BioPhys

SPRING

BOOK OF ABSTRACTS

24th International Workshop
for Young Scientists
"BioPhys Spring 2025"

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24th International Workshop for Young Scientists
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to be held

on 29th-30th May 2025 in Prague,

Czech Republic

under the auspices of Mgr. Petr Hladík,
Minister of the Environment of the Czech Republic

Ministry of the Environment
of the Czech Republic

under the auspices of prof. Ing. Petr Sklenička, CSc.,
Rector of the Czech University of Life Sciences Prague

2025

Conference Organisers

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Dear friends and colleagues,

It is our privilege and great pleasure to invite you on behalf of organising institutions – the **Czech University of Life Sciences Prague (Czech Republic), together with Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra (Slovakia), Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary)** and **Institut Teknologi Nasional Bandung (Indonesia)** – to participate in the 24th International Workshop for Young Scientists "BioPhys Spring 2025" to be held in Prague on **29th – 30th May 2025**.

The workshop is oriented on the deeper insight into the physical processes occurring in biological, agricultural and food systems. The workshop combines two basic tasks of international meeting: exchange of professional experience and integration of young people from different countries. We cordially invite young scientists to participate in the BPS 2025 Workshop and to present results of your **research in application of physical methods to agriculture, biology and/or life sciences**.

The workshop is organised as an open **English spoken event**. One-page abstracts of contributions will be published in the Book of Abstracts of the BPS 2025 Workshop. It is my pleasure to invite you to spend a few days of May 2025 in a friendly atmosphere between young people in Prague.

Martin Libra
Chairman of the Organising Committee

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UTILIZATION OF MANGO STONES FOR ENERGY

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Keywords: waste biomass, mango endocarps, biofuels, fuel-energy properties

The study assesses the potential of mango endocarps as a renewable bioenergy feedstock. Given growing demand for renewable energy and low utilization levels of agro-residues, mango endocarps are a possible substitute material. The study analyzed a mango endocarp sample comprising of a blend of native Cambodian varieties to establish their physicochemical attributes, calorific value, elemental content, and thermal properties. The samples were dried, crushed and underwent ultimate and proximate analysis.

Based on results, mango stones have 6.7% moisture content that is ideal in biomass fuel to reduce the process of pre-drying on a large scale (ISO 18134–2:2017). The tested biomass has 1.8% ash content which reduces residue while burning and adds efficiency when being burned (ISO 18122:2015). The volatile matter is 78.6%, that is the highest energy-releasing capacity(ISO 18123:2015). Carbon content is 47.3% (ISO 16948:2015), gross calorific value (GCV) and net calorific value (NCV) are 18.36 MJ/kg and 17.13 MJ/kg, respectively (ISO 18125:2017).

This reflects mango endocarps to be a biomass of high energy content equivalent to wood pellets. Elemental analysis also felt the presence of good combustible contents in terms of calcium (6.4%) and potassium (4.5%), accounting for high combustion properties (ISO 16967:2015). Trace metal analysis also revealed zero toxicity emissions with less than 0.20 mg/kg lead

and mercury content being 0.002 mg/kg. The study of thermal decomposition revealed high stability with peak decomposition temperatures ranging from 1030°C to 1390°C, thus accounting for suitability in high-class thermochemical conversion processes such as pyrolysis and gasification (ISO 21404:2020). The crushed biomass was also subjected to mechanical compression in briquetting press, and compact, durable briquettes were produced (ISO 17225-6:2014). The findings show that mango endocarps are a viable feedstock for bioenergy production with potential applications in solid fuel.

Acknowledgments:

The research was supported by the Internal Grant Agency of the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague [grant numbers 20233108 and 20243101].

ISO-STANDARDS USED

ISO 17225-3:2021, ISO 17225-8:2023, ISO 21404:2020, ISO 16967:2015

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PERFORMANCE OF SOLAR POWER PLANT MODEL WITH AND WITHOUT TRACKING SYSTEM

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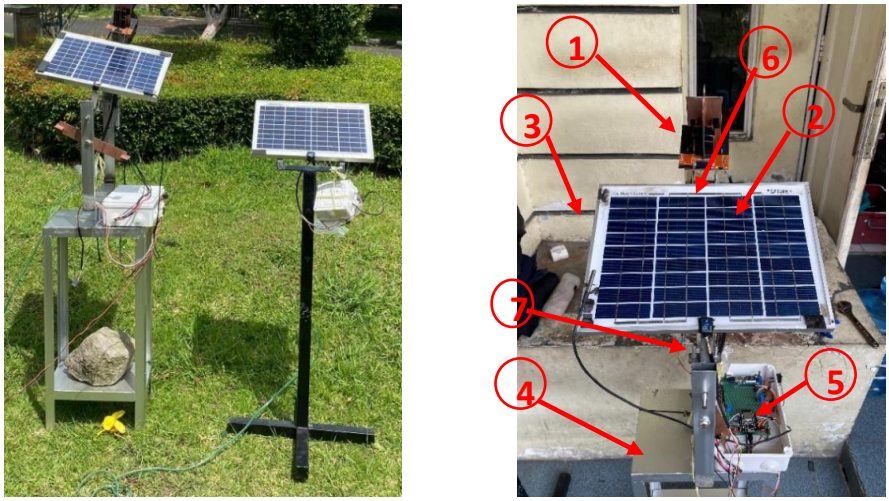
Keywords: Tracking system, Performance, ESP32 Microcontroller

Factors that affect the performance of a solar power plant include sunlight intensity, temperature, the influence of dust, the slope of the photovoltaic angle and orientation towards the direction of sunlight [1]. In order to optimally utilise sunlight energy, the angular direction of the solar panel must follow the movement of the sunlight direction [2].

In previous research, a PLTS tool with a sun tracking system with a pollycristalline-type solar panel with a capacity of 10 Wp based on the ESP32 microcontroller was designed and constructed. IoT (Internet of Things) based test data reading, which can be read on a smartphone or PC using the Blink application are applied. Then testing will be carried out on the performance of solar power generation tools that have been made before, then comparing between solar power generation tools with silent or non-tracking solar panels and solar power generation tools that use solar panels with tracking systems with the same type and capacity of solar panels. From the test results, the efficiency of the power plant without a tracking system is 18.75%, while with a tracking system of 20.17%. The solar power plants model is shown in Fig. 1.



a) b)

Fig. 1. a) Solar power plants b) Implementation of a tracking system

Description: 1. LDR Sensor, 2. 10 Wp Solar Panel, 3. DS18B20 (Temperature Sensor), 4. Frame, 5. Panel Box (ESP32, etc.), 6. Servo Motor, 7. SCC.

Acknowledgments:

The synopsis of this scientific work is presented in a scientific exchanges joint event, as one of the partnership implementations between Institut Teknologi Nasional Bandung (Indonesia), Czech University of Life Sciences Prague (Czech Republic), Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra (Slovakia), and Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary).

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EXAMINING THE IMPACTS OF NANOPARTICLE CONCENTRATION ON PHOTOVOLTAIC SYSTEM PERFORMANCE: REVIEW

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Keywords: thermal efficiency, electrical efficiency, cooling efficiency, heat transfer enhancement

The modern world relies heavily on energy for essential services such as heating, lighting, and transportation [1]. As technology progresses, energy consumption rises. Consequently, photovoltaic-thermal (PV/T) systems are crucial solutions to these challenges. To optimise PV/T energy generation effectively, reducing panel temperatures is essential. Therefore, using nanofluids for cooling can enhance thermal performance and electrical efficiency by lowering operating temperatures. Moreover, the concentration of nanofluids significantly affects the performance of PV/T systems through heat transfer and fluid dynamics; an optimal balance exists between cooling enhancement and optical transparency.

The thermal conductivity of nanofluids increases with higher solid volume fractions of ZrO_2 nanoparticles, as shown in Fig. 1a) and b). Specifically, at solid volume fractions of 0.05%, 0.075%, 0.1%, and 0.125%, the percentage increases are 6.5%, 8.76%, 16.26%, and 16.87% respectively at a temperature of 70 °C, with the maximum thermal conductivity reaching 0 .77 W/m°.C for G-ZrO_2 concentrations at 0.125% [2].

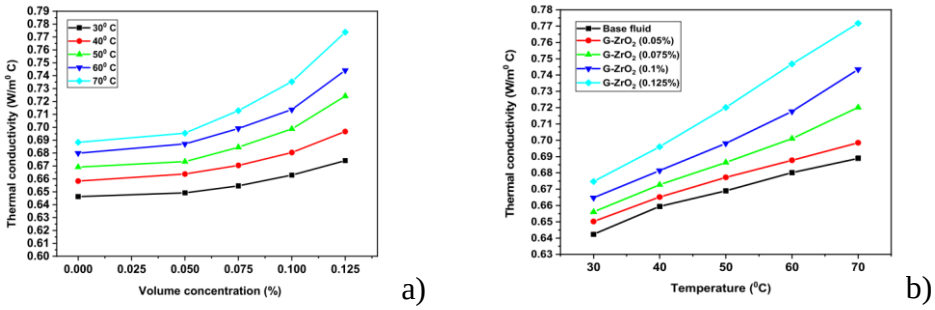

Fig. 1. Thermal conductivity of nanofluid:
a) volume concentration, b) temperatures

Similarly, it has been explored the cooling effects of nanofluids on photovoltaic (PV) modules to enhance efficiency [3]. They tested Al_2O_3-water and TiO_2-water nanofluids at volumetric fractions of 0.01%, 0.1%, and 1%. The results showed that cooling improved module voltage but reduced current output, with TiO_2 outperforming Al_2O_3 in electrical efficiency, especially at lower concentrations. Overall, effective cooling could boost panel efficiency by up to 8.32%.

Acknowledgments:

This work was supported by the Stipendium Hungaricum Program and by the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

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COMPARATIVE ESTIMATION OF SEMI-TRANSPARENT PHOTOVOLTAIC ENERGY PRODUCTION IN HUNGARY

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Keywords: energetic, energy prediction, mathematical modelling

Evaluating the energy generation capacity of semi-transparent photovoltaic (STPV) systems is essential for comprehending their efficacy across various climatic conditions [1, 2]. This study uses a newly formulated mathematical model to evaluate and contrast the energy output of STPV systems in Hungary for 2023 and 2024. The model integrates essential parameters, including global tilted irradiance, temperature influences, and system efficiency, to forecast energy output utilizing meteorological data from both years.

The findings reveal a significant difference in projected energy output for 2023 and 2024, showcasing an average energy yield of 5,545.91 kWh in 2024, contrasted with 3,905.90 kWh in 2023. The observed rise aligns with an elevated average solar irradiation level of 156.23 kWh/m² in 2024, compared to 110.03 kWh/m² recorded in 2023. The analysis of energy production across seasons reveals that maximum output is achieved in the summer months, coinciding with peak irradiation levels. In contrast, a decline in production is noted during the winter season.

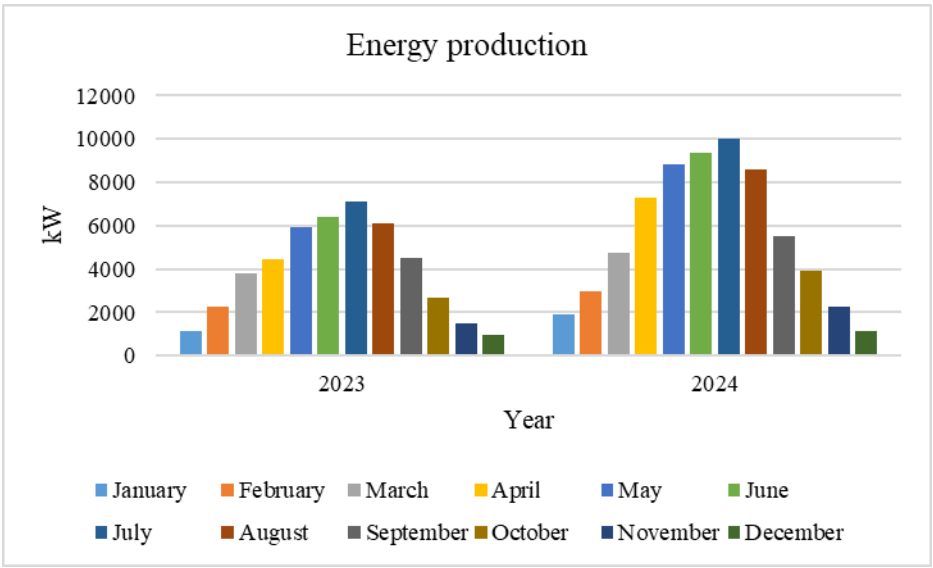

Fig. 1. Energy production comparison

The mathematical model remains unvalidated by real-world measurements; thus, these findings should be regarded as preliminary estimates rather than conclusive performance values. Future research will refine the model, integrate additional environmental parameters, and validate predictions with experimental data to enhance accuracy in assessing STPV performance under Hungarian climatic conditions.

Acknowledgments:

This work was supported by the Stipendium Hungaricum Program and by the Doctoral School of Mechanical Engineering, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

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COMPARISON OF CHILLER PERFORMANCE USING R-123 AND R-134A REFRIGERANT: PRELIMINARY RESEARCH

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Keywords: Chiller Performance, HCFC-123, HFC-134a

The chiller cools the fluid, transferring heat energy from one place to the outside environment through the refrigeration cycle [1]. The refrigerant in this chiller, R-134a, works by transferring heat within the refrigeration cycle. While advantageous for having zero Ozone Depletion Potential (ODP), its high Global Warming Potential (GWP ≈ 1430) is a drawback, contributing to global warming. As an alternative, R-123 is proposed because it has a low GWP in the range of 77-79 [2].

This study aims to analyse and compare the efficiency of the chiller engine performance with HCFC-123 (R-123) refrigerant (Hydrochlorofluorocarbon) and HFC-134a (R-134a) refrigerant (Hydrofluorocarbon). R-123 has a larger molar mass, 152.93 g/mol, compared to R-134a, which is only 102.03 g/mol. Under normal conditions, R-123 is a colourless liquid, while R-134a is a colourless gas. The boiling point of R-123 is much higher, ranging from 27.6 to 29.5°C, compared to R-134a, which ranges from -26.1 to -26.5°C. The freezing points are relatively slightly different, with R-123 having a freezing point of -107 °C, while R-134a is between -101 and -103.3 °C. The liquid density of R-123 is also higher, ranging from 1.4638 to 1.50 g/cm³, compared to R-134a, which has a density

between 1.202 to 1.21 g/mL [2]. In addition, the solubility of R-134a in water is 0.15%, while the solubility of R-123 in water is lower at less than 0.1%.

Efficiency will be measured and compared based on the Energy Efficiency Ratio (EER). EER is the ratio between the cooling energy produced and the electrical energy consumed. Higher EER values indicate lower energy consumption to deliver the same cooling, thus reflecting optimal energy performance.

$$EER = \frac{Cooling\ Capacity\ (BTU/h)}{Power\ Input\ (BTU/h)}$$ [3].

Tests were conducted using two types of refrigerants, HCFC-123 and HFC-134a, with similar procedures. The chiller system was charged with 500 tons of HCFC-123 and 700 tons of HFC-134a. The chiller was operated under controlled conditions to produce a stable chilled water output at 9°C. After reaching a steady state, temperature, pressure and energy consumption data were recorded for each refrigerant. The results from both tests were analysed and compared to evaluate the efficiency and performance of the refrigerants.

Acknowledgments:

The synopsis of this scientific work is presented in a scientific exchanges joint event, as one of the partnership implementations between Institut Teknologi Nasional Bandung (Indonesia), Czech University of Life Sciences Prague (Czech Republic), Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra (Slovakia), and Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary).

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WEED CONTROL IN VEGETABLE WITH A FOCUS ON NON-CHEMICAL WEED CONTROL

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Keywords: weed, non-chemical, vegetable, kontrol

Together with the requirement for the production of vegetables with a minimum content of residues and foreign substances, economic and ecological measures are being taken that use alternative methods of plant protection against diseases, pests and, of course, weeds. [1,2,3]

One of the main goals of the project will be to create a detection system for recognizing weeds in vegetable crops using camera systems. A multispectral camera capturing the R, G, B and NIR spectral bands, supplemented by high intensity flashlights, will be used to capture the image. Vegetation indices will also be created based on images taken with a hyperspectral camera. In the case of brassica vegetables, there are spectral differences from most types of field weeds. This can be used to detect weeds in crops. The next step will be to create a classification algorithm that will enable automated recognition of weeds in the created images. Based on morphological and spectral properties, weed plants and crops will be identified in multispectral images using software algorithms based on artificial intelligence.

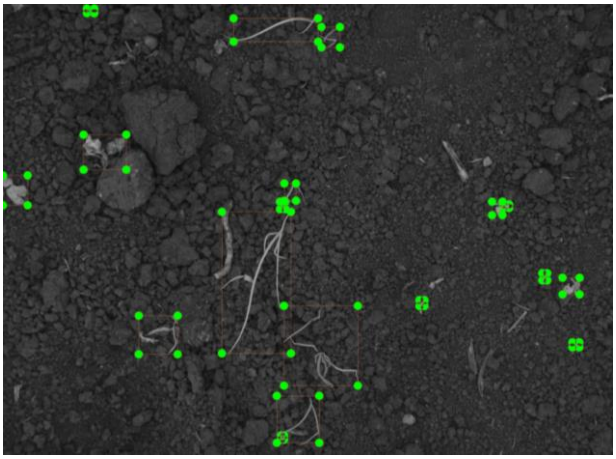

Fig. 1. Searching and recognizing individual weeds

The aim of the work is to solve the cultivation technologies of field vegetable cultivation with a focus on zonal soil cultivation, the use of auxiliary crops in the interrows and the use of targeted applications and physical methods of weed control for real possibilities of applying procedures for weed control of vegetable crops and treatment of field vegetable crops with limited chemical protection.

Expectations are to prove that agrotechnical changes in vegetable cultivation can provide an effective way of weed control with reduced need for herbicide protection, physical methods of weed control can be competitive with chemical treatments and a combination of imaging and image evaluation methods can achieve weed species classification accuracy of over 90% with the assumed machine working speed.

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MECHANICAL DURABILITY OF BRIQUETTES PRODUCED FROM DIFFERENT AGRICULTURAL BY-PRODUCTS

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Keywords: solid fuels, mechanical compression, biomass, waste-to-energy

Bulk density of biomass is one of the challenges hindering its direct utilisation as a combustion renewable fuel. This challenge can be managed through densification, which is a process involving the application of pressure to compact the biomass, thereby significantly reducing its bulkiness [1]. The process was discovered to increase not only bulk density, but also the energy density of the biomass [2,3]. This study is aimed at measuring and comparing the mechanical durability of briquettes produced from different potential and abundant agricultural by-products.

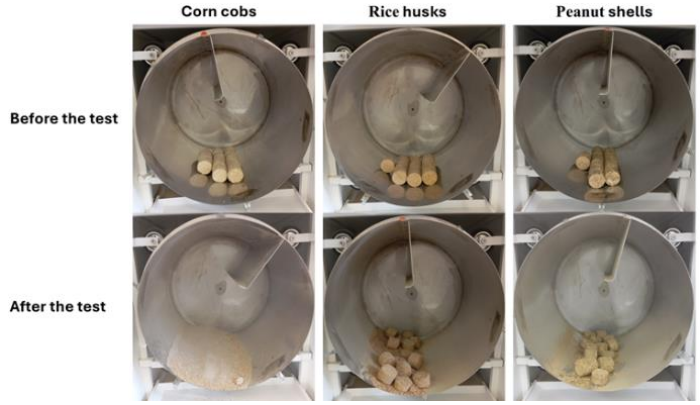

Fig. 1. Mechanical durability test.

The mechanical durability was measured using a durability drum (BT 105, Czech Republic) in accordance with the standard ISO 17831-2:2015 [4]. The briquettes were subjected to collisions for 5 min inside the rotation drum at the speed of 21±0.1 rpm, after which they were sieved through the 31.5 mm screen.

The results of the mechanical durability test of the briquettes produced from peanut shells, rice husks and corn cobs were discovered to be 95.37%, 82.38% and 0%, respectively. This indicates that peanut shells briquettes will be more resistant to abrasion and can withstand handling and manipulation more than rice husk briquettes (Fig. 1). However, corn cobs briquettes may completely crumble during handling. Adding a binder during briquettes production will help in increasing the durability of corn cobs briquettes.

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INFLUENCE OF *BACILLUS MEGATERIUM* B107/23 INOCULATION ON MICROGREENS GROWTH AND SHELF-LIFE UNDER NORMAL, DROUGHT STRESS, AND COLD STORAGE CONDITIONS – METHODOLOGICAL FRAMEWORK

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Keywords: microgreens, abiotic stress, bacterial inoculation

Microgreens, which are described as young seedlings of edible plant species, are known for their numerous health benefits, which increase their popularity among consumers [1,2]. However, despite the simplicity of their cultivation, they present significant challenges due to their short shelf-life. Their vulnerability toward the abiotic stresses, especially the drought stress, leads to the loss of flavour, visual appearance and, most importantly, the precious phytochemicals [3,4]. Currently, literature offers limited solutions for the microgreens' storage problem. However, research on particular microbial species, especially bacteria, indicates that inoculation with selected strains can impart promising adaptive mechanisms to plants, enhancing their freshness and shelf-life. Studies suggest that bacteria from the genus Bacillus have a beneficial impact on plants under drought stress, significantly aiding in the maintenance of their freshness, which provides an opportunity for further exploration and investigation [5]. Our study investigates the effect of cultivation substrate and microgreens' seeds inoculation with B. megaterium strain B107/23 on various plants' parameters. Additionally, we studied inoculation effects under the drought stress and the alterations in the shelf-life of the studied microgreens species in the cold storage conditions. We present the methodological framework and know-how of the seeds and substrate

inoculation process and the application of drought-stress conditions in microgreens cultivation, with the initial visual results of the aforementioned actions.

Acknowledgments:

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STUDY ON THE DESIGN AND INTEGRITY OF CO_2 PIPELINE TRANSMISSION

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Keywords: Liquid CO_2, transmission pipeline, wall thickness design, pipeline integrity

The increasing industrial emission of carbon dioxide (CO_2) has prompted the development of Carbon Capture and Storage (CCS) technologies, with pipeline transportation serving as a crucial link in the chain. This study presents a design and integrity assessment for a CO_2 transmission pipeline operating in the liquid phase, emphasizing safety and reliability in accordance with international standards[1, 3]. The pipeline wall thickness was calculated based on ASME B31.4, considering internal pressure, pipe diameter, and material strength. Material selection was made based on corrosion resistance and mechanical strength, with carbon steel and appropriate coatings chosen to mitigate degradation due to contaminants. The pipeline integrity was further evaluated using risk-based approaches outlined in DNV-RP-J202, including corrosion risk, fatigue, and failure modes. Fig. 1. shows the process flow in the Carbon Capture and Storage (CCS) system [2].

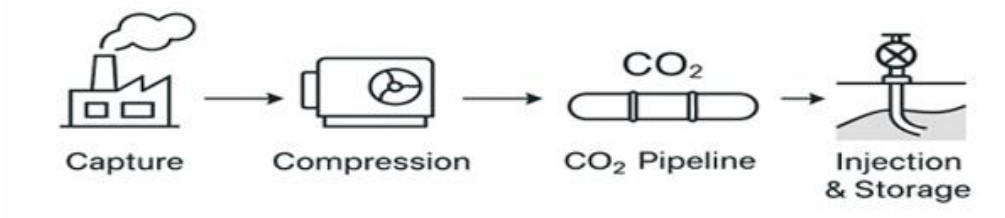

Fig. 1. Process flow in the Carbon Capture and Storage (CCS) system.

The results from this study support the implementation of safe, efficient CCS infrastructure and provide a reference for future developments in CO_2 transport systems. As illustrated in Fig. 1, the pipeline serves as a key component in the overall CCS process, linking carbon capture sources to underground storage facilities.

Acknowledgments:

The synopsis of this scientific work is presented in a scientific exchanges joint event, as one of the partnership implementations between Institut Teknologi Nasional Bandung (Indonesia), Czech University of Life Sciences Prague (Czech Republic), Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra (Slovakia), and Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary).

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IN VITRO MICROPROPAGATION OF SWEET CHERRY CULTIVARS

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Keywords: cherry, micropropagation, tissue culture, sterilization

Sweet cherry (*Prunus avium* L.) is an important fruit tree valuable for its nutritional and tasty fruits. *In vitro* micropropagation methods of sweet cherry can be applied in tree propagation, for experimental studies, preservation or transformation methods [1,2,3]. The objective of this study was to compare two types of culture media and their ability to increase the bud survival rate of sweet cherry cultivars. A bud was extirpated from a 2-year-old sweet cherry shoot and cleaned from outer and inner scales. The bud was washed in sterile distilled water and sterilized by a sodium dichloroisocyanurate solution.

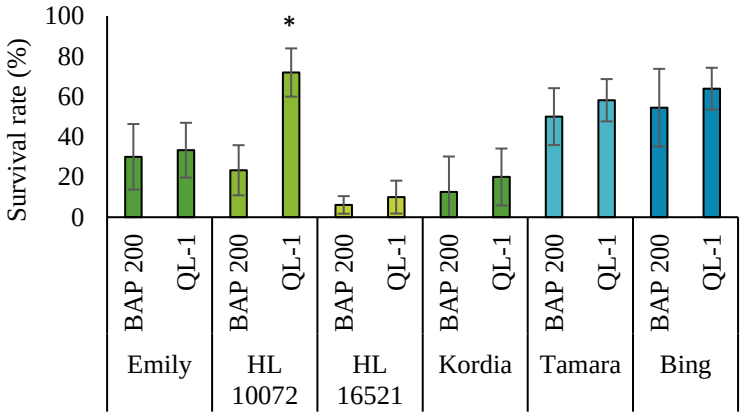

Fig. 1. Bud survival rate of sweet cherry cultivars cultivated on two different culture media for 2 month. Asterisk marks significant difference between tested groups (QL-1 and BAP 200).

After the sterilization the bud was washed again by sterile water, blotted dry and cultivated either on QL-1 or BAP 200 culture media for 2 months with set cultivation conditions. Buds were subcultured after 4 weeks of cultivation.

Increased bud survival rate for all tested cultivars was detected when cultured on QL-1 medium compared to cultivation on BAP 200 medium (Fig. 1). The survival rate of HL 10072 buds was significantly higher on QL-1 medium than on BAP 200. It was also the highest survival rate of all tested cultivars. Cultivars ´Tamara´, ´Bing´ and hybrid ´HL 10072´ had relatively higher survival rates. Generally lower survival rates were detected for ´Kordia´ and hybrid ´HL 16521´. Study demonstrated the ability of QL-1 medium to increase bud survival rate for selected sweet cherry cultivars. A likely reason may be the more suitable composition of media for sweet cherry propagation. Some cultivars are more recalcitrant to *in vitro* cultivation than others. Successful introduction of certain cultivar plant material into *in vitro* conditions often depends on physiological needs of cultivar [1]. The following findings are applicable in improving micropropagation protocols and in other methods using plant tissue cultures.

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MINERALOGICAL AND MICROBIAL CHARACTERISTICS OF AEROBIC GRANULAR SLUDGE DEVELOPED IN TEXTILE WASTEWATER AND ITS POTENTIAL USE AS A SOIL AMENDMENT

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Keywords: aerobic granulation, microbial diversity, mineral composition, soil amendment

Aerobic granular sludge (AGS) develops through bioaggregation processes that involve physicochemical interactions and the biological characteristics of microbial cells. This study aimed to characterize AGS that had previously been cultivated [1], focusing on its surface morphology (via SEM-EDS), mineral composition (via XRD), and microbial diversity (via next-generation sequencing or NGS). SEM-EDS analysis revealed the presence of microbial structures interspersed with micro- and nanoparticle minerals. XRD analysis indicated that the AGS consisted of the following minerals (% mass): hydroxyapatite ($Ca_{4.7}H_{0.46}Mg_{0.05}Na_{0.1}O_{12.51}P_{2.61}$, 22.3%), collinsite ($Ca_2(Mg,Fe^{2+})(PO_4)_2 \cdot 2H_2O$, 19.7%), langbeinite ($Ca_2K_2(SO_4)_3$, 19.4%), whitlockite ($Ca_{9.5}Mg(PO_4)_7$, 15.1%), and gypsum ($CaSO_4.2H_2O$, 7.9%). NGS analysis (Fig.1) revealed that functional microbial groups as organic matter decomposers [2] were *Thermomonas, Rhodanobacter, Thiobacillus, Parvibaculum, Paludibaculum,* and *Bryobacter.* The mineral composition of AGS indicates its potential as a nutrient source for plants and a slow-release fertilizer [3]. Additionally, the microbial community may contribute to soil activation. These findings suggest that AGS may serve as a viable soil

amendment, although further research is required to evaluate its effectiveness and safety in field conditions.

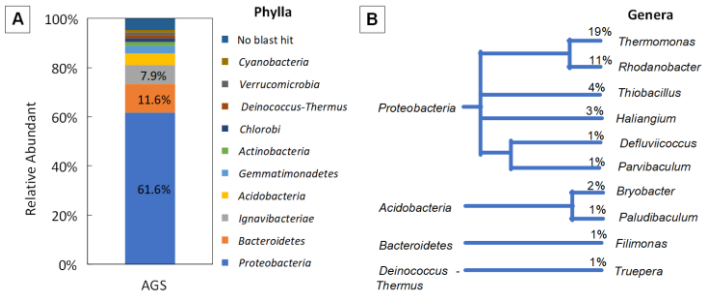

Fig. 1. (A) Relative abundance of phyla, (B) Phylogenetic tree of the top ten genera identified in AGS developed in textile wastewater.

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FACE SYMMETRY ANALYSIS USING NEURAL NETWORKS

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Keywords: neural networks, facial nerve, dynamic time warping, data whitening

Facial palsy, often resulting from balance system surgeries, impairs facial nerve function and leads to asymmetrical facial movements. The severity of this condition is typically assessed by clinicians using the House-Brackmann (HB) scale based on visual observation during facial exercises. To provide a more objective and potentially remote assessment tool, this work presents an approach for automatic classification of facial palsy severity using facial motion data acquired via Microsoft Kinect, analyzed through machine learning methods [1].

Three approaches were evaluated. The first utilized raw Kinect data as direct input to convolutional neural networks, capturing temporal and spatial facial movement patterns with minimal preprocessing. The second approach focused on geometric feature extraction, computing Euclidean distances, angles, and triangle areas between facial landmarks to better quantify asymmetry. These features were structured as time series and proved more informative than raw coordinates.

The most advanced pipeline incorporated Dynamic Time Warping [2], which parameters were found using Genetic algorithm [3] to segment only the active parts of the exercise, followed by dimensionality reduction using data whitening. Tarjan's algorithm was applied to the correlation matrix of features to identify and reduce redundancy by selecting one representative per group. This led to more compact and uncorrelated feature sets, improving classification robustness.

Experimental evaluation was conducted using neural networks with five-fold cross-validation, applied to both five-class and six-class HB groupings. Merging the sparse and difficult-to-distinguish HB grades 4 and 5 into one group improved classification by about 2%. Overall, the complete preprocessing pipeline yielded a 13% accuracy improvement compared to using raw data alone.

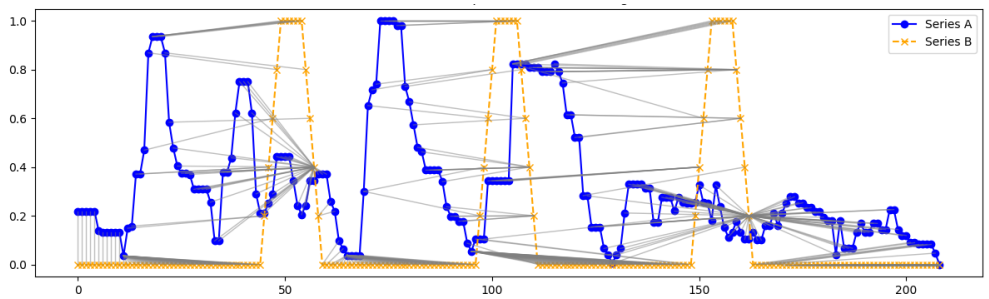

Fig. 1. Results of Dynamic Time Warping for Exercise Selection

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CHARACTERIZATION OF BIOCHAR PRODUCED BY PYROLYSIS FROM PIG FARM BIOGAS DIGESTATE

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Keywords: biogas digestate biochar; biogas digestate; pyrolysis

The rapid increase in concentrated livestock operations has resulted in a large amount of animal manure that requires a hygiene and careful treatment[1,2]. The aim of this study is to produce biochar from biogas digestate sourced of a pig farm using pyrolysis at different processing temperatures ranging from 500 – 700°C.

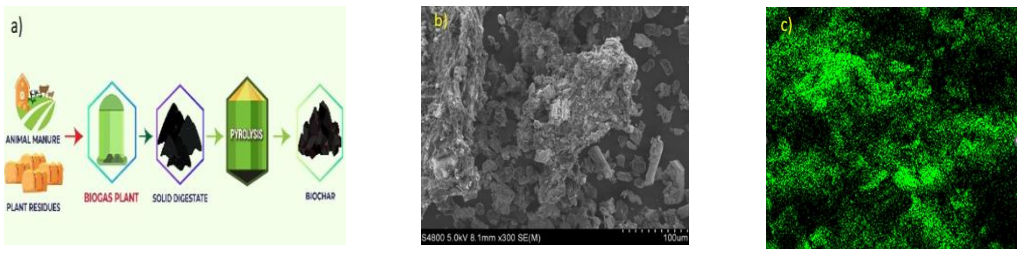

Fig 1. a) Diagram of prepared biogas digestate biochar, b) SEM, and c) Mapling EDX

The derived biochar was characterized by analysis of metal elements, nitrogen adsorption/desorption isotherms, energy-dispersive X-ray spectroscopy and elementary mapping, scanning electron microscopy, and X-ray diffraction. SEM analysis of biogas digestate biochar showed irregular,

rough-surfaced particles with variable sizes. The N_2 adsorption and desorption isotherms revealed that the porous properties and surface area of the biochars gradually increase with the pyrolysis temperature, with a corresponding surface area of 15.5, 58.8, and 87.9, respectively. This outcome was consistent with several previous studies [3]. However, compared to the findings of Chao Yi Hung et al. (2019), although the temperature range was similar (500–700 °C), the BET surface area in their study was below 15 $m^2.g^{-1}$ [4]. Moreover, high concentrations of potassium (K), iron (Fe), magnesium (Mg), and zinc (Zn) were found in the biogas digestate and the derived biochar.

The findings of this research introduce a novel recycling pathway for the management of biogas digestate waste, highlighting its potential use as a sustainable fertilizer and soil conditioner.

Acknowledgements:

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ALGORITHMS OF A ROBOTIC ARM FOR FRUIT HARVESTING

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Keywords: algorithms, robotic arm, fruit harvesting

Agriculture is currently undergoing a significant transformation toward automation, with the development of robotic arms for fruit harvesting is a key focus area. These systems must integrate advanced algorithms for trajectory planning, fruit detection, and adaptive force control to enable efficient and delicate harvesting. Despite progress in computer vision and machine learning, optimizing robotic arm movement remains a complex challenge requiring interdisciplinary collaboration. Analyzing current algorithmic solutions, their hardware integration, and future development prospects considering growing demands for agricultural efficiency and sustainability.

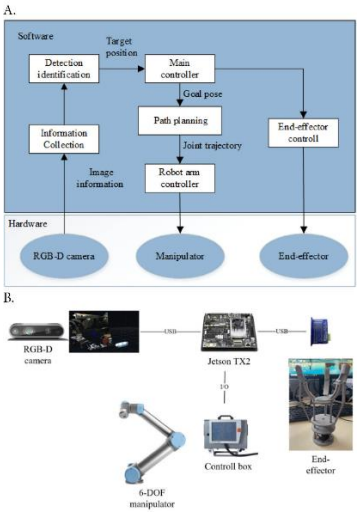

Fig. 1. [1-A] AI-generated picture of a robotic arm for fruit harvesting. [1-B] Harvesting robot software system (A) and hardware system (B) [1]

The RRT (Rapidly-exploring Random Tree) algorithm, originally designed for robot motion planning in complex environments, has found broad application in fruit harvesting due to its ability to generate collision-free trajectories in dynamic conditions. In experiments with a 6-DOF robotic arm equipped with binocular vision, this approach achieved an 89.4% success rate in apple harvesting within a simulated obstacle-rich environment [1]. Optimization using genetic algorithms (GA) subsequently reduced motion energy consumption by 17% by eliminating redundant directional changes [2]. A key limitation remains computational time–planning a single trajectory in real-time averages 4.7 seconds, insufficient for continuous harvesting operations [1]. STOMP (Stochastic Trajectory Optimization for Motion Planning) offers an alternative approach based on stochastic optimization, particularly suited for tasks with complex end-effector position constraints. A critical improvement involves implementing a specialized noise generator operating in Cartesian space, enabling more efficient configuration space exploration [4]. However, this method requires 3.8× more computational resources compared to standard RRT, limiting practical deployment in field conditions [3].

Automating fruit harvesting using robotic arm is a complex task requiring the integration of advanced algorithms, adaptive hardware, and sensors. Key challenges include improving energy efficiency, ensuring reliability in real-world conditions, and achieving system versatility.

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VIBRATION ANALYSIS OF THE GEAR BOX

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Keywords: Fast Fourier Transform, Vibration analysis for gaer box problems, CENTAUR 40 Type Gas Turbine

The gearbox is an important component in the mechanical power transmission system that has functions to transfer torque and speed between machine components. However, failure in the gearbox can cause performance degradation and overall system damage. One effective method to detect early damage in the gearbox can be perfomed through vibration analysis (Artelmus, W., & Zimroz, R. 2009).

This study aims to evaluate vibration patterns in the gearbox to identify potential damage such as tooth wear, bearing damage, and shaft misalignment. Vibration data is collected using an accelerometer sensor installed at strategic points of the gearbox. Furthermore, the data is analyzed using time and frequency domain methods, including Fast Fourier Transform (FFT) and envelope analysis. (Mobley, R. K. 2002).
The analysis result shows that certain amplitude and frequency changes can be used as an indicator of damage to gearbox elements. Thus, vibration analysis can be an effective diagnostic tool in predictive maintenance program to improve gearbox efficiency and service life.

Vibration data is collected using accelerometer sensor installed at strategic points of the gearbox under normal operating conditions and continuously monitored. Furthermore, the data is analyzed using time and frequency domain approach, including Fast Fourier Transform (FFT), envelope analysis, and RMS (Root Mean Square) analysis to obtain vibration

pattern characteristics of each type of damage. In addition, vibration signal modeling was also performed to compare with actual data to verify the accuracy of the detection method. The results showed that each type of damage produces different frequency and amplitude patterns, where gear tooth damage produces strong harmonics, while bearing damage tends to produce low amplitude signals at high frequencies. (Climaco, P., at al 2021)

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ENVIRONMENTAL IMPACT OF THE FASHION INDUSTRY IN INDONESIA: A HUMAN ECOLOGY PERSPECTIVE ALIGNED WITH SDGS 12 AND LIFE SCIENCES

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Keywords: textile waste, human ecology, microplastics, sustainable fashion campaigns

Indonesia's fast-growing fashion industry produces 2.3 million tons of textile waste annually, but only 0.3 million tons are recycled [1]. The rest pollutes land, air, and water. Notably, 35% of ocean microplastics come from textiles, and 70% of the Citarum River contains polyester-based microplastic pollution. [2], [3].

From a human ecology perspective, fast fashion reflects a deep imbalance between cultural habits and environmental limits. In Indonesia, 66% of people discard at least one clothing item annually, with 30% doing so after just one use [3]. This overconsumption leads to environmental harm and health risks. Microplastics from synthetic fabrics enter aquatic ecosystems and food chains, posing threats such as endocrine disruption and inflammation. These findings highlight the urgent need for sustainable and preventive strategies [4].

In support of SDG 12 (Responsible Consumption and Production), Indonesia is seeing a rise in sustainable fashion campaigns. A 2023 Greenpeace report showed a 17% increase in participation at swap events in Jakarta and Bandung. Initiatives like #TukarBaju by Zero Waste Indonesia and Greenpeace promote clothing swaps, while Fashion Revolution Indonesia pushes for transparency in production [5]. Local brands are adopting zero-

waste and upcycling methods. Public interest in ethical fashion is rising, urging design innovation, community involvement, and ecological literacy.

By aligning with SDG 12 and using human ecology insights, Indonesia can address harmful consumption patterns, reduce environmental impact, and foster a sustainable fashion culture that balances human needs with ecological resilience and responsibility.

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THE EFFECT OF BACKSHEET REPAIRS ON INSULATION RESISTANCE IN PHOTOVOLTAIC MODULES

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Keywords: gel repair, photovoltaic module

Abstract

The degradation of the backsheet layer of photovoltaic modules is a highly relevant topic today. It was not initially anticipated that the plastics and encapsulation materials used could degrade. Recent findings indicate that this degradation significantly reduces the lifespan of photovoltaic modules manufactured around 2010. Additionally, the degradation of the backsheet layer dramatically decreases the insulation resistance of individual modules and the entire chain, often leading to the disconnection of the entire string for safety reasons, causing production losses. Repairs of photovoltaic modules directly in the field are highly sought after, and assessing the increase in insulation resistance after such repairs is critical and will be the subject of the following study.

Introduction

The reliability of photovoltaic (PV) panels strongly depends on the quality of their encapsulation, especially during the lamination process. Encapsulation thus plays a crucial role in protecting PV cells from various environmental stressors such as moisture, oxygen, and mechanical damage. Ethylene-vinyl acetate (EVA) is commonly used as an encapsulation material due to its excellent electrical insulation properties and ability to maintain mechanical integrity [1], [2]

However, the efforts of manufacturers to continually reduce the production costs of photovoltaic modules, along with the requirements for the most

recyclable plastics used in module production, have led to a decrease in both the quality and quantity of encapsulation materials used. [2], [3], [4]. The back sheets, which protect the module's components from environmental stress, have also declined in quality. They have transitioned from high-grade polyvinyl fluoride (PVF) to less durable options like polyvinylidene fluoride (PVDF), polyethylene terephthalate (PET), and polyamide (PA) [3]. The back sheet primarily acts as a moisture barrier and environmental shield, essential for maintaining PV module performance in harsh conditions [3]. Degradation of these materials can lead to problems such as water vapor diffusion, causing corrosion of metallic components, hydrolytic degradation of the encapsulant, and delamination between layers [4], [5]

Cracking of the back sheet, which results from decreased tensile strength, allows moisture ingress and is considered the most catastrophic failure mode because it significantly impacts performance and reliability. This hydrolysis reduces tensile strength, which is crucial for the mechanical integrity and crack resistance of the back sheet [6].

Methods

Diagnose the functionality of repairs to the backsheet of photovoltaic modules and the impact of these repairs on the change in the insulation resistance of the modules is the subject of the study. Since the issue of cracked backsheets is relatively new, methods and materials for repairs (such as epoxy, polyurethane, acrylic, nitrile rubber, and silicone materials) are still under development and research. Currently, there are two types of repairs on the market:

a) coating with polysiloxane gel, usually done on-site at the power plant;

b) coating with laminate foil, done after removing the respective module and repaired in a repair shop.

The samples used, specifically four Candian Solar photovoltaic modules, were repaired with gel; two modules were repaired only in the cracked joints and one was repaired over its entire surface. The last fourth module remained unrepaired as a reference.

The insulation resistance of the modules was calculated based on the leakage currents that could be obtained thanks to automated measurement of voltage drop on an additional resistor (Rm) 330 kΩ. The calculation of insulation resistance (R1) was performed according to the equation [1]. Each

PV module was stressed with a DC voltage of about 600 V. The entire experiment was set up according to the diagram in Figure. 1.

$$I_1 = \frac{U_1}{R_m}$$

$$U_x = U_1 + I_1 R_{test} = U_1 + \frac{U_1}{R_m} R_{test}$$

$$R_1 = \frac{U_x}{I_1} - R_m$$

Equation 1

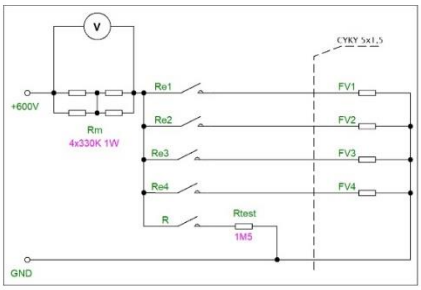


Figure. 1

Results and discussion

The switching of measurements between individual modules or the reference resistance (R_{test}) of 1.5 MΩ was facilitated using a control board equipped with 5 relays. The measurement of the entire setup occurred cyclically every 15 minutes. This periodic measurement allowed for relatively continuous monitoring of the insulation resistance, enabling further evaluation of the influence of environmental factors such as humidity and outdoor temperature on the insulation resistance of individual modules and any effects of repairs made using insulating gel. Details and the status of the repair are indicated in Tab. 1.

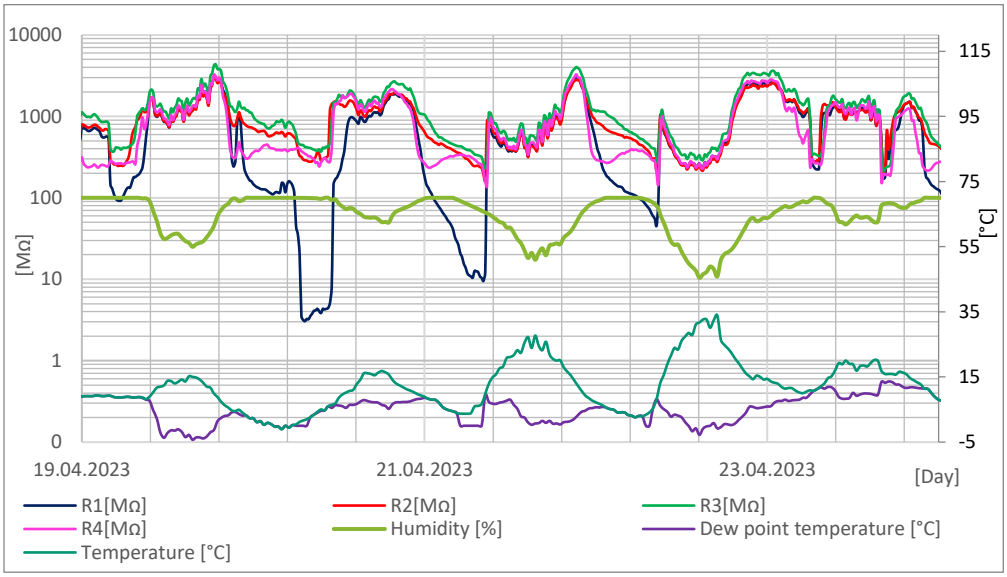
TABLE 1.

Serial number	Mark of module	Mark in Figure 1	Insulation resistance	Repair status
610190450330	1	FV1	R1	uncorrected
610190451868	2	FV2	R2	along the seams
610190450398	3	FV3	R3	Full corrected area
610190451860	4	FV4	R4	along the seams

The main axis of the graph present the insulation resistance trajectories of the modules and the humidity trend are plotted. On the secondary axis, the graph shows the ambient temperature and dew point temperature in degrees Celsius. The graph reveals four significant drops in resistance. When the temperature curve intersects with the dew point temperature, condensation on the module occurs, followed by a decrease in insulation resistance. The

subsequent drying phase is visible as the humidity decreases, the temperature rises, and the insulation resistance increases. During the second and third major resistance drops of R1 (unrepaired module), the values reach tens to single megohms. Extreme drops occur due to rainfall and condensation when water enters the module, potentially soaking the encapsulating EVA layer.

The decrease in insulation resistance is mainly due to the water-absorbing properties of ethylene vinyl acetate (EVA). Typically used as an encapsulating material, EVA has adequate mechanical, optical, and chemical properties suitable for PV module production but is hydrophilic. The backsheet, usually made of Tedlar, protects the encapsulating EVA material and the entire PV module from moisture penetration. Degradation of this cover layer and its subsequent cracking expose the absorbent EVA film, potentially creating a conductive path between the photovoltaic cells and the frame, leading to current leakage.



From the measured data, it is evident that the repair with silicone gel prevented a sharp decrease in insulation resistance upon contact with water. The threshold insulation resistance is 40 MΩ per module area, with anything below this value considered a module failure. Modules that underwent our measurements had a threshold value of 31.3 MΩ. The unrepaired module reached this minimum value several times, as shown in Graph 1, whereas the repaired modules never dropped to 31.3 MΩ. The best insulation resistance values were measured on module number 3, which was repaired across its entire surface.

Acknowledgments:

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RECENT ADVANCES AND FUTURE PROSPECTS IN SOLAR PHOTOVOLTAIC TECHNOLOGIES

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Keywords: solar PV market, efficiency, agrivoltaics, cell technologies

This paper discusses recent advancements and future developments in the rapidly evolving field of solar photovoltaic (PV) technologies. As shown in Fig. 1, the solar PV market experienced a 26% growth in 2023, reaching a global capacity of 1.589 terawatts (TW), with annual additions totaling 407 gigawatts (GW). The cumulative capacity achieved the highest growth rate seen in the past decade (Renewables, 2024).

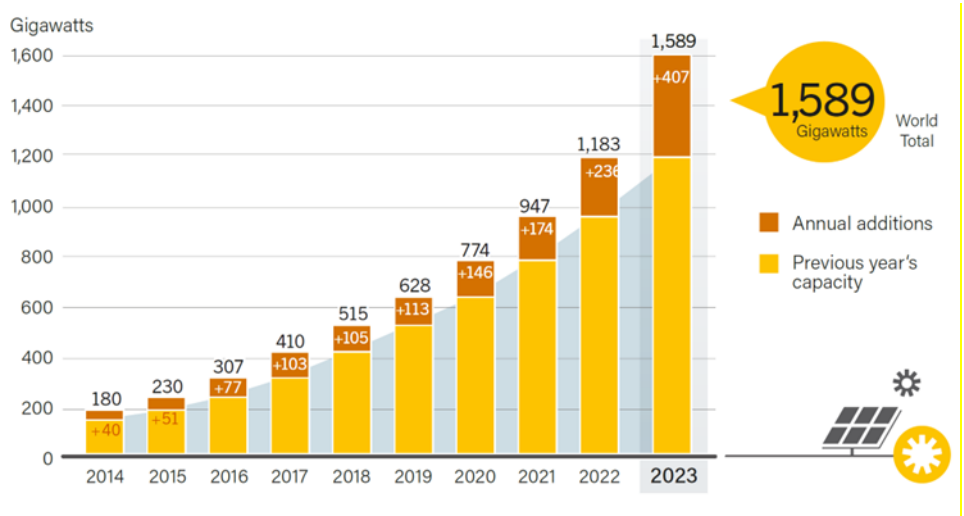

Fig. 1. Solar PV capacity (in GW) and annual additions in 2023

In 2024, China led with the largest increase in new capacity, while the European Union (EU) also showed substantial growth, adding 55.8 GW. In

Europe, Germany remains the primary contributor, reaching 81.6 GW, followed by Spain and Italy, each with over 30 GW in cumulative capacity. Other countries, such as the Netherlands and Poland, also saw significant increases. Additionally, several European nations installed over 1 GW of PV capacity in 2023. The European Union aims to achieve more than 320 GW of solar PV capacity by 2025, with a target of nearly 600 GW by 2030 (Renewables, 2024; IEA PVPS, 2024).

Beyond traditional rooftop, building-integrated, and ground-mounted systems, innovative PV applications are gaining traction. These include agrivoltaics (solar PV on agricultural land), floating PV systems (installed on bodies of water), and vehicle-integrated PV systems. These technologies are expanding the versatility of solar power and addressing both energy demands and land use challenges (Renewables, 2024).

Regarding PV module prices, increased production rates, improved supply chain efficiency, and heightened market competition have led to a significant price drop, now at €0.06 per watt peak (Wp). In terms of cell efficiency, the best-performing laboratory modules are based on monocrystalline silicon, achieving 24.9% efficiency. High-concentration multi-junction solar cells have reached efficiencies of 47.6%, while concentrator modules achieve 38.9% efficiency (NREL report, 2024). Perovskite cells have set a record with an efficiency of 33.7% (Fraunhofer ISE, 2024). At the module level, efforts are underway to develop higher-power modules, with output exceeding 700 W, primarily for building applications.

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GREEN COMPOSITES FROM AGRO-WASTE: EXPLORING THE POTENTIAL OF BANANA PSEUDO-STEM AND PINEAPPLE LEAF FIBERS

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Keywords: Green composites; Natural fibers reinforcement; Polymer matrix; Banana Pseudo-Stem Fiber (BPSF); Pineapple Leaf Fiber (PALF); Mechanical properties

Green composites offer benefits such as biodegradability, reduced carbon footprint, and potential for enhanced mechanical properties in lightweight industrial applications [1,2]. Agro-waste fibers like Banana Pseudo-Stem Fiber (BPSF) and Pineapple Leaf Fiber (PALF) are promising candidates for green composites supporting a circular economy [3]. BPSF, with Young's modulus of 3.49 GPa and tensile strength of 54 MPa, is known for its stiffness and biodegradability [4]. PALF, with a tensile strength of 290.61 MPa and a tensile modulus of 5.83 GPa, is ideal for high-performance composites [5].

This study evaluates the mechanical performance of composites made from BPSF and PALF, reinforced with Epoxy resin LH 288 and hardener H 282. The tensile properties of these composites at 5%, 10%, and 15% fiber content were tested using a Universal Testing Machine, following ASTM D3039/D3039M-08 standards. The tests measured tensile strength, Young's Modulus, and failure mechanisms, with Scanning Electron Microscopy (SEM) used to analyze fracture surfaces and fiber-matrix interaction [6].

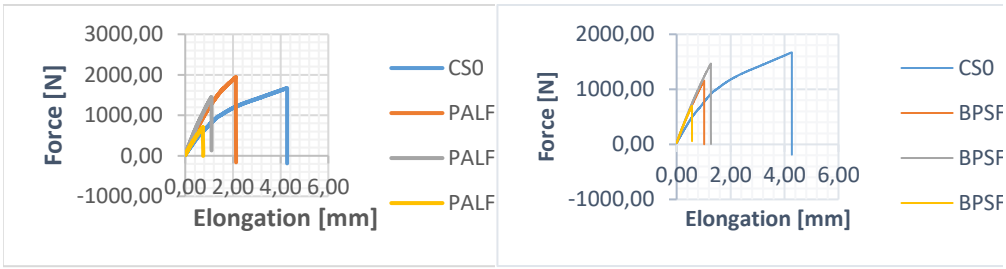

Fig.1. Load Force vs. Elongation of PALF & BPSF Composite

The results show that fiber reinforcement significantly improves mechanical properties (Fig.1.). Composites with 10% fiber content had the highest Young's Modulus (3126.42 N/mm² for BPSF and 3085.34 N/mm² for PALF), indicating optimal performance. SEM analysis confirmed that these composites had better fiber-matrix bonding and more uniform fracture surfaces compared to those with 5% and 15% fiber content (Fig.2.).

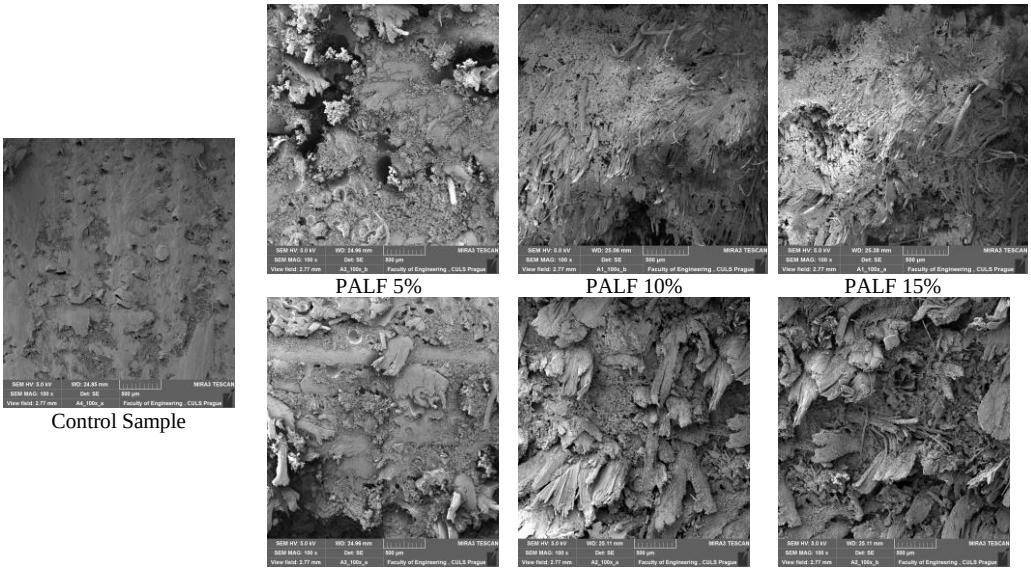

Fig.2. PALF & BPSF Composite Scanning Electron Microscopy (SEM)

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COMPARATIVE ANALYSIS OF MEDICINAL PLANTS USING VISION TRANSFORMER: A NOVEL APPROACH TO HERBAL SPECIES CLASSIFICATION

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Keywords: Vision Transformer, Medicinal Plant Classification, Deep Learning

Advancements in image recognition technology have opened new opportunities for the classification of medicinal plant species. Medicinal plants play a crucial role in both traditional and modern medicine. However, accurate identification and classification of these species often pose challenges due to morphological similarities and high variability among different species [1].

In this study, we conducted a comparative analysis of several transformer model variants for the classification of medicinal plant species, namely CAiT [2], DeepViT [3], ViT [4], NaViT [5], and T2TViT [6]. The research highlights the effectiveness of Vision Transformers in classifying medicinal plant species. The T2TViT model excelled with a test accuracy of 85.51%, outperforming other models like ViT with 82.25%, DeepViT with 80.07%, and NaViT with 77.54%. The CAiT model, however, performed poorly with an 8.70% accuracy. Vision Transformers show promise in enhancing classification accuracy and efficiency, benefiting phytotherapy research and biodiversity conservation through improved plant identification. The accuracy of the transformer model is shown in Fig. 1.

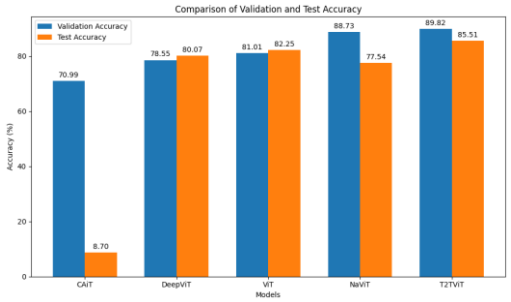

Fig. 1. Comparison of Transformer models

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AN ANALYSIS OF BEHAVIOR OF ELECTRIC VEHICLE USERS BASED ON CHARGING STATION DATA – FOCUS CHARGING DURATION

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Keywords: electric vehicles, charging stations

Predicting and managing the charging of electric vehicles (EV) will be a major challenge for the electric grid of the future due to increasing penetration of battery electric vehicles. This study analyzed 2 datasets from the Czech Republic representing "Public" and "At work" charging, focusing on differences between both and comparing to available date from other countries and trying to find some patterns in charging duration, separately for AC and DC charging. The Public dataset was further divided into 3 clusters – Petrol Station („on the way charging"), Commercial (shopping areas) and In the street (housing estates, etc.).

Fig. 1. Rel. frequency AC charging duration in minutes (10 min. steps)

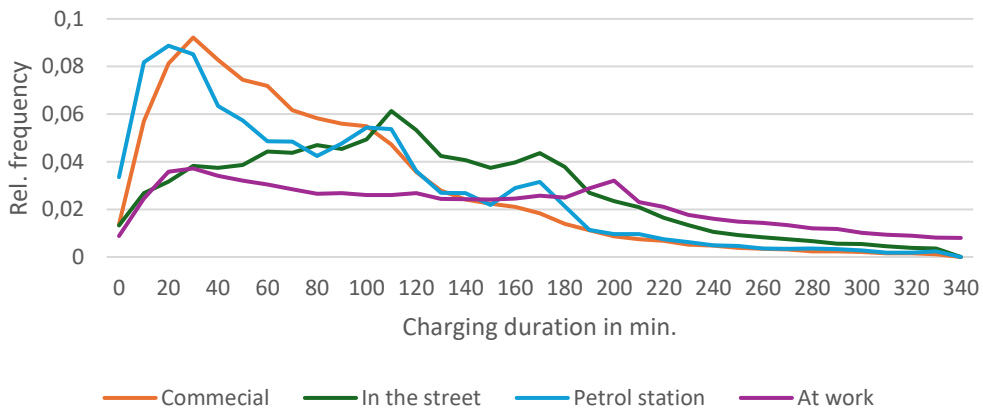
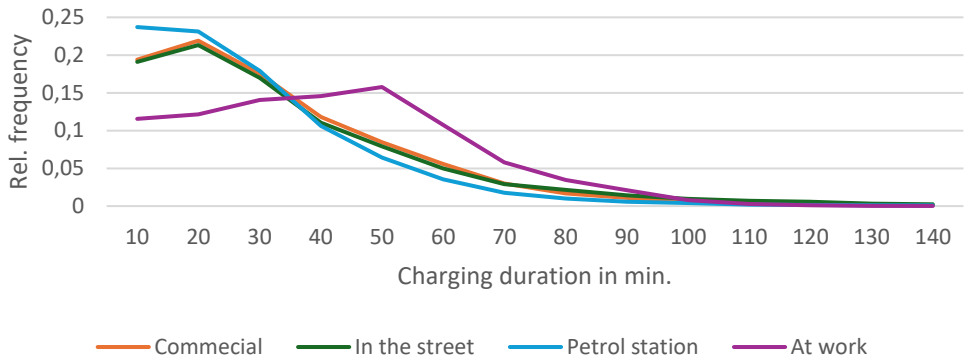


Fig. 2. Rel. frequency DC charging duration in minutes (10 min. steps)



The outcome of Fig. 1 and 2 is, that the Public and At work charging are very different, which was confirmed by the Kruskall-Wallis test. But there are huge differences between clusters of Public charging, especially in case of AC charging, which is connected to parking reason (typical time for shopping, typical break on the way, etc.). Other aspects influencing charging duration are price-policy of the charging provider, car park (proportion of BEV/PHEV), density of charging stations, car technology etc..

The data from Public charging were further compared to other studies from other countries (Canada [1], German [2], Scotland [3], Scandinavia [4], Italy [5]) on the base of average values, s. Fig. 3. Unfortunately for AC charging, there is not enough available sources for a relevant comparison. In case of DC charging, most of countries show values around 30 Min., but e.g. Germany deflects with 57 Min..

Fig. 3 Comparison average charging duration, Public charging

	Czech Rep.	**Italy**	**Germany**	**Norway**	**Sweden**	**Finland**	**Scotland**	**Canada**
AC	131,4	165	186	NA	NA	NA	174	144,6
DC	34,2	36,4	57	29,6	33,6	27,7	40,8	25,7
Period	*2022-23*	*2021-23*	*2019-20*	*2023*	*2023*	*2023*	*2018-19*	*2018-20*

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POLYMERIC COMPOSITES FOR ARCHITECTURAL APPLICATIONS

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Keywords: Polymeric Composites, Fiber-Reinforced Concrete, Compression Testing, Sustainable Materials, Computational Model, Architectural Applications

The composite's constituent parts maintain their inherent physical or chemical identities while being bound together by physical or chemical interactions. In comparison to the individual pristine state, the composite displays enhanced characteristics [1,2]. Sustainable materials are becoming more popular in the construction sector in an effort to enhance structural performance and environmental results. Fiber-reinforced concrete (FRC) plays a pivotal role in the construction industry. By using fiber as a reinforcement in concrete works to get the structural integrity of existing concrete structures, providing both internal and external reinforcement [3]. In order to improve the qualities of concrete, this study explores the use of polymeric fiber-reinforced composites, which combine synthetic recycled polyester fiber (RPET) with natural fibers like pineapple leaf fiber (PALF) and banana fiber (BF). A cementitious matrix was supplemented with fibers at different concentrations (1%, 1.5%, and 2%). Compression tests and 3D modeling were used to evaluate strength, deformation, and load distribution.

(a) (b) (c) (d)

Fig. 1. (a) PALF (b) BF (c)RPET (d) Sample FRC 5x5x5mm

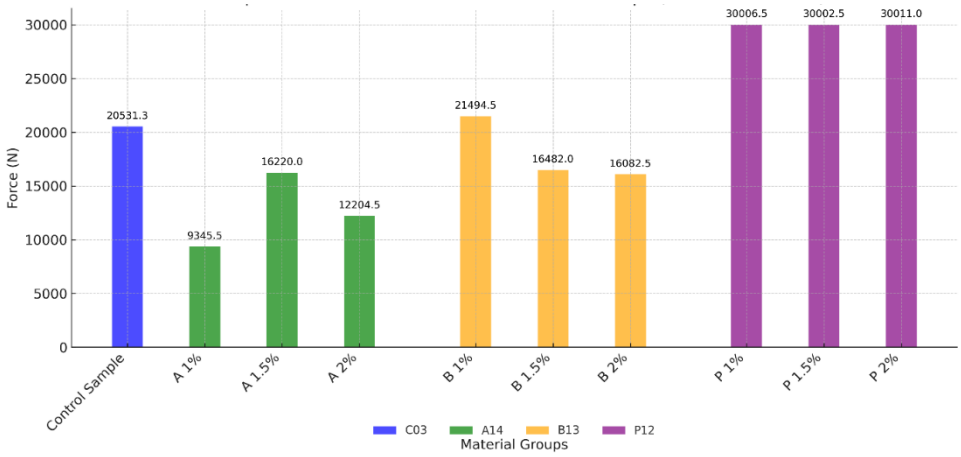

Fig. 2. Diagram of Compressive Strength
(The compression strength of different fiber-reinforced concrete samples: Pineapple Fiber (A1%, 1.5%, 2%), Banana Fiber (B1%, 1.5%, 2%), Recycled Polyester (P1%, 1.5%, 2%), and the control sample with varying fiber percentages.)

According to the results, 1% BF produces the strongest results; larger concentrations increase flexibility but decrease strength. Although PALF did not boost strength, it did increase flexibility, indicating that smaller dosages might work better. Although early cracking was noted, RPET fibers greatly increased compressive strength and ductility. Fiber type influences deformation, with more flexible materials exhibiting higher displacement, according to 3D simulations. By blending strength, flexibility, and environmentally friendly materials, this study promotes the creation of high-performance, sustainable composites for contemporary architecture.

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EVALUATING THE INFLUENCE OF ENZYMATIC HYDROLYSIS PRETREATMENT ON RICE STRAW FOR ENHANCED BIOGAS GENERATION

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Keywords: lignocellulosic biomass, enzymatic hydrolysis pretreatment, straw, cellulose degradation, biomass conversion, agricultural waste

Lignocellulosic biomass, especially agricultural waste such as rice straw, is a promising feedstock for biofuel production due to its abundance. However, the accessibility of cellulose is restricted by its complex structure, particularly the presence of lignin. Pretreatment techniques are required to disrupt the structural integrity, enhance cellulose degradation and improve biofuel generation. The study focused on analyzing the changes of the primary structural component, cellulose hemicellulose and lignin, before and after enzymatic hydrolysis. The samples were characterized for the initial composition before the enzymatic pretreatment. Rice straw was pretreated using crude enzyme obtained from white rot fungi for 24 hours under controlled condition. After the treatment, samples are subjected to compositional analysis to determine the level of cellulose using standard analytical protocol. This study evaluates the efficiency of the enzymatic hydrolysis pretreatment in breaking down rice straw by comparing the composition of untreated and treated straw. The results showed that the cellulose content decreased significantly after pretreatment, suggesting the

successful conversion to simpler sugar, which are crucial for subsequent biofuel production processes. This indicated that enzymatic hydrolysis was effective in breaking down cellulose, demonstrating its viability as a strategy for biomass conversion technology. This study highlights the importance of compositional analysis in evaluating pretreatment of agriculture residues and improving hydrolysis performance to produce biofuels. Understanding the lignocellulosic component provide valuable insight for developing biomass conversion strategies to contribute in more sustainable and effective biofuel production.

THE AESTHETIC APPEAL AND CHARISMA OF FRESHWATER FISH: IMPLICATIONS FOR PUBLIC PERCEPTION AND CONSERVATION IN CZECHIA

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Keywords: charismatic species, aesthetic perception, freshwater fish, invasive species, conservation attitudes

Aesthetic and charismatic traits of animal species strongly influence public preferences and conservation attitudes [1]. This effect may paradoxically benefit not only native, endangered species but also invasive or non-native organisms, whose visual appeal can mislead public perception [2; 3]. This study investigates how various social groups in Czechia perceive freshwater fish species, and how these perceptions influence conservation relevance. Using Q-methodology, we analyzed preferences towards 42 fish species based on visual stimuli. Participants included stakeholders (anglers, ministry officials, researchers) and lay audiences (students, children, general public).

Five key perception types ("factors") emerged. Stakeholders, especially anglers and academics, prioritized native and commercially valuable species (e.g. *Perca fluviatilis*, *Tinca tinca*). Members of the general public, on the other hand, preferred light-colored fish with red fins (e.g. *Scardinius erythrophthalmus*, *Rutilus rutilus*), a pattern likely influenced by visual attention biases. Participants with an interest in aquarium keeping favoured species with vivid colouration or unusual body shapes, such as Lepomis gibbosus or Lampetra planeri, regardless of their ecological impact or native status.

These findings highlight the challenge of aligning public perception with ecological priorities. Conservation campaigns could benefit from integrating aesthetic appeal by promoting native "umbrella" species with both ecological value and visual attraction (e.g. *Thymallus thymallus*). Findings also emphasize the need to educate the public about lesser-known, ecologically important fish, while addressing biases driven by appearance and familiarity [3].

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THE EFFECT OF GLYPHOSATE FORMULATIONS ON METHANE OXIDATION IN GLEYSOL

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Keywords: methane oxidation, glyphosate, adjuvants, soil

Methane contributes to approximately 20% of the global greenhouse effect and its atmospheric concentration continues to increase. One of the main natural sources of methane are hydric soils, and are related with acrtivity of methanogens. Noteworthy, their activity is counterweighted by the methane-oxidizing microorganisms (methanotrophs), which, serve as a natural biofilter for methane, before it reaches the atmosphere [1]. Soil methanotrophy, however, is vulnerable to human-induced disturbances resulting from agricultural practices (e.g. fertilization, ploughing etc.). In spite importance of the issue, little is known about the influence of pesticides on soil methane cycling.

Glyphosate is the world's most widely used herbicide, with annual consumption estimated at 9.2 x 10^{11} g by 2025 [2]. Despite of growing concerns about the environmental safety of glyphosate, the EU has extended its legal authorization untill 15 December 2033 [3]. Due to the need to intensify agricultural production and increasing weed resistance to glyphosate, the frequency of glyphosate application rates has increased. There is a growing evidence that the application rate of the herbicide may be higher than the dissipation rate, leading to its accumulation in the soil environment [4].

Another issue related to glyphosate-based herbicides, are the adjuvants that are an essential part of commercial formulations. These compounds are commonly used to preserve and enhance the biological properties of the active ingredient. Adjuvants are not chemically and biologically inert and can therefore affect soil microbiota.

In the case of glyphosate, the majority of studies investigating its effect on soil microbiota are based on the application of commercial formulations. This approach does not reveal the adjuvant effects. The results indicate that the Gleysol microbial community response is different when exposed to commercial formulation and pure glyphosate.

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EVALUATING THE SPECIFIC SURFACE AREA OF BIOCHAR: NITROGEN VS. WATER VAPOUR ADSORPTION ISOTHERMS

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Keywords: biochar, surface area, nitrogen vapour adsorption isotherms, water vapour adsorption isotherms

Surface area and porosity are key physical properties of biochar, significantly influencing its applications in areas such as wastewater treatment and soil remediation [1]. These properties are closely related to various structural aspects of biochar. The specific surface area affects the accessibility of surface charges, which in turn influences the cation exchange capacity (CEC) [2]. Additionally, the reactivity of biochar is strongly associated with active sites that increase with a greater accessible surface area [3].

Despite certain limitations and uncertainties associated with adsorption isotherms, low-temperature nitrogen adsorption remains the most widely used method for evaluating specific surface areas. However, the use of nitrogen as a non-polar adsorbate poses specific challenges for complex structure of biochars due to the slow diffusion of nitrogen at low measurement temperatures leads to prolonged measurement times and difficulties in achieving equilibrium. An alternative to assessing the specific surface area of porous organic materials may be the use of water vapour adsorption [4] that utilizes a polar molecule and operates under analytical conditions more closely resemble those in natural environments. This study presents a comparative evaluation of both methods.

The research material included biochars produced by pyrolyzing various organic substrates, such as residues from mechanical and aerobic treatment of sewage generated during the production of fruit (F) and dairy (D)

products, waste from agricultural biogas plants (B), acidic peat (P), and willow sawdust (W).

The surface areas estimated from water vapour adsorption were significantly higher than those obtained from nitrogen adsorption. Moreover, nitrogen surface areas increased with pyrolysis temperatures, while water vapour surface areas decreased. The obtained results indicate that with pyrolysis temperature increase, the biochar becomes microporous and less able to bind water, which is important in the context of its use in the soil environment.

Water vapour adsorption proved to be a more suitable method for estimating the specific surface area of biochars, as the obtained values were more consistent with the sorption capacity of tested organic materials. These findings suggest that traditional surface area measurement methods, such as nitrogen adsorption, may not fully capture the true surface properties of biochars.

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INCREASING COMMUNICATION RANGE OF AUTOMATIC SPRINKLER USING LORA MODULE

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Keywords: soil moisture, solenoid valve, LoRa

Attempts to increase the communication distance of automatic sprinklers using nRF24L01 module only resulted in a distance of about 20 meters [1]. Besides being affected by line of sight, the communication distance of the nRF24L01+ is also affected by the data transfer rate [2]. LoRa has a longer transmission range than the nRF24L01 and low power consumption, although it has a lower data transmission rate [3]. Purpose of this study was to increase the range of automatic sprinkler data communication for agricultural field coverage using LoRa module. For this study, the microcontrol on the Automatic Sprinkler uses Arduino UNO and LoRa RFM95W as a transmitter from the field, and on the receiver side uses ESP32 and LoRa RFM95W (Fig. 1).

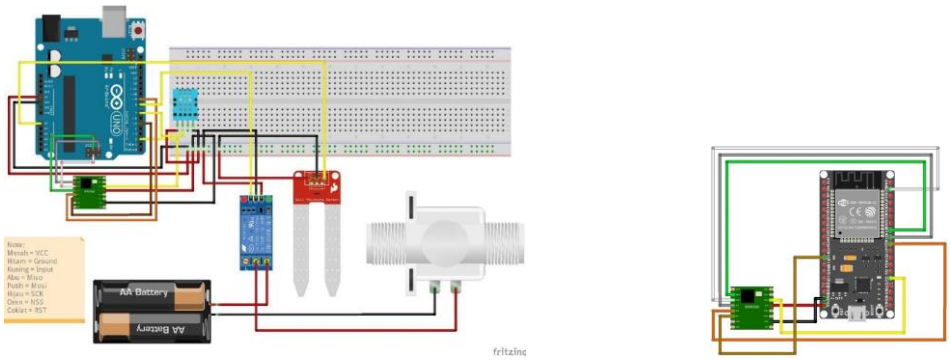

Fig. 1. Wiring Diagram on Transmitter (Left) and Receiver (Right) side.

Data from the field is sent to the receiver from transmitter via LoRa RFM95W module. From the receiver, data is sent to the internet via WiFi Router using ESP32 micocontroller and can be monitored on the IoT MQTT Panel application.

From testing the distance between the Automatic Sprinkler and the Receiver, data reception can reach 140 meters with value of RSSI around -103 to -101 dBm. The influence of environmental conditions (such as trees) greatly affects this distance.

Acknowledgments:

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ANALYSIS OF OPERATIONAL CONDITIONS AND STATION ARCHITECTURE ON AIR QUALITY IN THE PRAGUE METRO

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Keywords: particulate matter, metro stations, air quality

Increasing urbanization emphasizes the need for efficient, eco-friendly transport. Though metros seem 'clean', enclosed stations accumulate PM. This study analyzes how platform design, season, passenger load, and altitude affect PM levels in Prague metro stations.

Literature indicates that PM_{10} concentrations in metro systems can reach up to 550 μg/m³ and $PM_{2.5}$ up to 253 μg/m³, with the highest levels recorded during winter at deeper stations (15–17 m) [1]. The most common elements found in particles include iron (Fe), along with benzene, formaldehyde, and other volatile organic compounds [2, 3]. Studies confirm that the installation of platform screen doors can improve air quality, reduce noise, and decrease energy consumption by approximately 20 % if ventilation is properly designed [4, 5].

The experimental part of this study will be conducted at selected stations of the Prague metro, comparing side and island platforms. Measurements will be carried out in different seasons, recording passenger volume, station altitude, and surrounding conditions.

A graph (Fig. 1) depicting PM concentration trends in the Prague metro shows a sharp increase in pollution during high passenger density and at lower altitudes. Conversely, the lowest levels were observed at stations located at higher altitudes with fewer passengers. These findings confirm that both operational and architectural characteristics have a significant impact on air

quality. These factors should be considered in station modernization plans, especially in ventilation system design and operational management.

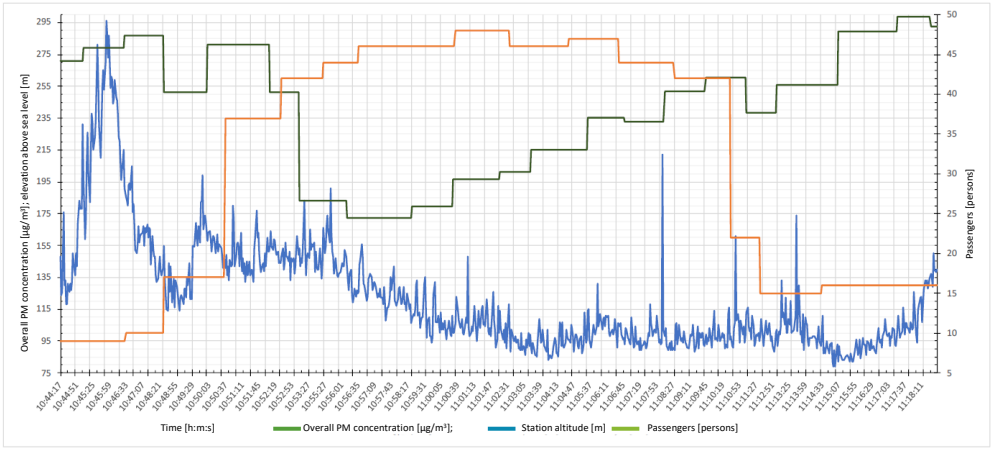

Fig. 1. Overall PM concentration in relation to the number of passengers and station altitude

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VIBRATION ANALYSIS OF BEARING IN CENTAUR 40 TYPE GAS TURBINE WITH FAST FOURIER TRANSFORM METHOD

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Keywords: Fast Fourier Transform, Vibration Analysis, Bearing, CENTAUR 40 Type Gas Turbine

The Fast Fourier Transform (FFT) is a transformation model applied to convert signals from time domain form to frequency domain form (Widnyana & Sanjaya, 2024). A time domain graph shows how a signal changes over time, while a frequency domain graph shows how much of the signal lies within each given frequency band over a frequency range.When a machine has a problem, the FFT spectrum can be used to provide information by determining the cause or source of the vibration. Machines that vibrate at a certain frequency can be diagnosed so that the cause of the vibration can be determined (Isranuri & Sabri, 2019). Fig. 1. Shows an image of a time domain graph, and Fig. 2 Shows the frequency domain graph image

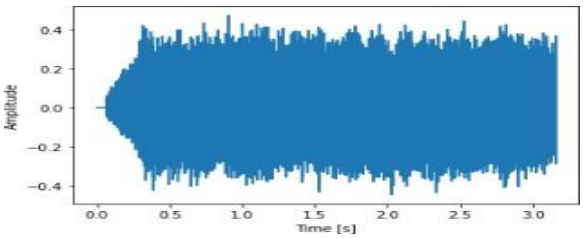

Fig. 1. Time Domain [1].

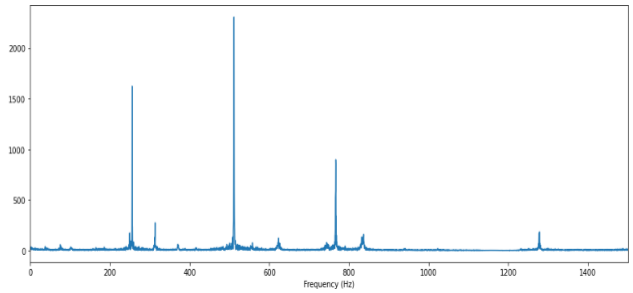

Fig. 2. Frequency Domain [2].

Bearings are components in the engine that function as a holder or support a shaft to stay on the holder. Bearings also function to reduce shaft friction with the pedestal pedestal (Harling & Apasi, 2018).

Gas turbines are turbines that move using hot gas from combustion that occurs in the combustion chamber. Kinetic energy in the gas turbine turns into mechanical energy that will produce power (Puspawan et al, 2023).

Vibration in gas turbines can cause failures that can result in turbine damage. To prevent it, good maintenance must be carried out on the gas turbine. Before performing maintenance, the cause of failure due to vibration must first be known. The cause of failure due to vibration can be analyzed using the FFT method.

The purpose of this research is to analyze bearing vibration in CENTAUR 40 type gas turbine using the FFT method in microsoft excel and determine the factors causing bearing vibration in CENTAUR 40 type gas turbine. This research was conducted by converting time domain signal to frequency domain signal in microsoft excel.

The analysis was conducted by comparing the frequency domain graph of the bearing on the CENTAUR 40 gas turbine with the failure graph to determine the factors causing vibration. The indicated failures are unbalance, looseness, and misalignment.

Acknowledgments:

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FABRICATION OF MONOLITHIC DSSC MODULES FOR PHOTOCHARGING OF SUPERCAPACITOR

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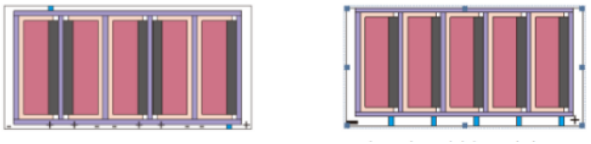
Keywords: DSSC, module, monolithic, interconnection, series, parallel, photo-charging

Dye-sensitized solar cell (DSSC) is a third-generation solar cell that uses dye molecules as a light absorber. Engineering of DSSCs into modules is essential to pave the way towards their future commercialization [1,2]. Herein, DSSC modules with monolithic configuration have been fabricated, wherein each module consists of five cells connected in series and parallel [3], with a total active area of 4.75 cm^2 as described in Fig. 1.

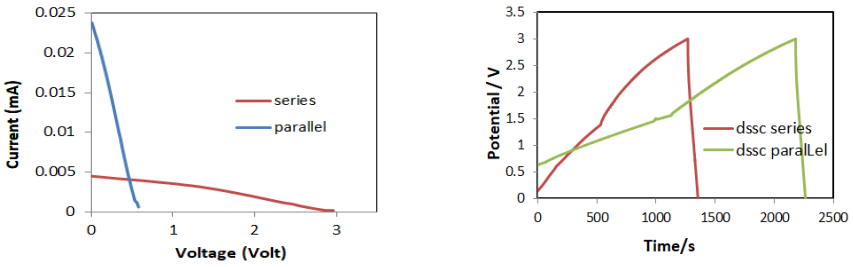
The electrical performance of the DSSC modules was measured under sun simulator with an intensity of 100 mW/cm^2 (1 sun). The photovoltaic parameters in the form of open-circuit voltage (Voc)= 3.09 V, short-circuit current (Isc)= 4.501 mA, P_{max}= 4.3 mW, and efficiency = 0.91% were obtained by the monolithic DSSC module with a series interconnection. Meanwhile, the monolithic DSSC module with parallel interconnection produced Voc= 596.6 mV (0.597 V), Isc 24.13 mA, P_{max} = 3.6 mW, and efficiency = 0.77% (Fig. 2a).

The DSSC modules were then applied for photo-charging a supercapacitor with a capacity of 0.1 F. Fig. 2b shows that the monolithic DSSC module with series interconnection requires a charging time of 1,265 seconds to be fully charged, while the parallel interconnected monolithic DSSC module requires almost two times longer to charge, with a total duration of 2,142 seconds.



(a) (b)

Fig.1. Schematic configuration of monolithic DSSC module with (a) series, and (b) parallel interconnection.



(a) (b)

Fig. 2. Comparison between (a) current-voltage (I-V) curves and (b) photo-charging profiles for monolithic DSSC module with series and parallel interconnection.

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REAL-TIME PLANT STEM SEGMENTATION FOR PRECISION AGRICULTURE USING YOLO ON A SMARTPHONE

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Keywords: precision agriculture, deep learning, plant phenotyping

Plant phenotyping is a crucial aspect of precision agriculture because it provides insights into plant health, status and productivity. Analysis of various traits such as stem structure enables farmers to make data-driven decisions. However, for widespread adoption, solutions must be both cost-effective and accessible [1].

Single Shot Detectors (SSDs) are deep learning-based architectures that enable real-time performance for object detection and instance segmentation tasks. One widely praised architecture is YOLO, which divides an image into a grid and predicts bounding boxes and class probabilities simultaneously.

In our experiment, we first captured 400 photos of tomato plants on a regular smartphone. After manual annotation, we trained YOLO11n-seg model with image size of 640 pixels, using an 80/10/10 data split. Validation on the test split yielded precision=0.821, recall=0.667 and mAP50=0.727 (mean average precision at 50% IoU) for stem segmentation.

The model was then tested on another smartphone to measure inference speed. Using the Ultralytics HUB mobile app, the inference speed was approximately 50 ms, resulting in an average frame rate of 20 fps.

Our results show that YOLO-based models offer an efficient, cost-effective solution for real-time stem detection in greenhouses. The results also indicate that even a small dataset and a lightweight model can still produce

satisfactory results. The ability to run inference on a smartphone further demonstrates the practicality of deploying such models in resource-constrained settings, making them accessible for small-scale farmers and researchers.

Acknowledgements:

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PRELIMINARY STUDY OF RELIABILITY CENTERED MAINTENANCE (RCM) PLAN FOR TURBOGENERATOR

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Keywords: Turbogenerator, Reliability Centered Maintenance (RCM), Risk Priority Number (RPN)

The turbogenerator is a system that functions to convert mechanical energy into electrical energy by utilizing the magnetic field in the stator that induces electric current. Turbogenerator has a complex component sub-system so that if one of them is damaged, it has the potential to cause damage to the turbogenerator itself. One of the causes of this damage is the lack of maintenance on the turbogenerator components. To overcome these problems and improve reliability, the application of Reliability Centered Maintenance (RCM) to turbogenerators is an effective solution.

RCM aims to reduce the risk of damage through failure and function analysis, and selection of appropriate maintenance strategies. To use the qualitative-based RCM method, the following steps need to be taken: conducting component breakdown, compiling system functional diagrams and system blocks, compiling the functions and failures of each component, implementing Failure Modes, Effects and Criticality Analysis (FMECA) by calculating the Risk Priority Number (RPN) value, prioritizing components with the highest RPN value and choosing the right maintenance strategy [1]. Its application increases the reliability of the turbogenerator by preventing or

delaying failure, thereby increasing system efficiency, extending component life and, significantly reducing operational costs [2]. Fig. 1. shows a decision logic diagram. The diagram systematically describes the sequence of actions to be taken according to the calculation of the RPN value that has been evaluated.

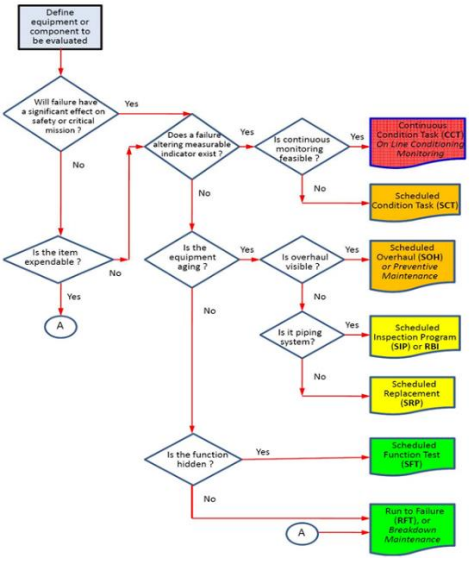

Fig. 1. Decision Logic Diagram

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NUMERICAL STUDY OF INFLUENCE OF ORIFICE PLATE THICKNESS TO PRESSURE DROP ON FLUID STREAM OF ENTRANCE AND FULLY-DEVELOPED FLOW REGION

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Keywords: orifice plate, pressure drop, fluid stream, computational fluids dynamics

In the food industry, fluids are predominantly transported on the closed units called pipe for rounded-shape and ducts for other geometries [1]. Controlling the fluid flow within these closed units is essential for achieving desired efficiency of industrial process [2]. Therefore, having the reliable data of fluid flow measurement is critical prerequisite before delving into subsuquent analysis [3].

Orifice plate is the most preferred choice to measure the fluid flow within the pipelines due to its robustness, simplicity, and maintainability [4]. However, installation of the orifice plate inside the fluid-carrying pipe inherently causes the irrecoverable pressure drop on the flowing fluid stream, which will adversely impact the industrial process in general. Hence, selecting the appropriate design of orifice plate can ensure minimal pressure drop occurs within the system. Our research aims to investigate the variation of the plate's thickness and its placement within the pipelines installation's influence the irrecoverable pressure drop of fluid stream.

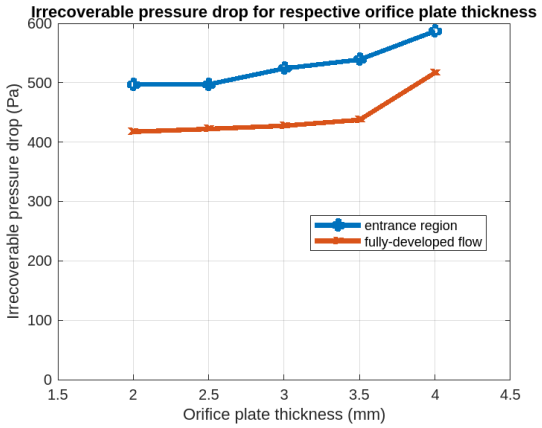

Fig 1. Simulation results of pressure drop in respective orifice plate thickness for both entrance region and full-developed flow region

Computational fluids dynamics (CFD) is employed as analytical tool to examine the process. CFD is simulation-based method to study fluids behaviors, particularly in relation to fluid flow and heat transfer [5]. The simulation results in Fig. 1 indicate pressure drop increases as the thicker plate is chosen. The greater pressure drop occurs in the entrance region area due to its proximity with the source of fluid which causes fluctuating velocity profile of fluid flow while the opposite phenomenon happened in the fully-developed flow area.

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INVESTMENT DECISIONS OF CZECH AND SLOVAK DOLLAR MILLIONAIRES ON THE REAL ESTATE MARKET

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Keywords: dollar millionaire, investment behavior, investment strategy, real estate market, real estate investment, economic decision-making

This contribution was created as part of a research carried out within the IGA project "The influence of the nature of the competitive environment on the formation of the price of new apartments on the real estate market", *identification number: 2025A1005.*

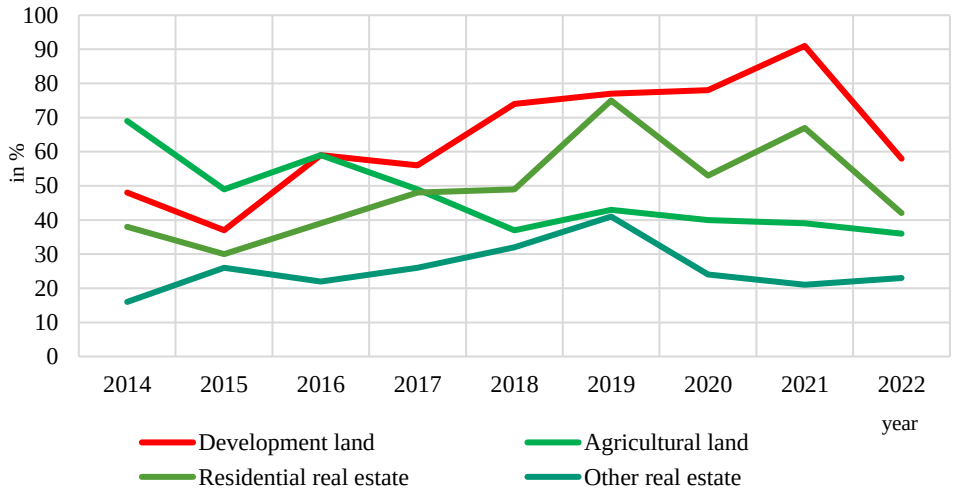
The research focuses on the investment decisions of Czech and Slovak dollar millionaires with an emphasis on the real estate market during a period of significant economic volatility between 2014 and 2024. The research was conducted by J&T Bank. It was based on an extensive dataset including more than 300 dollar millionaires and 1,000 people from the general population. Structured interviews and questionnaires were used.

In an environment of increasing economic uncertainty and rapid changes in financial markets, the investment behavior of dollar millionaires is undergoing a fundamental shift. Traditionally considered as stable and long-term-oriented, these investors are facing new challenges that affect their approach to portfolio diversification, investment selection and expected capital appreciation. A particular attention was paid to properties as a tool for portfolio diversification and protection against inflation.

Interest rates are one of the main external factors that significantly influences investment decisions. Higher rates increase the attractiveness of fixed-income instruments, such as term deposits or government bonds, which were previously overlooked by dollar millionaires. On the other hand, higher interest rates negatively affect the attractiveness of riskier assets, such as startups or cryptocurrencies. A decrease in confidence and expected returns have been experienced by millionaires in these types of assets. Similar

development has been observed in properties. Under the influence of tighter monetary policy, properties are no longer considered as the most attractive investment class.

Fig. 2**.** Property investments with expected appreciation in the period 2014–2022



Most od the millionaires remained optimistic during the pandemic period. Current economic development has a greater impact on the expectations of dollar millionaires. According to older investors, the expected global recession will affect not only developing countries, but also Europe and the USA. The recession may also lead to uneasiness and the growth of populism. In the Czech Republic and Slovakia, the current situation is considered more as a threat than an investment opportunity, which represents the most pessimistic mood in the last decade. Younger millionaires remain optimistic. They believe the modern technology and innovation helps with the temporary nature of the fluctuation. On the other hand, the older respondents focus on preserving their assets. Also, they are starting to engage their children in its management with the aim of long-term asset appreciation.

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ENTOMOREMEDIATION OF HEAVY METALS CONTAMINATED MAIZE BY *TENEBRIO MOLITOR* LARVAE

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Keywords: mealworm, entomoremediation, heavy metal contamination

Currently, due to anthropological activities, increasing amounts of heavy metals in the soil are becoming a growing problem [1]. One method of treating such contaminated soil is phytoextraction, i.e. the cultivation of plants with the capacity to take up these substances, such as maize. Such biomass can then be incinerated or used for biogas production [2]. However, through entomoremediation, the chain of products obtained can be further extended, with a decrease in the total amount of waste biomass [3]. The present study aimed to determine the degree of utilization of maize contaminated with heavy metals, as well as the potential for bioaccumulation of heavy metals by the insect larvae of *Tenebrio molitor*.

Three substrate variants were used for the experiment: maize after hydroponic cultivation with the presence of various heavy metals: Cd, Ni and Zn, and a control (no heavy metals added). Two hundred of *T. molitor* larvae were used and a dose of 25 mg of dry matter per larva was provided. The rearing lasted for 22 days. After this time, the larvae were left in an empty container for 24 hours to defecate. The larvae were then washed in distilled water, dried and frozen at -20 °C. The degree of utilization was determined as the percentage of maize dry matter lost from the total initial maize dry matter. The samples were then first dried at 105 °C, grounded in a laboratory grinder, and then mineralised in a microwave mineraliser in the presence of *aqua regia*, and thus prepared samples were analysed using inductively coupled plasma-optical emission spectroscopy to determine elemental composition values.

The only significant change in the degree of utilisation relative to the control variant was determined in the Cd variant, where its utilisation value was significantly lower. Higher concentrations of the tested elements (Cd, Ni and Zn) were determined in the larvae reared on each variant than in the control larvae, indicating their bioaccumulation ability. The presence of all three heavy metals affected the composition of macro- and micronutrients in the bodies of the larvae, as shown by their highest concentrations in larvae reared on control maize. Interestingly, the larvae from the Zn variant had the lowest amounts of other heavy metals, such as As, Hg, Cr and Pb.

Acknowledgments:

This research was founded by the National Science Centre, Poland, Sonata 15 Grant Number 2019/35/D/NZ9/01835.

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IMPACT OF POST-HARVEST MATURITY ON THE MOLECULAR AND NANO-STRUCTURAL CHARACTERISTICS OF PECTIN FROM THE GOLDEN DELICIOUS APPLE CULTIVAR

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Keywords: pectin, post-harvest maturity, monosaccharide composition, atomic force microscopy, persistence length

Pectin is a versatile anionic polysaccharide found in the in the cell walls and middle lamella of plants with wide utilization in food, cosmetics and pharmaceutical field. The cell wall of climacteric fruits, including apples, undergoes significant biochemical changes during both on-tree and post-harvest maturation. The chemical and structural properties of pectin in plant cells are notably influenced by solubilization and enzymatic degradation [1,2]. This study investigates the impact of post-harvest maturity on the molecular and conformational characteristics of water-soluble (WSP), chelator-soluble (CSP), and dilute alkali-soluble pectin (DASP) fractions extracted sequentially from alcohol-insoluble residue (AIR) of Golden Delicious apple cultivar pomace [3]. Pectin was extracted from three maturity stages: optimal harvest (S1), after six months of cold storage at 4°C (S2), and after 12 days of shelf life (S3). The yield of each fraction was determined, and the monosaccharide composition was analysed using gas chromatography- flame ionization detection (GC-FID). Galacturonic acid content was quantified via continuous flow analysis.

The structural properties of DASP fractions were further examined using atomic force microscopy (AFM), and SPIP software was employed to determine the chain length of smooth and hairy regions. Additionally, the persistence length of DASP fractions from S1 and S3 was calculated using the

mean squared end-to-end method [4]. Both Python and R software were utilized for analysing the persistence length of pectin with this method.

The findings provide insight into the nano-structural modifications of pectin during post-harvest maturation, contributing to a better understanding of apple cell wall dynamics and potential applications in pectin-related industries.

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SOLAR DRYING SYSTEM PERFORMANCE: AN EXERGY-BASED EVALUATION

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Keywords: solar collector, solar thermal energy, deflection, stress, strain

Drying is an exceptionally effective and widely practiced method for food preservation, used across the globe for generations. Solar drying is one of the most used methods worldwide. Evaluating its performance is crucial for determining its suitability for the intended purpose. Factors such as drying efficiency, energy consumption, and overall effectiveness must be carefully analyzed. A well-performing system ensures optimal drying rates, preserves product quality, and enhances sustainability. By assessing these aspects, we can determine whether the system meets the required standards and is viable for long-term use. The second law of thermodynamics, specifically through exergy analysis, offers a more comprehensive evaluation. Exergy analysis considers both the quantity and quality of energy used and lost during the drying process, providing deeper insights into thermodynamic efficiency and identifying opportunities for improvement.

Exergy analysis plays a key role in identifying energy losses and optimizing system design, making it a powerful tool for enhancing overall performance and achieving optimal drying conditions [1]. Exergy is a real measure of the grade or quality of energy and offers distinctive perspectives on the varieties, positions, and reasons behind inefficiencies, thus aiding in the identification of potential enhancements [2]. The exergy effeicny of drying system is determined by using Eq. (1) [3]:

$$\text{Exergy efficiency } (\eta_{Ex}) = \frac{E_{xo}}{E_{xi}} = \frac{E_{xi} - E_{xL}}{E_{xi}}. \quad (1)$$

The drying experiment was conducted for two days. As illustrated in Fig. 1(a) both solar air heaters (SAH 1 and SAH 2) achieved their highest exergy efficiencies around 12:00 on both days. Similarly, on Fig. 1(b) both dryers achieved their highest exergy efficiency around 12:00. The average efficiency of SAH 1 and SAH 2 were 47.18% and 44.19%, respectively, with the dryers' average efficiencies at 35.9% and 34.4%. The average exergy efficiency of SAH 1 and SAH 2 on day 1 were 11.85% and 9.15%, respectively, while the corresponding dryers had average exergy efficiencies of 20.37% and 16.00%. On day 2, the average exergy efficiency of dryer 1 was 17.93%, and dryer 2's was 15.73%.

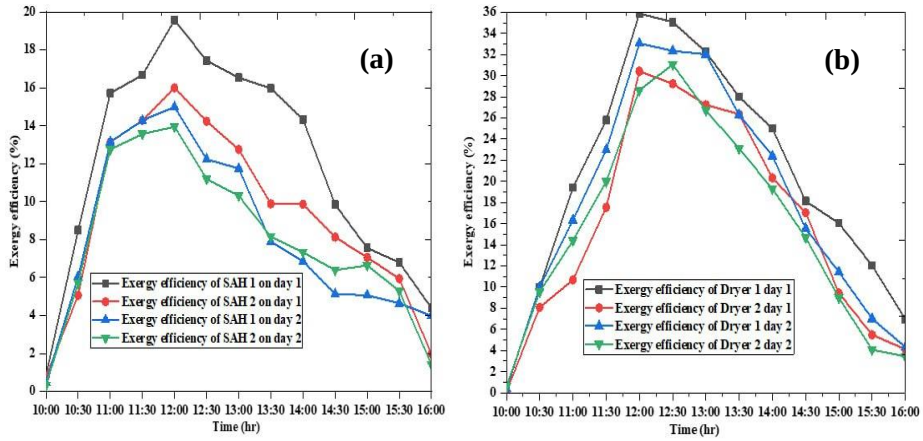

Fig. 1. Exergy efficiency: a) solar air heaters, b) drying chamber

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OPPORTUNITIES AND CHALLENGES OF USING UAVS FOR PASTURE MONITORING

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Keywords: UAV, pasture monitoring, weed detection, remote sensing, RGB imagery, image processing, machine learning, precision agriculture

Introduction

Effective pasture management is challenged by weed encroachment, impacting livestock productivity and ecosystem health. This ongoing research investigates the potential of using commercial Unmanned Aerial Vehicles (UAVs) equipped with RGB cameras, integrated with publicly available Light Detection and Ranging (LiDAR) data [1], for the identification and mapping of weed infestations in pasture environments. The development of accurate and efficient weed detection methods aims to provide a foundation for targeted weed management strategies, potentially involving automated ground robot interventions. This presentation outlines the proposed methodology, specific objectives, and anticipated challenges associated with developing such a system for practical application on small- and medium-sized farms.

Materials and methods

High-resolution aerial imagery (~1.7-2.1 cm/pixel) was acquired over pilot pasture sites (ZD Kvetna, CZ; SERIDA, ES) using commercial quadcopter UAVs (Autel EVO 2 Pro, DJI MAVIC 3M) following pre-planned flight paths. Collected georeferenced images were processed using photogrammetry software (Pix4D or Open Drone Map) to generate orthomosaics of the surveyed areas. For initial weed localization, RGB orthophotos were analyzed in QGIS software by applying a greenness threshold (>120) to segment highly green pixels, followed by DBScan clustering (max_dist=2m, min_clust=10) to group potential weed patches (Fig. 1). To differentiate weeds from arboreal vegetation, publicly available LiDAR

data (DMR5G-CZ, MDT02-ES) were processed to create Digital Terrain Models (DTMs) and subsequently Canopy Height Models (CHMs). A height threshold (>2-2.5m) was applied to the CHM to classify tree objects, which were then used to filter the RGB-derived weed map. The potential for improving classification accuracy using machine learning algorithms (Random Forest/Support Vector Machine) trained on extracted image features is also being investigated [2, 3].

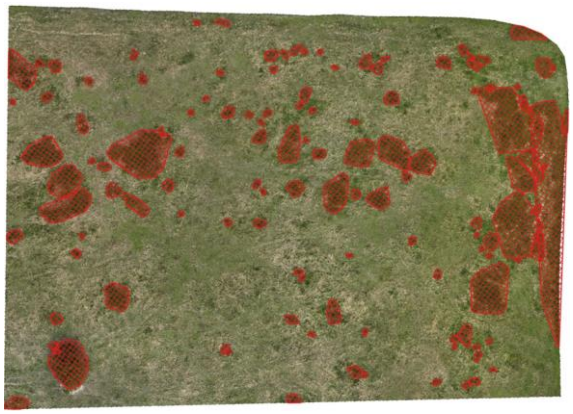

Fig. 1. Example illustration of RGB thresholding applied to pasture orthophoto to identify potential weed clusters (red areas).

Preliminary Findings and Discussion

The acquired UAV imagery, with spatial resolutions of 1.7-2.1 cm/pixel, proved sufficient for visual interpretation and processing. Initial analysis indicates that integrating LiDAR-derived CHMs effectively filters tree canopies [1], achieving near-complete removal (100%) of this major source of false positives from the RGB thresholding results in our case study. This fusion approach significantly enhances the specificity of detecting ground-level vegetation patches compared to using RGB data alone. However, a noted limitation is the potential lack of timeliness in publicly available LiDAR datasets, suggesting a need for ground verification in practical applications. Refining classification accuracy by incorporating texture features and relative greenness metrics remains a central focus for ongoing work, with machine learning techniques [2] offering a promising avenue for improved weed/non-weed discrimination.

Acknowledgements:

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RELIABILITY OF PHOTOVOLTAIC PANELS FOR AGRIVOLTAIC SYSTEMS

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Keywords: photovoltaics, agrivoltaics, PV panels, service expenses

A majority of PV panel producers declare a PV panel lifetime round 25 years. But our data evaluation from long-term monitoring of many PV power plants show, that PV panels start to fail after about 10-12 years. Compared to standard PV systems, the agrivoltaic systems are exposed to extraordinary influences of agriculture like dust, humidity, vibrations, fertilizers etc. Our studies compare the quality of PV panel components within last 25 years. We performed long-term monitoring of 85 PV power plants, including agrivoltaics in the Czech Republic and in abroad. PV panel failures within strings cause subsequent damage to multistring inverters. The total expenses for PV panel and PV inverter replacement are growing quickly after 10-12 years of the PV power plant operation. Hence, it is very important to study the reliability characteristics of PV panels to predict their real lifetime and to predict PV power plant service expenses.

During the last 15 years, the price of PV panels has decreased by about 15 times. Mass production has certainly contributed to this, but the main reason was the use of cheaper and lower quality materials and more economical construction. This ultimately had to reduce the real lifetime of PV panels. For example, cheaper polymers degrade faster and let moisture through [1] (see fig. 1). Thinner frames cause more bending [2]. It is obvious that the lower lifetime of photovoltaic panels will cause lower profitability of the entire photovoltaic power plant (see fig. 2). The next step of the research will be focusing attention on all components of agrivoltaic power plants and assessing the overall reliability of the entire system.

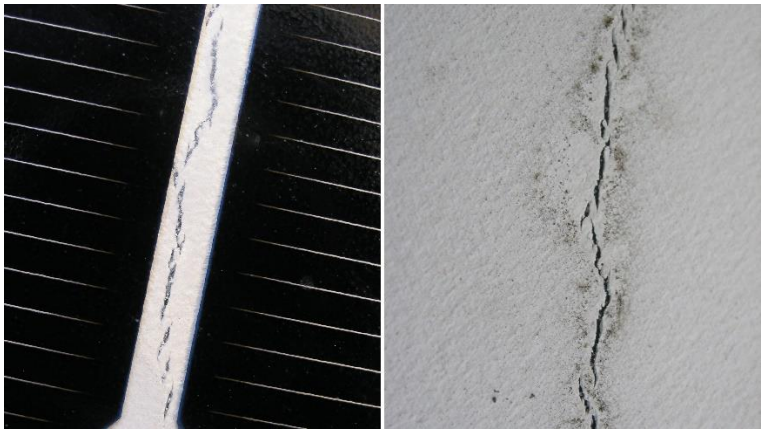

Fig. 1. Degradation of the polymer on the back side.

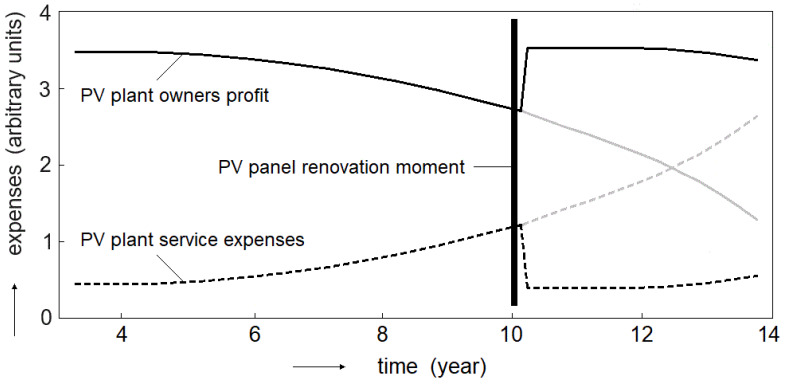

Fig. 2. Comparison between PV power plant owners' profit and service expenses.

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INSTANTANEOUS PROFILE METHOD: INFLUENCE OF EXPERIMENTAL CONDITIONS ON THE UNSATURATED HYDRAULIC CONDUCTIVITY COEFFICIENT ACROSS DIVERSE SOIL SAMPLES

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Keywords: unsaturated hydraulic conductivity, instantaneous profile method, axis translation

The accurate determination of unsaturated hydraulic conductivity (UHC) is essential for modeling water dynamics in soils. While the Instantaneous Profile Method (IPM) remains one of the most practical laboratory techniques for UHC estimation, its reliability can be significantly influenced by specific experimental conditions and data processing strategies. In this study, we explore how variations in measurement resolution and boundary condition dynamics affect the outcomes of UHC estimation using IPM. A series of numerical experiments was conducted using the Richards equation to simulate the desaturation of soil columns under controlled conditions. Soil hydraulic parameters were derived from the Global Soil Hydraulic Properties (GSHP) database, covering a broad spectrum of 450 soil types. Three distinct drying scenarios were analyzed, each involving different rates of decrease in soil water potential: constant soil water potential of -10 mH2O over 8 days, a linear decrease in soil water potential from 0 mH2O to -10 mH2O over 2.5 days, followed by maintenance at -10 mH2O until the 8th day, and a linear decrease in soil water potential to -10 mH2O over 5 days, followed by maintenance at this level until the 8th day of simulation. It is also investigated how different combinations of measurement frequency and vertical separation between measurmement points influence the UHC, particularly in terms of error propagation across layers.

Additionally, this study evaluates the robustness of noise-reduction technique *Bézier curve* applied to noised soil water content data. Effects on the reliability of the derived UHC values were compared across all simulated scenarios.

The results highlight that the dependence between measurement design and data post-processing critically shapes the outcome of UHC determination.

Acknowledgments:

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IMPACT OF COMPLEX MODIFICATION ON THE PROPERTIES OF HAPLIC LUVISOL

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Keywords: soil modification, fruit wastes, activated carbon

Soil degradation, leading to the loss of fertility and structure, is a growing global concern, as it threatens sustainable agriculture and food security [1]. Soil physicochemical properties can be restored and modified by various additives, such as water-soluble macromolecular compounds (polyelectrolytes) or solid materials of agricultural waste origin (e.g., activated carbons). The aim of this study was to determine changes in various physiochemical parameters (e.g., pH, surface charge) of Haplic Luvisol (HL) after modification with orange peels-derived activated carbon (prepared at 800 °C in a microwave furnace, under CO_2 atmosphere) and/or polymers: cationic (CtPAM) and anionic (AnPAM) polyacrylamide and exopolysaccharide (EPS) synthesized by soil bacteria *Rhizobium leguminosarum bv. trifolii*. Activated carbon (OFM800) used in the study was considered as suitable for environmental applications, according to *European BC Certificate* [2].

Some parameters of soil before and after amendment are presented in Table 1. Each modification resulted in an increase in both pH_{H2O} and pH_{1MKCl} compared to the control. Modifiers addition also increased organic matter content of all tested systems. In the system containing both OFM800 and AnPAM this parameter changed from 1.86% to 3.94%. Among all modifiers,

only the addition of EPS increased Q_{pH10} from 1.2208 to 1.2868 cmol/kg. In other cases, a decrease in this parameter was observed. However, analyzing the results of all the studies conducted, it can be concluded that the prepared carbonaceous material alone and enriched with polyelectrolytes is a promising agent for remediation of Haplic soils.

Tab. 1. Parameters of Haplic Luvisol before and after modification with various amendments.

Modification	pH_{H2O}	pH_{1MKCl}	Organic matter content [%]	Q_{pH10} [cmol/kg]
HL (control)	5.7	4.4	1.86	1.2208
HL + EPS	6.2	4.6	2.18	1.2868
HL + CtPAM	6.0	4.6	2.18	1.1748
HL + AnPAM	6.1	4.6	1.91	1.1468
HL + OFM800	7.3	5.7	3.68	1.1888
HL + OFM800 + EPS	7.7	5.8	3.78	1.1588
HL + OFM800 + CtPAM	7.5	5.9	3.78	1.1748
HL + OFM800 + AnPAM	7.5	5.9	3.94	1.1628

Acknowledgments:

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DETECTION AND EVALUATION OF WATER STRESS OF HOPS USING UAV IMAGES

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Keywords: optical images, SAR images, hop, spectral indices

When cultivating hops, it is important to monitor both biotic and abiotic factors that determine its quality and yield. To monitor these factors, UAV images can be used, which, after processing, help assess the health status of the plants. The use of UAV images enables regular monitoring of crop condition. To determine the health status of hops, it is appropriate to monitor water stress, which can be determined using the Crop Water Stress Index (CWSI), calculated from thermal images taken with a thermal camera.

Four hop varieties grown in both organic and conventional hop gardens situated near the village Stekník, close to Žatec were monitored in 2023. In the organic hop garden, the varieties Premiant and Saaz were cultivated; in the conventional hop garden, Premiant, Agnus, and Sládek were grown. To monitor structure, health, vitality, and chlorophyll content, spectral indices calculated from UAV images were used—specifically NDVI, CIR, GNDVI, NDRE, and SAVI. In addition, images from the Sentinel-1 satellite were used to calculate SAR indices: IDPDD, VDDPI, DPDD, and DPSVI.

Variables	NDVI	GNDVI	CIR	SAVI	NDRE	DPDD	DPSVI	IDPDD	VDDPI
CWSI SE	0.21	0.15	0.14	0.06	0.14	0.08	0.10	0.08	0.00
CWSI FL	0.38	0.21	0.35	0.11	0.37	0.56	0.75	0.56	0.14
CWSI CD	0.21	0.08	0.11	0.01	0.10	0.59	0.65	0.59	0.04

Table 1: Coefficients of determination between CWSI and other variables in main phenological phases: stem elongation (SE), flowering (FL), and cones development (CD). Top values per row are highlighted.

The coefficients of determination between CWSI and selected SAR indices are shown in Table 1. It is evident from table that the CWSI of the monitored hops can be explained by 75 % using the SAR index DPSVI during the flowering growth phase (FL). In the phenological phase "cones development", DPSVI index can explain CWSI up to 65 %. This implies that the flowering phase shown in the Figure 1. is the most suitable for monitoring water stress by SAR indices. On the other hand, optical vegetation indices did not show significant results compared to SAR indices.

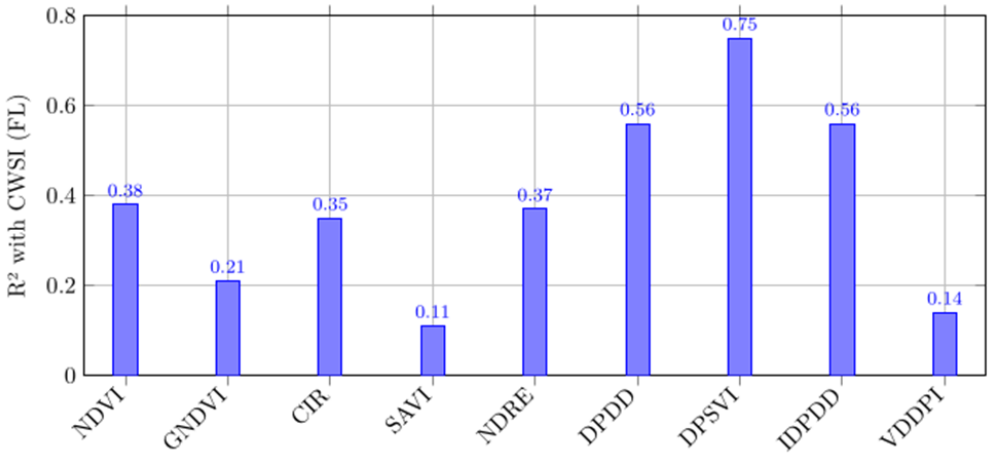

Figure 1: Coefficients of determination between spectral indices and CWSI in flowering growing stage.

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CLASSIFICATION OF DAIRY COW POSITION BY ULTRASONIC METHOD WITH THE APPLICATION OF MACHINE LEARNING

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Keywords: dairy cow, machine learning, precision livestock farming, welfare

The application of artificial intelligence is the defining standard in Agriculture 4.0. This paper is concerned with the comparison of the accuracy of selected classification models (Fig. 1) in determining the position of a dairy cow in a cubicle. The measurement was performed by an ultrasound impulse method.

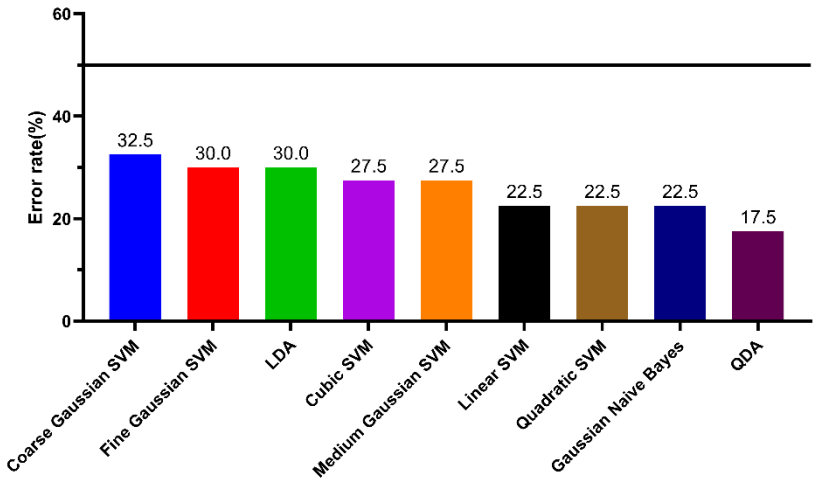

Fig. 1. Evaluation of the error rate of selected classification models [1]

The quadratic discriminant analyser (QDA) was evaluated as the best model, where the error value was at the level of 17.5%. The position of the dairy cow has been identified with reference to the measurement system.

The experiment was analyzed in depth by the research article [1]. The used measurement system is based on patent [2].

Acknowledgements:

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INNATE RESILIENCE MECHANISMS OF *NEOSARTORYA* SP. (*ASPERGILLUS* SP.) – WHOLE GENOME SEQUENCING INSIGHTS

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Keywords: Whole Genome Sequencing, Ascomycota, Food Preservation

Fungal contamination significantly threatens food safety, particularly in heat-processed products where thermoresistant species can survive conventional preservation methods [1]. *Neosartorya* spp., the teleomorph of *Aspergillus* spp., are known for their resilience, with certain isolates exhibiting high resistance to both thermal and antifungal treatments [2, 3]. These moulds endure extreme conditions and produce mycotoxins, further complicating their control in food systems [4]. Understanding the genetic basis of their defence mechanisms is crucial for developing more effective mitigation strategies. Whole genome sequencing (WGS) provides valuable insights into the molecular adaptations contributing to their persistence.

This study presents the functional genome analysis of the *Neosartorya* sp. isolate G150/14, originally obtained from soil. The isolate was characterised as being the most sensitive to antifungals in previous experiments. The main objective was to analyse the genes encoding defence mechanisms, including those enabling survival under high-temperature conditions and other abiotic stress factors. Whole genome sequencing (WGS) was performed using the Illumina® MiSeq v3 platform, followed by a bioinformatic analysis. Compared to closely related isolates, G150/14 exhibited the highest proportion of virulence-related genes (13.19%) and pathogen defence genes (28.57%), suggesting an enhanced ability to counteract biotic stress. However, it possessed the fewest genes related to sporulation (1.65%) and antifungal substance resistance (6.59%), which may nagetivedly influence its environmental adaptability.

Presented findings help to build a better understanding of the genetic basis of fungal resistance mechanisms and may contribute to improving strategies for controlling these contaminants in food production and storage.

Acknowledgements:

The work was supported by the National Science Centre, Poland, Preludium Bis-2, 2020/39/O/NZ9/03421.

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EXPLORING CHANGES IN SOIL PROPERTIES DURING PLANT GROWTH USING IOT

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Keywords: soil, IoT, soil sensor, precision agriculture, agriculture

The integration of Internet of Things (IoT) technology into agriculture has revolutionized the way changes in the soil context are monitored and managed during plant growth [1]. By leveraging sensors and IoT-enabled systems, farmers and researchers can now track various soil parameters in real time, enabling precise, data-driven decision-making. This section explores the role of IoT in monitoring soil context dynamics, the key technologies employed, and the benefits and challenges associated with such systems [2-3].

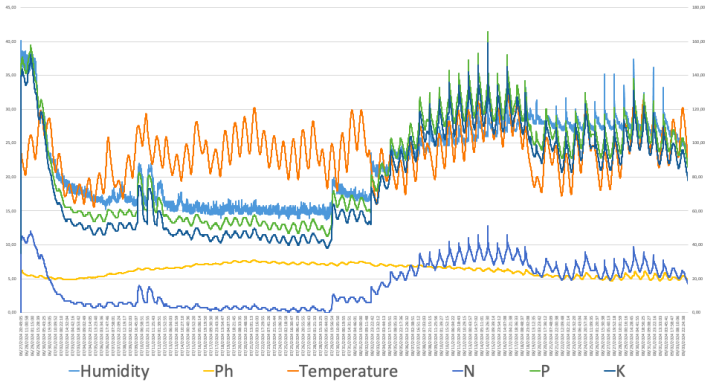

Fig. 1. Graph illustrating changes in soil properties in a test potato field

An experiment was established in a experimental field to investigate soil changes during the growth of cultivated crops. For this purpose, the Rossana potato variety was grown in containers with a volume of 90 liters. A loamy soil was selected for the experiment. Fig. 1. presents the seasonal course of changes in soil properties. The monitored parameters included soil

temperature, soil moisture, pH, electrical conductivity, and nutrient content. The monitoring station was powered by a solar panel, and data collection was carried out via an IoT-based system. The containers were irrigated regularly.

The experiment demonstrated that it is feasible to monitor long-term changes in soil conditions throughout the plant growing season. The graph clearly illustrates how individual parameters evolve over time. From the observed relationships between soil properties, it is possible to determine optimal timing for the application of essential nutrients and to fine-tune cultivation conditions. These data can be further utilized in the development of precision agriculture methods, supporting farmers in maximizing crop yields while minimizing environmental impacts[2].

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INTERMACROMOLECULAR INTERACTIONS OF THE ONION POLYSACCHARIDES IN THE PRESENCE OF SELECTED MACROELEMENTS IN THE AQUEOUS SOLUTION

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Keywords: onion polysaccharides, macroelements, intermolecular interactions

Macronutrients are the elements that organisms need in high concentrations for their proper growth and development. Six macroelements are essential for the plants: nitrogen, phosphorus, potassium, calcium, magnesium and sulfur [1]. Some of the agricultural practices lead to the loss of these nutrients from the soil. Therefore, it is necessary to provide them.

Nowadays, we try to find and choose products that are natural and safe for people and the environment, such as biopolymers. They can also be used with additional compounds that may improve their effectiveness.

The aim of this study was to investigate the influence of the valence and structure of cationic forms of nutrients (K^+, NH_4^+, Mg^{2+}) on the behaviour of onion polysaccharide macromolecules in the aquous solution.

Polysaccharides were extracted from the cell wall of red onion bulb. Two pectin fractions and one hemicellulose fraction were selected due to their highest extraction efficiency. The series of aqueous polysaccharide dispersions at the concentration ranging from 0.01 to 2% w/v were tested at the constant ionic strength. Basic physical and physicochemical studies were performed.

The influence of tested cations varied depending on the valence and structure of the ion present and the type of polysaccharide.

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COMPARATIVE EVALUATION OF ESG REPORTING IN THE AGRI-FOOD SECTOR: CASE STUDY OF NESTLÉ, DANONE, AND AGROFERT

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Keywords: ESG reporting, sustainability disclosure, agri-food sector, corporate transparency, European sustainability standards

This paper investigates the level of transparency, standard compliance, and strategic integration of ESG (Environmental, Social, and Governance) reporting among three agri-food companies with contrasting regional and global reach—Nestlé, Danone, and Agrofert. Utilizing a qualitative comparative analysis grounded in ten multidimensional evaluation criteria derived from international frameworks, such as the Global Reporting Initiative (GRI, 2023), the Task Force on Climate-related Financial Disclosures (TCFD, 2017), and the European Sustainability Reporting Standards (ESRS) under the Corporate Sustainability Reporting Directive (European Commission, 2023; EFRAG, 2023), the study applies a structured content analysis to the companies' 2023 ESG disclosures.

The findings reveal substantial disparities in ESG disclosure maturity. Nestlé and Danone demonstrate comprehensive alignment with international standards, with clear integration of ESG within corporate governance, disaggregated emissions reporting, and measurable sustainability targets (Hahn & Kühnen, 2013; Eccles et al., 2012). Their reporting practices reflect a strategic understanding of sustainability as a value-creating element, supported by stakeholder-inclusive materiality assessments and verification mechanisms.

In contrast, Agrofert's disclosures are characterized by limited adherence to international frameworks, a predominantly qualitative approach, and minimal evidence of standardized data reporting or external assurance. Although basic themes such as energy efficiency and employment practices are present, the lack of structured objectives and ESG governance undermines the comparability and transparency of its report.

The findings emphasize the need for capacity-building in regional firms and support further harmonization of ESG disclosure obligations at the EU level (EFRAG, 2023). The study provides relevant insights for the advancement of sustainability transparency and reporting practices in the agri-food sector.

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NEXT-GENERATION ACOUSTIC INSULATORS: LIGHTWEIGHT 3D HYBRID COMPOSITES REINFORCED WITH BIOMASS-DERIVED JUTE AND GLASS FIBERS

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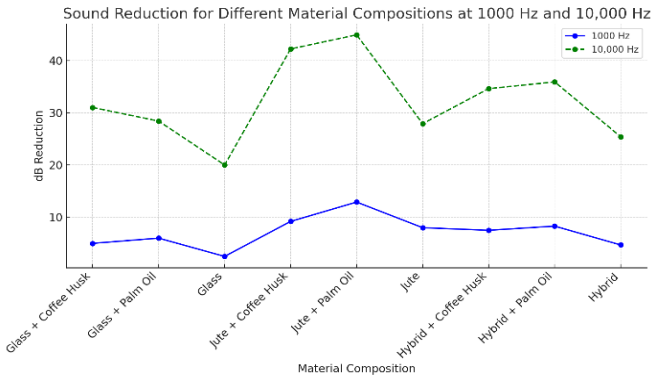
Keywords: eco-friendly construction materials, sustainability, biomass utilization, 3D spacer panels, acoustic insulation

This research focuses on assessing the acoustic insulation efficiency of three-dimensional woven composites reinforced with natural jute and glass fibers, integrated with agricultural waste fillers such as coffee husk and palm fiber. The materials were evaluated at 1000 Hz and 10,000 Hz using a sound-insulated chamber. The results revealed that jute-based composites, particularly those incorporating palm fiber waste, exhibited superior noise reduction performance—achieving up to 44.9 dB at higher frequencies. One-way ANOVA confirmed that both the reinforcement architecture and biomass fillers significantly influenced the acoustic response. The study highlights the promising application of sustainable, bio-derived materials in soundproofing technologies relevant to agriculture, biology, and related fields.

As shown in Fig. 1, the highest sound absorption was observed in the 3D woven jute composites(3DJF) with palm oil, which outperformed the other samples. This enhanced performance can be attributed to the superior sound-absorbing qualities of natural fibres such as jute, combined with the scattering effect that palm oil creates on the surface of the material. Jute fibers exhibit better damping of vibrations compared to synthetic materials, which is a key factor in their higher sound absorption capacity.

(a)



(b)

Figure 1. (a) An image of the (3DJGF); **(**b**)** Bar illustrating the sound reduction levels for different materials at both 1000 Hz and 10,000 Hz.

Hybrid 3D jute glass fabric(3DJGF) also showed good performance, in particular, with waste palm fibers, in which the sound was absorbed by 35.9 dB at 10,000 Hz. Comparatively, the 3D glas fabric(3DGF) composites provided a lower level of acoustic performance but still performed satisfactorily.

From the one-way ANOVA, it was proved that fiber composition in the 3D spacer fabric and additive fillers have a considerable influence on soundproofing, with p-values less than 0.05. This information strengthened the overall perspective that eco-friendly materials derived from natural resources and waste fibers could be more beneficial in the sound insulation field, providing sustainable solutions to industries ranging from interior design of house buildings to automotives and constructions at airports.

Acknowledgements:

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ORGAN-SPECIFIC AND SEASONAL VARIATION OF FURANOCOUMARIN CONTENT IN *HERACLEUM MANTEGAZZIANUM*

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Keywords: *Heracleum mantegazzianum*, furanocoumarins, GC-MS, phototoxicity, invasive species

Heracleum mantegazzianum, one of the most invasive plant species in Europe, produces furanocoumarins—phototoxic compounds that pose serious risks to human health and biodiversity [1]. This study investigates the seasonal and organ-specific variation in the content of these compounds, with the aim of improving our understanding of their ecological role and informing management practices.

Plant material was collected from a plant population found in Prague 5–Zličín during three stages (July, August, September 2023). Three plant organs (leaf, stem, umbel) were separately sampled, dried, and homogenized. Furanocoumarins were extracted using methanol and analyzed via gas chromatography–mass spectrometry (GC-MS).

Four furanocoumarins—angelicin, methoxsalen, pimpinellin, and bergapten—were identified. Leaf tissues contained the highest total content of phototoxic compounds, particularly in August, when furanocoumarin concentrations peaked. Methoxsalen was found exclusively in leaves, while bergapten was detected only in late-summer samples. Notably, the study also identified fatty acids such as palmitic and oleic acid, with palmitic acid dominant in umbels and leaves, and oleic acid primarily in stems and September samples.

These results confirm that the distribution of furanocoumarins in *H. mantegazzianum* varies significantly depending on both plant part and season. This variation highlights the importance of considering developmental stage and environmental timing in risk assessment and invasive species control. The presence of pharmacologically active compounds also opens potential for medicinal research using controlled plant-derived substances [2].

Acknowledgments:

This research was supported by the Internal Grant Agency of the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague [grant number 20243101].

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ESTIMATION OF OIL PALM AGE USING GLOBAL CANOPY HEIGHT DATA FOR SMART AGRICULTURE IN INDONESIA

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Keywords: Oil Palm, Canopy Height Model, GEDI LiDAR, Google Earth Engine, Age, Remote Sensing

Oil palm (Elaeis guineensis) is one of the world's most important agricultural commodities, with Indonesia as the world's largest producer, cultivating around 16.78 million ha (Junaedi 2022). Despite its economic value, the sector is facing declining performance in export revenues of almost 20% in 2019, caused by old plantations and disease (Darmawan et al. 2024). This study aims to address these needs by developing a national-scale oil palm age estimation model using an integrated remote sensing approach. LiDAR data from the Global Ecosystem Dynamics Investigation (GEDI) were used to generate a Canopy Height Model (CHM) by subtracting the Digital Elevation Model (DEM) from the Digital Surface Model (DSM) (Zhou et al. 2023). All of the data were processed on the Google Earth Engine (GEE) platform.

Fig 1. Oil Palm Age Distribution

We developed a 10-meter resolution oil palm age map for Indonesia, classifying it into five age categories (0–5, 6–10, 11–15, 16–20, and 21–25 years) (Figure 1). The map indicates that the majority of plantations are in the early vegetative phase becoming to the productive generative phase, in 5–8 and 8–15 year ages with characterized by optimum canopy growth and high yields of fresh fruit bunches. At the age of 0–3 years and 3–4 years, indicating continuous replanting. Oil palms over 20 years are found only in limited areas generally include younger palms (0–8 years), indicating an initial developmental phase early in reaching maximum productivity. Validation showed a strong correlation with an R^2 of 0.8731, indicating a high level of accuracy, especially for plantations aged 0–15 years. Overall, the model produced a Root Mean Square Error (RMSE) of 2.58 years by analyzing estimated and actual oil palm age using GCH.

Acknowledgements:

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RESEARCH ON RICE STRAW PRE-TREATMENT FOR UTILISATION AS SOLID BIOFUEL

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Keywords: biomass energy, valorisation of agricultural waste, water washing, fuel co-blending, combustion

Agricultural residues are mostly challenged by low calorific value, high moisture and high ash content which affects their energy yield and efficiency upon use for combustion purposes [1]. This study investigates the optimisation of fuel-energy properties of rice straw using different treatment techniques such as water washing and fuel co-blending with rice husks and peanut shells which are prevalent in the North-Western Nigeria. The objective was to evaluate and improve the fuel properties of rice straw and to make it a viable and sustainable biofuel.

Water washing was applied to remove ash-forming minerals, while co-blending aimed to optimize the energy characteristics of the resulting fuel mixtures. The effects of water washing for different soaking durations (1 to 24 hours) were evaluated in addition to the effects of different fuel blend ratios on the biomass (a blend of rice straw, rice husk and peanut shell) with respect to the ISO Standards for solid non-woody biofuel [2].

The results demonstrated that water washing test did not show significant impact on improvement of biomass fuel-energy properties. Some positive effect was only monitored in case of ash content reduction in rice straw and especially peanut shells. Where the longer time of water soaking resulted in lower ash values, with almost 3 times reduction of peanut shells ash content after 24 hours of water treatment. Water washing did not show any improvement of calorific values. On the other side, co-blending test had better impact on overall energy quality of rice straw and rice husk fuels, where the bigger proportions of peanut shells in the mixtures impacted increase of calorific values and decrease of ash contents.

This study concludes that fuel co-blending proved to be more effective overall in enhancing the calorific value and in reducing the ash content, hence offering a sustainable solution to energy challenges in rural Nigeria. These findings support the development of locally sourced, high-efficiency biofuels from readily available crop residues.

Acknowledgment

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THE INFLUENCE OF FREQUENCY ANALYSIS ON THE OPTIMISATION OF PROCESSES IN LIVING ORGANISMS AND THUS ALSO IN AGRICULTURAL BUSINESSES

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Keywords: processes in living organisms, disease - health of plants and animals

"The influence of frequency analysis on profitability and optimisation of processes in selected agriculture production" is the subject of the doctoral thesis and the research topic. The aim is to optimise the processes in living organisms so that resources can be conserved, costs in agricultural production can be reduced and higher product quality can be achieved.

Living organisms are characterised by a sequence of processes. These processes need certain prerequisites in order to take place, such as minerals, trace elements and vitamins. Chemotrophic cells use the chemical energy of the compounds built up by photosynthesising cells (P.Christen etal, p.12). If these nutrients are not supplied, the organism begins to compensate. If it can no longer compensate, it builds up deficits that lead to disease. Each substance contains a certain amount of energy, which can increase during conversion (Hopp V., p. 26). These deficits cause a change in the environment (acidic) and certain pathogens accumulate there. Viruses, for example, are cell parasites without their own metabolism and use building blocks and energy from the cellular machinery, according to Christen in his work published in 2016 (p. 144). In addition, there are pollutants from the environment, food and water. This pathogen/pollutant environment now begins to weaken the organism's immune system. Rapid and comprehensive methods of analysis are needed to reactivate the blocked and impaired processes. Morphology, serological and molecular biological methods are standard methods for identifying pathogens (Börner, p.337). However, these methods are complex and time-consuming.

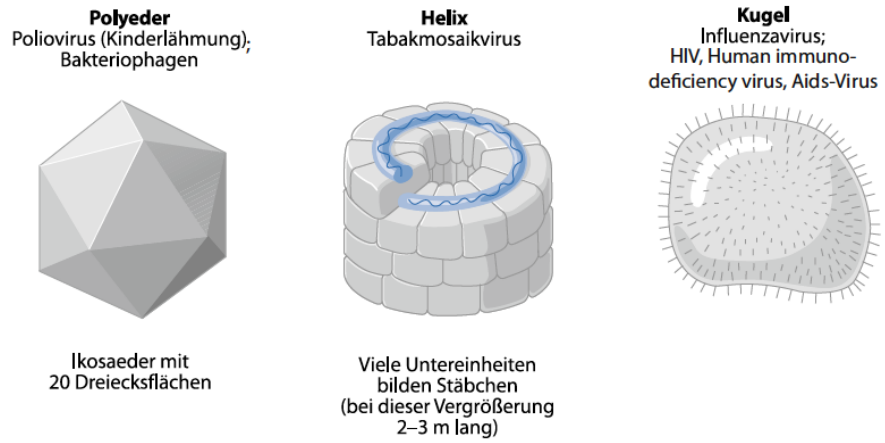

Fig. 1. Examples of a schematic structure of different viruses (Christen, p.144)

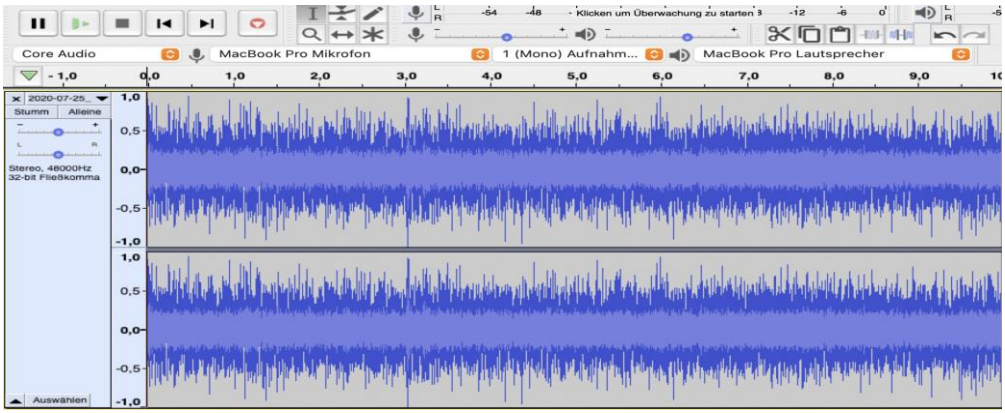

Fig. 2. Vibrational spectrum of Herpes Virus Type 6 - determined in a wine plant in root, leaf and stem

Vibrations and their partial frequencies, such as the one shown in Figure 2, are emitted by all objects, whether living or non-living. According to Bannwarth, the frequency is the inverse of the duration of an oscillation and defines how many oscillation cycles take place in 1 second. This is measured in Hertz (1 Hz = oscillation per second) (Bannwarth et al, p. 59). This means that the oscillations of pathogens and pollutants can also be determined, measured and subsequently neutralised. Frequency analysis makes use of this fact to identify and neutralise process-impeding and obstructing objects.

By restoring process capability in crops and livestock, the risk of disease is reduced, chemicals for symptom treatment become superfluous, which significantly increases product quality, reduces financial expenditure and simplifies work processes.

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Illustration:

Fig. 1. Christen P., Jaussi R., Benoit R. 2016. biochemistry and molecular biology. Springer Spektrum Verlag. Berlin-Heidelberg

Fig. 2. Dirk Osada. OSENUM Institute. 2019. own photo

USE OF GIANT HOGWEED LEAVES AS A SUBSTRATE FOR ANAEROBIC CO-DIGESTION

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Keywords: *Heracleum mantegazzianum*, invasive plant, biogas, bioreactor

Dense stands of Giant Hogweed (*Heracleum mantegazzianum* Sommier & Levier) in invaded areas produce large quantities of biomass. Mechanical eradication of plants (taking safety precautions due to furanocoumarin content) before seed dissemination is regarded as an effective method of management. Therefore, there is a potential for the use of resulting biomass for biotechnological applications as a lignocellulosic feedstock. This study aimed to determine whether biomass (leaves, which were sampled at the end of spring) is suitable for anaerobic co-digestion (with inoculum sampled from an operating large-scale biogas plant), performing a laboratory batch test. The experiment was carried out following the VDI 4630 [1]. Each of the bioreactors - sealed 2 L glass bottles was connected via silicone tubing to a bottle of distilled water and an empty bottle (Fig.1).

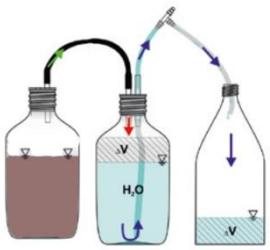

Fig. 1. Scheme of bioreactor and bottles connection setup. Source: [2]

The volume of produced biogas was measured using a liquid displacement method, and its composition was analysed using a portable gas monitor GeoTech Biogas 5000.

The results of the batch test demonstrated that the anaerobic co-digestion of Giant Hogweed biomass resulted in a yield of 39.09 L/kg of biogas and a yield of CH_4 18.4 L/kg (both for wet). CO content and H_2S content at the beginning of the process were quite high, but later gradually decreased. CO_2 content (also high at the beginning) clearly showed the process of the hydrolysis stage. Throughout the process, the pH level was monitored, and it was within a stable range in all bioreactors (this confirms that ammonia inhibition did not occur during the process).

The obtained data confirm the acceptable performance of invasive Giant Hogweed biomass during anaerobic co-digestion. The findings suggest that the substrate in the form of leaves is suitable for biogas production, with moderate biogas yields under the tested conditions.

Acknowledgment: This research was supported by the Internal Grant Agency of the Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague [grant number 20243101].

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MODIFICATION OF ADHESIVE USING FILLER FROM RECYCLED PUR FOAM

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Keywords: Bonded joint, recycling, recycled filler, ecological utilization, mechanical properties of the bonded joint

Objective of the Work

The main objective of the project is to gain knowledge about the ecological processing and subsequent utilization of polyurethane foam, particularly in the area of bonded joints (use as a binder).

The partial objectives are:

- To describe the mechanical properties of a modified adhesive or resin containing recycled polyurethane foam.
- To evaluate the effect of environmental degradation (UV radiation, temperature, humidity etc.) on the mechanical properties of the bonded joint.

Methods Used

To produce the modified adhesive, recycled PUR foam will be used, which will be shredded using a vertical grinder VM3. The honeycomb structure will then be printed using a Bambulab X-1 Carbon Combo 3D printer. Particle size analysis of the filler will be carried out using the Horiba LA-960V2 device, and the filler will be dried in a Memmert UN30. For homogenizing the adhesive, an LCD digital magnetic stirrer DLAB will be used. Degradation will be performed in a UV chamber, Q-SUN Xenon Test Chamber Model Xe-3-HS. The measurement period will last for four weeks, with samples taken every week and subjected to mechanical testing on a LabTest 5.50ST universal testing machine equipped with an AST KAF 50 kN load cell and Test&Motion

evaluation software. SEM analysis will be conducted using an electron microscope to capture images of the adhesive layer after mechanical testing.

Main Results

The outcome of the research will determine the optimal percentage of filler that can be added to the adhesive without compromising its mechanical properties. The result will be obtained from measurements on the LabTest 5.50ST device.

Conclusion and Significance

This research will contribute to expanding knowledge in the field of bonded joints and modified adhesives using recycled PUR foam as filler. The study will focus on observing changes in the mechanical properties of bonded joints (with both modified and unmodified adhesives) under controlled UV degradation. SEM analysis will then be used to evaluate the adhesive layer, and measurement results from the LabTest 5.50ST device will be compiled into graphs, which will subsequently be used in a scientific article.

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ADSORPTION STUDIES OF ACETYLATED HEMICELLULOSES ON MICROFIBRILLAR CELLULOSE

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Keywords: acetylation, hemicellulose, cellulose, adsorption

Polysaccharides such as hemicelluloses and cellulose are naturally occurring, relatively abundant, non-toxic, and economically beneficial biomaterials. These polysaccharides can be isolated from post-agricultural waste and food processing. They are amenable to a range of chemical modifications, producing biomaterials with specific properties. Among other applications, they are used in wastewater treatment, packaging production, or even biomedical device technologies [1,2].

Hemicelluloses in the plant cell wall can be acetylated, and the degree of acetylation depends on the plant species and even variety, organ and developmental stage [3]. Commonly, hemicelluloses from cell wall material are extracted with an alkaline medium that deacetylates them. However, it is possible to chemically acetylate hemicelluloses, obtaining a product with a specific degree of acetylation, and thus modifying its physicochemical properties. In the plant cell wall, hemicelluloses interact with cellulose microfibrils to form loops and coils on the surface of microfibrils and specific connections of microfibrils called biomechanical hotspots. On the other hand, there are still gaps in the literature on the effect of acetylation of hemicelluloses on interactions with cellulose. Among others, model systems in adsorption studies are being used to study the interactions between these polysaccharides.

The purpose of the study, was to demonstrate the effect of acetylation of selected hemicelluloses on adsorption on microfibrillar cellulose. A controlled acetylation of hemicelluloses was carried out, followed by

adsorption kinetics and equilibrium. It was shown that acetylation of hemicelluloses did not affect adsorption kinetics, while a low degree of acetylation of hemicelluloses influenced greater adsorption of glucomannan and xyloglucan.

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DESIGN AND DEVELOPMENT OF AN AUTOMATIC FAN CONTROL SYSTEM BASED ON ARDUINO USING PASSIVE INFRARED SENSOR AND DHT11

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Keywords: Arduino, Automation, DHT11 Sensor, Efficiency, PIR Sensor

Ambient temperature significantly influences user comfort in indoor environments. To maintain this comfort, develop of an automatic fan control system based on Arduino, utilizing a passive infrared receiver (PIR) and DHT11 sensors, was conducted. The methods employed of system design, testing, and data analysis. The measured results indicated that the system effectively detected user presence and adjusted the fan operation based on temperature and humidity levels. The comfort level improved notably, with measurements showing that the automatic fan usage can be used to maintain temperatures within a comfortable range. Energy usage analysis revealed a saving of up to 30% between automatic fan operation and no fan usage. This research concluded that the automatic fan control system not only enhanced user comfort but also provided higher energy efficiency in the operation of cooling devices.

Acknowledgments:

The synopsis of this scientific work is presented in a scientific exchanges joint event, as one of the partnership implementations between Institut Teknologi Nasional Bandung (Indonesia), Czech University of Life Sciences Prague (Czech Republic), Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra

(Slovakia), and Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary).

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DEVELOPMENT OF THE INK MADE OF LOW METHYL PECTIN FOR 3D PRINTING

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Keywords: 3D printing, pectin, bio-ink, fidelity

Biofabrication of plant-based bio ink by 3D printing is getting significant attention due to its sustainable approach. Pectin, an anionic heteropolysaccaride, is getting popular as a bio ink due to its shear-thinning and tunable rheological properties [1]. Although pectin shows great potential as bio ink, it is still unexplored to some extent.

Since low methyl (LM) pectin forms ionic gel in the presence of cations [2] this study reveals the printability of LM pectin with calcium chloride as a crosslinker. The galacturonic acid content of the commercial pectin is determined using a continuous flow analyser, and the nanostructure is examined by atomic force microscopy (AFM). Different formulations of bio inks have been prepared by varying the concentration of LM pectin and calcium chloride. The printability of each formulation is determined at three different pressures at one speed and compared. The printed lines and meshes were subjected to image analysis by digital camera and optical microscope. The uniformity of the printed lines was calculated using the uniformity factor equation with Python software [3]. The porosity porfactor and the perimeter coefficient of printed grids were evaluated, and the fidelity of each structure is compared using the statistical software itself.

It was shown that by varying the concentrations of both LM pectin and calcium chloride, it is possible print structures with different uniformity factor, porfactor as well as perimeter coefficient and to optimise the fidelity of 3D printed biomaterials from LM pectin.

Acknowledgements:

Current study was supported by the National Science Centre, Poland as a part of OPUS25 project (grant nr – 2023/49/B/NZ9/02979).

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MAPPING SCIENTIFIC TRENDS IN PYROLYSIS GASIFICATION: BIBLIOMETRIC REVIEW

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Keywords: pyrolysis gasification, bibliometric, VOSviewer, biochar, syngas, research trend

Pyrolysis gasification is a hybrid thermochemical process that converts biomass into syngas and value-added products through pyrolysis and subsequent gasification [1-2]. This method is gaining popularity due to rising concerns over sustainable energy and climate change [3]. Despite the increase in related publications, comprehensive thematic mapping is still limited. This article aims to address that gap through a bibliometric analysis using VOSviewer, which is effective in visualizing keyword co-occurrence, author networks, and thematic structures [4].

The analysis used Scopus-indexed publications (2005–2024) with keyword mapping conducted via VOSviewer. Figure 1 shows the keyword co-occurrence map, where node size reflects frequency, and colors indicate thematic clusters. The analysis revealed four main clusters: (1) green – solid product utilization (e.g., biochar, activated carbon); (2) red – environmental policy and waste management; (3) blue – thermal parameters and reactor studies; and (4) yellow – syngas and hydrogen production.

The trend reveals a shift from fundamental thermochemical exploration toward applications in clean energy and sustainability. The visualization emphasizes the interdisciplinary nature of pyrolysis gasification research.

In conclusion, this study provides a concise overview of current and emerging trends, offering a useful reference for future research planning and collaboration strategies.

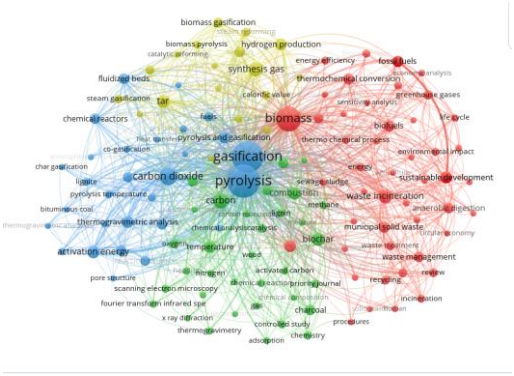

Fig. 1. Keyword co-occurrence network in pyrolysis gasification research (VOSviewer visualization).

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RESEARCH COLLABORATION IN THE SOLAR ENERGY FIELD: INSTITUTIONAL CHALLENGES

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Keywords: new and renewable energy, photovoltaic

Research in solar energy can be recognized as part of our awareness in support of utilization of the new and renewable energy. A further impact of our engagement in this research is protecting the environment.

Concerning the solar energy application, there are 2 (two) types of utilization, i.e., as an electricity generation (by the photovoltaic system) and as a producer of thermal energy (by the solar thermal system), or even as both electricity generation and producer of thermal energy (by the photovoltaic thermal system).

Related to research on the photovoltaic (PV) system, out of PV module materials topic, a focus can be emphasized on the electricity generation performance of the PV module/solar power plant (SPP) system, and SPP system application in supporting daily life/human needs. Research on the thematic PV has been carried out not only in the ITENAS Bandung (Indonesia), but also in the CZU Prague (Czech Republic), SUA Nitra (Slovakia), and MATE Godollo (Hungary).

Presently, some current research activities, for BSc & MSC students in ITENAS Bandung and our staff (as Doctoral students of the MATE Godollo campus), have been implemented, and can be summarized as follows [1]:

- Development of the PV and the Internet of Things (IoT) systems in the farming field;
- Development of the Organic Rankine System using solar energy (collaboration with MATE Godollo, Hungary);
- Development of the microprocessor and programmable logic controller (PLC) based prototype solar tracker system;
- Study, design, and realization of the agrivoltaics for a tropical climate;
- Thermal model of the existing PV module (collaboration with SUA Nitra, Slovakia);
- Optical model of the (existing) PV module;
- Study on the semi-transparent photovoltaic/STPV(collaboration with MATE Godollo, Hungary).

The research activity on solar energy at the ITENAS Bandung is addressed to the practical application, as at this moment, the study programs available are BSc (Bachelor) and MSc (Master). Wide and deep research, like in the CZU, SUA, and MATE is needed to increase wide scientific impact, and one of the solutions to reach there by establishing a Doctoral Program at the ITENAS, and it's possible to involve/invite a human and equipment resources of the partner universities, as part of our collaborations and partnership.

Acknowledgments:

The synopsis of this scientific work is presented in a scientific exchanges joint event, as one of the partnership implementations between Institut Teknologi Nasional Bandung (Indonesia), Czech University of Life Sciences Prague (Czech Republic), Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra (Slovakia), and Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary).

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PRODUCTION AND CHARACTERIZATION OF AMMONIA-MODIFIED CORNCOB AND RAPESEED POMACE BIOCHAR

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Keywords: Agricultural waste, biochar, biochar modification, physiochemical properties

With more than 140 billion metric tons of agricultural waste produced annually, managing it has become a crucial problem with both financial and environmental implications (Buam and Hussin, 2021). A sustainable alternative is to turn waste into biochar (BC), a substance that shows promise for a range of applications including soil regeneration, contaminant remediation and carbon sequestration (Zheng et al., 2023). However, this material can occasionally possessed inadequate physiochemical properties to suit its specific use (An et al., 2023). Therefore, this study was conducted to evaluate the physicochemical properties of biochar chemically modified with ammonium hydroxide, which gave the most satisfactory results during initial experiments.

The biochars were produced from corncob (CC) and rapeseed pomace (BR) at the temperature of 700 °C for 1 h, with a heating rate of 12 °C/min. To modify biochar, its mixture with ammonium hydroxide was prepared in the ratio of 1:2, after which the system was stirred with a magnetic stirrer at 60 °C. After 24 h, the mixture was washed with deionized water 3 times and dried in a vacuum chamber at 105 °C for 24 h.

The performed modification changed the surface functional groups of BC. In the FTIR spectra, the introduction of amine and nitro functional groups was observed. The basic functional group increased by 31.8% for CC and 25.4% for BR. In addition, the hydrophilicity of both biochars were enhanced

after modification. The modified biochars were characterized by the lowest dissolved organic carbon (DOC) release followed by the pristine biochars, and the highest from the biomasses. Both modified biochars demonstrated the best physiochemical properties, especially in the application of removing pollutants from the environment.

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OPTIMIZATION OF INDOOR ENVIRONMENT IN POULTRY FATTENING HALLS: INTERRELATIONS BETWEEN BUILDING DESIGN, VENTILATION, AND OPERATIONAL CONDITIONS

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Keywords: microclimate, ventilation, poultry welfare, passive measures, intensive farming

The quality of the indoor environment in halls for poultry fattening significantly affects not only animal welfare, but also production efficiency and the environmental impact of fattening. This work addresses an interdisciplinary approach to optimizing microclimatic conditions, emphasizing the interconnections between building design elements, technological equipment for ventilation and heating, and the dynamics of operational parameters during the fattening cycle. Discussed are the possibilities of using various ventilation systems and passive measures. The work summarizes findings from literature studies and ongoing research activities in real operational conditions. The goal is to support the development of sustainable and energy-efficient strategies for modern livestock production, respecting animal welfare and the requirements for indoor environmental quality.

THE WONDERS OF VISION: 3D, OPTICAL ILLUSIONS AND STEREOGRAMS

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Keywords: 3D vision, optical illusion, stereogram

At conferences, almost all participants present their research results, the most common for this is the Prezi/Powerpoint presentation. But we believe that among the important theoretical presentations, the fun and entertaining side of science should also be shown. This is why we started presenting experiments from different areas of biophysics, this year we plan to present optical experiments.

Our eyes are our most important sense organ, the eye collects most of the information. Despite the very sophisticated functioning of the eye, there are many tricks on how to make it "fool". Some experiments are related to the natural functioning of the eye. For example, the color perception of the eye is very relative. Changing the environment of an object can cause the sensation of a change in the color of the object. This fact allows for a wide range of images, and experiments have fooled our eyes.

Although our eyes are sensitive to the visible (380-780 nm wavelength range), very colorful experiments can be performed using neighboring frequencies, the infrared and UV ranges, and we hope to show some of them.

Many technical devices use optical methods for their operation. Some of these, which split the polarization of light, are demonstrated by experiments with polar filters. For example, the operation of LCD screens or 3D vision technologies will be shown.

But 3D vision is also possible without technical assistance. If you cannot see the 3D image of stereograms, we will try to teach you.

A stereogram, just for practicing ☺ (OK, it is easier in full page)

While natural light (e.g. sunlight) is of constant intensity, many of our artificial light sources vibrate, their intensity changing periodically over time. This can be distracting in some cases, but it's perfect for creating real-time optical illusions where your brain goes crazy, even though you know what you're seeing is impossible. We use a strobe with an adjustable frequency for this purpose.

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APPLICATION OF BUILDING PHYSICS IN BIOPHILIC ARCHITECTURE: ENHANCING ENVIRONMENTAL PERFORMANCE THROUGH NATURE-BASED DESIGN

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Keywords: biophilic architecture, building physics, indoor environmental quality, daylighting, thermal comfort

The implementation of biophilic architecture supported by building physics provides an evidence-based framework for optimizing indoor environmental quality while fostering a stronger human-nature connection in built environments. This study explores the physical performance of various biophilic design elements including green walls, water features, natural materials, and organic spatial layouts through simulation-based environmental analysis [1]. Parameters such as daylighting, thermal comfort, and natural ventilation were assessed using digital tools, bridging aesthetic intentions with quantitative building performance [2].

As a case study, a biophilic retrofit was analyzed in a co-working space located in the Dago area of Bandung, Indonesia a tropical highland city with moderate temperatures but high humidity levels. The building incorporates passive design strategies such as a green façade, internal courtyard, cross-ventilation corridors, and extensive use of natural light through skylights and clerestory windows [3]. Environmental simulations using Ladybug and OpenStudio revealed that the design reduced cooling energy demands by approximately 22%, increased useful daylight illuminance by 37%, and significantly improved thermal comfort based on adaptive thermal models [4], [5].

These results highlight the effectiveness of combining biophilic design with building physics to enhance environmental performance and occupant well-being [6], [7]. In tropical urban contexts such as Bandung, this integrated approach offers a replicable model for sustainable development that respects both ecological principles and climatic realities. The research contributes to a growing body of knowledge that supports a scientific, human-centered, and climate-responsive practice in contemporary architecture [8].

Acknowledgments:

The synopsis of this scientific work is presented in a scientific exchanges joint event, as one of the partnership implementations between Institut Teknologi Nasional Bandung (Indonesia), Czech University of Life Sciences Prague (Czech Republic), Institute of Agrophysics of the Polish Academy of Sciences (Poland), Slovak University of Agriculture in Nitra (Slovakia), and Hungarian University of Agriculture and Life Sciences, Gödöllő (Hungary).

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INTERCROPPING ENHANCES SOIL BACTERIAL ACTIVITY, ENZYME FUNCTIONS, AND FUNCTIONAL POTENTIAL IN DIVERSE CROPPING SYSTEMS

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Keywords: intercropping, sustainable agriculture, soil health

Modern agriculture depends heavily on chemical inputs and non-renewable energy resources, raising concerns about its harmful impact on environmental sustainability and human health. It prompted a shift towards more sustainable farming practices that harness ecological principles and ecosystem services. Intercropping, planting two or more crop species simultaneously in a field during a growing season, holds significant potential for improving cropping systems due to its ability to enhance biodiversity. However, its influence on soil microbial communities remains underexplored.

In this study, we conducted a detailed investigation into the effects of three distinct agricultural production systems on soil microbiome structure and function in a wheat-clover intercropping system. The experiment compared organic and integrated systems with and without intercropping against conventional wheat monocropping. The organic system included a diverse mix of wheat, red clover, and grasses, while the integrated system incorporated wheat and clover, thus differing in plant biodiversity. Soil samples were collected during the grain-filling stage to assess microbial activity using BIOLOG ECO plates (metabolic efficiency), enzymatic assays of five key soil enzymes: dehydrogenases, β-glucosidase, protease, urease, and acid & alkaline

phosphatases involved in carbon, nitrogen and phosphorus cycling, and the metataxonomic analysis was also conducted using 16S rDNA amplicon sequencing to assess bacterial community composition. The functional profile of the bacterial community was predicted using PICRUSt based on the KEGG pathway database.

Results indicated that intercropping, particularly in organic (OI) and integrated (II) systems, enhanced soil microbial activity and enzymatic functions compared to conventional monocropping (CM). OI and OM exhibited the highest carbon substrate utilization, especially for compounds like D-Xylose and N-Acetyl-D-Glucosamine, reflecting increased microbial diversity due to organic inputs and diverse root exudates. In contrast, CM showed the lowest utilization, indicating reduced microbial functionality. Enzymatic activities aligned with these trends: dehydrogenase activity peaked in OI, β-glucosidase in II (carbon cycling), and acid phosphatase in integrated systems (phosphorus mineralization), while protease activity declined from organic to conventional systems, suggesting diminished nitrogen cycling. Bacterial communities in intercropped systems were dominated by beneficial phyla such as Proteobacteria, Actinobacteria, and Acidobacteriota. Functional predictions revealed that II had the highest abundance of genes involved in key metabolic pathways, particularly amino acid and carbohydrate metabolism, essential for microbial growth, energy production, and nutrient cycling. Additionally, pathways related to cofactor, vitamin, terpenoid, and polyketide metabolism were more enriched, supporting microbial resilience and plant-microbe interactions. Genetic Information Processing pathways, another major KEGG class, were also enriched in II. These included functions related to replication and repair, protein folding, degradation, and translation, vital for maintaining genome integrity, stress adaptation, and microbial community stability. The dominance of these functions further highlights the role of intercropping and integrated systems in promoting a functionally capable microbiome, contributing to long-term soil health and agroecosystem sustainability.

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PUBLIC ADMINISTRATION ENTITIES AND THE CIRCULAR ECONOMY

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Keywords: Circular economy, production chain, strategic documents, circular economy, public

The article characterizes the differences between linear and circular economies. It presents strategic documents, action plans and legislative frameworks of the circular economy functioning. Using the example of regional cities, it presents specific aspects of waste processing and the overall transition to a circular economy in the studied public administration and economic entities, including agricultural and food systems. The issue of waste as a secondary raw material is relevant from the beginning, even when applying research in agriculture, biology or biological sciences.

Circular economy is presented as a theory and practice of a method of replacing linear production chains with cyclical ones, with the aim of minimizing waste generated during the chain, as well as at its end, as waste becomes a secondary raw material. The objective of the circular economy is to produce so-called zero waste, which represents a state where almost no waste is produced. Implementing a circular economy is a challenging task, because individual sectors of the economy and society, including science and research, have been set up for a linear economy. It is necessary to pay attention to this issue, as it is a significant innovative factor also in the field of science and research.

The article characterizes the differences between the linear and circular economy. It presents strategic documents, action plans and legislative frameworks of the circular economy functioning.

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LANDSCAPE IN MOTION: HOW MINING RESHAPED THE CZECH REPUBLIC OVER TWO CENTURIES

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Keywords: mining, landscape, reclamation, change dynamics, GIS

The Czech Republic faces a major environmental problem compared to neighbouring countries due to extensive opencast mining, especially of coal. Mining goes back a long way, specifically to the 13th century. Surface mining in the Czech Republic has profoundly altered the landscape, leading to significant environmental and social changes. There is no region in the Czech Republic that is not affected by mining.

The research question is to identify and analyse how the landscape has changed from 1842 to the present. Such large-scale studies covering sites across the country have not yet been carried out. As a result of the study, 60 randomly selected sites in 14 regions can be used to demonstrate how the landscapes at the sites of surface mining have evolved over time and what ecosystems they have been transformed into, using images from the 1850s, images from the 1950s and contemporary orthophotos of the Czech Republic.

Study examines the overall change in our valuable landscape in selected areas affected by mining across the Czech Republic. Current maps with historical imprints are analysed in ArcGIS PRO. The specific methodology and procedure are based on the application of advanced GIS functions to identify the area of individual change dynamics (recent, continuous, extinct), by using historical imperial obligatory imprints of stable cadastre and current aerial photographs.

By understanding the dynamic changes in the Czech landscape caused by mining, this research contributes to the development of more sustainable mining practices and environmental policies. The findings underscore the need

for effective reclamation strategies to mitigate long-term environmental damage and support sustainable development.

The work will contribute to the understanding of the dynamics of the evolution of the mining landscape. In addition to contributing to the improvement and updating of information of the mining landscape, the results of the project will also follow on current knowledge in landscape ecology. The results will be applicable, for example, in the fields of nature and landscape conservation and spatial planning, because if the principles of the dynamics of these landscape elements are known and the main propulsive forces that shape them, we can positively influence their current management.

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EVALUATION OF THE BIOCHEMICAL COMPOSITION OF MICROALGAL CELLS GROWING IN THE PRESENCE OF EXOPOLYMERS

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Keywords: extracellular polimeric substances, unicellular algae, plant metabolites

Green algae play a very important role in the environment because they affect the Earth's climate due to their ability to photosynthesize. Due to their ability to produce valuable metabolites, mainly fatty acids, they are perceived as organisms with high energy potential, and their biomass can be used, among others, in the production of biofuels [1].

The aim of the study was to investigate the influence of bacterial extracellular polymeric substances on the growth processes and metabolic profile of unicellular green algae.

Algae were cultivated in Erlenmeyer flasks in BG11 liquid medium and illuminated at 16 h light/ 8 h dark cycle. The parameters of growth kinetics analysed during algal growth were determined based on the optical density and biomass dry weight measurements. In order to analyse the influence of bacterial EPS on the process of metabolite synthesis, the microalgal biomass was subjected to spectrophotometric determination of carbohydrate content using the anthrone method, spectrophotometric determination of chlorophyll content, spectrophotometric determination of protein content using the Bradford method, and determination of lipid content by gravimetric method using the Bligh & Dyer extraction method.

The results indicated that the extracellular polymeric substances affected the growth and synthesis of metabolites by the microalgae. It was also shown that the amount of biomass and the quantitative composition of metabolites were dependent on the type and concentration of EPS in the algae culture.

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ISOLATION OF BACTERIAL DNA FROM MATERIAL COLLECTED DURING THE SOIL SPLASH PHENOMENON - PRELIMINARY STUDIES

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Keywords: soil, splash, drop impact, bacteria, DNA

The soil splash phenomenon, affected by the impact of raindrops, is a dynamic process resulting in the detachment and ejection of soil particles (Fig. 1) [1]. The effect of this phenomenon are for instance the loss of soil material, the breakdown of soil aggregates and surface deformation leading to changes of structure and infiltration parameters of soil. Though primarily studied as an initial stage of water erosion, splash could be also recognized for its role in transporting soil microorganisms. These microbes can be passively displaced alongside ejected soil particles or water droplets, contributing to the dispersal of entire microbial communities. The influence of splash extends beyond physical soil degradation to microbiological and agro-ecological implications, especially concerning the spread of pathogens and changes in microbial diversity [2].

The aim of this study was to present preliminary results regarding to isolation of bacterial DNA from material collected during the soil splash phenomenon including the methodological issues. Collecting and isolating splash-released material is crucial for investigating the mechanisms of microorganisms transportation through the soil splash. In this study, ejected material was captured on a filter membrane during water drop impacts on saturated soil samples (*Haplic Luvisol*). Bacterial DNA was subsequently extracted using the Qiagen DNeasy PowerMax Soil Kit following standardized protocols. Products of the research, in this case highly diluted DNA solutions,

were analyzed with fluorometric and PCR methods. The low biomass of collected material resulted in DNA concentrations below detection limits for fluorometry and insufficient for PCR, necessitating downstream DNA concentration steps aimed to recover amplifiable DNA from highly dilute splash-derived samples. The study presents a methodological basis for future splash-related microbiome transport research and supports the development of quantitative and qualitative tools for investigating this underexplored vector of microbial dispersal.

Fig. 1. Soil splash phenomenon affected by single drop impact with visible ejection of splashed material.

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INTEGRATED THERMO-STRUCTURAL EVALUATION OF ABSORBER TUBES FOR DIRECT STEAM GENERATION IN CYLINDRO-PARABOLIC TROUGH SOLAR COLLECTORS

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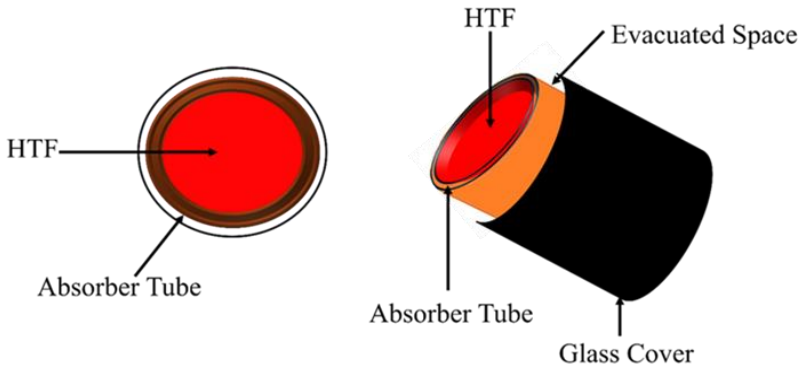
Keywords: solar collector, solar thermal energy, deflection, stress, strain

The absorber tube plays a crucial role in cylindro-parabolic trough solar collectors and for any solar thermal concentration (Touaref et al., 2025), with its bending significantly influencing receiver failures, as shown in the Fig. 1. A comprehensive review of existing commercial solar power plants indicates that 54.92% of failures result from glass envelope rupture, while 28.91% are due to annulus vacuum loss. This study examines absorber tube thermo-mechanics in steam generation using coupled thermal-hydraulic and structural models, solving flow via FVM and structure via FEM.



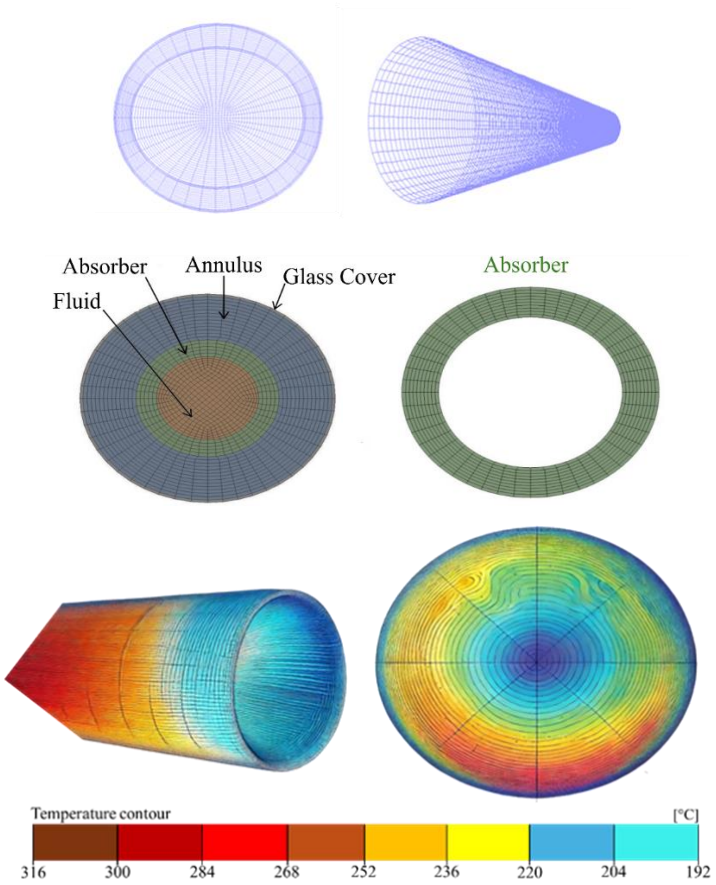


Fig. 1. Computational modelling and heat distribution of CPC absorber

Simulations have been performed for operating pressures of 60 bar and 100 bar, mass flow rates of 0.4 kg/s and 0.6 kg/s, and an irradiance of 750 W/m^2. The study analyses temperature gradients, deflection, strain, and stress distributions in the absorber wall. Findings reveal that using a copper-steel bimetallic absorber instead of a steel absorber reduces the temperature gradient by 50% and deflection by 41%. The maximum thermal strain is 6.268 mm/m for the steel absorber and 5.98 mm/m for the bimetallic absorber. Additionally, the peak equivalent stress observed is 31.1 MPa in the steel absorber, and 39.79 MPa in the bimetallic absorber. This research provides valuable insights into the thermo-structural performance of absorber tubes.

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HYBRID MICROFLUIDIC TISSUE-ON-A-CHIP DEVICE WITH 3D-PRINTED POROUS STRUCTURES FOR BBB AND TUMOR INTERACTION STUDIES

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Keywords: Microfluidics, Tissue-on-a-Chip, 3D nanoprinting, Porous structures, Photolithography, Blood-brain-barrier

The blood-brain-barrier (BBB) limits the effectiveness of drug delivery by blocking most compounds and drugs from entering the affectedtissue from bloodstream [1]. As animal models often poorly replicate human BBB function and intricacies, and are ethically challanging, Tissue-on-a-chip (ToC) systems are gaining traction [2]. These devices can offer accurate modeling of the tissue microenvironment, andwhen paired with 3D tumor spheroids, can be used in preclinical studies.

Fabrication of microfluidic devices with porous structures is of great importance in biological and medical research – mainly in cellular assays, cell transport studies or blood-tissue barrier formation (i. e. BBB). The most common forms of porous structuresused for ToC devices are: i) integrated porous membranes, ii) porous hydrogels or scaffolds, iii) micropillar arrays or iv) polymer scaffolds [3,4].

Purpose of this study is to fabricate ToCdevice by photolithography or hot-embossing processes in combination with innovative 3D nanoprinting of vertically aligned porous structures. This approach can facilitate cell-cell interaction analogical to porous membrane integration and enable real-time

observation and evaluation of cell-cell and cell-tumor interactions, BBB formation and transport of selected compounds or nanoparticles through BBB.

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RENEWABLE AND ALTERNATIVE ENERGY SOURCES FOR ORGANIC RANKINE CYCLE

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Keywords: renewable energy, solar energy, biomass energy, geothermal energy, waste heat recovery, ocean thermal

The growing global energy demand and environmental concerns necessitate the exploration of renewable and alternative energy sources. The potential of Organic Rankine Cycle (ORC) systems utilising various renewable sources, including solar, biomass, geothermal, waste heat recovery and ocean thermal, as shown in Fig. 1. The objective of this study is to analyse the thermodynamic performance, working fluid selection, and economic viability of integrating these energy sources with ORC technology.

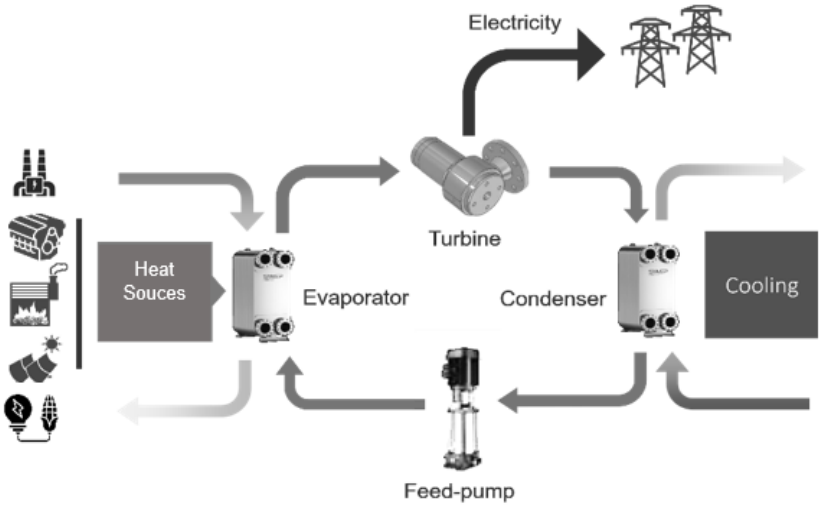

Fig. 1. Schematic layout of basic ORC with various heat sources, adapted from (Source: ecoprius.pl)

The selection of appropriate working fluids is crucial, with refrigerants such as R245fa and Iso-butane showing optimal performance in low-temperature heat source applications [1]. The analysis also reveals that hybrid energy integration enhances system reliability and efficiency [2]. The solar ORC systems benefit significantly from thermal energy storage, while biomass ORC systems are the second most common ORC application after geothermal, accounting for 11% of total installed capacity [3]. Geothermal ORC systems offer continuous power generation with operational temperature ranges of 60-300 °C, providing high thermal efficiency with low operation and maintenance costs [4]. Waste heat recovery ORC systems demonstrate economic viability due to the utilization of residual energy sources, with cement industries showing the highest waste heat potential of 40% [5]. Ocean thermal technology (OTEC) offers a sustainable, continuous, renewable power source in tropical regions, but challenges persist in infrastructure and efficiency optimization. The study consolidates key research findings and identifies future directions for improving ORC technology through advanced working fluid formulations and hybrid renewable energy integration.

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SPECIAL ENERGETIC ANALYSIS OF REFLECTED LIGHT FROM SOLAR CELL

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Keywords: solar surface, spectrum analysis, reflection

The use of solar modules is one of the most important renewable energy applications today, both from energy and environmental perspectives. The increase in popularity of solar applications is due to the favorable price resulting from mass production, the fact that the electricity generated by photovoltaic systems can be easily converted into any other form of energy and the solar cell technology still has many additional development opportunities [1]. The use of nano-coatings that meet special needs (anti-reflective, self-cleaning, polarization-reducing, spectrum-selective, etc.) offers many development possibilities, as well [2, 3].

The present work investigates the properties of light reflected from the surface of a solar module. Besides coating development, the study of reflection is also important, because the non-reflected part from the solar radiation can be utilized by the solar module. In this work, the optical properties (spectrum, intensity) of the reflected light are in focus, from which energetic results can also be determined. Fig. 1 shows the basic tools of the measurement.

Fig. 1. The examined solar module and the used spectrometer

The solar module is a 20 x 20 cm, 4 W_p, polycrystalline, without special coating. The spectrometer detects the number of photons of a given wavelength in the 340 - 1026 nm wavelength range with a step of 0.36 nm. The spectrometer is connected to a computer. The data can be recorded using the Oventure program.

During the measurements performed under artificial lighting, the light source (a conventional 40 W bulb) was at a constant distance of 20 cm from the horizontally positioned solar module, thus examining the dependence on the angle of incidence, while under natural lighting (sunlight), the spectra were recorded by rotating the solar module surface in clear weather with constant solar radiation.

The results obtained with the help of spectrum analysis are detailed in the presentation. The results can be used as a basis for the development of coatings designed for the surface of solar modules.

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CELL AS A FACTORY: CAN WORKERS IN THE RIGHT POSITIONS AND ENVIRONMENT ENSURE MAXIMUM OUTPUT?

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Keywords: fluorescence, antibody, molecular pharming, Nicotiana benthamiana

This project aims to enhance transient antibody production in *Nicotiana benthamiana* by integrating subcellular targeting with the coexpression of helper proteins, including chaperones, protease inhibitors, and transcription factors. By directing both antibodies and helper proteins to specific compartments, such as the endoplasmic reticulum and vacuole, we seek to maximize production yields while ensuring proper assembly and stability. A key focus of this study is the synergistic effect of coexpressing helper proteins with antibody constructs. Chaperones will promote correct folding and assembly, preserving antibody functionality, while protease inhibitors will prevent degradation, extending stability and half-life. Additionally, transcription factors will modulate the (sub)cellular environment to enhance gene expression and optimize conditions for recombinant protein production and deposition.

A critical part of the experimental workflow will be the quantification of antibody accumulation using fluorescence measurements of fluorescent timers—fluorescent proteins that change their emission spectrum over time. This dynamic shift in fluorescence allows for more detailed temporal analysis of protein expression from a single measurement. Furthermore, these fluorescent timers can be effectively utilized in microscopy to visualize spatial and temporal patterns of antibody localization and deposition in planta.

By integrating these strategies, this research aims to establish an efficient and scalable platform for high-yield antibody production. The main approach will be microscopic observation of changes in the cellular microenvironment and the dynamics of antibody deposition. The findings will have significant implications for biopharmaceutical manufacturing, advancing applications in diagnostics, therapeutics, and fundamental biological research.

IMPACT OF PARTICLE SHAPE IN BULK MEDIA ON PRE-PROCESSING IN AGRICULTURE AND FORESTRY

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Keywords: seeds, shape, pre-processing, discrete element method, numerical modelling

The shape of particles in bulk media plays a crucial role in determining the efficiency and effectiveness of various processing operations in agriculture and forestry. During the pre-processing phase, particle shape influences critical operations such as sorting, cleaning, grinding, and drying, as well as the filling and discharge of storage bins or components of agricultural machinery, affecting the overall quality and ease of handling.

The goal of this study was to analyze the effect of particle shape on the silo discharge mechanics of bulk plant-based materials from a flat-bottomed cylindrical silo. Numerical simulations of the central discharge of material were performed using the discrete element method (DEM) [1] for monodisperse particle beds with spherical shapes, dimers with varying aspect ratios (Ar=1-1.6), and polyhedral particles with number of faces (n) of 6, 8, 20 and 80 (Fig.1). The particles were generated inside the model silo with a diameter of 150 mm and a height of 450 mm and subsequently discharged through a centrally located circular orifice with a diameter ranging from 4.71 to 10.08 particle mean diameter. The 3D DEM simulations were performed using the Hertz-Mindlin elastic contact model.

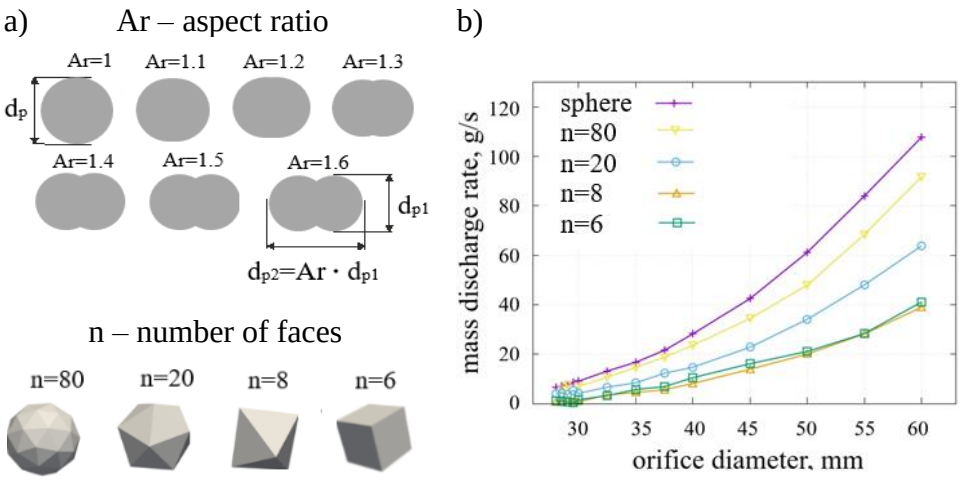

Fig. 1. Particles used for DEM simulations (a) and mass discharge rates for various orifice size and particle shape (b).

The particle shape was found to affect, among other factors, bulk density, distribution of particle velocities, and mass discharge rate. The highest mass discharge rates were obtained for spheres due to their smooth, rounded surfaces which minimize friction and interlocking, facilitating smoother and more consistent flow. The velocity profiles have shown the widest flame-like area of particles with increased velocity in the sphere bedding. This area became smaller as the particle shape approached that of a hexahedron (Fig.2).

By examining the behavior of different materials in bulk media, we aimed to highlight the significance of particle shape in optimizing both the pre-production processes and the large-scale industrial operations in these sectors. The findings presented offered insights into how particle morphology could be leveraged to enhance production efficiency, material handling, and the development of high-quality agricultural and forestry products.

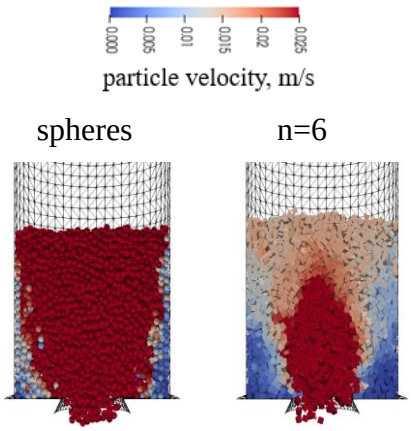

Fig. 2. Profiles of particle vertical velocities for spheres and hexahedrons.

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SELECTION OF PREBIOTIC SUPPLEMENTS FOR A BIOPREPARATION AGAINST BULL'S EYE ROT

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Keywords: Bull's Eye Rot, apples, prebiotic supplements, biocontrol, biopreparation

Biopreparations based on antagonistic microorganisms are becoming increasingly important in agriculture, especially in plant protection against fungal diseases. In response to the need to develop an effective and ecological protection agent against Bull's Eye Rot (BER) caused by fungi of the genus *Neofabraea* sp. (syn. *Phlyctema, Pezicula*), strains with antagonistic properties against the pathogen were selected. Selected isolates of *Bacillus velezensis* B134/22, B233/22, B267/22 and *Trichoderma koningiopsis* G779/22 obtained from the soil under apple trees are the active component of the biopreparation consortium.

The aim of the study was to conduct phenotypic analyses based on the Biolog™ system to qualitatively screen for the potential prebiotic supplements constituting a component of the biopreparation that are intended to enhance its effect and increase the biomass of selected *Bacillus velezensis* and *Trichoderma koningiopsis* isolates.

The studies assessed the level of utilization of carbon and nitrogen substrates located on PM1, PM3B, and PM5 plates (containing a group of potential supplements), as well as GENIII and FF, by the strains suggested as components of the biopreparation consortium, as well as isolates of the *Neofabraea* sp. representatives.

Xylose and ribose 1% addition was selected as targeted prebiotic supplements. These substrates showed a significant positive effect on the

strains from the consortium (increasing the concentration of microorganisms three times for *B. velezensis* B134/22, six times for *B. velezensis* B233/22, even by three orders of magnitude of CFU for *B. velezensis* B267/22 and no effect on a 80% of the representative group of 20 isolates of *Neofabraea* genus.

These findings highlight the potential of targeted prebiotic supplementation to enhance the effectiveness of biopreparations. The selective stimulation of beneficial microorganisms without promoting the growth of the pathogen supports the development of a more efficient and sustainable biological control strategy against Bull's Eye Rot. Further research will focus on formulation and field application to confirm the practical utility of the proposed consortium and supplements.

Acknowledgements:

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THE MOST FREQUENT FAILURES DURING THE PV POWER PLANT OPERATION

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Keywords: photovoltaics, inverter, PV panels, service expenses

The PV panels manufacturers usually declare the lifetime 25÷30 years. We monitor many PV power plants and the results show that the real lifespan is usually around 12 years in central Europe and even less in countries with extreme climatic conditions. After about 10 years, various types of malfunctions appear and their frequency increases rapidly. Here we present data from two selected PV power plants in the Czech Republic as an example.

During the operation of the power plants, we monitored the gradual degradation of PV panels and some results were already in the mentioned work [1]. For example, Fig. 1 shows the formation of a conductive channel between the electrode and the grounded frame of the PV panel, where there is a high probability of short-circuit currents that can destroy not only the PV panel but also other power plant equipment such as the inverter. Fig. 2 shows how the number of damaged inverters rises rapidly after about 10 years of operation. For better comparison, the number of inverters is given as a percentage of the total number of inverters in the power plant. The expenses for replacement of damaged inverters are shown as well. The total nominal power of the power plants is written in the figure.

These both PV power plants have been operating for more than 10 years. Both the selected PV power plants are equipped with PV panels based on crystalline silicon. PV panels are installed on fixed stands facing south with an inclination of 35°. The new information could be helpful for owners of PV power plants to get a more realistic estimation of profits.

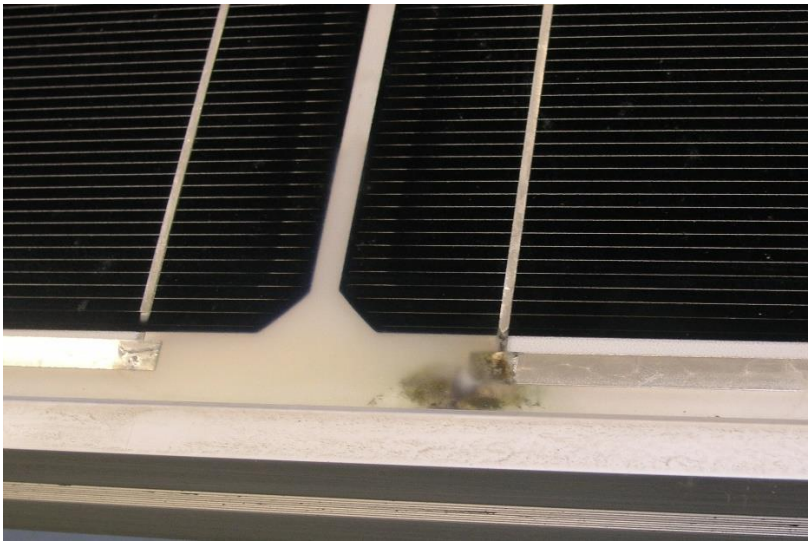

Fig. 1. The conductive channel between the electrode and the grounded frame of the PV panel.

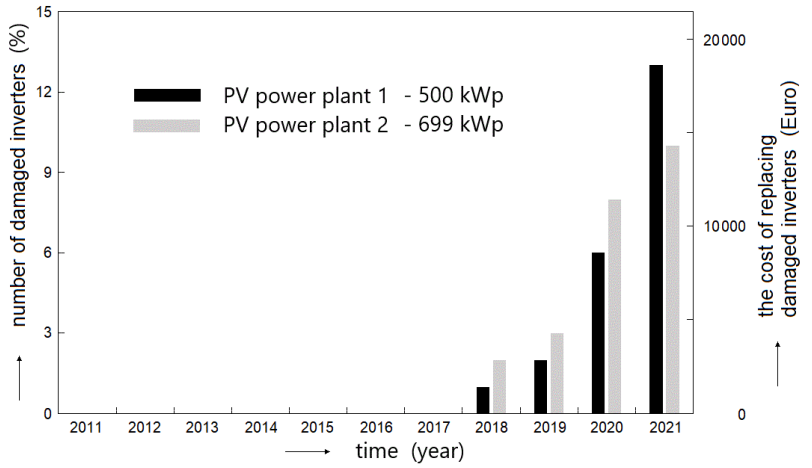

Fig. 2. The number of damaged inverters in the case of two selected PV power plants.

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EFFECT OF BAFFLE ON THE PERFORMANCE OF SOLAR AIR COLLECTORS

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Keywords: COMSOL software, thermal efficiency, longitudinal baffles, simulation

In solar air collectors, baffles play a crucial role by inducing airflow disturbance, prolonging the flow path, and promoting more uniform temperature distribution. The presence of baffles enhances turbulence and heat transfer, thereby improving the overall thermal efficiency of the system [1, 2]. This study aims to investigate the impact of different baffle quantities (2 baffles, 4 baffles, and 6 baffles) on the thermal efficiency of a solar air collector through simulations conducted using COMSOL software. The structure of the solar air collector is shown in Fig. 1.

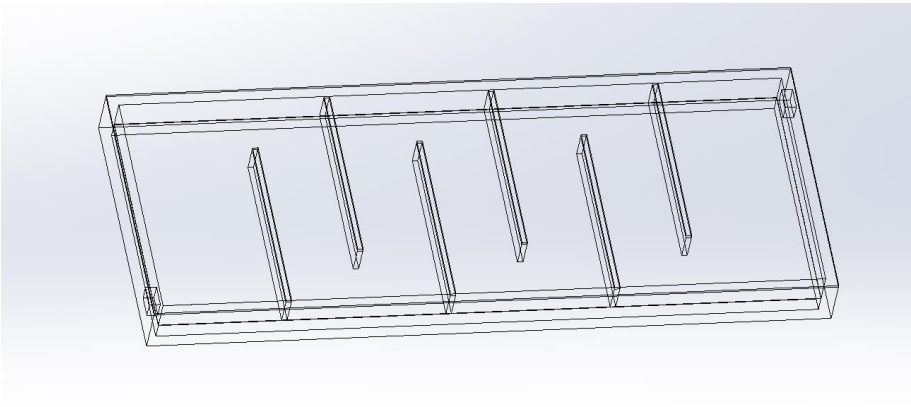

Fig. 1. Schematic diagram of a solar air collector

The solar air collector is composed of a glass cover, insulation layer, wooden frame, wooden baffles, and an absorber plate. The modeling and

meshing processes were carried out using COMSOL software. Based on the calculated Reynolds number, the operation of the solar air heater falls within the laminar flow regime. A steady-state simulation was employed, with the physical field configured as heat transfer in solids and fluids.

The initial and boundary conditions were defined for the simulation, and the corresponding results were obtained. The simulation results show that solar air heaters with different numbers of baffles exhibit varying outlet temperatures. As the number of baffles increases, the outlet temperature rises. The simulation results of this study show a certain degree of similarity with those reported in previous literature [3].

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