienė A., Volungevicius J. 2019. The effect of over 50 years of liming on soil aluminium forms in a Retisol. The Journal of Agricultural Science, 157(1): 12–19. **IF – 1.330**
54. Česonienė L., Daubaras R., Tamutis V., Kaškonienė V., Kaškonas P., Stakėnas V., Zych M. 2019. Effect of clear-cutting on the understory vegetation, soil and diversity of litter beetles in scots pine-dominated forest. Journal of Sustainable Forestry, 38 (8): 791–808. **IF – 1.242**
55. Toleikiene M., Arlauskiene A., Fliesbach A., Iqbal R., Kadziuliene Z. 2019. The decomposition of standardised organic materials in loam and clay loam arable soils during a non-vegetation period. Soil and Water Research, 31/2019-SWR. **IF – 1.210**
56. Kazlauskaitė-Jadzevicius A., Tripolskaja L., Volungevicius J., Baksienė E. 2019. Impact of land use change on organic carbon sequestration in Arenosol. Agricultural and Food Science, 28 (1): 9–17. **IF – 1.200**
57. Viškelis J., Uselis N., Liaudanskas M., Lanauskas J., Bielicki P., Univer T., Lepsis J., Kviklys D. 2019. Location effects across northeastern Europe on bioactive compounds in apple fruit. Agricultural and Food Science, 28 (2): 93–100. **IF – 1.200**
58. Akinroluyo O. K., Urbanavičiūtė I., Jaškūnė K., Kemešytė V., Statkevičiūtė G. 2019. Differences in salt tolerance between diploid and autotetraploid lines of *Lolium multiflorum* at the germination and vegetative stages. Zemdirbyste-Agriculture, 106 (4): 329–336. **IF – 1.020**
59. Borutinskaitė V., Treigytė G., Matuzevičius D., Čeksterytė V., Kurtinaitienė B., Serackis A., Navakauskas D., Navakauskienė R. 2019. Proteomic studies of honeybee- and manually-collected pollen. Zemdirbyste-Agriculture, 106 (2): 183–190. **IF – 1.020**
60. Karčauskienė D., Repšienė R., Ambrazaitienė D., Mockevičienė I., Skuodienė R., Šiaudinis G. 2019. A complex assessment of mineral fertilizers with humic substances in an agroecosystem of acid soil. Zemdirbyste-Agriculture, 106 (4): 307–314. **IF – 1.020**
61. Kryževičius Ž., Janušienė L., Karčauskienė D., Šlepėtienė A., Vilkienė M., Žukauskaitė A. 2019. Aluminium leaching response to acid precipitation in a lime-affected soil. Zemdirbyste-Agriculture, 106 (4): 315–320. **IF – 1.020**
62. Krokaitė E., Shakenėva D., Juškaitytė E., Rekašius T., Nemanėiūtė-Gužienė J., Butkuvienė J., Patamsytė J., Rančelienė V., Vyšniauskienė R., Duchovskienė L., Jocienė L., Sinkevičienė Z., Naugžemys D., Kleizaitė V., Chmura D., Anderson N. O., Žvingilė D., Kupčinskienė E. 2019. Nitrogen concentration of the aquatic plant species in relation to land cover type and other variables of the environment. Zemdirbyste-Agriculture, 106 (3): 203–212. **IF – 1.020**
63. Liatukas Ž., Supronienė S., Ruzgas V., Leistrumaitė A. 2019. Effects of organic seed treatment methods on spring barley seed quality, crop productivity and disease incidence. Zemdirbyste-Agriculture, 106 (3): 241–248. **IF – 1.020**
64. Mankevičienė A., Semaškienė R., Dabkevičius Z., Kochiieru Y., Janavičienė S., Jonavičienė A. 2019. Do black dots on wheat grains have an impact on deoxynivalenol accumulation? Zemdirbyste-Agriculture, 106 (3): 249–256. **IF – 1.020**
65. Mažeikienė I., Juškytė A. D., Stanys V. 2019. Application of marker-assisted selection for resistance to gall mite and Blackcurrant reversion virus in *Ribes* genus. Zemdirbyste-Agriculture, 106 (4): 359–366. **IF – 1.020**
66. Mažeikienė I., Šikšnėnianienė J. B., Baniulis D., Gelvonauskienė D., Frercks B., Starkus A., Žebrauskienė A., Stanys V. 2019. SSR analysis based on molecular characterisation of apple germplasm in Lithuania. Zemdirbyste-Agriculture, 106 (2): 159–166. **IF – 1.020**
67. Rasiukevičiūtė N., Uselis N., Valiūškaitė A. 2019. The use of forecasting model iMETOS® for strawberry grey mould management. Zemdirbyste-Agriculture, 106 (2): 143–150. **IF – 1.020**
68. Ramanauskienė J., Dabkevičius Z., Tamošiūnas K., Petraitiienė E. 2019. The incidence and severity of take-all in winter wheat and *Gaeumannomyces graminis* soil inoculum levels in Lithuania. Zemdirbyste-Agriculture, 106 (1): 37–44. **IF – 1.020**
69. Skuodienė R., Tomchuk D., Kinderienė I. 2019. The influence of natural and anthropogenic environments on the earthworm population in different grassland ecosystems. Zemdirbyste-Agriculture, 106 (3): 219–226. **IF – 1.020**
70. Šiaudinis G., Karčauskienė D., Aleinikovienė J. 2019. Assessment of a single application of sewage sludge on the biomass yield of *Silphium perfoliatum* and changes in naturally acid soil properties. Zemdirbyste-Agriculture, 106 (3): 213–218. **IF – 1.020**
71. Traskovetskaya V., Gorash A., Liatukas Ž., Saulys N., Ternovyi K., Babayants O., Ruzgas V., Leistrumaitė A. 2019. Virulence and diversity of the *Blumeria graminis* f. sp. *tritici* populations in Lithuania and Southern Ukraine. Zemdirbyste-Agriculture, 106 (2): 107–116. **IF – 1.020**

72. **Toleikienė M., Brophy C., Arlauskienė A., Rasmussen J., Gecaitė V., Kadžiulienė Ž.** 2019. The introduction of soybean in an organic crop rotation in the Nemoral zone: the impact on subsequent spring wheat productivity. *Zemdirbyste-Agriculture*, 106 (4): 321–328. **IF – 1.020**
73. **Tripolskaja L., Ražukas A.** 2019. Improving potato microclone productivity by exogenous application of proline, glutamic acid and stem decapitation. *Zemdirbyste-Agriculture*, 106 (2): 129–134. **IF – 1.020**
74. **Vaitkevičienė R., Žadeikė D., Bartkienė E., Krunglevičiūtė V., Baliukonienė V., Supronienė S., Juodeikienė G.** 2019. The use of rice polish medium for the evaluation of antifungal activity of lactic acid bacteria. *Zemdirbyste-Agriculture*, 106 (1): 59–64. **IF – 1.020**
75. **Vasinauskienė R., Brazienė Z., Avižienytė D.** 2019. The effects of water steam on weeds and fungal diseases in the stands of onion. *Zemdirbyste-Agriculture*, 106 (1): 53–58. **IF – 1.020**
76. **Volungevičius J., Feiza V., Amalevičiūtė-Volungė K., Liaudanskienė I., Šlepetienė A., Kuncevičius A., Vengalis R., Vėlius G., Prapiestienė R., Poškienė J.** 2019. Transformations of different soils under natural and anthropogenized land management. *Zemdirbyste-Agriculture*, 106 (1): 3–14. **IF – 1.020**
77. **Žydelis R., Lazauskas S., Volungevičius J., Povilaitis V.** 2019. Effect of organic and mineral fertilisers on maize nitrogen nutrition indicators and grain yield. *Zemdirbyste-Agriculture*, 106 (1): 15–20. **IF – 1.020**
78. **Arlauskienė A., Cesevičienė J., Velykis A.** 2019. Improving mineral nitrogen control by combining catch crops, fertilisation, and straw management in a clay loam soil. *Acta Agriculturae Scandinavica, Section B – Soil & Plant Science*, 69 (5): 422–431. **IF – 0.810**
79. **Janušauskaitė D., Feizienė D., Feiza V.** 2019. Comparative response of spring and winter triticale productivity and bioethanol yield to fertilisation intensity. *Acta Agriculturae Scandinavica, Section B – Soil & Plant Science*, 69 (2): 95–104. **IF – 0.810**
80. **Jurkšienė G., Baranov O. Y., Kagan D. I., Kovalevič-Razumova O. A., Baliuckas V.** 2019. Genetic diversity and differentiation of pedunculate (*Quercus robur*) and sessile (*Q. petraea*) oaks. *Journal of Forestry Research, In Press*. **IF – 0.777**
81. **Čeksterytė V., Borutinskaitė V., Matuzevičius D., Treigytė G., Navakauskas D., Kurtinaitienė B., Navakauskienė R.** 2019. Evaluation of proteome profiles of *Salix* spp. pollen and relationship between glucose oxidase activity and pollen content in willow honey. *Baltic Forestry*, 25 (1): 83–96. **IF – 0.754**
82. **Onefeli A. O., Stanys V.** 2019. Phylogenetic Study of African Combretaceae R. Br. based on rbcL Sequence. *Baltic Forestry*, 25 (2). **IF – 0.754**
83. **Vaitkeviciene N., Jariene E., Danilcenko H., Kulaitienė J., Mažeika R., Hallmann E., Blinstrubienė A.** 2019. Comparison of mineral and fatty acid composition of wild and cultivated sea buckthorn berries from Lithuania. *Journal of Elementology*, 24 (3): 1101–1113. **IF – 0.733**
84. **Česonienė L., Masaitis G., Mozgeris G., Gadal S., Šileikienė D., Karklelienė R.** 2019. Visible and Near-Infrared Hyperspectral Imaging to Describe Properties of Conventionally and Organically Grown Carrots. *Journal of Elementology*, 24 (2): 421–435. **IF – 0.684**
85. **Januškaitienė I., Sakalauskienė S.** 2019. Dynamics of photosynthetic and oxidative stress parameters of two spinach species after short-term low UC-B radiation effect. *Acta Scientiarum Polonorum Hortorum Cultus*, 18 (1): 141–149. **IF – 0.443**

Monographs, books, textbooks and their sections published by internationally recognized publishers

1. **Brazaitytė A., Vaštakaitė-Kairienė V., Rasiukevičiūtė N., Valiuškaitė A.** 2019. UV LEDs in Postharvest Preservation and Produce Storage. Koutchma T. (ed.): *Ultraviolet LED Technology for Food Applications – From Farms to Kitchens*. Academic Press, p. 67–90.
2. **Cramer W., Bhaduri S., Zakharov S.D., Zhang H., Baniulis D., Yamashita E.** 2019. Cytochrome b6f Complex. In: Roberts G., Watts A., European Biophysical Societies (Eds.) *Encyclopedia of Biophysics*. Springer Berlin Heidelberg, p. 1–9.
3. **Tamošiūnė I., Andriūnaitė E., Stanys V., Baniulis D.** 2019. Exploring Diversity of Bacterial Endophyte Communities Using Advanced Sequencing Technology. *Microbiome in Plant Health and Disease*. Springer, p. 447–481.
4. **Viršilė A., Samuolienė G., Miliauskienė J., Duchovskis P.** 2019. Applications and Advances in LEDs for Horticulture and Crop Production. Koutchma T. (ed.): *Ultraviolet LED Technology for Food Applications – From Farms to Kitchens*. Academic Press, p. 35–65.

LITHUANIAN RESEARCH CENTRE FOR AGRICULTURE
AND FORESTRY

Annual report 2019

Compiled by: Ada Alejūnaitė, Vita Tilvikienė, Valda Araminienė,
Giedrė Samuolienė, Asta Eigirdienė
Layout designer Irena Pabrinkienė

SL 1610. 2020 04 20. 11 printer's sheet

Published by Lithuanian Research Centre for Agriculture and Forestry
Instituto av. 1, Akademija, Kėdainiai distr.
LITHUANIA

CONTACTS

LITHUANIAN RESEARCH CENTRE FOR AGRICULTURE AND FORESTRY

Instituto av. 1,
Akademija, LT-58344 Kėdainiai distr.
Tel.: +370 347 37 271, 37 057
Fax: +370 347 37 096
E-mail: lammc@lammc.lt
<http://www.lammc.lt>



INSTITUTE OF AGRICULTURE

Instituto av. 1, Akademija, LT-58344 Kėdainiai distr.
Tel.: +370 347 37 271
Fax: +370 347 37 096
E-mail: zi@lammc.lt
Enterprise code 302474007,
VAT code LT100005122310

INSTITUTE OF HORTICULTURE

Kauno st. 30, Babtai, LT-54333 Kaunas distr.
Tel.: +370 37 55 52 10
Fax: +370 37 55 51 76
E-mail: institutas@lammc.lt
Enterprise code 302474014,
VAT code LT100005122310

AGROCHEMICAL RESEARCH LABORATORY

Savanorių pr. 287, LT-50127 Kaunas
Tel.: +370 37 31 24 12
E-mail: agrolab@lammc.lt
Enterprise code 302474021,
VAT code LT100005122310

VĖŽAIČIAI BRANCH

Gargždų st. 29, Vėžaičiai, LT-96216 Klaipėda distr.
Tel.: +370 46 45 82 33
E-mail: vezaiciai@lammc.lt
Enterprise code 302474377,
VAT code LT100005122310

PERLOJA EXPERIMENTAL STATION

Perloja, LT-65373 Varėna distr.
Tel.: +370 310 47 624
E-mail: perloja@lammc.lt
Enterprise code 302474306,
VAT code LT100005122310

INSTITUTE OF FORESTRY

Liepų st. 1, Girionys, LT-53101 Kaunas distr.
Tel.: +370 37 54 72 21
Fax: +370 37 54 74 46
E-mail: miskinst@lammc.lt
Enterprise code 302474530,
VAT code LT100005122310

VOKĖ BRANCH

Žalioji sq. 2, Trakų Vokė, LT-02232 Vilnius
Tel.: +370 5 264 5439
E-mail: voke.sekretoriatas@lammc.lt
Enterprise code 302474815,
VAT code LT100005122310

JONIŠKĖLIS EXPERIMENTAL STATION

Karpių st. 1, Joniškėlis, LT-39301 Pasvalys distr.
Tel.: +370 451 38 224
E-mail: joniskelis@lammc.lt
Enterprise code 302474509,
VAT code LT100005122310

RUMOKAI EXPERIMENTAL STATION

Klausučiai st. 20, Klausučiai, LT-70462 Vilkaviškis distr.
Tel.: +370 342 49 422
E-mail: rumokai@lammc.lt
Enterprise code 302474523,
VAT code LT100005122310