Hana Středová (Ed.)

32nd International Conference
MendelNet 2025

BOOK OF ABSTRACTS

November 5, 2025
Brno

MENDELU
Faculty
of Agronomy

2025

Mendelova univerzita v Brně

32nd International Conference

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ABSTRAKT

Sborník abstraktů z 32. mezinárodní konference doktorandů MendelNet 2025.

Klíčová slova: MendelNet, agroekologie, živočišná biologie, živočišná produkce, aplikovaná chemie a biochemie, rostlinná biologie, rostlinná produkce, technika a technnologie & potravinářství, živá příroda

ABSTRACT

Book of abstracts from MendelNet 2025, International Ph.D. Students Conference.

Keywords: MendelNet, agroecology, animal biology, animal production, applied chemistry and biochemistry, plant biology, plant production, techniques and technology & food technology, wildlife research

OBSAH

PREFACE

We are delighted to present the Book of Abstracts for the 32nd MendelNet Conference, an event where students from diverse agriscience fields gather to share knowledge, foster collaboration, and drive innovation within their disciplines. Over its 32-year history, MendelNet has become a valued platform for students to showcase their findings, exchange ideas with peers and mentors, and gain experience in professional presentation. This year's conference proudly continues that tradition with eight specialized sessions: Agroecology, Animal Biology, Animal Production, Applied Chemistry and Biochemistry, Plant Biology, Plant Production, Wildlife Research and Techniques and Technology & Food Technology. Each session provides a dedicated space for students to present research and insights that address critical challenges within agrisciences.

Beyond the experience of presenting, participants are also eligible for awards recognizing outstanding research and presentation quality. To confirm active participation, students must complete registration, including the submission of an approved annotation, and deliver a 15-minute oral presentation in English. All active participants will receive a Certificate of Participation, recognizing their dedication and contributions to the conference.

To further enhance the impact of this year's conference, we introduced an opportunity for active presenters to publish a short communication of their work in this Book of Abstracts. Out of 76 active presenters, 57 expressed interest in this option, and on the following pages, we are pleased to share their scientific efforts with you.

On behalf of the organizational team,
Assoc. Prof. Hana Středová, Ph.D

MendelNet 2025

ABSTRACTS

USE OF 3D MODELS FOR PREDATION EXPERIMENTS IN NATURE

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ABSTRACT

This paper deals with the predation of lizards of the family Lacertidae by wild animals. The sand lizard (*Lacerta agilis*, *Linnaeus*, 1758) was chosen as the model species. Its distribution throughout the Palearctic region and the associated number of different color forms make it a suitable species for this type of experiment. Coloration is very important for them in terms of thermal biology, sexual selection, and anti-predatory behavior. The study aimed to map in more detail the influence of coloration on the rate of predation of individual color morphs in natural conditions. To achieve this goal, an experiment was conducted using 3D-printed models of selected color forms of the common lizard. The results indicate a positive trend in predation toward a preference for less common color variants.

Keywords: lacerta agilis, 3D Models, predation experiment

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WOMEN'S ROLE IN AGROFORESTRY AND FOOD SECURITY IN UGANDA

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ABSTRACT

Agroforestry is an essential element of sustainable land management since it provides nature-based solutions (NBSs) that address environmental degradation, food insecurity, and climate change resilience. Even though women are said to contribute considerably to agroforestry, they continue to face constant encounters because of social and cultural norms and economic restrictions in Uganda. Therefore, this study investigated women's involvement in Ugandan agroforestry activities to understand their challenges and opportunities while examining their impact on achieving SDGs related to poverty reduction and food security, gender equality, and environmental management. The study employed Focus Group Discussions (FGDs) of eight different groups to explore women's roles and perceptions of their involvement in agroforestry systems in Uganda. The research indicated that women play an essential role in agroforestry and sustainable land management, and possess the necessary indigenous knowledge in the sector; yet, they continue to face restricted decision-making authority. We noted that the success of enhanced agroforestry and equitable development requires addressing structural barriers through gender-sensitive and centered policies, such as providing women and other vulnerable groups with access to resources and opportunities that enhance their decision-making capacity. The integration of gender considerations into agroforestry programs remains essential for Uganda to achieve its developmental goals.

Keywords: agroforestry and livelihood, cultural and social norms, land ownership, decision-making power, indigenous knowledge

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THE INFLUENCE OF URBAN LIGHT POLLUTION ON THE PLANT PHENOLOGY

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ABSTRACT

Ecosystems worldwide are under increasing pressure, primarily due to climate change accelerated by human activity. Plant communities, as the dominant component of terrestrial ecosystems, are highly sensitive indicators of these changes. Unlike mobile organisms, plants cannot relocate when conditions shift; if unable to adapt, they risk decline, leading to altered species composition and potential ecosystem transformation. Plant phenology, reflecting both long-term climate and annual weather conditions, is disrupted by artificial illumination that alters natural light–dark cycles. Such disturbance may cause irregular germination, flowering, or fruiting, as well as growth orientation toward light sources, ultimately influencing competition, community dynamics, and biodiversity. This study aims to assess how light pollution from human settlements affects plant life cycles, focusing on phenological phases, including monitoring of selected species at varying distances from urban centers and light sources. Field research took place in the area of Brno and focused on three tree species widespread in urban environments: Acer platanoides, Betula pendula, and Tilia cordata—chosen for monitoring their photosensitive phenophases (sprouting, flowering, etc.). For each species, individuals were selected according to lighting intensity: (a) an unilluminated standard, (b) moderately illuminated, and (c) directly exposed to a light source. Monitoring took place during the 2024 and 2025 growing seasons. Detecting anomalies and trends in phenological manifestations is vital to understanding the link between artificial light and biodiversity. Insights from this work may support nature protection, biodiversity conservation, and mitigation strategies, while also contributing to knowledge at the European and global level.

Keywords: artificial illumination, biodiversity, Brno, human settlements, plant communities

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A NOVEL ROUTE OF ENCAPSULATION OF PHOSPHORYLATED COMPOUNDS INTO FERRITINS EXPLOITING NATURAL P-FE AFFINITY

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ABSTRACT

Ferritins are iron-storage proteins that form nanocages capable of accumulating trivalent iron inside their negatively charged cavities. Besides their physiological role, ferritins can be exploited as nanocarriers for therapeutic molecules. In particular, their ability to bind to transferrin receptors, which are overexpressed on many tumor cells, makes them attractive for targeted drug delivery. Encapsulation of negatively charged phosphorylated compounds into ferritins is challenging due to negatively charged inner ferritin cavity. To overcome this limitation, we take advantage of the natural affinity between Fe^{3+} ions and phosphate groups. The project focuses on developing an effective strategy for encapsulating phosphorylated model compounds into iron-preloaded ferritins, with the final goal of delivering acyclovir 6-monophosphate (ACV-P) as a potential anticancer agent. To monitor encapsulation efficiency, chromogenic and fluorogenic phosphate substrates are tested and quantified after phosphate cleavage by alkaline phosphatase (ALP). So far, successful encapsulation of 4-methylumbelliferyl phosphate (MUP) has been achieved, while other substrates showed interference. Interestingly, our results also indicate that ferritin itself exhibits intrinsic phosphatase activity, which must be considered during further analyses. The optimized method is used for ACV-P encapsulation. The resulting ferritin/Fe^{3+}/ACV-P complex will be evaluated for stability, loading efficiency and most importantly for cytotoxic potential in tumor cell lines with different transferrin receptor expression levels. This approach may open a novel route for efficient delivery of phosphorylated therapeutics with otherwise poor cellular uptake.

Keywords: ferritin, acyclovir monophosphate, nanocarrier

ACKNOWLEDGEMENT

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IN VITRO ANALYSIS OF RAT PRIMARY OSTEOBLASTS AFTER TREATMENT WITH METFORMIN, SEA BUCKTHORN BERRY EXTRACT AND THEIR CO-ADMINISTRATION

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ABSTRACT

The aim of this study was to investigate the effects of metformin (MET) at concentrations of 0.1 and 1 mM, sea buckthorn berry extract (SB) at concentrations of 0.1 and 0.5 µg/ml, and their combinations (MET 0.1 mM + SB 0.1 µg/ml; MET 0.1 mM + SB 0.5 µg/ml) on cultured rat primary osteoblasts. According to our results, osteoblast viability was considerably enhanced by MET at 1 mM, while it was moderately decreased by SB at 0.5 µg/ml. In contrast to SB administered alone, co-treatment with MET and SB (0.1 mM + 0.5 µg/ml) enhanced cell viability. Additionally, MET markedly increased BALP protein levels and ALP activity, suggesting a stimulatory effect on matrix mineralization and osteoblast development. Conversely, MET (0.1 mM) was linked to lower COL1A1 levels. Notably, COL1A1 levels were significantly increased by simultaneous treatment with MET and SB (0.1 mM + 0.1 µg/ml), indicating a synergistic effect that could promote collagen synthesis. The aforementioned results point to the fact that MET stimulates osteogenic activity, mainly through ALP-related pathways, and SB berry extract may improve some of the osteogenic responses induced by MET, although it is not particularly effective alone at the doses tested. Therefore, co-administration of MET and SB may be a promising option for improving bone health.

Keywords: metformin, sea buckthorn, osteoblasts, in vitro

ACKNOWLEDGEMENT

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THE USE OF SEM/EDX FOR THE CHARACTERIZATION OF SUSPENDED PARTICULATE MATTER

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ABSTRACT

Particulate matter (PM), a term for suspended particles, comprises a mixture of solid and liquid components with diverse chemical compositions, sizes, and origins. PM is classified as an air pollutant and can have both anthropogenic and natural origins. PM exhibits significant variability, which depends, among other factors, on meteorological and dispersion conditions, as well as on terrain relief. The SEM/EDX method, which combines scanning electron microscopy with energy-dispersive X-ray spectroscopy, is, despite its limitations, a powerful tool for analyzing the morphology and elemental composition of particulate matter. This technique is beneficial for identifying air pollution sources, as major sources often produce particles with a unique combination of shape and chemical composition. This study demonstrates the variability of PM during the heating season in relation to the characteristics of the measured localities and also considers the influence of long-range transport. The first locality is an air pollution monitoring station located on Kroftova Street in Brno, which reflects the broader urban environment. The second locality is the village of Hustopeče u Brna, where measurements were conducted in a residential area within a garden. The third locality is a rural background air pollution monitoring station in Kuchařovice, representing typical rural conditions without direct influence from urban or industrial sources. It was found that particles from individual localities differ from each other in both elemental composition and particle size distribution. This reflects the character of the locality and the typical sources of air pollution that had an influence at the site.

Keywords: suspended particles, SEM/EDX, air pollution

ACKNOWLEDGEMENT

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GRASS-CLIPPING MULCH BUFFERS SOIL MICROCLIMATE AND SUPPRESSES WEEDS: RESULTS FROM A SMALL-PLOT FIELD TRIAL WITH FODDER BEET

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ABSTRACT

Mulching is a practical, low-input tactic to stabilize crop microclimates. A two-block, small-plot field experiment in the Vysočina Region, Czech Republic (627 m a.s.l.; 9 Apr–24 Sep 2024) evaluated grass-clipping mulch on 1.2 × 2.0 m fodder-beet beds. Treatments were (i) unmulched control with manual weeding and (ii) grass-clipping mulch applied in two stages after BBCH 10. Soil temperature at 5 cm (DS18B20), volumetric soil moisture at 30 cm (VIRRIB Circular electromagnetic sensors), and weed cover were monitored. Mulch delivered strong weed suppression (< 1% cover) versus ~85% on the unmulched plot, reducing hand weeding to a single early pass. It consistently buffered 5-cm soil temperature: the diurnal range fell from 4.3 °C (unmulched) to 1.9 °C (mulched; −56%), and during a late-season cool phase the mulched soil was modestly warmer (+2.27 °C), indicating damping of extremes. Soil moisture stayed higher in mulched beds through the warmest months, reflecting reduced evaporation from protected surface and cooler upper (5 cm) soil layer and lower transpiration via weed suppression; mulch also likely limited surface crusting, improving infiltration. Operationally, fresh clippings were abundant and effective but require prompt application to avoid anaerobic heating. Overall, locally available grass clippings offered a low-cost strategy to conserve soil moisture, dampen 5-cm soil-temperature swings, and reduce weeding labor in temperate small-scale production.

Keywords: microclimate buffering, soil moisture, soil temperature, mulch, weed suppression

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ORGANIC, SUSTAINABLE AND CONVENTIONAL APPLE ORCHARDS: EFFECTS ON NOCTURNAL MOTH DIVERSITY

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ABSTRACT

In recent years, we have seen the development of so-called sustainable agricultural production and organic crop cultivation, which, although logistically and financially more demanding, should ensure a smaller negative impact on biota. However, the importance of agroecological practices for biodiversity conservation is insufficiently documented in certain habitats and in some taxa. Although moths are a typical group that can be considered bioindicators, their diversity in apple orchards has not yet been sufficiently documented. Apple production takes place both in an integrated management and in a purely organic production with almost no use of insecticides. The aim of the project was to demonstrate the differences between approaches to apple orchard management on the example of moth communities, using a statistically comparable method of trapping with automatic UV-light traps. The research took place in 18 apple orchards in the Czech Republic under organic, integrated, and also completely extensive managements, which were used as control sites. Selected functional traits (wingspan, range width, feeding niche, etc.) of the captured moths were also assessed and should differ significantly between differently managed orchards. Differences in the species composition of communities between selected orchards were then analysed using indirect ordination by correspondence analysis (CA), revealing differences in species composition and characteristics of individual species, especially in unmanaged extensive orchards, which can also serve as reservoirs for pests. The results of the case study will contribute to verifying the actual impact of ecological orchard management on moths representing the invertebrate fauna.

Keywords: apple orchard, moths, Lepidoptera, species richness

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PAW USED FOR SEED PRIMING TREATMENT IN SAGE FOR STIMULATION OF SEED GERMINATION AND EARLY SEEDLING GROWTH

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ABSTRACT

Sage (*Salvia officinalis* L.) is an important medicinal plant in the Lamiaceae family. To obtain strong and vital seedlings, it is possible to treat seeds using seed priming treatment. Seed priming is a short-term pre-soaking of seeds to activate metabolic processes without germination, followed by drying seeds to storage moisture. Plasma-activated water (PAW) is the water treated with non-thermal plasma (NTP), which generates rich reactive oxygen and nitrogen species (RONS), and other radical compounds, leading to changes in chemical properties (pH, ORP and conductivity). PAW can thus break seed dormancy, nourish seedling growth, show antimicrobial effects against biotic stress, and modulate plant physiology to resist abiotic stress. This study novelly applied seed priming with PAW, prepared by NTP during 5 (P5), 10 (P10), 15 (P15), and 20 (P20) minutes. Seed germinations were P5: 61.34%; P10: 38.67%; P15: 51.33%; P20: 57.33%; hydropriming: 48.67%; control: 22.00% and germination indexes were P5: 57.82; P10: 31.92; P15: 51.01; P20: 49.56; hydropriming: 37.90; control: 14.46 after 14 days seed cultivation. Comparing P5 (the best PAW enhancer) to control, both fresh and dry biomass in P5 maximally rose by 230%. In addition to a slight decrease in root length (1.11 mm), both shoot (5.61 mm) and seedling (4.73 mm) lengths were enhanced. Seedling vitality index (SVI III) grew up to 7439.14 from 827.08. This study proved that PAW-priming treatment can stimulate sage seed germination and early seedling growth.

Keywords: sage, PAW, stimulation, seed priming, RONS

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GENOTYPING OF THE ABCG5 GENE MUTANTION IN THE T1 GENERATION OF SPRING BARLEY

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ABSTRACT

ATP-Binding Cassette (ABC) transporters represent one of the largest protein families in both prokaryotes and eukaryotes. They function as ATP-driven membrane transporters involved in a wide range of processes, including metabolite transport, stress response, and the establishment of structural barriers. The ABCG subfamily has been implicated in the regulation of lipid transport and suberin deposition in plants. In rice, ABCG5 has been shown to control the formation of suberin layers in roots and shoots, as well as to regulate stomatal closure through abscisic acid (ABA) signaling. Using CRISPR/Cas9-mediated mutagenesis, we prepared homozygous mutant lines of ABCG5 spring barley (*Hordeum vulgare* L.) plants that were subsequently segregated from the Cas9 transgene.

Keywords: gene editing, CRISPR-Cas, spring barley

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NUTRITIONAL COMPOSITION AND SENSORY ASSESSMENT OF NON-TRADITIONAL MICROGREENS

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ABSTRACT

The aim of this project is to evaluate new and promising species suitable for cultivation as microgreens. The domestic market is currently limited to approximately twenty commonly grown species, but many less familiar species also have the potential to be introduced. These species may be attractive due to their content of mineral and organic compounds and their sensory properties. Five unconventional microgreen species were selected for evaluation based on germination capacity and other limiting factors. The research focused on the chemical composition and sensory acceptability of the selected microgreens. Alongside selected mineral elements, heavy metals, dry matter, vitamin C, antioxidant activity, total phenols and flavonoids, and nitrate content were assessed. In industrial hemp (*Cannabis sativa* L.), the most significant phytocannabinoids were also analyzed. The evaluation included three cultivars of industrial hemp together with purslane (*Portulaca oleracea* L.), evening primrose (*Oenothera biennis* L.), red clover (*Trifolium pratense* L.), and ribwort plantain (*Plantago lanceolata* L.).

Keywords: microgreens, mutritional composition, antioxidants, sensory evaluation, industrial hemp

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THE INFLUENCE OF FEEDING TECHNIQUES ON THE REPRODUCTIVE PERFORMANCE OF SOWS AND THE GROWTH OF PIGLETS

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ABSTRACT

The aim was to evaluate the effect of feeding technique (dry vs. wet) on the reproductive performance of sows and the growth capacity of piglets. The evaluation was carried out under commercial breeding conditions over a two-year period. A total of 1,468 sows were evaluated using wet feeding and 1,681 using dry feeding. The growth capacity of piglets was evaluated in 260 piglets for each feeding technique. Based on the results of the analysis, it can be concluded that feeding technique has a significant effect on the reproductive indicators of sows and the growth of piglets. Wet feeding ($p = 0.000$) led to a higher number of all piglets (16.3 vs. 15.73 piglets/litter) and live-born piglets (15.48 vs. 14.79 piglets/litter). The length of gestation ($p = 0.000$) was 0.72 days longer with dry feeding, while the interval between weaning and estrus ($p = 0.000$) was longer in sows fed wet (1.25 days). The number of weaned piglets ($p = 0.000$) was higher with wet feeding (14.12 vs. 13.44 pcs/litter). The number of weaned piglets tended to be higher ($p = 0.119$) with wet feeding (by 0.62 piglets), while piglet losses ($p = 0.006$) were slightly higher with wet feeding (by 0.5 piglets). The average live weight of piglets at weaning (8.17 vs. 6.24 kg/piglet) and weight gains (189.86 vs. 264.25 g/day) were higher with wet feeding ($p = 0.000$), regardless of sex ($p = 0.181$). The results of this study show that the use of wet feeding can significantly improve performance parameters of sows, including milk production, which has a positive effect on the growth capacity of piglets.

Keywords: feeding, reproduction, piglets, sows, gains

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SITE-SPECIFIC WEED MANAGEMENT IN SUNFLOWER FIELD USING UAV MULTISPECTRAL IMAGERY AND MACHINE LEARNING

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ABSTRACT

Early and accurate weed detection is critical for sustainable crop management, yield protection, and reducing environmental impacts. Ambrosia artemisiifolia (common ragweed) is one of the most aggressive weeds in Central Europe, competing strongly with crops such as sunflower (*Helianthus annuus*) for water, nutrients, and sunlight, while also producing allergenic pollen that poses public health concerns. In this study, unmanned aerial vehicle (UAV)-based multispectral imagery was employed to discriminate between sunflower and Ambrosia in field conditions. Data were acquired using a DJI Mavic 3 Multispectral camera, which provided four spectral bands (Green, Red, Red Edge, Near Infrared) and an RGB sensor. Orthomosaics were generated in Pix4D Fields, and vegetation indices including NDVI, GNDVI, and NDRE were calculated in QGIS. Supervised classification was performed using multiple algorithms (Random Forest, Support Vector Machine, Multi-Layer Perceptron, Maximum Likelihood, Minimum Distance, and Spectral Angle Mapper). Accuracy assessment was carried out with independent validation samples using confusion matrices, producer's and user's accuracies, overall accuracy, and the Kappa coefficient. The results indicate that machine learning classifiers (Random Forest, SVM, MLP) achieved the highest accuracy in distinguishing sunflower from Ambrosia artemisiifolia and other unwanted plants while traditional classifiers such as Maximum Likelihood were less reliable. This approach demonstrates that UAV-based multispectral classification can provide accurate weed maps, supporting site-specific herbicide application and thereby minimizing chemical use for environmental protection in sunflower production systems.

Keywords: UAV multispectral imagery, sunflower, *Ambrosia artemisiifolia*, machine learning classification, site-specific weed management.

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YELLOW MEALWORM LARVAE (*TENEBRIO MOLITOR*) QUALITATIVE PARAMETERS AND THEIR MODIFICATION DUE TO PROCESSING AND STORAGE CONDITIONS

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ABSTRACT

The aim of this study was to evaluate the quality parameters of the yellow mealworm larvae (*Tenebrio molitor*) and their modification regarding different processing methods and storage conditions. Live larvae were killed by boiling, blanched for 4 minutes and dried using hot air and microwave radiation combined (200 °C/ 350 W/ 18 min). Two variants of larvae were prepared: "conventional" (water blanched) and "citric" (2% citric acid blanched). Each variant was stored in sealed plastic bags at different temperatures: room (22 °C), refrigerator (2–5 °C) and freezer (–28 °C) temperature. Each month larvae were analysed for descriptive parameters, dry matter content, pH, colour and firmness determination. Drying resulted in weight loss of 61% (conventional) and 66% (citric) and volume increase of 40% (citric) and 72% (conventional). During storage, dry matter content ranged from 87% to 98% (conventional) and from 91% to 98% (citric). pH of "citric" variants was consistently 0.04–0.78 lower than "conventional" variants. Colour parameters L*, a* and b* changed similarly within the same variant regardless of the storage conditions. No statistically significant differences in firmness values were found in "citric" variants, nevertheless "conventional" variants showed a significant increase in firmness values after 2 months of storage.

Keywords: edible insect, blanching, drying, colour stability, firmness determination

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ENHANCING THERMOTOLERANCE IN FATTENING PIGS WITH *MORINGA OLEIFERA*-DERIVED SELENIUM NANOPARTICLES IN SUB-TROPICAL CLIMATE

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ABSTRACT

Heat stress is a major constraint in pig production, particularly in tropical and subtropical regions, where elevated ambient temperatures compromise animal health, growth, and productivity. This study evaluated the efficacy of biogenic selenium nanoparticles (SeNPs) synthesized using _Moringa oleifera_ (MO-SeNPs) in mitigating oxidative stress in fattening pigs exposed to high environmental temperatures. Thirty-three Topigs Norsvin (TN70) pigs were randomly assigned to three dietary groups: a control group, a sodium selenite (Na_2SeO_3) group, and a treatment group receiving MO-SeNPs (0.5 mg Se/kg feed). Over a 30-day period, oxidative stress biomarkers glutathione peroxidase (GPx) and superoxide dismutase (SOD) were assessed alongside physiological parameters. Pigs supplemented with MO-SeNPs exhibited significantly enhanced antioxidant enzyme activities and reduced lipid peroxidation compared to both control and Na_2SeO_3 groups. These findings suggest that MO-SeNPs improve thermotolerance by enhancing antioxidant defense mechanisms, offering a promising dietary strategy to mitigate heat stress in swine production systems under subtropical conditions.

Keywords: Moringa oleifera, selenium nanoparticles, heat stress

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MICROALGAL EXTRACTS AS POTENTIAL SUPPLEMENTS IN ANIMAL CELL CULTURE

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ABSTRACT

Microalgae represent a promising source of bioactive compounds that may serve as sustainable supplements in animal cell culture. Conventional media rely heavily on fetal bovine serum (FBS), which is costly, variable in composition, and associated with ethical concerns. The use of microalgal extracts could provide an alternative source of nutrients, while potentially reducing the overall requirement for serum. In this study, extracts from Chlorella sorokiniana, and Spirulina sp. are investigated for their effects on the growth and survival of animal cells. The primary focus is on evaluating cell viability and proliferation, while also monitoring potential cytotoxic effects. Experiments employ the MTT assay to quantify metabolic activity, with a range of extract concentrations tested in order to capture dose-dependent responses. The study aims to provide insight into whether compounds present in microalgae can support cellular metabolism and maintain culture stability under reduced-serum conditions. By addressing the dependence on animal-derived supplements, this work seeks to contribute to the development of more sustainable and ethically acceptable practices in biotechnology.

Keywords: microalgae, cell culture, serum alternatives, MTT assay

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NOVEL ZINC-RESPONSIVE GENES REGULATED BY MTF1

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ABSTRACT

Zinc is an essential trace element involved in a broad range of cellular processes, including DNA replication, transcriptional regulation, metabolism, signalling, apoptosis, and many others. Like other trace metals, the intracellular zinc concentration has to be strictly regulated. The metal-responsive transcription factor 1 (MTF1) plays a key role in maintaining zinc homeostasis, acting as a sensor of intracellular zinc levels. Among proven MTF1 target genes belong several zinc transporters and metallothioneins, which serves as cytoplasmic reservoirs and donors of Zn^{2+} to a wide spectrum of zinc-dependent proteins. In addition to these, there are a only few other genes, like CSRP1, that have been confirmed as MTF1 targets. An important question is whether MTF1 also regulates the expression of additional target genes and whether these genes potentially contribute to zinc homeostasis. To identify novel MTF1 target genes, CHIP-seq data from The Encyclopedia of DNA Elements (ENCODE) database were analysed genes containing at least one metal-responsive element (MRE) in their promoter regions were selected. A HEK293 cell model with MTF1 knockdown was generated, and the basal as well as zinc-inducible expression of the selected genes was examined by RT-qPCR. In addition, the expression of genes regulated by other transcription factors that may respond to zinc metabolism and its fluctuation was assessed. The results showed that the expression of some novel MTF1 targets was zinc-inducible, but not affected by MTF1 knockdown. Interestingly, expression of HMOX1, a signature NRF2 target gene, was significantly increased following MTF1 knockdown, suggesting that partial loss of MTF1 function may be compensated by NRF2. These findings indicate potential crosstalk between MTF1- and NRF2-mediated regulatory pathways, which should be further validated in future studies.

Keywords: MTF1, NRF2, zinc homeostasis, gene expression

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FROM PADDOCK TO PERFORMANCE: MONITORING ENERGY EXPENDITURE AND NUTRITIONAL ENERGY SUPPLY IN HORSES

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ABSTRACT

The aim of the study was to evaluate energy expenditure and heart rate dynamics in horses during free movement and training activities using GPS monitoring and heart rate measurements. Data from an observation period were analyzed with a focus on time distribution across gaits, variability of heart rate (HR), and its relationship to estimated energy expenditure (kcal). Descriptive analysis revealed that horses spent the majority of free mooving time in walk (95.1%), while trot (2.8%) and canter (2.1%) represented only a minor proportion of the total activity. Mean HR values differed across gaits, ranging from approximately 55 bpm in walk to over 80 bpm in canter, with corresponding increases in estimated energy expenditure. Variability in HR was highest in trot and canter (SD ± 23 bpm), suggesting greater physiological demands and individual differences during these gaits. Correlation analysis showed a weak to moderate positive association between HR and energy expenditure ($r = 0.34$), indicating that HR alone may not fully capture energetic cost, which is likely influenced by gait type, duration, and individual fitness level. Time-series analysis further demonstrated dynamic fluctuations of HR during measurement, reflecting the variable intensity of activity across training sessions. The mean value of energy expenditure during paddock turnout was determined to be 62.44 kcal per hour. These findings highlight the potential of combined HR and GPS monitoring to quantify workload and energy expenditure in horses under practical conditions. The results may contribute to improved understanding of equine energy balance and provide a basis for optimizing training programs and feeding strategies.

Keywords: horse, heart rate, energy expenditure

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OPTIMIZING CROP PROTECTION WITH EO DATA: A COMPARATIVE ANALYSIS OF SENTINEL-2, PLANETSCOPE, AND UAV FOR DAMAGE MAPPING

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ABSTRACT

The rising frequency of biotic damage in field crops, particularly from rodents infestations in winter wheat and oilseed rape, necessitates precise and timely mapping for effective management. Unnecessary application of agrochemicals in these damaged areas contributes to a significant environmental burden. While UAV imaging offers ultra-high spatial resolution for detection, its operational demands limit continuous, large-scale monitoring. This study evaluated the potential of Earth Observation (EO) data from the Sentinel-2 and PlanetScope satellite systems as a more efficient alternative for long-term, continuous monitoring of crop damage. The research, conducted in the Czech Republic during the 2023–2024 growing season on winter oilseed rape and winter wheat, used high-resolution UAV imagery as a benchmark for identifying three damage levels (severely damaged, moderately damaged, and undamaged) based on the NDVI vegetation index. Time-series analysis of satellite NDVI data tracked the temporal dynamics of damage, which ranged from 2% to 40% of the field area. The UAV survey is more spatially accurate and can be directly used for preparing prescription maps fortargeted application in crops like oilseed rape. Conversely, satellite imagery is ideal for large-scale damage identification and assesment its development over time, which can be practical as decision support for variable rate fertilizer application. The analysis revealed distinct crop recovery patterns: rapid recovery in cereals around the stem elongation stage contrasted with only partial recovery in oilseed rape. Integrating these two remote sensing approaches enhances the efficiency of agricultural interventions and significantly contributes to reducing the environmental footprint of agrochemicals.

Keywords: rodents, remote sensing, time-series analysis

ACKNOWLEDGEMENT

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ENERGY ANALYSIS OF GRINDING MACHINES

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ABSTRACT

This PhD research focuses on the energy analysis and optimization of hammer mill grinding in the feed industry, with special emphasis on broiler feed production. The current suction system of the mill, based on a fixed-speed fan, will be replaced by a frequency-controlled fan, allowing precise regulation of air flow and real-time monitoring of energy consumption via the PLC. This modification not only enables more accurate experiments but also serves industrial interests by reducing energy losses and improving process efficiency. The experiments will vary three main parameters: sieve aperture size (3.0, 3.5 and 4.0 mm), suction intensity, and hammer mill rotor speed. Only one parameter will be altered at a time to determine its specific influence on grinding efficiency, energy demand, particle size distribution, and pelletability. The research covers the entire broiler feeding program, with laboratory analyses of ground and pelleted samples to evaluate homogeneity, pellet durability index (PDI), and transport resistance. A feeding trial at the newly established Zalavég broiler farm will validate the practical impact of the different grinding settings. Three groups will be compared: a control group with 3.5 mm grinding, a 3.0 mm group, and a 4.0 mm group, involving over 270,000 broilers per cycle. Performance parameters, feed conversion ratio, and animal health indicators will be monitored. The expected outcomes include the identification of energy-efficient grinding parameters, improved pellet durability, and better digestibility. The study contributes both to scientific knowledge and to industrial practice by offering cost-effective, sustainable solutions for modern feed manufacturing.

Keywords: hammer mill grinding, energy efficiency, particle size distribution, pellet durability, broiler feed

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HETEROGENOUS BIOORTHOGONAL PD/ZIF NANOZYMES AS AN EFFECTIVE TOOL FOR PRECISION ACTIVATION OF ANTICANCER PRODRUGS

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ABSTRACT

Despite decades of intensive research, achieving precise and effective anticancer therapeutic toolbox remains an unresolved challenge, emphasizing the urgent need for smarter therapeutic strategies. Bioorthogonal chemistry offers unique opportunities to selectively activate chemotherapeutic prodrugs directly within the tumor tissue, thus minimizing systemic toxicity. In this work, we present heterogenous bioorthogonal nanozymes based on palladium-embedded zeolitic-imidazolate frameworks (Pd/ZIF) for long-lasting activation of anticancer prodrugs within the tumor microenvironment. Two distinct types of Pd/ZIF were developed: cobalt-based ZIF67 and zinc-based ZIF8, both post-synthetically modified with palladium acetate (PdAc), serving as the catalytic moiety. These highly engineered catalytic nanoparticles were designed to maintain the catalytic activity of palladium within the complex biological environment which is a significant challenge when using palladium catalysts in biomedical applications. A solvochemical synthetic approach yielded uniform, stable and catalytically active Pd/ZIF67 and Pd/ZIF8 with mean diameters in range of 130–200 nm and polydispersity indeces below 0.1, depending on the reaction conditions. The morphology and structure were thoroughly characterized by various methods such as dynamic light scattering, atomic force microscopy and scanning electron microscopy. The catalytic activity of as-synthesized nanozymes was evaluated using a series of assays with propargylated fluorescent probes mimicking the behaviour of locked prodrug within the complex biological environment. These findings establish Pd/ZIF nanozymes as a robust and versatile platform with great potential to overcome current limitations in bioorthogonal prodrug activation for the development of more targeted and safer cancer therapies.

Keywords: bioorthogonal therapy, nanozymes, palladium, anticancer prodrugs, zeolitic imidazolate frameworks

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TRADITIONAL FLORAL FOAM VS. SUSTAINABLE ALTERNATIVES – WHICH FUTURE WILL BLOOM?

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ABSTRACT

The main component of traditional floral foam is phenol-formaldehyde resin, with global production reaching several million tonnes annually. Each year, billions of floral foam blocks are consumed worldwide, making them a significant environmental concern. These foams are energy-intensive to manufacture, difficult to recycle, and release microplastics and other substances during use and disposal. This study focuses on comparing the environmental impacts of conventional floral foam with two alternatives – one based on coconut fibre and another made from basalt fibre – using the Life Cycle Assessment (LCA) method in accordance with ISO 14040 and ISO 14044. The functional unit is defined as one kilogram of foam, and the system boundaries cover the entire life cycle from the extraction of raw materials to final disposal (from cradle to grave). Environmental impacts were assessed with the ReCiPe 2016 method across categories such as climate change, water consumption, and others. Preliminary results show that both alternatives have a lower environmental footprint than traditional floral foam. For example, in the category of climate change, the difference can reach up to 70%. These findings confirm the potential of natural and mineral-based solutions as more sustainable substitutes and highlight the need for their wider implementation and further development, which could significantly contribute to reducing the ecological footprint of the floral industry.

Keywords: floral foam, floristry, LCA, sustainable, environment

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HOW THISTLE FEMALES WIN? REPRODUCTIVE SUCCESS AND GRANIVORY IN TWO GYNODIOECIOUS CIRSIUM SPECIES

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ABSTRACT

Gynodioecy—the coexistence of hermaphrodites and females within a species—poses a classic evolutionary puzzle: why do females persist when hermaphrodites can reproduce in both roles? We addressed this by comparing two gynodioecious thistles with contrasting life histories and female frequencies: *Cirsium heterophyllum* (polycarpic, high female frequency) and *C. palustre* (monocarpic, low female frequency). We measured vegetative traits (plant height, stem robustness), reproductive output (number of capitula, achene viability, total and developed achenes), and pre-dispersal achene predation. In both species, females consistently produced more fully developed achenes than hermaphrodites and experienced lower levels of achene predation. The most damaging predators were weevils, whose larvae used the capitula as brood sites and consumed the achenes, accounting for most achene loss in both species. These results suggest that enhanced reproductive success, combined with reduced granivory, underpins the persistence of females in gynodioecious Cirsium, offering fresh insight into the maintenance of plant sexual polymorphisms.

Keywords: gynodioecy, female advantage, achene predation, *Cirsium*

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ROLE OF EXPANSINS IN MODULATING STRESS RESISTANCE IN TOBACCO: EFFECTS ON DROUGHT AND PATHOGEN RESPONSE

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ABSTRACT

Expansins are proteins involved in the loosening and remodelling of the plant cell wall, facilitating plant growth and mediating responses to environmental stimuli. The cell wall is a key structure in plants' response to both abiotic stresses and biotic challenges, including pathogens and parasites. The study and modification of expansins could contribute significantly to the adaptation of plant growth to changing environmental conditions. Genetic modifications of crops could drastically increase the efficiency of agricultural production and thus contribute to the improvement of the quality of the environment. Expansins, as key mediators of cell wall dynamics, are proposed as prime research targets for the genetic improvement of crops. In our study, we focus on tobacco (Nicotiana tabacum), a plant belonging to the Solanaceae family, due to its close relation to agriculturally important crops such as tomato, potato or eggplant. Transgenic tobacco plants with dexamethasone-inducible expression of AtEXPA1 were created by transformation with Agrobacterium; induction of expression was verified by GUS staining and RT-qPCR. Subsequently, the plants were infected with Pseudomonas by various methods. The obtained results show that increased expression of AtEXPA1 can have a positive effect on the plants' resistance to Pseudomonas infection. The inducible AtEXPA1 tobacco plants were also subjected to prolonged drought stress. We assessed key photosynthetic parameters and discovered enhanced photosynthetic performance including higher effective quantum yield of PSII and decreased non-photochemical quenching. These results support the role of AtEXPA1 in enhancing plant drought tolerance.

Keywords: expansin, cell wall, pseudomonas, nicotiana tabacum, phytopathology

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SMART LIPID NANOCARRIERS FOR BRAIN DELIVERY OF ACETYLCHOLINESTERASE REACTIVATORS

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ABSTRACT

Organophosphate poisoning causes severe neurological damage, but treatment remains limited by the inability of therapeutic oximes to cross the blood-brain barrier (BBB). The challenge is addressed by developing solid lipid nanoparticles (SLNs) as nanocarriers for targeted oxime delivery to the central nervous system. SLNs are formulated using solid lipids, such as Compritol 888 ATO (C), which creates a stable core that supports efficient drug encapsulation. Surfactants like Tween 80 (T) and Pluronic F127 (P127), or lipids containing polymers (polyethylene glycol – PEG), stabilise the dispersion and enhance BBB permeability by fluidising endothelial membranes and reducing P-glycoprotein efflux. The choice of surfactant influences particle properties, where differences in interfacial behaviour and steric stabilisation affect size, surface charge, and homogenity. Formulated C-based SLNs exhibit a size of 83 nm, ζ-potential of –8.9 mV, and polydispersity index (PdI) of 0.109. PEGylated C-SLNs are even smaller at 49 nm (PdI 0.111) with a ζ-potential of –3.38 mV, suggesting that PEG contributes to more compact particle formation with reduced surface charge. All formulations maintain uniform particle distributions and remain physically stable for at least one month. Using complementary methods such as SEM and AFM, spherical, non-aggregated particles were demonstrated. This nanoformulation strategy represents a promising non-invasive platform for brain-targeted oxime delivery.

Keywords: solid lipid nanoparticles, acetylcholinesterase reactivators, brain delivery

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ASSESSING SMALLHOLDER MAIZE FARMERS' ADOPTION INTENTIONS OF CLIMATE-SMART AGRICULTURAL PRACTICES IN ZAMBIA

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ABSTRACT

Maize, produced predominantly by smallholder farmers under rain-fed conditions forms the backbone of Zambia's agriculture, yet remains highly vulnerable to climate change. In light of this, Climate Smart Agriculture (CSA) has been widely promoted as a pathway to building resilience and improving productivity among smallholder maize farmers in Zambia. However, adoption levels remain low in Zambia. This study applies the extended Theory of Planned Behavior (TPB) to examine factors shaping smallholder farmers' intentions to adopt CSA practices. A total of 428 farmers were surveyed across three districts namely Chongwe, Chibombo, and Monze using a structured questionnaire. Data were analyzed through Structural Equation Modelling with Smart PLS 4.0. Results show that attitudes, subjective norms, and knowledge strongly influence farmers' willingness to adopt CSA among smallholder farmers in Zambia. In addition, climate information services emerged as a critical enabler, significantly reinforcing TPB constructs and supporting informed decision-making. These findings suggest that CSA adoption is not only a matter of awareness but also of social influence, access to credible climate information, and knowledge integration. The study underscores the need for practical interventions, such as strengthening agricultural extension systems, mainstreaming climate information into local advisory services, and developing community-based learning platforms. For policymakers, investing in localized and timely climate services, coupled with initiatives that enhance positive attitudes and leverage social networks, can accelerate CSA uptake. Overall, the study highlights actionable strategies that bridge the gap between CSA awareness and adoption, offering insights that are transferable to similar smallholder contexts across sub-Saharan Africa.

Keywords: agriculture, climate change, climate smart agriculture, developing countries, TBP, smallholder farmers, Zambia

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THE EFFECT OF SORGHUM SILAGE IN DAIRY DIETS ON DIETARY AND MILK FATTY ACID PROFILE AND MILK LIPID QUALITY INDICATORS – PRELIMINARY RESULTS

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ABSTRACT

The study aimed to assess how incorporating sorghum silage into dairy cow diets influences the fatty acid (FA) profile in the total mixed ration (TMR) and in milk, as well as selected health and technological indicators of milk fat. The on-farm experiment was conducted on mid-lactating Czech Fleckvieh cows (Agrospol a.d. Knínice, farm Vanovice) over two consecutive periods of three months each. During the first period, cows received a TMR based on maize silage and grass haylage, while in the second period, part of the grass haylage was substituted with sorghum silage. In each period, feed samples were collected monthly. Milk samples were collected monthly from ten cows and were analysed for basic composition and FA profile. The FA profiles were analysed using gas chromatography with flame ionization detection. Incorporation of sorghum silage into the diet decreased the concentrations of palmitic and stearic acids and increased the concentration of linoleic acid in TMR ($P < 0.05$). This also influenced the final composition of milk fat. The inclusion of sorghum silage increased the contents of capric, lauric, stearic, oleic, linoleic, α-linolenic, eicosatrienoic, heneicosanoic acids, monounsaturated FA, polyunsaturated FA, n-3 FA and n-6 FA in milk and decreased the contents of butyric, palmitic acids and saturated FA ($P < 0.05$). Sorghum silage in dairy diets also had positive impact on health and technological indicators increasing the content of essential FA, the ratio of hypocholesterolemic to hypercholesterolemic FA and spreadability index while also decreasing the n-6 to n-3 ratio, atherogenicity index and thrombogenicity index ($P < 0.05$).

Keywords: α-linolenic acid, linoleic acid, polyunsaturated fatty acids, saturated fatty acids, technological and health indicators

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THE VIEW ON GENETIC BASIS OF MALE FERTILITY RESTORATION IN WINTER TRITICALE WITH PAMPA AND AEGILOPS SHARONENSIS STERILIZING CYTOPLASM

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ABSTRACT

Cytoplasmic male sterility (CMS) is considered the most effective tool for male sterilization of mother lines in hybrid breeding. For triticale, Pampa and Aegilops sharonensis sterilizing cytoplasm are promising alternatives for previously tested cytoplasm Triticum timopheevi. However, the mechanisms determining the restoration of the male fertility in F1 hybrid varieties have not been specified, nor have the nuclear Restorer-of-fertility (Rf) genes that are responsible for it. The research focuses on identifying the Rf genes interplaying with Pampa and Ae. sharonensis cytoplasm regards the male fertility restoration. The research objects were triticale lines with Pampa and Ae. sharonensis cytoplasm in male-sterile and restored male fertility variants, their maintainer lines with normal cytoplasm, as well as F1, F2, and BC1 generations. Plant fertility was performed by assessing the pollen viability, the anthers appearance and finally the number of grains on the bagged spikes that was evaluated after harvesting. The results were calculated using the correlation coefficient, the index of restoration (IR) and the chi-square test. The correlation coefficient confirmed the consistency of fertility assessments in both cytoplasm. The IR for F1 plants with Pampa and Ae. sharonensis cytoplasm was 86.54% and 77.08%, respectively. The results of chi-square test for the F2 and BC1 populations indicated monogenic inheritance of the male fertility restoration: at least one major Rf gene is responsible for the male fertility restoration in both tested cytoplasm. Further research should clarify whether this is the same gene. However, it seems that the effects of additional genes with minor effects cannot be excluded.

Keywords: triticale, cytoplasmic male sterility, fertility restoration

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NATURAL OCCURRENCE OF ENTOMOPATHOGENIC FUNGI IN POPULATIONS OF *LEPTINOTARSA DECEMLINEATA* IN GEORGIA

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ABSTRACT

The paper demonstrated the Colorado potato beetle (CPB), *Leptinotarsa decemlineata* (Say) (*Coleoptera: hrysomelidae*) its natural enemies such as entomopathogenic fungi. Six isolates were obtained from larvae and adults of the population of *L. decemlineata*, at the different geographical and climatic zone of potato production. Morphological studies show that five isolates belong to the genus of Beauveria and one isolate of Metharhizium. Microscopic observation of colony growth and conidia arrangement showed general and typical characteristics of Beauveria bassiana in five isolates and one isolates Metharizium anizopliae. Distribution of EPF among the insects, horizontal transmission, is a critical issue for the control of decemlineata. Experimental results show that adults of the *L. decemlineata* were infected with a fungal disease as a result of movement in the soil and spread naturally among them. The beetles moved on the surface of the soil, as well as deep into the soil. On the 5th day few beetles appeared infected with mycosis; on the 9th day their number increased and infected beetles achieved around 50%; Finally, on the 14th day all the beetles were infected and their mortality reached 100%. The identification and investigation of mycosis infection in the population of Colorado potato beetle, which has developed resistance to many insecticides used, is important to reduce economic losses and save the environment from pollution and is an important pathogen that can be used for the control of this insect.

Keywords: Georgia, Potato, Colorado potato beetle, entomopathogenic fungi, Beauveria bassiana, Metharizium anizopliae

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EFFECT OF INOCULANT ADDITION ON THE DEVELOPMENT OF POPULATIONS OF SELECTED MICROORGANISMS, NUTRITIONAL COMPOSITION AND QUALITY OF SORGHUM SILAGE

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ABSTRACT

Sorghum has increasingly been used in recent years as a forage crop for livestock, primarily due to its resilience and ability to produce high yields even during increasingly frequent periods of high temperatures and drought. Ensiling sorghum represents a promising approach to securing sufficient high-quality roughage. However, the final quality of silage is strongly influenced by the microbial population, which determines the course of fermentation and subsequently the aerobic stability of the silage. From the perspective of feed quality and safety, promoting lactic acid bacteria, which rapidly acidify and preserve the material, is desirable, while suppressing undesirable microorganisms is crucial. Among these, clostridia can cause nutrient losses and pose hygienic risks. The use of additives is one accessible option to improve silage quality and enhance its aerobic stability. In this study, model silages were prepared in vacuum-sealed bags. Nutritional parameters determining silage quality and selected microbial populations were monitored at regular intervals using qPCR, both during the entire fermentation process (60 days) and during the aerobic exposure phase (44 days) after opening the bags. Special attention was given to lactic acid bacteria and clostridia and the development of their populations under aerobic conditions. The results indicate that the initial phase of fermentation is characterized by a rapid microbial dynamic. Daily sampling allowed a detailed observation of these changes, providing a first insight into the early fermentation processes. Trends observed after opening the model silages offer valuable information on factors affecting the aerobic stability of sorghum silage.

Keywords: sorghum, silage, microorganisms

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This research was supported by IGA25-AF-IP-050.

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EVALUATION OF SELECTED FAMILIES OF HOLSTEIN DAIRY COWS

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ABSTRACT

The experiment "Evaluation of Selected Families of Holstein Dairy Cows" deals with the importance of cow families in Holstein cattle breeding and was conducted at the company Agras Bohdalov, a.s. Cows from two families were compared with their contemporaries in terms of milk yield, reproductive traits, and selection index. The overall average milk yield of all selected cows was 14,844 kg with 3.65% fat and 3.26% protein. Differences in individual traits between families and their contemporaries were minimal (families: 14,833 kg milk, 3.61% fat, 3.3% protein; contemporaries: 14,855 kg milk, 3.69% fat, 3.23% protein). A significant difference was found between cows from families and contemporaries in first lactation and cows in higher lactations. The lowest average milk yield (12,809 kg) was recorded in contemporaries, while the highest average yield was reached by cows from families in third lactation (16,746 kg). A significant difference was also found in the selection index, where cows from families achieved an average value of 125, while contemporaries reached 112. Reproductive indicators were mostly comparable between both groups. In family cows, the lowest average insemination index was found in first-lactation heifers (1.96), and the highest index was reached by cows in third lactation (4.31); these differences were statistically significant. The average insemination interval values between groups and individual lactations were not significant (families: 77.2 days; contemporaries: 77.1 days). The average length of service period was shorter in the family group (126.5 days) compared to contemporaries (135.5 days), but this difference was not statistically significant. The average age at first calving was 684.3 days in family cows and 682.7 days in contemporaries. In the herd, a higher proportion of females with a longer productive lifespan was observed in the group of contemporaries (44.3% of cows in third or higher lactation).

Keywords: Holstein cattle, families, milk production, reproduction, breeding

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INFLUENCE OF MECHANICAL PROPERTIES OF COFFEE BEANS ON THEIR QUALITY PARAMETERS

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ABSTRACT

Global coffee bean production continues to grow steadily, with current research increasingly focusing on their chemical composition, quality attributes, and processing technologies that significantly influence the final bean quality. An important factor in this context is the mechanical behavior of green beans, which affects their performance during roasting. The aim of this study was to determine and describe the mechanical, structural, and color properties of coffee beans in relation to their chemical composition, with the potential application in controlling and optimizing the roasting process. Samples of Coffea arabica, Coffea robusta, and Coffea liberica beans processed using the washed, natural, and honey methods were analyzed for their mechanical and structural properties as well as for their chemical composition. The beans were subsequently subjected to three different roasting profiles and re-analyzed. Green beans showed significantly higher density and mass compared to roasted beans. The chlorogenic acid content decreased with increasing roasting intensity across all samples, while caffeine content exhibited a slight increase. The mechanical strength of coffee beans was markedly reduced after all three roasting regimes. Conversely, with increasing roasting time and intensity, the beans expanded in volume and became more brittle. The results may contribute to the optimization and refinement of coffee bean roasting processes based on mechanical and chemical characteristics, potentially leading to improved quality and production efficiency.

Keywords: coffee, strenght, beans, roasting

ACKNOWLEDGEMENT

This research was conducted with the support of the project AF-IGA2025-IP-039 "Influence of Mechanical Properties of Coffee Beans on Their Quality Parameters" (IGA AF MENDELU).

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MOLECULAR PHYLOGENY OF ANACAMPSEROS GENUS

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ABSTRACT

The phylogenetic relationships within the family Anacampserotaceae (*Caryophyllales*), a group of predominantly succulent plants native mainly to southern Africa, remain unresolved despite previous research. This is particularly true for the genus Anacampseros, which shows remarkable morphological diversity and taxonomic ambiguity. Pronounced morphological differences have been observed between the previously separated groups Anacampseros and Avonia, yet their evolutionary relationships remain unclear. The aim of this study is to contribute to the clarification of evolutionary relationships and to refine the systematic concept of the group based on extensive sampling and analysis of multiple molecular markers. PCR testing and optimization were performed for several chloroplast (rpl16, matK, psbA, rps16, etc.) and nuclear (ITS) markers, including an evaluation of their phylogenetic information value. The first sequencing allowed the construction of preliminary phylogenetic trees and provided the basis for selecting the most suitable markers for further analysis. In the next phase, the sample database will be expanded to include additional species, which will provide a more comprehensive picture of the evolutionary history of this group and potentially enable molecular dating analyses. The results of the project will bring new insights into the evolutionary relationships of the genus Anacampseros and contribute to a better understanding of the diversity and evolutionary history of the family Anacampserotaceae.

Keywords: molecular phylogeny, plant taxonomy, Anacampseros

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NOWHERE TO HIDE: COMPARING LTR RETROTRANSPOSON DYNAMICS IN HOLOCENTRIC CYPERIDS AND MONOCENTRIC GRASSES

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ABSTRACT

Long terminal repeat retrotransposons (LTR-RTs) are the most abundant group of transposable elements in plant genomes. They transpose via a copy-and-paste mechanism, generating high sequence similarity that can lead to ectopic recombination. However, recombination is often suppressed in pericentromeric and other heterochromatic regions of monocentric chromosomes. As a result, full-length LTR-RTs may accumulate in these recombination coldspots, while solo-LTRs mark their removal from recombination hotspots in the arms. In contrast, holocentric chromosomes exhibit a more uniform chromatin organization without evident euchromatic or heterochromatic clusters. Therefore, it may be more difficult for LTR-RTs to hide, and both full-length LTR-RTs and solo-LTRs are expected to be more evenly distributed along holocentric chromosomes. Using a combined bioinformatic and cytogenetic approach, we compared LTR-RT family abundance and elimination dynamics in holocentric cyperids and closely related monocentric grasses. We find faster LTR-RT turnover in holocentric species, suggesting that holocentric genomes provide fewer refuges for transposable element survival. These findings shed light on how chromosomal architecture shapes LTR-RT dynamics and contributes to plant genome evolution.

Keywords: LTR retrotransposon, holocentric chromosome, monocentric chromosome

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MONITORING CHANGES IN THE COMPOSITION OF THE INTESTINAL MICROBIOTA AND SPECIFIC METABOLITES OF INTESTINAL BACTERIA IN RELATION TO DIETARY INTERVENTION AND BODY WEIGHT REDUCTION IN OBESE INDIVIDUALS

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ABSTRACT

Excessive body weight and obesity disease are the most current global problems with an ever-increasing prevalence leading to a negative impact on human health. Futhermore, most attempts for long-term and effective weight reduction including lifestyle changes or pharmaceutical efforts and specific medication remains mostly unsuccessful. In this context, one of the potential factors influencing the development and progression, but also the possible treatment of obesity is considered the intestinal microbiota, so-called gut microbiome (GM). Intestinal microbiota can produce many biologically active substances and bacterial metabolites such as short-chain fatty acids (SCFA) which may positively affect metabolic and immune functions of the host and thus regulate the presence of obesity. On the contrary, GM of obese individuals is predominantly associated with intestinal dysbiosis characterized by changes in the composition of gut bacteria which probably promote the development and progression of obesity. The aim of this observational clinical study was to monitor and evaluate possible changes in the GM composition including evaulation and quantification of SCFA in stool samples of obese probands who underwent nutritional and cognitive-behavioral therapy targeted for body weight reduction. Moreover, diet composition including intake of energy, macro/micro-nutrients and other food components, were evaluated, as well as changes in body composition of probands at the beginning, and the end of the therapy. The objective was also to perform a comprehensive analysis of all above mentioned parameters to point out the possible causal relationships between weight reduction, gut microbiota and human health.

Keywords: gut microbiota, obesity, short-chain fatty acids, weight reduction, diet composition

ACKNOWLEDGEMENT

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THE EFFECT OF CEMTIRESTAT ON VIABILITY AND GENE EXPRESSION IN RAT PRIMARY OSTEOBLASTS

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ABSTRACT

Objective: Cemtirestat (CMTI) is a novel aldose reductase inhibitor developed to mitigate diabetes-related complications, including diabetes-associated bone damage. Given the limited knowledge about AR inhibitors and bone biology, we investigated the effects of CMTI on primary rat osteoblast cultures.

Materials and methods: CMTI (3-mercapto-5H-1,2,4-triazino[5,6-b]indole-5-acetic acid) was tested at 10, 50, and 100 µM for 72 h; controls received no treatment. Total RNA was extracted, reverse-transcribed, and analyzed by real-time PCR for osteogenic markers including ALPL, BGLAP, IBSP, SPP1, COL1α1, RUNX2, VDR, BMP2, BMP7, TGFB1, TGFBR1, FGF23, TNFSF11, TNFRSF11B, CDH11, and VEGFA.

Results: CMTI did not impair osteoblast viability; instead, a mild increase was observed (121–128% of control). Gene expression profiling revealed modest, non-significant trends across several osteogenic markers, whereas only FGF23 was significantly upregulated at 50 and 100 µM ($P < 0.05$).

Conclusion: CMTI may exert mild pro-survival effects on osteoblasts, likely linked to its antioxidant activity, and selectively increases FGF23 expression. These findings provide the first evidence of AR inhibitor–mediated transcriptional modulation in bone cells and raise the possibility that CMTI could influence phosphate metabolism and local osteoblast function.

Keywords: cemtirestat, rat osteoblasts, gene expression, viability

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SEASONAL CHANGES IN THE DYNAMIC AND QUALITY OF HUMIC SUBSTANCES

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ABSTRACT

The study focuses on the dynamic and quality of organic matter in permanent grassland soils. Application of fertilizers (mineral, organic, and farmyard manure) and their effect of humic substances composition was evaluated. Soil samples were taken during 2025 (spring, summer, autumn; n=4) from humic horizon 0-15 cm. The aim of the study was to determine seasonal dynamic of humic substances and the effect of applied fertilizers on humic substances composition. Furthermore, to emphasize the significance and importance of soil organic matter on to soil quality and production of of aboveground biomass. The following parameters were determined: content of humic substances, the ratio of humic and fulvic acids, and the content of total organic carbon. The statistical tests, including graphical outputs were used for dataset evaluation. Obtained results confirmed seasonal dynamic and different effect of applied fertilizers. The research contributes to a better understanding of soil processes and can serve as a basis for more effective fertilizer application, improving management of permanent grasslands, and overall sustainability of land management in the context of climate change.

Keywords: permanent grassland, humic substances, ferilizing

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NEGATIVE IMPACT OF FISHING METHODS ON TROUT FISHING GROUNDS

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ABSTRACT

Salmonid fish populations are significantly affected by climate change, low flow conditions, fish-eating predators and recreational fishing. Recreational fishing is often an overlooked negative factor among fishermen themselves. Given the complexity of detecting the individual behavior of anglers and their approach to fishing, we can only speculate about the overall impact of recreational fishing. As the negative impact of recreational fishing, and the quantification of this specific data have only been researched a little. Although the available literature often compares these two fishing methods in terms of their negative impact, information regarding the effectiveness of individual gear is difficult to determine. This study assesses the extent of the negative impact caused by spin fishing and fly fishing. For these fishing methods, comparisons were made regarding the sizes and characteristics of the gear used for fishing, as well as the anatomical location of the hooks. The results of the study suggest a certain correlation between hook size and the degree of severity of anatomical location. Fly fishing resulted in rarely severe injuries compared to spin fishing. This is because fly fishing uses significantly smaller hooks than spin fishing. The specific influence of individual lures will be explained in detail in the presentation. This study may also contribute to the sustainability of recreational fishing based on adjustments to fishing in trout areas. Since comparing effectiveness may play a significant role in understanding the negative impact, further research is necessary.

Keywords: trout fishing grouds, hook location, fishing methods

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ADVANCED TRIBOLOGICAL DIAGNOSTICS FOR PREVENTIVE VEHICLE MAINTENANCE

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ABSTRACT

Tribological diagnostics represents an effective tool for improving the reliability of vehicles, reducing maintenance costs, and minimizing unplanned downtime. This study focused on emergency medical service vehicles, whose operational patterns differ significantly from those of comparable vehicles in regular use. Motor oil samples were collected at regular intervals and analyzed using advanced methods, particularly infrared and X-ray fluorescence spectroscopy, as well as quantification and classification of wear particles. These procedures allowed for the assessment of oil composition and property stability, as well as the presence of contaminants. Based on the analyses, trends in the degradation of lubricating oils were identified, including, for example, decreases in total base number and increases in concentrations of wear elements (Fe, Cu, Al). From the results obtained and analyzed so far, recommendations are being prepared for adjusting or supplementing the existing maintenance and service schedules to better match the real operational load of the studied vehicles. The results suggest that the use of tribological diagnostics may contribute to reduced failure rates and improved operational readiness of emergency medical service vehicles. They also indicate potential opportunities for optimizing maintenance and repair costs. It is anticipated that the proposed approach could be applicable in other transport sectors where high operational reliability is required.

Keywords: tribology, lubricants, maintenance, vehicles

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MATHEMATICAL MODELS FOR A SOLAR POT

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ABSTRACT

Developing easy-to-use mathematical models to predict temperatures in solar cookers is crucial, as solar cooking plays a key role in utilizing renewable energy and reducing emissions. The focus of this research is the solar pot, a recent invention registered with the Hungarian Intellectual Property Office as a utility model (patent no. 5489). Designed for heating or cooking foods, beverages, and other liquids, the pot resembles a double-pipe heat exchanger, featuring an outer jacket and an inner cooking chamber. Although a prototype has been built, its performance had not previously been examined through modelling, simulation, or experimental testing from many aspects. The aim of the present work is to create mathematical models for the pot, enabling prediction of the jacket and cooking space temperatures. Modelling and simulation results are reported, providing insight into the device's efficiency and potential applications. The study also includes constructing an experimental setup of the pot and solar collector to perform measurements under varying conditions, thereby evaluating the pot's performance and validating the proposed models. Results prove the applicability of the solar pot and show that the models achieve an impressive temperature prediction error.

Keywords: mathematical models, solar cooking, simulation, measurements, experiments

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SPATIAL AND DEPTH-RELATED PATTERNS OF MACRO- AND MICROELEMENTS AND GRAIN-SIZE COMPOSITION IN POND BOTTOM SEDIMENTS FROM DIFFERENT REGIONS OF UKRAINE

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ABSTRACT

This study investigates the spatial and depth-related factors determining the chemical and grain-size characteristics of bottom sediments from five ponds located in the Kharkiv, Sumy and Volyn regions of Ukraine. Statistical analysis using Spearman's rank correlation coefficient ($p < 0.05$) revealed significant relationships between distance from the shoreline and water depth, and the contents of macro- and microelements in the sediments. Elevated concentrations of available forms of Zn, Ni, K_2O, S and NO_3^- were found in near-shore zones, whereas Cr, Cu, Fe, Pb and NH_4^+ prevailed in more distant areas. Grain-size composition also varied spatially: with increasing distance from the shore, the proportion of clay and silt generally decreased while the proportion of sand fractions increased; with increasing water depth, silt tended to increase. The ponds from different regions displayed distinct fraction profiles: finer particles dominated in the ponds from the Kharkiv and Sumy regions, whereas the ponds from the Volyn region contained a higher proportion of sand. These findings highlight the importance of spatial patterns and local conditions in assessing the agro-ecological potential of bottom sediments, including for post-war restoration of land quality.

Keywords: bottom sediments, grain-size composition, macroelements, microelements, distance from shore, water depth, correlation analysis

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THE INFLUENCE OF MICROORGANISMS ON GROWTH OF SPRING BARLEY

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ABSTRACT

With climate change progressing, plants face unprecedented pressure to adapt to changing environments, frequently at the expense of their growth and yield. Symbiotic microorganisms may provide a promising strategy to alleviate these stresses by promoting plant growth and improving resilience. In this study, we evaluated the effects of Pseudomonas simiae and Acremonium alternatum on spring barley under optimal and drought conditions. Drought stress was simulated under controlled growth chamber conditions using a polyethylene glycol solution with a water potential of -0.5 MPa. The results showed that the presence of microorganisms stimulated the growth of all examined root traits except root diameter. Under optimal conditions, P. simiae had the strongest effect on root traits (increased 14–37%), whereas under drought conditions both inoculants promoted root growth more effectively when applied in combination (increased 34–45%). It appears that plants exposed to stress relied more on symbiotic microorganisms, which helped them maintain a more balanced root-to-shoot biomass ratio, closer to values observed under optimal conditions. This suggests that microbial inoculation also supports the coordination of above- and below-ground growth under water-limited conditions. These findings demonstrate that P. simiae and A. alternatum have significant potential as biostimulants for improving crop performance under drought, and they highlight the practical relevance of applying beneficial microorganisms in sustainable agriculture to reduce yield losses caused by water scarcity.

Keywords: spring barley, Acremonium alternatum, Pseudomonas simiae, symbiosis, promoted plant growth

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PRECISION WEED MANAGEMENT THROUGH SITE-SPECIFIC HERBICIDE APPLICATIONS

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ABSTRACT

Site-specific hebicide application represents an important approach for reconciling modern crop protection practices with the environmental objectives of the European Union's Common Agricultural Policy (CAP). By applying herbicides only where weeds are detected, site-specific approaches allow for a significant reduction in the overall amount of chemical inputs. This not only lowers the risk of soil and water contamination but also mitigates negative impacts on biodiversity. At the same time, such practices support the ambitions of the EU Green Deal and the Farm to Fork strategy. Within the study, several locations and crops were examined in recent years in order to demonstrate the versatility of site-specific herbicide applications. One illustrative case study with combination of herbicide treatments was realized at alfalfa (*Medicago sativa*) field with area of 9.8 ha in Višňové (Znojmo). Part of the crop stand was insufficient emerged after sowing, while other significant field area was increasingly suppressed by the infestation of perennial ryegrass (*Lolium perenne*). The field was mapped by UAV in March 2025 to identify the crop status and weed infestation from ortophoto. Based on the NDVI map, three treatments were suggested: untreated control (33%), glyphosate (32%), and graminicide (35%). The delineation of area allows selective herbicide to support alfalfa competitiveness under grass weed pressure and to replant crop after glyphosate application. This example highlights how the crop mapping by remote sensing and application strategy of two different herbicides can be tailored to address the specific crop–weed interaction.

Keywords: site-specific herbicide application, precision agriculture, remote sensing, UAV mapping

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A CASE STUDY ON ECONOMIC BENEFITS OF PRECISION WEED MANAGEMENT IN WINTER WHEAT

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ABSTRACT

Site-specific weed management (SSWM) is an important approach in precision farming, offering both economic and environmental benefits by lowering herbicide use. Its implementation, however, often requires significant investment in technologies such as modern sprayers, UAVs, image processing software, and data analysis. Farms may adopt different models, from outsourcing the full service to managing UAV flights, data processing, and weed detection in-house. This study examines the use of SSWM for controlling creeping thistle (*Cirsium arvense*) in winter wheat (*Triticum aestivum*) during growth stage BBCH 33–35. The field trial with 252.5 ha of winter wheat at farm 997 ha was monitored for weed infestation. Weed patches were identified using a DJI Mavic 3 Multispectral UAV with 7 mm GSD imagery. Data were processed in OpenDroneMap, and infestation maps were produced using Pix4Dfields with the Magic Tool classification. Herbicide treatments consist of clopyralid with the rate of 0.3 $l.ha^{-1}$ and 270 $l.ha^{-1}$ spray volume. Application was realized by trailed sprayer Amazone UX 4201 Super, equipped with individual nozzle control. Out of the 252.5 ha surveyed, only 55.5 ha required spraying, resulting in herbicide savings of 78%. With herbicide costs of €43.7 ha^{-1} and UAV detection costs of €10 ha^{-1}, the total net savings reached €6,116. Besides reduced chemical use and lower costs, this approach also decreases environmental impact by herbicides residues and may support healthier crop growth by lower risk of phytotoxicity. The case study demonstrates that SSWM can be both cost-efficient and environmentally sustainable for modern agriculture.

Keywords: site-specific weed management, precision agriculture, UAV, herbicide savings, winter wheat

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A NOVEL CHEMILUMINESCENCE POINT-OF-NEED PROTOTYPE FOR RAPID ADIPONECTIN DETECTION

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ABSTRACT

Adiponectin is a clinically relevant biomarker with great potential in early diag nosis and monitoring of metabolic diseases. However, current detection methods typically laboratory-based immunoassays are time-consuming, complex, and unsuitable for decentralized or time-critical testing. Here, we present a novel chemiluminescent point--of-need prototype for rapid adiponectin quantification from small-volume biological samples. This approach aims to combine analytical precision of laboratory assays with the speed and portability required for on-site applications. Our instrument named MALIA (Magnetic-Assisted Chemilumines cence Immunoassay) is a portable chemiluminescence analyzer tailored for low volume immunodiagnostics. The analytical principle is based on a magnetic bead sandwich immunoassay, in which adiponectin is selectively captured by antibody coated magnetic microparticles and subsequently detected using acridinium ester-labeled secondary antibodies (ACR). The light generated by the ACR-trig gered reaction is measured by an integrated photomultiplier tube. Key innovations include an optimized ACR labeling protocol ensuring sufficient signal-to noise ratio, and a streamlined workflow with rapid magnetic separation in a disposable cartridge. The total assay time is under 15 minutes and the platform achieves a detection limit in the low ng ml^{-1} range. Calibration using recombinant adiponectin yielded a curve with excellent fit (2 = 0.99). Comparative analysis R with commercial methods revealed strong correlations: 2 = 0.90 versus ELISA, R and 2 = 0.92 versus the CLIA-based KleeYa platform. This novel point-of-need prototyperepresentsasignificantadvanceinaccessiblediagnosticsformetabolic health monitoring. Its compact design, rapid turnaround, and minimal sample requirements offer a compelling solution for use in primary care, home settings, or remote environments.

Keywords: chemiluminiscence, point of need device, Adiponectin, Acridinium, antibodies

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SPECIES COMPOSITION OF RAPTOR AND OWL FAUNA AND ITS CHANGES DEPENDING ON FOREST MANAGEMENT

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ABSTRACT

Research of owl and raptor species was realized at six forest localities (Žákova hora, Peperek, Radenice, Štěpánovice, Blansko and Koryčany) with different number of clearcuts. This research combined a field survey (from January 2023 to July 2025) and audio recordings (March 2025). The most common owl species was Strix aluco and the most common raptor species was Buteo buteo. In addition, the endagered species were found – for example *Milvus milvus* or *Haliaeetus albicilla*. Local and landscape parameters were measured (tree species, tree height, damage of trees, clearcut area, distance to forest edge) due to find a relationship with the bird species richness. Overall, the highest owl species number was in Radenice (3 species) and the highest raptor species number was in Blansko (4 species). Both taxonomic groups were the most common in localities with the highest number of clearcuts.

Keywords: owl, raptor, bird, tree, clearcut

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STRESS AND WINGS: DISPERSAL MORPHOTYPES MODULATE ENVIRONMENTAL STRESS IN CARABID BEETLES

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ABSTRACT

Fluctuating asymmetry (FA), which involves small, random deviations from perfect bilateral symmetry, can reveal developmental instability under environmental stress. In this study, we investigated whether wing morphology modulates FA in ground beetles inhabiting solar parks and natural grasslands. Four dry-loving species were collected between May 2022 and May 2023: *Ophonus cribricollis*, *Harpalus subcylindricus*, *H. flavicornis* and *H. picipennis*. The beetles were preserved in 70% ethanol, photographed under standardised conditions and three antennal segments (a2–a4) were measured twice using DeepLabCut and Napari. Rigorous data filtering excluded traits showing high measurement error, directional asymmetry, or antisymmetry. FA was calculated using the size-corrected FA3 index and analysed using generalised linear mixed models, with treatment (solar park vs. grassland), wing morphology (*apterous*, *brachypterous* or *macropterous*), sex and body size as fixed effects, and site and individual identity as random effects. Two species exhibited valid FA patterns: *O. cribricollis* and *H. picipennis*. In *O. cribricollis*, FA in a2 was significantly influenced by the interaction between treatment and wing morphology ($p = 0.032$): brachypterous individuals exhibited higher FA in solar parks, while macropterous individuals exhibited slightly higher FA in grasslands. In H. picipennis, a similar interaction ($p = 0.045$) revealed higher FA in macropterous individuals from grasslands. These results suggest that dispersal capacity, as indicated by wing morphology, modulates susceptibility to habitat-related developmental stress. Such trait–stress relationships are particularly relevant for conservation in human-modified landscapes such as solar parks.

Keywords: fluctuating asymmetry, wing morphology, dispersal capacity, Carabidae, solar parks

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BETA-CAROTENE AS A MODULATOR OF OXIDATIVE STRESS AND APOPTOTIC PATHWAYS IN HEPG2 CELLS

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ABSTRACT

Phytonutrients represent a broad group of plant-derived secondary metabolites whose biological activity includes antioxidant, anti-inflammatory, and antiproliferative effects. Among the key compounds with documented bioactive potential is beta-carotene, a carotenoid characterized by its pronounced antioxidant properties. Its biological activity is associated not only with the elimination of reactive oxygen species (ROS) but also with the modulation of cellular signaling pathways governing proliferation, differentiation, and apoptosis. Hepatocellular carcinoma ranks among the most prevalent liver malignancies, and the HepG2 cell line represents a well-established in vitro model for investigating mechanisms of tumorigenic transformation and the metabolism of bioactive compounds. The present study aims to elucidate the impact of beta-carotene on HepG2 cells, focusing on parameters of cell viability, oxidative stress, and the induction of apoptotic processes. The experimental strategy combines colorimetric and fluorescence-based assays to quantify cytotoxicity, ROS production, and apoptotic markers. The obtained results may provide a more detailed insight into the molecular mechanisms of beta-carotene activity in the context of tumor-derived hepatocytes and contribute to elucidating its potential role in the prevention or adjuvant therapy of hepatocellular carcinoma. Moreover, the study advances the broader understanding of the interplay between nutritional factors and the regulation of tumor progression in hepatic models.

Keywords: Carotenoids, Phytonutrients, cell viability, nutritional oncology

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GENETIC VARIABILITY ANALYSIS OF SNPS ASSOCIATED WITH VARROA AND DISEASE RESISTANCE IN WESTERN HONEYBEE USING WHOLE GENOME NANOPORE SEQUENCING

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ABSTRACT

The increasing rate of honeybee colony losses on a global scale represents a serious problem for agriculture and beekeeping worldwide. Parasitic mite Varroa destructor and associated viruses have been identified as significant contributors to colony loss and increased vulnerability to environmental and other stressors that impact bee populations. One of the strategies to mitigate damage caused by pathogens and parasites is to breed resistant honeybee stocks. Genetic and genomic methods hold considerable potential as powerful tools in this field. This research aims to evaluate the prospect of applying these methods to Czech honeybee populations. The objective of present research is to evaluate and compare genetic diversity of candidate single nucleotide polymorphisms (SNPs) associated with resistance in bees from populations exhibiting varying degrees of Varroa resistance. The DNA from sampled bees was extracted using a magnetic beads kit for high molecular weight DNA and its quality was assessed by electrophoresis, spectrophotometry and fluorimetry. The resulting DNA concentration was between 5–50 ng/µl. Highest quality samples (≥20 ng/µl) will be sequenced by whole genome nanopore sequencing technology. Approximately 100–150 candidate SNPs related to resistance traits such as Varroa-specific hygienic behavior (VSH) and suppressed mite reproduction (SMR) will be determined. Resulting genotype frequencies should provide information about the diversity of a large number of candidate markers and genetic differences between vulnerable and resilient honeybee populations. These findings could provide valuable data for future breeding experiments using molecular methods.

Keywords: genetic diversity, honeybee, resistance, Varroa mite, SNP

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INFLUENCE OF THREE-POINT HITCH DESIGN AND IMPLEMENT COUPLING METHOD ON MASS DISTRIBUTION AND ACTING FORCES

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ABSTRACT

The aim of this study is to examine how both the design of a tractor's three-point hitch and the method used to couple an implement influence overall mass distribution and the forces acting on the tractor–implement system. Controlled laboratory tests were carried out to observe how changing the height of the upper link (third point) alters the forces transmitted through the hitch, the load on individual axles, and the balance between the front and rear of the tractor. Further trials considered different coupling configurations and adjusted front-axle loads, using movable ballast to simulate shifts in the machine's center of gravity. By analyzing these measurements, the relationship between hitch-point geometry, the chosen coupling method, and the resulting distribution of forces were identified. The outcomes provide recommendations for optimizing the design and adjustment of the three-point hitch, along with practical guidance on attaching implements and positioning ballast to keep axle loads balanced, minimize energy use, and maintain operating performance.

Keywords: weight distribution, axle load, three-point hitch

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TEAMING UP WITH ALGAE: HOW ALGAL BASED CONSORTIA HELPS WITH REMOVAL OF PHARMACEUTICALS FROM WASTEWATER

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ABSTRACT

The widespread use of pharmaceuticals leads to their influx into watercourses, because conventional wastewater treatment plants do not efficiently remove them. One of the most common over-the-counter drugs used extensively is acetaminophen (paracetamol). Chronic exposure to low doses of acetaminophen causes endocrine disruption and hepatotoxicity in fish, and oxidative damage and altered enzyme activities in annelids and bivalves. An effective and low-cost way to remove it is through algal-based microbial biofilms, which can degrade a wide range of stable organic compounds thanks to their high biodiversity. In this project we built small-scale bioreactors inspired by industrial Algal Turf Scrubber (ATS) systems to cultivate biofilms capable of degrading paracetamol. As a source of microalgal consortia we collected samples from the wastewater treatment plant outlets. Paracetamol degradation was assessed using multispectral excitation-emission mapping. Consortia viable in laboratory environment were analysed via 16S rRNA amplicon sequencing to identify microorganisms that may be involved in relevant degradation pathways.

Keywords: acetaminophen, algal-based consortia, pharmaceuticals, wastewater

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BIOCHAR AND BIOAUGMENTATION APPLIED TO SOIL MITIGATE IMPACTS OF COMBINED STRESS ON RED FESCUE

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ABSTRACT

Potentially toxic elements (PTE) in soil can reduce plant growth. Grasses can better sustain PTE-induced stress, but when toxic stress and drought are combined, grass growth is deteriorative. The use of biochar and bioaugmentation might help mitigate the impact of toxicity in this case. This hypothesis was tested in a pot experiment with soil contaminated with PTEs, using red fescue (*Festuca rubra L.*) inoculated with bacteria (*Pseudomonas* + *Bacillus*) and amended with biochar. Uncontaminated soil was used as a control variant. After 7 weeks, grass was drought-stressed for 2 weeks with 1/3 watering compared to the control variant, then watering rate was restored to unreduced for next 3 weeks. Aboveground plant biomass (AGB_dry) was harvested, and the soil was sampled after 12-week cultivation. The concentration of plant pigments and the stress indicator proline were analysed in the aboveground biomass. The results showed that under dry conditions, soil treatment with either by biochar or inoculum tended to increased yield of AGB_dry in comparison to the untreated control, in gradual increment toward the significantly highest AGB_dry under treatment with biochar combined with inoculum, but not in regularly watered pots. There was not found any significant difference in soil microbial activity (dehydrogenase) but in conclusion, different yields of plant biomass were caused by drought, PTE content, biochar-sorption, or helper microbes, among which the combined effect of stress factors played key role and was efficiently mitigated by biochar and bioaugmentation.

Keywords: soil amendment, plant biomass, grass, osmotic stress

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ADDRESSING 16S AMPLICON BIAS THROUGH MATHEMATICAL INTEGRATION OF MULTI-AMPLICON SEQUENCING

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ABSTRACT

Sequencing of 16S rRNA gene amplicons is an established method for assessing microbiome composition. It is widely applied in studies of microbiome, including medicine, agriculture, and ecology. Currently, the most affordable sequencing methods on platforms like Illumina or AVITI allow for sequencing of amplicons with maximum lengths of approximately 500 bp. This length covers only a fraction of the 16S rRNA gene, which forces researchers to choose which 16S region to use for the microbiome analysis. The issue is that different regions of 16S rRNA gene provide different accuracy across various microbial groups and introduce different biases. Use of multiple amplicons to reduce this bias is uncommon, since it decreases the interpretability of the results, and increases the overall cost. We took a different approach and prepared plasmid-based mock community to demonstrate that applying simple mathematical operations across the sequencing data can integrate the results from multiple amplicons into easily comprehensible dataset. This provides more precise quantification across multitude of prokaryotic groups without necessarily increasing the sequencing cost.

Keywords: amplicon sequencing, mock community, metagenomics, bioinformatics

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STIMULATION OF CHICKEN OSTEOBLAST PRECURSOR CELLS WITH BIOLOGICALLY ACTIVE PHYTONUTRIENTS

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ABSTRACT

Phytonutrients are products of plant metabolism that are often biologically active and can therefore affect the metabolism of animals. Many of these phytonutrients belong to groups such as alkaloids, polyphenols, or terpenes. Berberine, ellagic acid, and carvone were selected as representatives of each mentioned group. Berberine, an alkaloid derived from the plant Coptis chinensis, is reported to have antioxidative, anti-inflammatory, and anticancer effects. Ellagic acid is a polyphenolic compound commonly found in berries such as cranberries, raspberries, and strawberries, as well as in nuts. It is believed to possess antioxidative properties at doses achievable through the consumption of foods containing this polyphenol. Carvone is a terpene present in herbs such as mint (*Mentha spicata*) and caraway (*Carum carvi*), and is thought to exhibit antibacterial, anti-inflammatory, antioxidative, and neuroprotective effects. Mesenchymal stem cells, which are precursor cells of osteoblasts, adipocytes, and chondroblasts, were isolated from chicken femurs and cultured under controlled conditions at 37 °C with 5% CO_2 in the atmosphere. These cultures were then exposed to a solution of phytonutrients for two passages. Gene expression analysis was performed for proteins important in bone metabolism, including PTH1R, PTH3R, Wnt1, Wnt5a, LRP5, LRP6, FRZ4, FRZ6, RUNX2, and OPG. Additionally, cell proliferation was analyzed to assess the effects of the selected phytonutrients on the tested cells. The cell proliferation experiment lasted one week.

Keywords: mesenchymal stem cells, berberine, ellagic acid, carvone

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MONITORING THE ELIMINATION OF MICROPOLLUTANTS BY WASTEWATER TREATMENT PLANTS AND POND ENVIRONMENTS

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ABSTRACT

Micropollutants, particularly pharmaceuticals and pesticides, represent a growing threat to surface water quality, aquatic organisms, and human health. These substances enter the environment mainly through municipal wastewater and combined sewer overflows, while conventional wastewater treatment plants (WWTPs) are not always able to ensure their complete removal. Long-term exposure to micropollutants in the aquatic environment can disrupt biological processes, cause hormonal imbalances, reproductive issues in aquatic organisms, and increase the risk of cancer development. Contaminants often accumulate in sediments, which increases the risk of their re-release into the water column and subsequent exposure of aquatic organisms and humans through the consumption of fish and other aquatic animals. The aim of the project was to comprehensively evaluate the efficiency of eliminating selected micropollutants in the municipal wastewater treatment plant of Miroslav and in the downstream pond Réna. The monitored compounds included pharmaceuticals (e.g., paracetamol, diclofenac) and pesticides (e.g., atrazine, carbendazim). The project involved sampling of three types of matrices – water, sediments, and fish muscle tissue – under different hydrological conditions. Samples were processed and analyzed in specialized laboratories according to standardized methodologies of MENDELU and RECETOX. Based on the obtained concentration data, the efficiency of micropollutant elimination was assessed primarily in the wastewater treatment plant and secondarily in the Réna pond. The project results confirmed that, for some of the studied substances, the wastewater treatment plant showed almost no removal efficiency, whereas in the Réna pond a more pronounced reduction of their concentrations was observed.

Keywords: micropollutants, pharmaceuticals, pesticides, wastewater treatment plant, pollution elimination

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CONSTITUTIVE DEFENSE IN BARLEY (*HORDEUM VULGARE*) SEEDS: SCREENING AND IDENTIFYING CADMIUM-BOUND COMPOUNDS IN SEED EXUDATES

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ABSTRACT

Background: The constitutive defense of seeds before germination includes the spermosphere and the covering layers including the seed coat. A study has shown that exposure to 20 mg/L of cadmium can increase the germination rate of barley seeds. While this concentration is neutral or harmful to most seeds, it suggests that cadmium-resistant compounds may be present in the spermosphere or covering layers of seed.

Scientific questions: which compounds in barley seed exudates have the ability to chelate cadmium ions and contribute to the constitutive defense, and how can they be screened?

Methods: Established omics techniques will identify proteins and metabolites linked to cadmium stress in seed exudates and determine the duration of constitutive defense responses. Exudates from stressed seeds will be collected, added to controls, and seed vitality assessed to screen for cadmium-bound compounds. The verification method will involve exogenous addition. Application validation will be carried out through seed priming in pots.

Applications: This study will provide a new approach to mitigate cadmium toxicity during seed germination as a seed priming.

Innovation: Screening Compounds: Explore and identify cadmium-chelating compounds in barley seed exudates, including potential new or understudied ones like SOD and other secondary metabolites. This will offer insights into barley seed germination and responses to metal ion stress.

Keywords: barley seeds, seed exudates, cadmium (Cd) stress, SOD, constitutive defense, proteomics and metabolomics

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PREDICTIVE EQUATION FOR WIND ERODIBLE FRACTION

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ABSTRACT

Assessment of wind erosion risk increasingly relies on models such as the WEQ, RWEQ, WEPS, EPIC, and APEX. A key parameter in these models is the wind erodible fraction (EF), defined as the proportion of soil particles with diameters < 0.84 mm. Although EF is traditionally determined by rotary sieving, this method is time-consuming and impractical for large datasets, which has led to the widespread use of predictive equations. This study evaluates the performance of the widely applied Fryrear *et al*. (1994) equation under Czech soil conditions and develops a region-specific alternative with improved predictive power. Representative soil samples from major Czech soil units were collected, air-dried, and analyzed for particle-size distribution, organic carbon, and carbonate content. EF was determined using the flat-sieve dry sieving technique, and both model validation and refinement were carried out using statistical modelling approaches. The analysis revealed substantial prediction errors when applying the Fryrear equation to Czech soils. In contrast, the newly developed model achieved high predictive accuracy ($R^2 = 0.8995$; adj. $R^2 = 0.8940$; $p < 0.001$). The effects of carbonate and organic matter were statistically insignificant and thus excluded from the new model. These findings underscore the need for regionally calibrated EF prediction models to enhance wind erosion simulations and provide a more robust basis for soil conservation planning and risk management.

Keywords: wind erosion, soil conservation, fryrear equation, Czech soils

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