



**INTERNATIONAL CONFERENCE OF YOUNG SCIENTISTS  
YOUNG SCIENTISTS FOR ADVANCE  
OF AGRICULTURE  
ABSTRACTS**

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INTERNATIONAL CONFERENCE  
OF YOUNG SCIENTISTS

**YOUNG SCIENTISTS  
FOR ADVANCE  
OF AGRICULTURE**

ABSTRACTS

2019

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# FOREWORD

The Lithuanian Research Centre for Agriculture and Forestry and the Division of Agricultural and Forestry Sciences of the Lithuanian Academy of Sciences are organising the 8th Conference ‘Young Scientists for Advance of Agriculture’. This traditional conference aims to rally young researchers working in the fields of agronomy, forestry science, animal science and veterinary medicine, agricultural engineering, food safety and quality, agrarian economy, and rural sociology. It seeks to encourage their cooperation and dispersion of their research results. The objective of the conference is to promote international collaboration of young scientists and exchange up-to-date research results achieved by Lithuanian and foreign scientists.

Participants at the conference are doctoral students, junior researchers, and lecturers engaged in scientific investigations at research and educational institutions of Lithuania, Latvia, and Finland. This publication contains abstracts of the 30 papers delivered at the conference. They are grouped by the sections of the conference and by order of their presentation.

We hope that the conference will facilitate the spread of information on latest fundamental and applied research among fellow researchers and the general public, consolidate relations between research and educational institutions of different countries, and attract specialists in agriculture and business entities that have expressed considerable interest in the conference and supported its organisation. We also hope that the conference will play at least some role in generating more high-quality and innovative recommendations aimed at rising competitiveness in agricultural production and entrepreneurship, and enhancement of environmental protection.

We are grateful to the conference participants, organising partners and sponsors, and to everyone who has contributed to the organisation of the conference and preparation of this publication.

CONFERENCE ORGANISING COMMITTEE



# PLENARY SESSION

## IMPORTANCE OF STAND STRUCTURE IN EUROPEAN BEECH REGENERATION

Povilas Žemaitis

*Institute of Forestry, Lithuanian Research Centre for Agriculture and Forestry*

The European beech (*Fagus sylvatica* L.) is a competitive and shade-tolerant species, with its regeneration in closed-canopy stands affected by a number of variables. The idea of our study was to combine stand structural indicators used in forestry practices with overstory and understory neighbourhood, ground-layer vegetation (herbs, moss and ferns), and coarse woody debris variables to highlight factors which determine beech regeneration in closed canopy stands. We selected mixed and pure beech stands to focus on two main questions: (1) can environmental and stand structural characteristics be identified which promotes beech regeneration or indicate suitable conditions for regeneration under closed canopy conditions, and (2) do environmental and stand structural characteristics favourable for beech regeneration differ among the ontogeny of seedlings and saplings? In order to answer these questions, we sampled four beech-dominated forest complexes located in northern and southern Poland. Study plots were established in sites with varying overstory composition, from beech-dominated to mixed to conifer-dominated stands. In all analysed forest complexes, regeneration consisted mostly of beech seedlings and saplings with admixture of shade tolerant or intermediate-light tolerant species – Norway spruce, silver fir (*Abies alba* Mill.), hornbeam and box elder (*Acer negundo* L.). The mean density of beech regeneration was 8380 trees ha<sup>-1</sup>, but the inter-plot variation of the regeneration density was high. Beech regeneration occurrence were determined by stand structural characteristics – stand basal area, beech basal area and stand density. The ecological prerequisites favourable for beech regeneration abundance differ along the ontogeny of seedlings and saplings, and structural stand characteristics were most important. The occurrence and abundance of beech regeneration was weakly influenced by intra/interspecific competition among understory plants, while the occurrence of light demanding species regeneration in beech-dominating stands positively correlated with beech regeneration abundance.

## **INFLUENCE OF SMALL-DIAMETER STUMP HEIGHT ON THE PREVALENCE AND DEVELOPMENT OF NATURAL *PHLEBIOPSIS GIGANTEA* AND *HETEROBASIDION* SPP.**

Liene Dārta Lukstiņa, Astra Zaļuma, Lauma Brūna, Dārta Kļaviņa  
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To limit the spread of *Heterobasidion* spp. root rot it would be important to protect small diameter stumps that are left after precommercial thinning. Growth of mycelium in small-dimension stumps is limited by the amount of moisture. Small diameter stumps have large surface area comparing to volume and they lose moisture faster, especially high stumps. With the increase in stump height, the amount of wood substrate available for fungus also increases, but the area of top surface decreases, which may affect the development of mycelia. Previous studies have shown that *Pinus sylvestris* stumps are less susceptible to *Heterobasidion* spp. and more susceptible to *P. gigantea* than *Picea abies* stumps. However, it was also concluded that infection of natural *P. gigantea* is not sufficient to efficiently control *Heterobasidion* spp.

To determine the presence of natural *P. gigantea* as well as development of natural and artificial infection of *Heterobasidion* spp. in small diameter stumps three sample plots were established. In total 300 pine stumps have been analysed, half of them 15 cm high and the other half – 50 cm high. 120 stumps in two sample plots were treated with *Heterobasidion* spp. spore suspension and 180 stumps were left untreated. To analyse growth of mycelia all stumps were cut in 4 to 6 cm thick discs to the ground level. The occurrence of *Phlebiopsis gigantea* and *Heterobasidion* spp. on each disc was analysed using stereo microscope.

Results of this study show that natural infection of *P.gigantea* was significantly more prevalent in small-dimension stumps than natural infection of *Heterobasidion* spp. Even stumps that were artificially treated with conidiospores of *Heterobasidion* spp. were significantly infected by natural *P. gigantea*. Height of stump was a significant factor for development of natural *P. gigantea*, but had no effect on growth of *Heterobasidion* spp.

## **CHANGES IN SOIL MICROBIAL BIOMASS AND DEHYDROGENASE ENZYME ACTIVITY FOLLOWING DIGESTATE FERTILIZATION IN AGRICULTURAL SOIL**

Modupe Doyeni, Vita Tilvikienė, Skaidrė Supronienė

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The increased output of biogas digestates from anaerobic digestion has resulted in their subsequent application to soil in agricultural system. Bio-digestates are rich in nutrients and its application aim to improve soil quality through transformation of organic matter content. An important component of the soil ecosystem that play a critical role in organic matter cycling are the soil microbes. They play important roles in the breakdown of complex organic molecules to simpler molecules and in the cycling of soil components of nutritional importance for the plants. Their functional diversity and activities in the soil constitute a precise reflection of the conditions of the soil quality.

The aim of this on-going study is to examine the role of fertilization of different digestate manures (liquid fraction of pig, chicken and cow manure) and mineral nitrogen fertilizer on the soil microbial biomass carbon (SMB-C) and on the dehydrogenase enzyme activity (DHA) of soil. The experiment field was split fertilized with application rate of 90 and 80 kg N ha<sup>-1</sup> respectively at the tillering and stem elongation stages. The soil microbial biomass was measured through the chloroform fumigation extraction method while the DHA was performed using Casida et al (1964) method with modifications. The effects on DHA and SMB-C were determined in relation to soil moisture, soil temperature and other soil factors. Cow manure digestate had the lowest impact on soil microbial biomass of 275 µg<sup>-1</sup> after the first year of fertilization and pig and chicken manure digestate applied on the soil showed the highest values of SMB-C. There were no significant differences between the treatments in dehydrogenase enzyme activity. However, cow manure digestate showed the highest DHA change after the second fertilization with 13.14 µgTPFg<sup>-1</sup>d.w.soil 24 h<sup>-1</sup> and a drop in pig digestate manure. The preliminary results suggest that soil microbial activities are very sensitive to both natural and anthropogenic disturbances and show quick responses to the induced changes. However, effective management practices in digestate application to soil is beneficial to the quality of soil and plant growth.

## OZONATED HEMP OIL AS A NEW ANTIFUNGAL AGENT IN VETERINARY MEDICINE

Gabrielė Slavinskienė, Aidas Grigonis, Marija Ivaškienė  
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**Introduction:** *Microsporium canis* is the main zoonotic pathogenic fungi in veterinary. All the conventional antifungal drugs have many side effects: drug induced liver injury (DILI), diarrhea, nausea, gastric pain, gynecomastia, hepatic coma and necrosis, contact allergy. While increasing resistance is being described to antifungals in dermatophytes, new drug development lags far behind. There is a growing need for new and safe antifungal alternatives. Ozonated oils could be a problem solution. They are strong oxidizers and pathogens can't develop resistance. Ozone is also friendly for environment. After reaction it breaks down into oxygen, leaving no residues. The aim of the present assay was to determine the effect of ozonated hemp oil to dermatophyte *M. canis in vitro*.

**Methods:** 6 *M. canis* strains obtained from clinical cases and 8 antifungals (4 commercial drugs (clotrimazole, enilconazole, olamine piroctone, terbinafine hydrochloride), 3 alternatives (*Pelargonium graveolens* var. *himalayica* essential oil, *Aloe vera*, Charmil plus) and ozonated hemp oil) were used in this study. Hemp oil was used as a control. It was conducted using disk diffusion method (6 mm disks) on Sabouraud agar.

**Results:** Inhibition zone of ozonated hemp oil was  $22.19 \pm 3.3$  mm. It was the largest inhibition zone of all alternative antifungals: Charmil plus – 16.88 mm; *Aloe vera* – 0 mm; *Pelargonium* essential oil – 0 mm. It was also found that only 3 out of 4 antifungal drugs had stronger inhibition effect on *M. canis* than ozonated hemp oil: clotrimazole – 54.85 mm; terbinafine hydrochloride – 51.95 mm; enilconazole – 49.77 mm; olamine piroctone – 15.29 mm. Using pH-meter it was concluded that after ozonation of hemp oil the pH value dropped significantly and the final ozonation product had acidic properties (pH 3.59). It was also established that holding ozonated hemp oil in the refrigerator during a three-month period ozone concentration change was slight ( $2.2 \pm 0.4\%$ ).

**Conclusion:** ozonated hemp oil could be used as antifungal agent for *M. canis* skin infection treatment. Its inhibition zone is similar to tested antifungal drugs, pH value is aggressive to dermatophytes and while kept in refrigerator it remains almost stable entire treatment time.

## GENETIC ORIGIN OF *FAGUS SYLVATICA* IN LITHUANIA ASSESSED BY N SSR MARKERS

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*Fagus sylvatica* is an introduced forest tree species in Lithuania. Based on historical data, *Fagus sylvatica* stands were planted by German foresters before the Second World. The main problem with these plantations is the unknown origin. If these plantations originate from too far south, their adaptability can be compromised due to its southern origin. If we use these planted stands as the main introduction source of beech in Lithuania, our new beech forests may suffer from maladaptation.

The material of the study was sampled in 5 planted mixed pine-beech and oak-beech forest stands and 4 old parks located mainly in western part of Lithuania, except 2 parks: Žagarė park is located in Northern part of Lithuania, Girionys park is located in central part of Lithuania. The target sample size per stand was 50 mature trees. In parks sampling has been done for all trees we have found.

The nuclear DNA was extracted from silica-gel dried wood samples based on modified ATMB DNA extraction method. 10 nSSR were used for genotyping the sampled trees. PCR was carried out with following thermocycling profile: initial denaturation step at 95 °C for 15 min, followed by 24 cycles each of 94 °C for 30 sec, annealing temperature at 55 to 57 °C for 1.3 min, 72 °C for 30 sec and final extension step of 60 °C. for 30 min. Capillary electrophoresis was carried out by 310 Genetic Analyzer (Applied Biosystems). The data set for the origin determination have been collected in collaboration with Bavarian Office for Forestry seed and plant breeding.

Obtain results show the main three origin sources for *Fagus sylvatica* in Lithuania. Kliošiai stand trees were introduced from the former Prussia region. The second introduction source is the southeast part of Poland. Norkaičiai forest stand is introduced from southeast Poland origin sources. All the rest stands or groups of *Fagus sylvatica* in Lithuania: Mociškiai, Jūrava, Viešvilė, Būbliškės, Žagarė, Girionys were introduced from Bavarian region. *Fagus sylvatica* of Būbliškės are originated exclusively from Bavarian part with high elevation. Results show that *Fagus sylvatica* in Lithuania originate.

## EXTRACTS OF VARIOUS PLANT FAMILIES FOR BIOCONTROL OF *BOTRYTIS CINEREA*

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*Botrytis cinerea* is a harmful fungal pathogen with a variety of hosts, resulting in the yields and plant losses. The primary control of this pathogen is chemical fungicides however it is well known that these measures have a negative impact on the environment, soil, and human health. Thus, alternative plant protection is on-demand, including material from plants, like essential oils and extracts. The antioxidant, antimicrobial, antifungal and medicinal properties of *Myrtaceae*, *Lauraceae* and *Lamiaceae* family plants are present. The aim of this research was to evaluate the inhibition of strawberry *B. cinerea* by several extracts from plant families: 1) *Myrtaceae*: allspice and clove; 2) *Lauraceae*: cinnamon and bay; 3) *Lamiaceae*: peppermint and rosemary. The research was carried out at LAMMC Institute of Horticulture, 2017–2019. The extracts obtained with CO<sub>2</sub> extraction were individually tested by mixing it with potato dextrose agar media at 200–1000 µl/l concentrations. Plates with extracts were inoculated with 6 mm pathogen plug and incubated at 22 °C in the dark. The diameter of the pathogen colony was evaluated 2, 4 and 7 days after inoculation. The antifungal activity of the extracts was expressed as inhibition percentage.

The results showed that inhibition of the extracts of *Myrtaceae* plants was clove – 100% and allspice – 56.32%. Meanwhile investigated extracts of *Lauraceae* family had similar inhibition: cinnamon extract fully inhibited the growth of the pathogen (100%) and bay extract reached 58.53%. However this extract did not demonstrate constant growing inhibition with the increased concentration. *Lamiaceae* plant extracts were least effective, as their inhibition was: rosemary – 52.21% and peppermint – 0%. To conclude, the highest antifungal activity had clove and cinnamon extracts, belonging to *Myrtaceae* and *Lauraceae*, and other extracts from these families (allspice and bay) showed moderate effect. Mentioned extracts have potential to become active ingredients of biocontrol products against *B. cinerea* after further investigation.

## THE EFFECT OF SOIL TEMPERATURE AND WATER CONTENT ON CO<sub>2</sub> EFFLUX ON ARABLE LAND OF CAMBISOL

Mykola Kochiieru, Virginijus Feiza, Jonas Volungevičius  
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Soil temperature and soil moisture, are the major abiotic factors controlling soil CO<sub>2</sub> concentration. Soil CO<sub>2</sub> concentrations often reveal a temperature-driven seasonal trend. The aim of the study was to quantify the effect of soil temperature and soil volumetric water content on carbon dioxide (CO<sub>2</sub>) efflux on arable land under conventional tillage (CT) and reduced tillage (RT) of *Cambisol*, Central Lithuania. In this research the temporal dynamic changes of CO<sub>2</sub> efflux from the soil surface using a closed chamber method (LI-COR LI-8100A Automated Soil CO<sub>2</sub> Flux System) were investigated. We also investigated the soil temperature (T<sub>soil</sub>) and soil volumetric water content (VWC) using HH2 WET sensor at same time. Soil CO<sub>2</sub> efflux was measured 11 times from January to December, 2018. Each measurement was performed in triplicate, at the same time of the day (from 10 a.m. to 5 p.m.).

The greatest efflux values ranging from 0.18 to 2.70 μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup> were recorded on the arable land under RT and from 0.10 to 2.34 μmol CO<sub>2</sub> m<sup>-2</sup>s<sup>-1</sup> were registered on the arable land under CT. The same trend of CO<sub>2</sub> efflux originating from the soil during investigation period was observed in two experimental treatments. Generally, the effluxes increased gradually after sowing, reached the maximum between the beginning of May till the end of July.

T<sub>soil</sub> amounted from 1.0 to 35.1 °C, VWC from 3.8 to 28.0% in the soil depth of 0–5 cm of the CT, and soil temperature (1.2–33.0 °C), VWC (2.5–28.2%) at the same soil depth were recorded in arable land under the RT.

Topsoil CO<sub>2</sub> efflux under arable land on *Cambisol* was directly related to T<sub>soil</sub> and VWC. T<sub>soil</sub> was dominant factor enhancing CO<sub>2</sub> on arable land during measurement period ( $y = 0.002x^2 - 0.010x + 0.182$ ,  $R^2 = 0.71$ ) and during vegetation period (from April to August) ( $y = 0.10x - 1.20$ ,  $R^2 = 0.53$ ). During the all investigation period, the correlation analyses showed poor relationship between soil CO<sub>2</sub> efflux and VWC at the 5 cm depth, but during the vegetation season (from April to August) CO<sub>2</sub> efflux displayed a typical polynomial relationship with VWC ( $y = -0.01x^2 + 0.29x + 0.17$ ,  $R^2 = 0.75$ ).

## **CHANGES OF CORTISOL AND WHOLE BLOOD LEVEL INDUCED BY EQUINE OSTEOPATHIC TREATMENT**

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Introduction: Osteopathy is a branch of complementary veterinary medicine involving gentle manipulation to promote healing in damaged and stiff muscles and joints. Even though many researches are done for humans, but there is still little known about horse body reaction to treatment.

The aim of study was to find osteopathy effect on horse haematology and blood cortisol levels.

Materials and methods. Eight clinically healthy and regularly trained Hanoverian breed horses (8 geldings, mean age from  $7 \pm 1$ ) were enrolled in the study. Animals were treated osteopathically in their stables to cause less stress to the horses. Each horse was treated one hour. Four periods were chosen for blood samples: before the treatment P(0), after treatment P(1), one hour post treatment P(3) and two hours post treatment P(4). Blood samples were taken by puncture of the jugular vein and collected in a test tube (BD Serum Tubes, UK) with silica particles added to trigger coagulation for checking cortisol and (BD Vacutainer, UK) with anticoagulant EDTA for morphological tests. After taking blood samples they were placed into transport refrigerator ( $0-4$  °C), and brought to the examination centre of Veterinary Academy, LUHS. Blood parameters were assessed by AIA-360 automated immunoassay analyser (Tosoh Bioscience, Inc., San Francisco, USA) and by automatic morphologic analyser "Abacus Junior Vet" (Diatron Messtechnik GmbH, Austria).

Results and conclusion. The study showed that P(1) cortisol level was highest and indicated significant difference  $p < 0.05$  compared with P(3), which dropped lower even compared with P(0). As well osteopathic treatment had impact on changes of RBC, HGB, HCT, WBC and LYM, which were statistically significant  $p < 0.05$ . Blood value measurements dropped lower 26.75% till P(3) and then went up again 18.33% in P(4) in comparison with starting point P(0). The findings undoubtedly show huge body reaction in physiological processes: stress, fluid balance, cardiovascular homeostasis, immune and inflammatory responses. Osteopathic treatment stimulates all body and promotes healing.



## **FACTORS AFFECTING FEMALE UNEMPLOYMENT IN THE BALTIC COUNTRIES**

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Reducing unemployment is one of the European Union's development priorities. Although the female unemployment rate is a couple of percent lower than the male unemployment rate, it is also relatively high and is influenced by factors that only apply women. Undeniably, both unemployment in general and women's unemployment have serious consequences for the economy and development of the nation, undermining the well-being of people and better living conditions, and that is why access to paid employment has always been of great importance. A country cannot become economically developed if it has a significant number of unemployed. The presentation compares the latest data on the factors affecting female unemployment in the Baltic States.

# SECTION A. AGRONOMY AND FORESTRY

## CROP ROTATION AND SOIL TILLAGE INFLUENCE ON WINTER WHEAT YIELD FORMATION

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Wheat (*Triticum aestivum*) grain yield increase can be achieved through various agro-technical measures. The aim of the research was to compare whether crop rotation, fore-crop, soil tillage and year have an impact on the grain yield formation of winter wheat.

Study was based on three year data (2016/2017 – 2018/2019) from a two factorial long-term trial. Two soil tillage variants (conventional and reduced) and three crop rotation schemes ((1) repeated wheat sowings (W–W), (2) oilseed rape (*Brassica napus*) – wheat – wheat (OR–W–W), (3) faba bean (*Vicia faba*) – wheat – oilseed rape – barley (*Hordeum vulgare*) (FB–W–OR–B)) were used in the trial. Crop rotation schemes include three fore-crops – wheat (in rotations **W**–W, and OR–**W**–W), oilseed rape (**OR**–W–W) and faba bean (**FB**–W–OR–B). Sowing rate was 450–500 germinable seeds per 1 m<sup>2</sup> depending on the year. Yield was recalculated at 100% purity and 14% moisture. Yield components were analysed from wheat sample-sheets. Four-factor Anova was used for mathematical data processing.

Crop rotation, fore crop and year conditions had a significant impact ( $p < 0.001$ ) on grain yield. The highest average grain yield was gained from rotation (3) FB–W–OR–B (7.35 t ha<sup>-1</sup>), but the lowest from (1) W–W rotation (5.52 t ha<sup>-1</sup>). Significant yield difference was not found depending on two fore-crops: oilseed rape (6.98 t ha<sup>-1</sup>) and faba bean (7.35 t ha<sup>-1</sup>). Soil tillage variant did not affect wheat grain yield significantly. TGW was significantly influenced by crop rotation scheme ( $p < 0.001$ ) and the year ( $p < 0.001$ ); highest TGW was noted in 2017 (46.1 g). TGW of wheat grown in crop rotation (3) FB–W–OR–B was significantly higher (46.5 g), if compared with other two rotations. Average number of spikes per 1 m<sup>2</sup> was 497, and it was significantly influenced by fore-crop and the year. Lower average number of spikes per 1 m<sup>2</sup> was observed in 2019 (402) due to low field germination. Number of kernels per spike differed significantly between all years ( $p < 0.001$ ) and fore-crops ( $p = 0.008$ ), and it varied from 24.6 in 2017 to 34.1 in 2019.

Crop rotation scheme affected the yield and TGW significantly. Fore-crop had a significant influence on yield, number of spikes per 1 m<sup>2</sup>, and number of kernels per spike. Soil tillage did not affect the studied parameters importantly.

## **DISTRIBUTION OF HUMIFIED ORGANIC CARBON IN THE CLAY LOAM SOIL DUE TO TILLAGE INTENSITY**

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The challenge for modern agriculture is to maintain the amount of humus in the soil as much as possible, and to find means to improve its quality. The aim of this study was to determine the changes in humic and fulvic acids and their fractions due to the long-term effects of different intensity tillage. The research was carried out in 2016–2018 at the Joniskelis Experimental Station of the LRCAF on a clay loam soil in the long-term experiment, established in 2006. The following tillage systems were investigated: deep ploughing (DP), shallow ploughing (SP), ploughless tillage (PT), ploughless tillage with lime sludge incorporation (PT+LS), ploughless tillage with cover crops for green manure (PT+GM), no-till with cover crop for winter mulch (NT+WM). The changes in group and fractional composition of the humus were measured in the soil samples collected from 0–10, 10–20 and 20–30 cm layers. Soil humus was fractionated into three humic (HA) and four fulvic (FA) acid fractions according to Ponomariova and Plotnikova scheme. Significant differences among experimental treatment means were assessed by Fisher's LSD test at the 0.05 probability level.

The reduction in tillage intensity resulted in a significant change in the humic acid content of all fractions in the upper 0–20 cm soil layer compared to the control DP. The most significant effect was caused by PT+LS application: it significantly decreased the amount of mobile HA1 and increased the amount of calcium-bound HA2 content in the 0–10 cm layer. The reduction in tillage intensity led to the formation of FAs, but only application of NT+WM resulted in a significantly higher concentration of aggressive FA1a in the upper 0–10 cm layer compared to DP, respectively 0.663 and 0.593 g C kg<sup>-1</sup>. The abundance of clay particles (27%) in the plough layer of clay loam soil resulted in almost 50% of the humified SOC was accumulated in clay minerals bound HA3 and FA3, and the applied tillage had the least influence on these fractions content.

## FABA BEAN QUALITY DEPENDING ON SOWING TIME

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Faba beans (*Vicia faba* L.) are well known for their good qualities as a pre-crop, and as food and feed with high crude protein content. In Baltic countries, mostly spring beans are grown, and only few studies were performed about the effect of sowing time and meteorological conditions on faba bean quality. The aim of this study is to compare faba bean quality depending on three different sowing times in spring.

The study was carried out at the Research and Study Farm “Pēterlauki” of the Latvia University of Life Sciences and Technologies (LLU) in 2018. Four factors were researched: A – sowing time (21, 29 April, and 08 May), B – variety (‘Laura’, ‘Boxer’, ‘Isabell’), C – seeding rate (30, 40 and 50 germinable seeds m<sup>-2</sup>), D – treatment with fungicide (with and without application of fungicide Signum (boscalid, 267.0 g kg<sup>-1</sup>, pyraclostrobin, 67.0 g kg<sup>-1</sup>), 1 kg ha<sup>-1</sup>). Quality characteristics of yield (crude protein content (%), thousand seed weight (TSW; g) and volume weight (g L<sup>-1</sup>) were detected. Meteorological conditions were not suitable for high yield formation due to drought and high temperatures in 2018. Drought in seed developing stage affected bean yield and quality regardless of sowing time.

Crude protein content was higher in beans sown on 08 May, but it did not differ highly from that, when beans were sown on 29 April. TSW and volume weight was higher when beans were sown on 21 April (Table). Beans sown on 08 May needed longer time to develop. When some pods had already ripened, green pods and even flowers were observed at the same time on other branches. Due to unsuitable meteorological conditions for bean yield formation, all seeds were small. Between TSW and volume weight a close, negative correlation was detected ( $r = -0.615 / > r_{0.01} = 0.590$ ). For more detailed information on how sowing time affects faba bean quality, this study should be continued.

Table. **Faba bean quality depending on sowing time ( $p < 0.001$ )**

Sowing time	Quality characteristics		
	Crude protein content, %	Volume weight, g L <sup>-1</sup>	Thousand seed weight, g
21 April	30.87	784.45	539.67
29 April	32.02	773.85	482.63
08 May	32.12	733.55	510.92

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## **THE SIGNIFICANCE OF LEAF AREA INDEX (LAI) DETECTED BY APPLYING HEMISPHERICAL PHOTOGRAPHIES IN THE FOREST HEALTHY AND PRODUCTIVITY REASERCHES**

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Leaf area index (LAI) quantifies the amount of leaf area bearing by a tree or whole stand normalized by the unit of crown projected or the whole stand ground area (Norman and Campbell, 1989). It is one of the most important structural characteristics of a tree foliage (Pokorny and Stojnič, 2012) in controlling many biological and physical processes in plant canopies (Chen et al, 1997). In the presented study LAI was detected at coniferous forest in Aukštaitija National park.

The research aims – to evaluate the significance of leaf area index (LAI) detected applying hemispherical photography method explanation the changes in mean dendrometric parameters of forest stands including tree crown defoliation. The strongest relationships were detected between dendrometric parameters obtained on observation plot radius of which was close to  $10 \pm 1$  meters ( $314 \text{ m}^2$ ) and trees LAI obtained applying just 20–30% of hemispherical photography plot. Changes in mean crown defoliation was the best explain by LAI applying 50% of hemispherical photography plot. The obtained data revealed that the use of hemispheric photograph for LAI estimation in multi-aged and multi-layered mature and over mature pine and spruce stands was rather problematic. Only cover intensity of understory vegetation (grasses and mosses) was reflected best. In pure pine stands LAI also significantly reflected spatial changes in cover intensity of shrubs, grasses and mosses levels and in addition – spatial changes in main dendrometric stand parameters.

In stand, where tree LAI value did not exceed  $0.2 \text{ m}^2/\text{m}^2$  the highest number of seedlings necessary for the new pine stand formation was found to be 7000–10000 per ha. This LAI corresponded to 75 pine trees the mean diameter of which made about 38 cm and their basal area about  $10 \text{ m}^2$  per ha. Pine stand volume after the next 100 year period including both retained and regenerated trees could reach up to  $700 \text{ m}^3$  of timber per 1 ha.

## EFFECTS OF FUNGICIDE APPLICATION PROGRAMS ON *SEPTORIA TRITICI* BLOTCH SEVERITY AND GRAIN YIELD OF WINTER WHEAT

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*Septoria tritici* blotch (STB) is a foliar disease of wheat caused by a pathogen *Zymoseptoria tritici*. If STB is not properly controlled, it may lead to up to 40% yield losses, when the disease severity is high. Preventive fungicide applications are a common STB control practice. It is essential to determine optimal spraying time, based on crop growth stage, disease severity and environmental factors: air temperature, leaf wetness and rainfall. Since *Zymoseptoria tritici* fungus after penetration grows slowly within plant tissues, the infection remains asymptomatic. Plant protection against STB relies on foliar fungicide sprays, for optimum, to protect the upper 3 leaves, which provide most of the grain-filling capacity and contribute to approximately 75% of the final grain yield. It is known that fungicide application at wheat BBCH 32 stage (third leaf fully unrolled), 5–7 days after rain provides the highest efficacy.

The study is aimed to estimate the effect of fungicide application programs on STB severity and grain yield of winter wheat. In 2019, two experiments were conducted in two fields with different rotations (winter wheat monoculture since 2005 with retained straw; after non-host crop (peas). Based on the recommendations of the product manufacturer and Agricultural and Horticulture Development Board and also according to the weather situation, six different fungicide application programs were developed and tested. Fungicide Adexar (a. i. fluxapyroxad 62.5g/l + epoxiconazole 62.5 g/l) at 1.0 and 2.0 l ha<sup>-1</sup> was used for all applications.

Comparison of both rotations showed higher STB severity in the winter wheat monoculture. In the field where winter wheat had been grown for 14 consecutive years, the severity of STB was almost 6 times higher than in the crop rotation where winter wheat had been sown after peas. In both experiments, all the tested programs resulted in a significant reduction in the STB severity. The difference between the tested programmes was clearer at higher disease pressure in the monoculture. Significantly higher STB severity in both experiments was established in the treatment applied with a full dose (2.0 l ha<sup>-1</sup>) 5–7 days after the first rain. The grain yield of winter wheat grown after peas was higher than that of wheat grown in the monoculture. In both experiments, fungicide application gave a grain yield increase, which was significant in the treatments where the first application was made 5–7 days after the rain.

## **YIELD PRODUCTIVITY OF GRASS-LEGUME MIXTURES IN THE SECOND YEAR OF SWARD**

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Grasslands ecosystems are affected by natural and anthropogenic factors. As a result, their productivity is not constant due to changing environmental conditions. In multifunctional grasslands spring harvest is important because the highest quality yield of biomass is accumulated and can be used for winter forage for livestock. The study identified the formation rates of the first year of grassland use after first cutting on which depends the further growth of grassland. In this experiment were used new, less investigated, Lithuanian varieties of four grasses and four legumes plants. Mixtures with one, three, four, six and eight grassland species was sown in experimental areas. There was a positive relationship between species richness and yield. Sward yields of eight-species communities were 1,4 times higher than in monocultures. Dry matter yields were significantly increased by diversity of multi-species ( $p < 0.05$ ). Non-nitrogen fertilized perennial ryegrass and festulolium grasses developed more slowly and their yield was lower due to lack of nutrient supply. Lucerne develop best and the yield all mixtures with lucerne was highest than the others with different species mixtures. Comparing grasslands with others legumes species, spring yield improved in mixtures with red clover and sainfoin more than with white clover.

## INITIATION OF ANCIENT OAK TISSUE CULTURE AND THEIR CULTURE DEPENDENT ENDOMICROFLORA

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In recent years the world has faced many climatic extremes. These shifts will carry on in the future. The effects of climate change are likely to be especially noticeable in Lithuanian forests, as they are located in a transition zone between temperate and boreal forest ranges.

Long-lived trees are of interest, because they have persisted through many climatic cycles and extremes. One of the most common long-lived trees in Europe is the common oak (*Quercus robur*).

Endophytes, often bacteria or fungi, are microorganisms that live within plants, without causing their hosts any obvious harm. Every plant species tested so far, has them. Endophytes can be mutualists. In this case they produce various secondary metabolites that affect plant growth and help them with stress response.

Endophytes can be used to create biological control agents that would help fight various pathogens and insect activity as well as improve plant health overall. They may also be used in tissue cultures.

Reports suggest that older individuals of the same species may have a changed endophyte biodiversity, density and distribution in contrast to their younger counterparts. This suggests that ancient common oaks might have endophytes that are uncommon to young oaks or that these ancient trees have over time established a successful endomicroflora that might have influenced their long life spans.

In this study we aim to initiate and establish common oak tissue cultures from several ancient trees (estimated > 500 y/o) from Lithuania as well as several trees from other age groups. We also want to find out what type of culture dependent endophytes these trees may host and share.

We gathered biomaterial from 11 individual trees from Lithuania, force flushed them in the lab, surface sterilized the leaves, buds and male flowers and used them to initiate oak tissue cultures. While some explants showed moderate success (buds) in microshoot development, others proved to be more difficult to work with and require further research. We've also managed to create preliminary endophyte isolates from 8 of the selected donor trees, both fungi and bacteria in appearance.



## **USE OF UNDERSOWN FORAGE LEGUMES FOR WEED SUPPRESSION IN ORGANIC CROPPING SYSTEMS**

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Research was carried out at the Lithuanian Research Centre for Agriculture and Forestry's Joniškėlis Experimental Station on a heavy loam *Cambisol*. The study was aimed to explore the weed-suppressive ability of sole forage legumes, oats and forage legumes–oats crops. In spring were sown sole crops: oats (*Avena sativa* L.), black medick (*Medicago lupulina* L.), white clover (*Trifolium repens* L.), Egyptian clover (*Trifolium alexandrinum* L.) and forage legumes were undersown into oats in an organic farm.

The weediness of sole oats and sole forage legumes depended on the ability of these plants to suppress weeds. Oats have outstanding tillering ability, peculiarities of nutrition: they grow tall and therefore their competitive properties are strong. The weeds in sole forage legumes had good conditions for growth. Due to the greater distribution of light, they grew up large and lush and to produce high dry weight of weeds. On the contrary, forage legumes sown in oats suppressed weeds less compared with sole forage legumes (91%). The number of weeds during the growing season was least changed in crops forage legumes was grown alone.

Undersown forage legumes establishes in the lower crop level and competes with weeds. This is especially important in the second half of summer when an undersown forage legumes with dried up crop leaves covers the soil surface (Gaudin et al 2013; Yeganehpour et al 2015). The competitive properties of forage legumes also depend on the size of their seeds, and the sowing rate and sowing time (Den Hollander et al 2007). Forage legumes undersown in cereals can both suppress weeds, however legume can compete with cereal, too (Den Hollander et al 2007; Arlauskienė et al 2011; Pfeiffer et al 2016).

## GROUND-LEVEL OZONE IMPACT ON INSECTS POLLINATORS

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Ground-level ozone ( $O_3$ ) and particulate matter are the most threatening air pollutants. Present mean ambient  $O_3$  concentrations are 2–5 times higher than in the last century. Northern Hemisphere,  $O_3$  concentrations remain potentially harmful not only to vegetation but also to animals, insects and human. Over large regions of the globe ground-level  $O_3$  is a serious air pollutant which induces oxidative stress in plants with a negative impact on the nutritional quality of leaves for insects. Moreover, reactive  $O_3$  molecules can modify or degrade volatile organic compounds (VOCs), and this may impair the communication between plants and their pollinators by affecting the olfactory system of pollinators.

Pollination services are known to provide substantial benefits to human populations and agriculture in particular. Global cultivation of insect-pollinated crops has expanded since the 1960s, leading to about a 300% increase in demand for pollination services. In 2005 the global economic value of pollination service was estimated to be about 189 billion Euro or 9.5% of global food production value and in 2009 the economic value of insect pollination is suggested to be worldwide 153 billion Euro per year. Typically honey bees are identified like main pollinator. However, they are not only insects that pollinate crops. Worldwide a variety of other insects such as flies, wasps, beetles, butterflies and moths. There was showed that non-bees pollinators performed 25–50% of the total number of flower visits. On average, non-bees accounted for 38%, honey bees for 39% and other bees for 23% of the visits to crop flowers. We find out that there are lack of studies which have been reported on the influence of  $O_3$  on floral nectar composition. Harmful effect of  $O_3$  on pollination activity could be described like following:  $O_3$  increase  $\Rightarrow$  decrease in plant health  $\Rightarrow$  decrease in the health of honey bee populations.

The aim of this study is to review the effect of  $O_3$  on the relationships between plants and pollinators and on insect behaviour and other services based on the current literature and to fill the gap of knowledges.

## **CALCULATIONS OF EMISSIONS OF BIOFUEL PRODUCTION CHAIN FROM FOREST HARVEST RESIDUES IN SCOTCH PINE (PINUS SYLVESTRIS) FORESTS STANDS**

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Solid biofuel from forests is the central part of increasing the percentage of energy made from renewable energy sources. Managers of Lithuanian State forests enterprise are obliged to prepare a higher amount of biofuel every year. It often happens that the material of biofuel is preparing without taking into consideration about climatic and technical criteria, is it sustainable from an ecological point of view.

An experiment was carried out to analyse material flows and evaluate the impact of biofuel production from logging residues on ambient air quality and climate change. In the course of the work, material collected from 2 Lithuanian territories of different yields, how much forest harvesting waste was produced from the main felling in a different pine tree (*Pinus Silvestris*) stands. The boundaries of the initial assessment system are from harvesting in forests sites waste collection (after different fellings) to carrying to intermediate sites, shredding and transporting to biofuel combustion plants. Calculated and compared material and energy flows for biomass production from forest harvest residues and logging, transporting produced biofuels to the boiler house and burning it. Accordingly, the direct and indirect impact of ambient air quality on air from mobile and stationary air pollution sources ( $\text{CO}$ ,  $\text{NO}_x$ , NMVOC, PM,  $\text{NH}_3$ ) and on climate change due to GHG ( $\text{CO}_2$ ,  $\text{N}_2\text{O}$ ,  $\text{NH}_4$ ) were assessed. It was estimated that 57% of GHG emissions (up to 145,971 kg/tonne of oil equivalent) and even 54% air pollutants (0.66 kg/toe) more were emitted in the production chain of woodchips from forest harvest residues compared with biofuel from firewood.

By continuing the research, it is planned to carry out a full life-cycle analysis of material and energy flows, extending the system boundaries from soil preparation, fertilization, planting, nursery care, intermediate and final felling, to energy production in biofuel boiler houses and the environmental impact of ash utilization or utilization.

## SECTION B. ANIMAL SCIENCE AND VETERINARY MEDICINE, HORTICULTURE AND ECONOMICS

### EFFECT OF EXOENZYMES AND YEAST SUPPLEMENTATION ON THE RUMINAL METHANOGENS IN DAIRY COWS DURING TRANSITION PERIOD

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Feeding dairy animals diets supplemented with exoenzymes or active yeast has been shown to improve rumen bacterial abundance, but the effect on archaea is still equivocal. Especially feed additive effect during transition period requires further investigation.

The aim of this study was to assess the effect of exoenzymes and yeast supplementation on the quantity of rumen methanogens in Lithuanian Red dairy cows during the transition period from pasture to barn feeding.

The study lasted for 24 days: 12 days adaptation period, when cows from grazing diet were shifted to total mixed ration based diet and supplementation was only offered for treatment group, and 12 days experimental period. Six clinically healthy Lithuanian Red mid-lactation dairy cows were divided into 2 groups (T – trial and C – control) applying the principle of analogous. T group was supplemented with the mixture of endo- $\beta$ -xylanase  $37 \times 10^4$ , endocellulase  $45 \times 10^4$ , endo- $\beta$ -glucanase  $12 \times 10^4$  (U/cow/day), and *Saccharomyces cerevisiae* CNCM I-1077  $10 \times 10^9$  (CFU/cow/day). Rumen fluid samples for methanogens quantification, were collected at the begging and at the end of experimental period by oesophageal-rumen probe.

DNA from the rumen fluid was extracted as described by Ruis et al (2012) and purified using QIAquick PCR Purification kit (Qiagen, Netherlands). A qPCR was performed in a total volume of 20  $\mu$ l with PowerUP SYBR green master mix (Thermo Fisher Scientific, USA) and applied in triplicates on Viia 7 (Applied Biosystems, USA). The results was analysed with SPSS v. 15 (SPSS Inc., Chicago, IL) and were considered statistically significant when  $p \leq 0.05$ .

The quantity of rumen methanogens (copies/ng of DNA) increased in group C from  $1.97 (\pm 0.53)$  to  $2.79 (\pm 0.23) \times 10^4$  (41.6%) ( $p < 0.05$ ), and decreased in the group T – from  $3.26 (\pm 1.23)$  to  $2.88 (\pm 0.68) \times 10^4$  (11.7%) ( $p > 0.05$ ). No significant differences between groups were observed.

In conclusion, exoenzymes and yeast supplemented to the diet have no statistically significant effect on methanogens in cow rumen, but higher DNA copies per ng of DNA was observed in T group.

## BIOFUNGICIDAL PROPERTIES OF ESSENTIAL OILS AGAINST CARROT DISEASE

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Carrots are affected by various fungal and bacterial pathogens in the field and post-harvest decay. Fungi of the genus *Alternaria* Nees are one of the major pathogens limiting carrot yield. Chemical fungicides are commonly used for plant protection. However, pathogens become more resistant to pesticides. Also, the toxic effects of the chemicals are infinitely harmful to plants, animals, and humans. Therefore, new biocontrol methods are required, one of the possible – essential oils – volatile, natural, complex compounds, produced as secondary metabolites in aromatic plants. This research aimed to determine the bio-fungicidal effect of *Thymus vulgaris*, *Lavandula angustifolia*, *Coriandrum sativum*, *Citrus sinensis*, and *Cedrus* spp. essential oils on *Alternaria* spp. *in vitro*. The research was carried out in 2018–2019 in LAMMC Institute of Horticulture. Different concentrations of essential oils (EO's) were evaluated: 0 µl/l, 200 µl/l, 400 µl/l, 600 µl/l, 800 µl/l, 1000 µl/l, and individually mixed with potato dextrose agar medium. The 7 days old mycelium disc of *Alternaria* spp. placed on each Petri dish and incubated at 25±2 °C in the dark. The inhibitory effect of the essential oils evaluated by measuring the radial growth (cm) of the fungus after 2,5 and 7 days. Research data revealed that *T. vulgaris* oil had the highest inhibition against *Alternaria* spp. growth (from 200 µl/l). *L. angustifolia* 800 µl/l concentration, *C. sativum* 600–800 µl/l and *Cedrus* spp. 400–800 µl/l had the best fungicidal effect. Meanwhile, *C. sinensis* at tested concentrations were not so effective as other EO's. *T. vulgaris* essential oil showed the most significant effect against *Alternaria* spp. Thus, EO's are suitable as natural bio-fungicides and promising for the development of alternative plant protection products.

## **STRAWBERRY PATHOGENS INOCULUM SOURCES AND *COLLETOTRICHUM* SPP. PATHOGENICITY**

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Strawberry spoilage and yield losses caused by *Botrytis* spp. are up to 50%, while *Colletotrichum* spp. up to 80%. Bacterial and fungal pathogens infect all plants parts during vegetation season (planting, harvesting, postharvest). The source of inoculum is in soil, infected plants, previous crops, weeds, etc. This study aimed to investigate the strawberry plants and soil pathogens distribution and to evaluate *Colletotrichum* spp. pathogenicity to different strawberry cultivars. The research carried out at the LAMMC Institute of Horticulture in 2018–2019. For strawberry plants and soil, contamination samples were collected in 4 leading strawberry farms. Soil evaluation was carried out using the soil dilution method. Colony-forming units of fungi and bacteria evaluated after 3 and 7 days post-inoculation (DPI). Strawberry plant parts of different strawberry cultivars washed under water and cut into 2 cm pieces. Plant fragments placed at the Petri with potato dextrose agar. Plant parts evaluated after 2 and 4 DPI. The pathogenicity of *Colletotrichum* spp. evaluated on different strawberries cultivars (cv.). Leaves are sterilized, dried and fungal disks placed in the center of each leaf. Disease severity of each inoculated leaf assessed 4, 8 and 10 DPI. Petri plates of all experiments incubated 25 °C in darkness. The research data showed that 2 DPI the lowest contamination with fungal and bacterial pathogens was found in cvs. ‘Senga Sengana’, ‘Darselect’ and ‘Salsa’. The highest contamination was observed in parts of the cv. ‘Rumba’. The results of soil experiments showed that the highest contamination of pathogens was in strawberry cv. ‘Rumba’. However, *Colletotrichum* spp. observed only in 3 farms (Nr. 1 LAMMC cv. ‘Elkat’, Nr. 10 – cv. ‘Florence’ and Nr. 12 – cv. ‘Rumba’). Thus, we can conclude from the results that the highest soil and plant parts contamination were in cv. ‘Rumba’. The pathogenicity results 10 DPI shows that mostly susceptible cvs. were ‘Deluxe’, ‘Furore’, ‘Malvina’ and ‘Pegasus’. However, least sensitive was cv. ‘Syria’. Based on the information generated in this study, we conclude that least sensitive to *Colletotrichum* spp. was cv. ‘Syria’. Considering all the results obtained, we can assume that cv. ‘Rumba’ and cv. ‘Syria’ are the most susceptible to anthracnose of all the strawberry varieties used in this study.

## **PRODUCTION AND EVALUATION OF FERMENTED MILK PRODUCTS WITH DILL (*ANETHUM GRAVEOLENS*) CO<sub>2</sub> EXTRACT AND WILD *LACTOCOCCUS LACTIS* WITH POTENTIAL PROBIOTIC CHARACTERISTICS AS A FUNCTIONAL DAIRY FOOD**

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Recently, main product development and research in the dairy industry is targeted to product enrichment with active natural preservatives and functional ingredients leading to enhanced product safety, sustainability and positive health impact. The most expanding fields of these ingredients are various plant extracts with aromatic, antioxidant and antimicrobial properties and probiotic lactic acid bacteria which could be used for the production of fermented products with added health benefits. The main task of this study was to evaluate the possibility of combining newly isolated probiotic-type *Lactococcus lactis* and dill (*Anethum graveolens*) CO<sub>2</sub> extract to enhance functionality, safety and sustainability of fermented dairy drinks. Probiotic-type *L. lactis* strain was selected out of 169 newly isolated *L. lactis* strains from various food sources. This strain was selected according to sensory, technological (enzymatic activity, acid production), safety (antibiotic activity, hemolytic activity) and probiotic properties (growth in bile acids and cholesterol, resistance to bile salts and acid). Due to the general acceptability, prominent phenolic content, ability to reduce D(-) lactate in fermented milk products and little impact on the industrial starter, wild *L. lactis* and dill extract could be incorporated in fermented dairy products that are traditionally associated with herbs such as sour milk. Probiotic-type *L. lactis* strain, isolated from raw cow's milk, actively acidified fermented milk creating acceptable flavor, so it can be used in dairy factories as a starter and probiotic culture. Synergistic effects of *L. lactis* and dill extract can be exploited so as to maximize the phenolic content and to decrease D (-) lactate concentration in fermented dairy products.

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## CHANGES OF BLOOD LACTATE LEVELS IN DOGS DURING BLOOD TRANSFUSION

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**Introduction:** Blood lactate level represents global tissue oxygenation, anaerobic metabolism and lactic acidosis. In case of severe anemia blood lactate level increases. Studies investigating hyperlactatemia in dogs with pyometra and gastric dilatation-volvulus have shown a negative correlation between blood lactate concentration and survival rate, but there are no studies done concerning blood transfusion effect on blood lactate changes in dogs.

**The aim** of this study was to determine whether the blood transfusion has an effect on blood lactate level in anemic dogs and how blood lactate levels correlates with HCT, RBC and HGB.

**Materials and methods.** Nineteen client-owned anemic dogs that required whole blood transfusion was included in study group. Blood samples were obtained from cephalic vein into EDTA tubes for blood morphological analysis immediately before blood transfusion (T<sub>0</sub>), then after the blood transfusion was finished (4 h ± 10 min) (T<sub>1</sub>) and 24 h ± 10 min after the T<sub>0</sub> (T<sub>2</sub>). After filling of the blood collection tube and release of the stasis, for analysis of blood lactate level a drop of the whole blood without preservative was analysed immediately by the lactate analyzer Lactate Pro<sup>®</sup> LT-1710 (Arkray Inc., Kyoto, Japan). Morphological blood evaluation was conducted by IDEXX Lasercyte<sup>®</sup> hematology analyser (IDEXX Laboratories, Inc., Westbrook, Maine, USA) within 5 minutes of samples collection.

**Results and conclusion.** The study showed that the highest (4.67±5.81 mmol/l) level of blood lactate level was before blood transfusion (T<sub>0</sub>) and indicated highly significant difference  $p < 0,001$  compared with T<sub>1</sub> (1.89±0.96) and T<sub>2</sub> (1.71±1.08) (normal level 2.5 mmol/l). The results also showed a moderate negative correlation between blood lactate level and HCT, RBC and HGB and highly significant difference ( $p < 0,001$ ) of HCT and RBC changes. We concluded that blood transfusion have an effect on decreased blood lactate level and it is associated with the increase of HCT and RBC. The findings show that blood lactates can be used as a biomarker of a successful blood transfusion.



## **APPLE TREE RESPONSE TO STRESS, CAUSED BY PRUNING AND SEASONALITY**

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Photosynthetic productivity and plants' growth are very strongly influenced by the environmental factors. Among other technological tools, pruning is a very important in horticulture. Manual pruning is expensive, and ways to reduce the cost of apple tree care in industrial gardens are being sought. One solution is mechanical pruning. Photosynthetic behaviour also are strongly influenced by the season, in spring the young leaves, rising temperatures activate all vital processes, the approaching autumn temperature drops, leaf aging occurs, the vital functions slow down, plants prepare for winter. Apple maturity also depends on the Nitrogen balance index, mineral elements uptake. The aim of this study was to find out the impact of stress, caused by different pruning ways and seasonality on photosynthetic behaviour of apple trees.

The apple tree (*Malus domestica* Borkh.) cultivar Ligol was grafted on dwarfing rootstock P60, planted in single rows spaced 1.25 m apart with 3.5 m between rows. 5 pruning techniques are used: super spindle, super spindle with long stubs, no pruning, mechanical pruning, mechanical pruning of one side (side changes every year). Measurements made three time a year: in June (then leaves fully expanded), the end of July (beginning of apple maturity), in October (harvest time). Mechanical pruning by one size increased specific leaf area by 8% at the beginning of apple maturity but decreased 18% during harvest time. Meanwhile mechanical pruning increased dry matter to 3–3.5 percentage points compared to pruning by super spindle regardless on the season. Photochemical reflectance index and nitrogen balance index significantly decreased during harvest time. Mechanical pruning by one size had negative impact for these indices, photochemical reflectance index decreased three times at the beginning of apple maturity and 20% during harvest time compared to hand pruning. At the same time nitrogen balance index decreased 20% at the beginning of apple maturity 27% during the harvest time compared to pruning by super spindle. In conclusion, mechanical pruning can be recommended for apple cultivar Ligol, while reducing nitrogen balance index and optical parameters, significantly increased dry matter accumulation and specific leaf area.

## THE USAGE OF PREBIOTICS FOR HEALTH AND PRODUCTIVITY BENEFITS IN DAIRY CATTLE FARMING

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Mycotoxins have a negative impact on many organs: liver, kidneys, digestive system, brain and nervous system, reproductive system.

Dairy cows were separated from the herd. They were segregated into two groups (n = 10). control group was fed with a feed mixture (TMR), test group was also fed feed mixture (TMR), but in its composition mycotoxin detoxifying preparation X (with prebiotic) was added. The samples (feed, biological liquids – rumen content, blood and milk samples) were taken 3 times. The concentrations of mycotoxins in the feed were assessed using ESCH-FLD method. The quantity of immunoglobulin A (IgA) in blood serum was estimated using ELISA commercial kit. Cortisol – stress hormone – in blood serum was determined using a commercial ELISA kit (Bovine Cortisol ELISA Kit). Volatile fatty acids in the content of rumen were analysed with gas chromatography (GC-2010 Plus).

The experiment demonstrated that there was a positive effect towards liver function while using detoxifying preparation X. The concentration of mycotoxins in ensiled forage during examination – ZEA – 0.500 mg/kg, DON – 0.200 mg/kg, AFLB1 – 0.003 mg/kg. The quantity of immunoglobulin A (IgA) in blood serum of the control group during experiment did not fluctuate marginally – from 309.5±28 ng/ml to 211±19 ng/ml, in test group the values had a decreasing trend from 358.5±26 ng/ml to 130±21 ng/ml. In the experiment, cortisol value in test group increased by 47.9 percent compared to the results from the beginning of examination. The variation of cortisol quantity in blood serum was not affected by the concentration of mycotoxins. The variation of volatile fatty acids (FVAs) in the content of rumen in both groups was not consistent. In addition, the value of somatic cell count (SCC) in control group did not fluctuate after two months, but in test group same value decreased more than two times.

## **PATHOGENESIS RELATED PROTEIN HOMOLOGS IN *RIBES* SPP.**

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Pathogenesis related proteins (PRs) are plant species-specific proteins induced by biotic stress and play an important role in plant defense against pathogenic fungi, oomycetes bacteria, viruses and insects. PRs are associated with the systemic acquired resistance (SAR) and can act directly on the pathogen or through enzymatic activity to generate signalling molecules that stimulate defense pathways. Seventeen families of PRs have been described in plants based on sequences homology, the isoelectric points, reaction with specific antisera and mRNA probes.

Sequences of genes related to pathogen resistance in *Ribes* genus is unknown and defense pathways are unclear. Currently, several molecular markers linked to pathogen resistance are identified in *Ribes* spp. Genes and genetic mechanisms that provide durable resistance are still in searching process. The aim of our research is to establish pathogenesis related protein homologs for the studies of pathogenicity response to gall mite and blackcurrant reversion virus (BRV) in *R. nigrum*.

Degenerate oligonucleotide primer pair for detection of PR gene in *Ribes* genus was designed based on the most conservative parts of 19 sequences submitted in NCBI GenBank. The whole length of PR gene is approximately 600 bp, substitutions and deletions among sequences were found. Our designed oligonucleotide primers flanked part of the gene at 3' end (from 196 to 584 nucleotide). The forward primer (22 bp) 5'GCMCARRAYWCHCCMCAAGAYT3' and the reverse primer (23 bp) 5'TTGCCNSGDGGATCRTAAYTGCA3' were generated from a sites where the homology of compared sequences from NCBI was 63.64% and 73.91%, respectively. Specific fragment 389 bp long were amplified and sequenced. Seven homologs of the PR gene in *R. nigrum* with genetic diversity from 68.18 to 98.34% have been isolated. The multiple alignments of obtained sequences revealed the dependence of PR gene homologs identified in *Ribes* species on the PR-1 and PR-4 families. PR-1 is the most abundant family of the PR's and the expression of genes is usable as molecular marker to indicate plant defense response. Members of family PR-4 are associated with ribonuclease, chitinase and anti-fungal activities in dicotyledons.

Depending on genotype resistance, expression of PRs homologs in blackcurrants occurred 2–12 days after inoculation *in vitro*. Newly detected PRs homologs in *R. nigrum* will be useful for further studies on the pathogenicity response to gall mite and BRV by gene expression.

## COMPARISON OF PROGESTERONE VALUES DETERMINED WITH DIFFERENT METHODS IN CATTLE BLOOD SERUM

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Progesterone (P<sub>4</sub>) is used to monitor functional ovarian activity, estrus detection accuracy and pregnancy in cattle. It is a hormone with different actions depending on the period in the estrus cycle. Concentrations of P<sub>4</sub> vary between different determination methods and the interpretation of these values become delicate business that may lead to an erroneous diagnosis.

The aim of the present study was to compare progesterone concentration in cattle blood serum from several period of estrus cycle determined by different methods.

Samples were collected considering having high (pregnant and D<sub>14</sub> after ovulation cows, n = 17) and low (non-pregnant and D<sub>7</sub> after ovulation cows, n = 22) progesterone values. Depending on the P<sub>4</sub> determination method, five groups were designed: Group 1 – direct samples assessed by ELISA, Group 2 – extracted samples assessed by ELISA, Group 3 – samples assessed by automated ELISA, Group 4 – samples assessed by RIA and Group 5 – samples assessed by luminescent ELISA.

The obtained results indicate correlation among groups ranging from  $r = 0,768$  to  $r = 0,984$ , ( $p < 0,001$ ), and among Group 2 and Group 4 was  $r = 0,623$ ,  $p < 0,005$ . The general mean values of progesterone concentration within groups were  $2,96 \pm 0,64$  ng/ml,  $1,19 \pm 0,21$  ng/ml,  $4,45 \pm 1,35$  ng/ml,  $2,26 \pm 0,36$  ng/ml and  $4,39 \pm 1,55$  ng/ml for Group 1 to Group 5, respectively.

The mean concentration in “high progesterone” samples was 2.71, 3.52, 1.47 and 3.71 times higher in Group 1, Group 3, Group 4 and Group 5 as compared to Group 2. The mean concentration in “low progesterone” samples was 8.48, 5.05, 19.34 and 9.84 times higher in Group 1, Group 2, Group 4 and Group 5 compared to Group 3. The differences among “high progesterone” and “low progesterone” values were statistically significant between Group 1 and Group 2 ( $p < 0,001$ ), and Group 3 ( $p < 0,01$ ) and Group 5 ( $p < 0,05$ ).

There are many commercially progesterone determination kits and quantitative values differ and varies between different methods.

Our findings show that there is evident variation among the methods of P<sub>4</sub> determination. The highest progesterone concentration in “high progesterone” samples was determined in Group 5 and lowest in “low progesterone” samples – in Group 3.

## **USAGE OPTIONS OF DEPRIVED AREAS IN LATVIA MUNICIPALITIES**

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As most of the country's population is concentrated in cities, economic activity and public services, incl. Higher education institutions then need to pay particular attention to business development and environmental quality when planning their development. Priority Public Infrastructure Investment Projects identified in Municipal Development Programs to Promote Urban Revitalization and Support Improvement in Former Industrial Territories and Other Brownfields – Locations or Subdivisions of the City that have been used, built or planned for business activities to date but currently have entrepreneurial activity and employment not at a satisfactory level.

## **A REVIEW OF CIRCULAR ECONOMY APPROACHES**

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The circular economy (CE), since its first publications in the early 1990s, has become an important research object in science and a useful tool of information for decision-making, both for policy makers and for business. In the literature, the CE paradigm is associated with sustainable development (SD) and other concepts, as well as the use of CE approaches to accelerate SD goals. To determine the validity of this approach, a systematic literature review (SLR) for peer-reviewed articles from 2005 to 2019 was conducted and a number of significant factors were identified. The CE approach (9R) works significantly differently at the following three levels: macro (global, national, regional), meso (eco clusters) and micro (company). A growing number of authors criticize the CE approach at the micro-level, citing measurement problems as well as over-orientation in economics and engineering, while neglecting the socio-political aspects of consumption and the importance of lifestyle changes. This article identifies the main problems with the CE approach at the micro level and launches a discussion on their possible improvement.







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