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One Health approach

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Abstracts of plenary lectures

One World, One Water Cycle, One Health: Examples how to tackle this global challenge

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Abstract

The presentation highlights the intertwined relationships in global context between seemingly independent processes such as migration, water resources availability and management, social equity, population growth, food security and climate change.

Climate change is generally regarded as the overwhelming challenge of our days. While the ongoing processes are undeniable and not without frightening perspectives it has to be acknowledged that climate change, but also human migration were and are recurring phenomena in Earth's history. The most recent, Holocene climate period which enabled the unprecedented development of our civilization and potentially high level of human well-being is rather a couple of thousand years long climate anomaly than the sustainable global standard of the Earth's otherwise naturally changing climate.

It is argued that climate change is one, albeit serious component, of a set of even more urgent global challenges (the "P" problems), notably population dynamics, poverty and pollution. In this context one may identify climate change predominantly as the thermal pollution of the atmosphere with the predicted severe societal and natural consequences.

The fact that the world lacks an effective global governance system which would be needed to adequately coordinate and develop compassion and partnership-based solutions remedying not only climate change, but global inequalities and rectifying trends of sustained or even increasing problems affecting hundreds of million people worldwide further accentuates the problems we are facing. As consequence of the global failure addressing these, in most of the cases very much water-related challenges implies that roughly one third of humanity live under conditions contradicting principles and requirements of human dignity, thus denying their access to services and livelihood commensurate with the justified expectations of the 21st century.

Beyond its own importance water resources management and the respective dedicated water goal (SDG No. 6) are considered as important basis of the whole development agenda, However, a recent UN Water assessment (based on the usually very optimistic self-reporting of UN member states), revealed an alarming delay in the implementation of SDG No.6. It is likely that the agreed upon targets won't be achieved by 2030.

The disturbing global status quo: Poverty, Inequity *(water relevance)*: how can the SDGs address it?

- **1 Billion Subsistence Farmers** *(irrigation & drainage)*
- **1 Billion Undernurished People** *(irrigation & drainage)*
- **2 Billion People with Dietary Deficiencies** *(water and food security)*
- **1 Billion Slum Dwellers*** *(water hygiene & water-borne diseases)*
- **1 (2) Billion People without Access to Safe Drinking Water** *(water supply)*
- **2 (4) Billion People without Adequate Sanitation** *(canalisation & waste water treatment)*
- **1 Billion People without Access to Electricity** *(hydropower, cooling water)*

Even with obvious „multiple counting" this implies that at least one third of humanity is excluded from „development".

***60% of urban population in Africa belongs to this category /DFID 2015/**

( ) Numbers mentioned by J. Áder during the Budapest Water Summit

No doubt that fulfilling social expectations associated with water and its management involves engineering interventions with profound, potentially negative consequences for biodiversity and other natural processes. It could even lead to tensions between states sharing the respective resource base. Yet, there is an obvious positive relationship between the state of societal development and human wellbeing and the available water storage capacity of the respective country or region. While North Americans can rely on 6150 m^3 storage capacity per capita to assure their water security, in the even more variable climate of South Africa this value is only 746 m^3/capita. In Ethiopia, even after commissioning the Great Ethiopian Renaissance Dam (GERD) the storage space for every inhabitant of the country would not exceed 630 m^3. Even this modest improvement from the original 43 m^3/capita causes considerable tensions with Egypt, the most water-dependent downstream country.

Reservoir capacity per capita in various countries. GERD will increase it to 630m^3 in Ethiopia

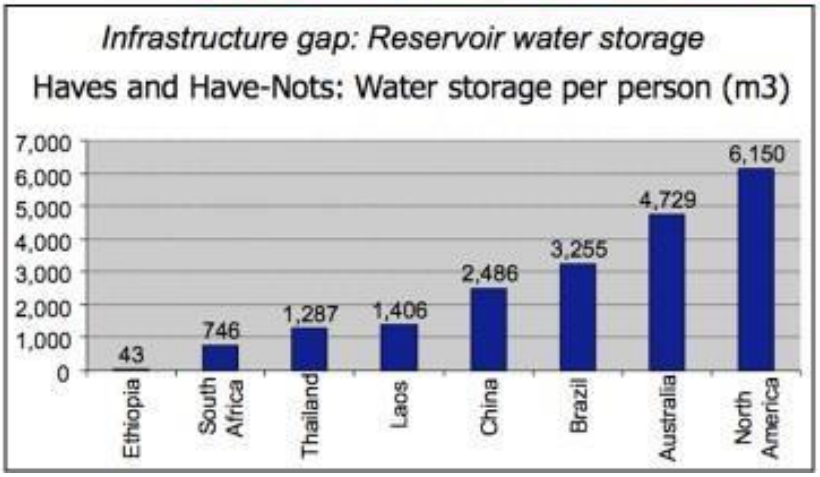
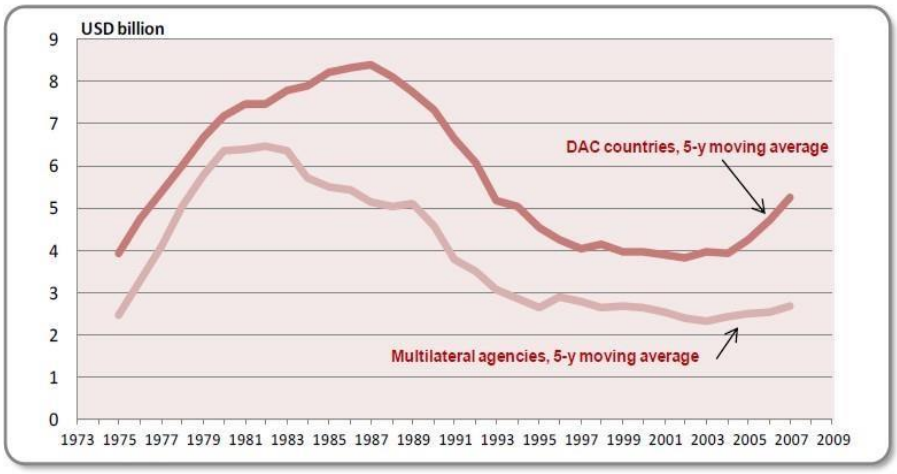


Chart 1. Trends in aid to agriculture and rural development (ARD)

1971-2009, 5-year moving average commitments, constant 2009 prices



Beyond providing better water security to meet increasing societal water demands reservoir capacity increases will be inevitable to cope with the consequences of climate change (longer droughts and increasing magnitude of floods). In light of this challenges the well-intended, but short-sighted interventions of environmental NGO's in the Global North created more harm than good. They achieved by the late 1980s that donor organizations and countries drastically curtailed their aid for rural development. This had negative consequences for irrigation projects and especially dam building. While this trend since 2005 is gradually reversed, considerable damage was done. Two decades of ill-advised development and practice of aid policy contributed in developing countries to an unregulated rural exodus, mushrooming informal urban settlements, transboundary migration and prolonged use of fossil energy sources without achieving substantial success in achieving the NGO's (certainly noble) environmental objectives.

This global analysis is then illustrated on the example of Southern Africa, a region including 8 countries, among them the Republic of South Africa with its already well-developed water resources management. Irrespective of the availability of over 500 reservoirs in that country, among them 8 over the storage capacity of 1 billion m^3 and elaborate interbasin transfer facilities, the country faces enormous challenges to feed its increasing population. The already import-dependent food supply will be further challenged as the negative effects of climate change would unfold during the ongoing century. This would necessitate to further develop water resources infrastructure, though the scarcity of water resources and adequate dam sites sets strict limits to this option in the region. While potential irrigable land may be found in the Zambezi basin bringing the water to the fields remain an important engineering challenge. Transboundary solutions would need long-term, trust based cooperation among the countries of the region. Land tenure and social acceptance, as well as funding and political stability are further issues to be addressed. Existing mega reservoirs like the Kariba and Cahora Bassa dams on the Zambezi river may need renegotiated operational and water allocation policies replacing the present single purpose (hydropower generation) operational mode. Even if all obstacles are successfully removed, it is estimated that the irrigated area in the region cannot be increased more than approximately 50%.

Exploring the Interplay of Microbiome, Proteome, and Animal Health

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Abstract

In intensive livestock and poultry production systems, animals undergo heightened stress levels, a phenomenon often manifested in the emergence of dysbiotic microbiota. Noteworthy characteristics of these microbial communities include a reduction in diversity, as an example. Dysbiosis culminates in chronic inflammation, thereby rendering animals more susceptible to infections.

The incorporation of plant extracts replete with bioactive compounds has demonstrated the capacity to enhance microbiota resilience. The University of Debrecen possesses an innovation that transforms food waste into nutrient-rich supplements infused with natural, biologically active constituents, thus championing circular food systems and engendering the creation of safer, value-added products.

In collaborative synergy with livestock breeders, our research delved into the impact of nutraceutical-enriched feed, derived from this innovation. Our results revealed that animals fed with the phytonutrient-enriched diets exhibited improved feed conversion rates, enhanced immune parameters, and significantly modulated intestinal microbiota. The poultry's gut microbiota holds a crucial role in maintaining intestinal health by influencing the host's physiological functions necessary for gut balance and well-being. This is achieved through the microbiota's capacity to competitively exclude harmful microorganisms and pathogens, thereby preventing their colonization. This process also reduces the energy expenditure that birds typically invest in maintaining an active immune response against these pathogens. Consequently, a healthier gut microbiota leads to energy conservation, which in turn can enhance the overall productive performance of the birds.

Our investigation aimed to assess whether variations in initial gut microbiota composition could influence livestock growth. By identifying community members exhibiting robust correlations with weight gain, we profiled and quantified their prevalence. Lactic acid bacteria consistently displayed negative correlations with farming animals' body weight, independent of treatment parameters and bird age, despite the absence of statistically significant body weight reduction. This trend might stem from the high efficacy and resilience inherent in intensive rearing systems.

Microbial networks exhibit remarkable orderliness, although their intricate nature posed significant challenges in the absence of suitable investigative tools. However, the advent of artificial intelligence has facilitated in a transformative paradigm shift in predictive possibilities. Random and scale-free biological networks are two types of network structures commonly used to model interactions among species in ecological or biological systems. The concept of keystone species is often associated with these networks, but the way keystone species operate within each type of network can be different. Based on our data, control group microbiomes typically represent scale-free networks having a few highly connected nodes (species) that act as hubs, while most other nodes have only a few connections.

Phytonutrient treated samples represent scale-free networks, a small number of species (keystone species) having a disproportionately large impact on the entire network's structure and function. These species serve as critical connectors between different parts of the network. Removing a keystone species from a scale-free network can result in cascading effects that disproportionately affect other species and the overall network's stability.

At the UD we have developed a service portfolio tailored for the comprehensive assessment of the gut microbiome health in livestock, specifically focusing on poultry. Through our service, we aim to provide actionable insights into the interplay between the gut microbiome and livestock health. By identifying microbial signatures associated with disease resistance, susceptibility, and growth promotion, we empower animal husbandry practices to optimize health, productivity, and overall well-being. We analyze the prevalence of microbes responsible for metabolic processes, including carbohydrate and lipid metabolism, amino acid metabolism, and synthesis of essential vitamins.

Microbiome research is highly relevant to addressing the risks posed by the presence of antibiotic residues and the associated health issues, while also offering potential solutions for improvement. The presence of antibiotic residues in the gastrointestinal tract can create an environment conducive to the emergence of antibiotic-resistant bacterial strains. Excessive antibiotic usage can disrupt the balance of the natural gut flora, favouring the growth of resistant bacterial strains over susceptible ones. This contributes to the spread of antibiotic resistance and the narrowing of effective treatment options.

Our investigations are centered on scrutinizing the resistomes of livestock and farm environments, and the significance of this research is underscored by its implications for public health, animal welfare, and the preservation of effective antibiotic therapies. By focusing on the resistomes of production animals and their housing environments, we gain insights into the dissemination and emergence of antibiotic resistance, thereby enabling informed strategies for mitigating its adverse effects.

Based on our research findings, it is evident that the overlap between resistance developed against antibiotics used in human medicine and resistance carried by microorganisms present in the environment is noticeably smaller compared to when comparing resistances between farm animals and their surroundings. This disparity can be attributed to the higher contribution of resistance dissemination associated with antibiotics employed in meat production.

Microbiome play vital roles in the overall homeostasis and health of the host by contributing to the host nutrition, rumen physiology immune system etc. Contrastingly, ‘macro-biota’ are the parasitic helminths, which are harmful to the survival of the host animals. Recent research on these has found that they live in complex mutualism, albeit in a delicate balance, usually along the gastrointestinal system of the host animals. There are already research on the “meta” microbiome inside the gut of the parasite itself, such as in *Haemonchus contortus* and its gut microbiome. Usually, the helminthic parasites and bacteria dwell in the same environmental niche and parasitic infections are well known to alter intestinal physiology, membrane permeability, mucous secretion and the secretion of antimicrobial peptides. The impact of gastrointestinal parasites infections on populations the microbiota mainly depends on the host animal and the infecting parasite species, resulting in varying findings. A detailed analysis using advance techniques such as high-throughput screening, shotgun metagenomic screening etc. of the nematode microbiota can be exploited for a next generation tool for a selective treatment of the parasites.

Proteomics facilitates the characterization of proteins expressed in specific tissues and organisms. The protein–protein interfaces during the host–parasite interaction could give certain alterations and modifications in of protein expression. Thorough examination and subsequent identification of such alterations in host protein profiles during infection could facilitate the understanding of disease and its progression. The main idea being that the evaluation of antigens and/or specific parasite proteins could yield an accurate immunodiagnostic technique. To do this, the most popular tool is the mass spectrometry (MS)-based proteomics. Under pre-determined criteria, the MS technique can give results on protein identification, quantification, protein dynamics ultimately creating useful information related to host invasion, parasite survival, host immune evasion and immunoregulation. The matrix-assisted laser desorption ionisation time-of-flight (MALDI-TOF) is an MS based technique already applied for differential diagnosis of *Entamoeba* spp or *Babesia canis canis* infections. The main target of the proteomics can be broadly discussed as "Secretome": proteins actively released from the nematode gut or the cuticular surface (for example, C-type lectins and transthyretin-like proteins during *H. contortus* infection); the "Extracellular Vesicles": other parasite-derived extracellular components (for example: heat shock proteins and metallopeptidase in *Ascaris suum, Trichuris muris* etc infection); and the "Somatic Proteome": entire protein component of the various life cycle stages of the parasite. This technique could offer a comprehensive tool for parasite diagnosis, prognosis and vaccine target studies. However, there is still a long way to go to achieve this and more research and study is warranted, including complementary "multi-omics approach".

Parasitic nematodes of livestock have a major economic impact worldwide. Despite the huge economical losses, only a limited attention has been paid to develop practical methods of diagnosis. Current diagnoses can be categorized as conventional technique (copro-microscopy) and nucleic acid amplification/molecular based technique. The conventional tool is becoming outdated as they are laborious, require expert skills and difficulty in differentiating morphological features in eggs by simple microscopy. To compensate, many molecular based techniques have been developed out of which the PCR based techniques are still the gold standard with its advantages and disadvantages. A promising approach is the isothermal amplification (IA) technique whereby the exponential amplification of the target DNA template is obtained under a constant temperature. The result is faster end-result time, basic heating element and hence efficient for point of care diagnostics. Out of the many, the most popular IA techniques are the loop-mediated isothermal amplification (LAMP) and recombinase polymerase amplification (RPA) techniques. We developed roboust, low-cost on-farm specific assays using these two techniques based on colourimetric and fluorescence detection.

Plant memory and its exploitation possibilities for innovative strategies for growing healthy plants

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Abstract

When thinking about how plants can be intelligent, or if they can be intelligent at all, can learn, or have memory functions, then we must consider, that plants do not have neural structures or nervous system, they are sessile organism with limited movement in space, i.e. they are not able to run away from the surroundings and change their locations when the environment becomes harmful. Nevertheless, in order to survive, they must respond to environmental stresses in a changing environment. This is particularly important amidst the sudden, unexpected environmental changes caused by climate change, but also in developing new plant production strategies. Four questions are attempted to answer based on the latest epigenetic and transcriptomic research. (1) How can a plant remember? (2) How long does plant's memory last? (3) Why is memory important for a plant; in terms of acclimation, adaptation and evolution?, and (4) How can we use it to develop new plant breeding and cultivation strategies, especially under challenges of climate change?

Latest research revealed that plants are able to learn, communicate, make decisions, and modify their behavior accordingly. As for the ability of plants to learn, this seems surprising only until we consider the exact definition of learning. Learning is a lasting and adaptive change in a system or its controlled sub-system as a result of the interaction with the environment. A prerequisite for learning is a precise memory, i.e. the ability of the living organism to store, retain and retrieve information based on acquired experience. When a stimulus hits the plant, and plant is able for its recognition and perception, the plant will respond to it. But meantime it also starts to build a memory about the stimulus. The plant memory is based on cellular, biochemical, and molecular networks and their cooperative functioning. The types of plant memory can be defined on the basis of its molecular mechanism, heritability, and duration (Figure 1). While *trans* memory mainly means that the concentration of diffusible signals (f.e transcription factors or other compounds) transmitted by cytosolic partitioning or feedback loops changes, *cis* memory is based on chemical changes on the chromatin. Chemical changes on the chromatin, such as changes in the methylation of DNA at cytosine or adenine sites, modifications in the acetylation, phosphorylation, methylation or ubiquitination of the histone, belong to the epigenetic modifications, just like RNA-directed modifications directed by non-coding RNAs. They can participate in the development of short-term, long-term and heritable memory, as well.

Intragenerational or somatic memory is known for a long time, lasts life-long or a part of life of the individual and is maintained by mitosis. A well-known example of this is the seed priming. Ultrasonication of seeds caused DNA hypomethylation in the seedlings leading to altered gene transcription and growth response. Epigenetic mechanisms are responsible for transmitting information across generations (inter-, or transgenerational memory). Vernalization, i.e. the memory of winter, is also based on epigenetic memory, which is meiotically stable during female gamete formation. One of the key steps of vernalization is the epigenetic silencing of FLC (Flowering Locus C) encoding a repressor of flowering and it is related to histone deacetylation, histone 3 subunit methylation (H3K27; H3K4) and functioning of lncRNA (COLDAIR).

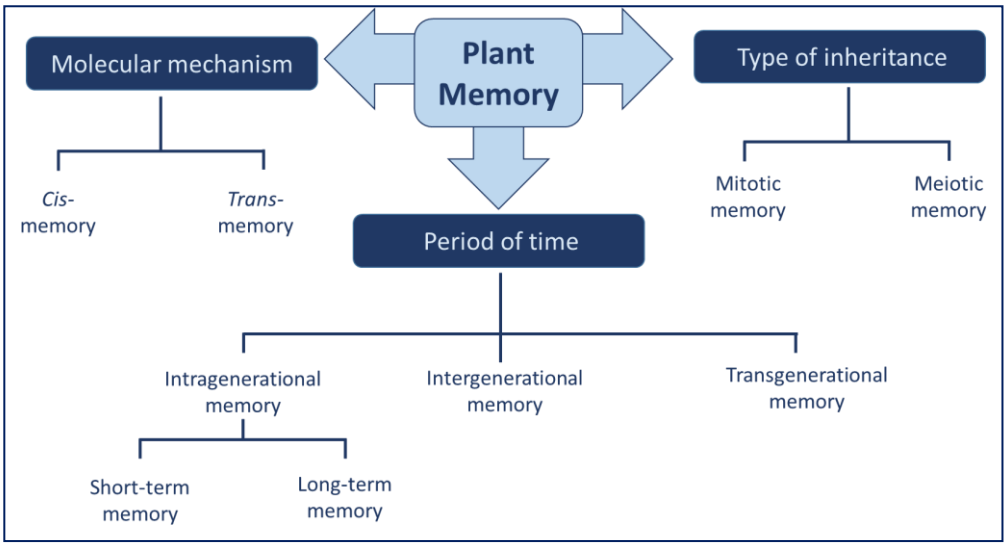

Figure 1. Types of plant memory

Plant memory plays role in the plant-to-plant and plant-to-environment communications and ensures survival and the overcoming of environmental abiotic and biotic stresses (acclimation), as well. Since, plants are able to memorize the warning signal of impending attack via histone modification or altering DNA methylation, by receiving miRNAs or VOCs from the environment. However, acquired traits can persist for several generations, i.e. acquired traits can be inherited. Heritable memory is often based on epiallels that are regions of the genome that differ in their epigenetic state, mainly DNA methylation, and are stably inherited into subsequent generations. They occur in nature and can also be induced experimentally. The frequency of their occurrence is 5 orders of magnitude higher than that of a mutant allele, which enables faster adaptation to the changing environment. They are subject to selection pressure just like any allele and thereby inherited epigenetic changes can become adaptive, and allow a population to respond to environmental changes even if in the absence of genetic variation. Epigenetic mutations have evolutionary effect, and able to affect the tempo and the outcome of adaptation.

Climate change with frequent, sudden and severe environmental stresses requires engineering flexible crop varieties having increased stress resilience that are prepared to be more responsive to occurring or reoccurring stresses of the environment, within or across the generations and that can be produced relatively quickly. A solution to ensure the safe crop production and food security is the exploitation of the plant memory for agricultural purposes. One possibility is teaching or training plants, which means adaptive stress stimulation based on plant memory and enable the development of cross-stress and multi-stress resilience in plants. Another possibility is using epigenetic variability for plant breeding, i.e. production of climate-smart crops by induction of epigenetic variation globally or site-specifically, or by the selection for the epigenome, as summarized in Figure 2.

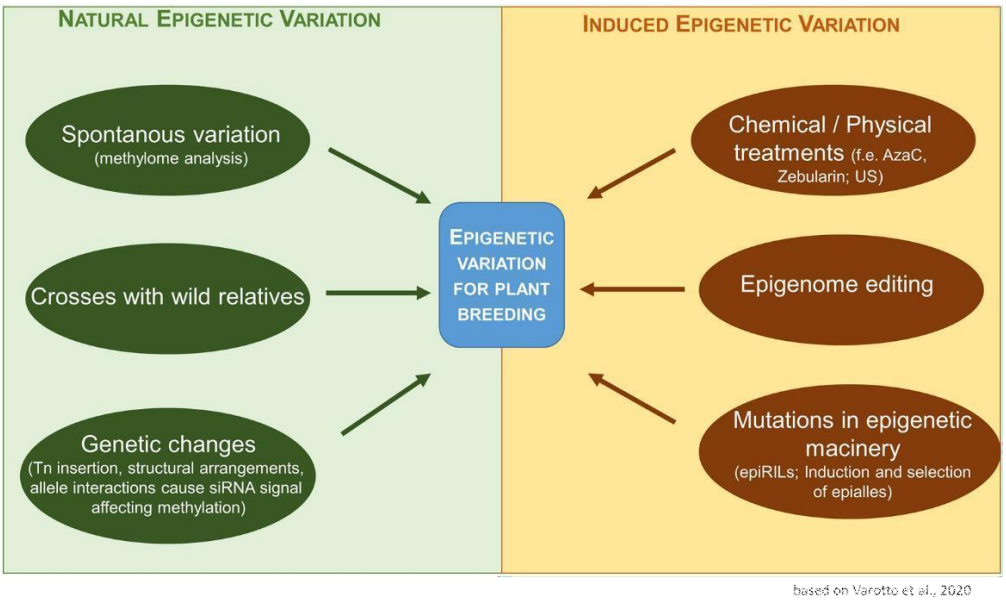

Figure 2. The main possibilities of climate smart crop production when breeding is based on epigenetic background (based on Varotto et al. 2020, modified)

Although it requires further and deeper investigations to establish the connection and regulation of different networks and levels of plant memory, some plant memory based methods can be used and are already used in plant production, moreover, the further directions of its application possibilities are also visible. The development of new plant breeding and cultivation strategies based on plant memory can be one of the environmentally friendly and efficient plant breeding advances of the future.

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On current multidisciplinary challenges in water management: selected Hungarian case studies

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Abstract

1. River with floodplain and secondary branch system. A procedure of river scaling concept - a scale-related analysis. Application e.g. in DanubeSediment - Danube Transnational Cooperation Project (DTP), 2017-2020, led by Budapest University of Technology and Economics, Hungary.

- Hydro- and morphodynamical processes occur over a wide range of scales, from continental/regional to the initiation of motion of individual particles.
- Smaller scale processes are usually embedded in larger scale ones.
- Biological processes also span different and reflect specific scales, key to biodiversity.
- Strong interdependency and interaction between the varying scales

Catchment-wide scale:

- Suspended sediment balance along the Danube River and its major tributaries before and after HPP construction. Sediment transport considered as a key feature of river morphodynamics and habitat quality.

Reach scale examples:

- Gradual inundation of floodplain and dynamic connection of side branches and terrain depressions.
- Multidisciplinary approach: Habitat classification based on hydraulic connectivity at ecologically relevant flow regimes.
- Estimated development of terrestrial vegetation based on an unsteady 50-year botanical simulation.
- 2D model based analysis of connectivity for habitat classification of the complex Gemenc and Béda-Karapancsa Danube secondary branch system, South of Hungary – Essential input for river restoration planning.
- Further example on reach scale.

Local scale studies:

- 3D mixing processes at river confluences – local features and their downstream impact.
- Artificial Intelligence based bed surface pattern classification.
- Joint modelling of fish motion and flow – Smooth Particle Hydrodynamics tests.

Point scale examples:

- Innovative methods to understand sediment transport processes.
- Particle Image Velocimetry based analysis of gravel motion from underwater videos
- Identification of moving particles with their velocity.
- In-situ identification of intermittency and patchiness in bedload motion.

2. Cooling water jet behaviour at low flow regime at a nuclear power plant – looking for extremes.

- Nuclear Power Plant Cooling water outlet – aerial detection by drone, video- and thermo- camera.
- Deriving conclusions on bathymetry, flow regime, etc., and climate change impact though the extremes.
- Habitat hydraulics aspects on fish also tackled.

3. Exploration and modelling of fractal pattern in lakes.
- Fractal mixing patterns, frequent occurrence as a result of chaotic advection.
- We are interested even more in the details: Mixing investigated by Lagrangian particle tracking.
- Lagrangian particle tracking simulation to see the spreading of hypothetic lake water supply.
- Example: wind-induced flows in Lake Neusiedl.
- Lagrangian particle tracking simulation to see the spreading of hypothetic lake water supply.
- Further example: Satellite image of lake Balaton (infrared spectrum) from the early eighties – development of highly filamental SSC pattern.
- Wind-induced SS transport modelled in Lake Balaton on adaptive quadtree grid.

4. MODIS-based estimation of earth surface evapotranspiration (ET)
- ET cools the surface very effectively → land surface temperature (Ts) must be related to ET rate.
- From observations: near surface air temperature gradient is directly proportional to Ts.
- The 1 km spatial scale of MODIS Ts data is ideal to use for Transformation of Ts into ET (CREMAP model).
- Accurate ET map, ratio of mean annual ET and precipitation, net groundwater recharge (P – ET) in the Danube-Tisza interfluvial region (Surface runoff is minimal) and surface temperature - ET - precipitation - landuse interaction for Hungary are presented

THE POTENTIAL ABILITY OF ENDOCRINE DISRUPTORS TO AFFECT THE LIVE SYSTEM – *in vitro* study

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Abstract

Endocrine disrupting chemicals (EDCs) are ubiquitous chemical compounds that may disrupt endocrine system functions and have adverse developmental, reproductive, neurological, and immunological impacts in both humans and wildlife. In our research, we used a diverse range of *in vitro* laboratory models to assess the impact of EDCs. For the alterations of the reproductive system, we used bovine spermatozoa, which were cultivated with distinct concentrations of nonylphenol (NP), octylphenol (OP), bisphenol A (BPA), and bis(2-ethylhexyl)phtalate (DEHP) for 0, 2, 4, 6, and 24h. The results of movement activity revealed a significant decrease in motility following exposure to concentrations of 100 g.mL of ED, with bisphenol A having the most influence. Low doses (10 g/mL) of NP, BPA, and DEHP increased spermatozoa motility considerably (P<0.001). Spermatozoa survival was considerably reduced following exposure to 100 g.mL of NP, OP, and BPA and at a concentration of 200 g.mL of DEHP. The aim of our steroidogenesis research was to look into the impact of NP and OP on the activity of isolated mouse Leydig cells and the TM3 cell line. The TM3 cell line was cultivated in the presence of 0.2, 1, 2.5, 5, 10, and 25 µg/mL 4-n-NP or 4-OP for 30 min, 6 h, and 24 h.Our findings show a considerable (P<0.001) increase in androstenedione and testosterone synthesis following 2.5 to 5 g/mL 4-n-NP treatment. In addition to 2.5 and 5 g/mL 4-OP, a similar tendency was seen in dehydroepiandrosterone and androstenedione secretion (P<0.05; P<0.001). Significant changes (P<0.001) in testosterone production were also observed at dosages of 2.5 and 5 g/mL. The simultaneous action of 1 mM cAMP and 4-n-NP caused a significant (P<0.05; P<0.001) decrease in dehydroepiandrosterone (1; 2.5; 5 g/mL) and androstenedione (5 g/mL) production. The highest concentrations of 4-OP (2.5 and 5 g/mL) decreased cAMP-stimulated dehydroepiandrosterone synthesis considerably (P<0.05; P<0.001). Another part of our study aimed to determine the potential effect of bisphenol A, AF, B, F, and S on the biosynthesis of steroid hormones in human adrenocortical carcinoma cells. Human adrenocortical carcinoma cells (H295R) were cultivated in the presence of bisphenol A, AF, B, F, or S (0.05, 0.1, 0.5, 1; 10; 25; 50; 75; 100 M) for 24 or 48 hours. The most significant biphasic effect was observed with BPF and BPAF; low concentrations of these endocrine disruptors stimulated mitochondrial activity, despite the fact that the viability of the cells was mainly affected by BPB. In the immunotoxic part of the study, we evaluated the *in vitro* effects of various (0.05–50 µM) BPS concentrations on human umbilical vein endothelial cells (HUVEC). Results showed that bisphenol S does not affect viability. Despite the fact that cell viability was unaffected, we detected a significantly increased production of IL-6. At a concentration of 1 µM, the level of significance was P<0,001, at 10 µM (P<0,01), and at 25 µM (P<0,05). Our results also shown that at concentrations of 1 µM BPS treatment, the increase in PGE2 production was at the level of significance (P<0,05), at 10 µM (P<0,01), and at 25 µM (P<0,05). Our findings show that EDCs can alter physiological processes on many levels in terms of reproductive and immunological mechanisms, and thus their ubiquitous nature may increase their harmful effects on living systems.

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Salinization & metal contamination in agroecosystems: Implications to food safety & security

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Abstract

Agroecosystems, which are crucial components of global food production, are facing escalating threats due to a combination of environmental degradation intensified by the effects of global climate change, as well as the mounting demands for food and water. Within this context, two critical challenges confronting agroecosystems are salinization (salt stress) and metal contamination (metal stress), both of which are recognized as the main threats to environmental resources and human health in the EU and many other countries worldwide.

Salinization is recognized as an increased concentration of dissolved salts (Na, Cl, Ca, Mg) in soil and/or water resources. Salinization leads to numerous negative implications for (agro)ecosystems, including primary and secondary salt stress on crops, resulting in reduced yields and quality. Currently, nearly 1000 million hectares of land globally are salt-affected. Moreover, freshwater resources are often tainted with salinity and metal contamination due to intensified human activities, including water over-extraction, mining, and the impacts of climate change. The consequences of excessive salinity encompass destructive and enduring outcomes, including soil dispersion, biodiversity decline, impaired ecosystem resilience, hyper-salinity of water and soils, and ultimately desertification.

Metals naturally occur in the environment through various natural processes (volcanic eruptions, weathering of parent rock materials, metal corrosion, sediment erosion) as well as anthropogenic sources (agrochemical application, military and mining activities, waste disposal). Among these metals, Zn, Pb, Cd, As, Cr, Cu, Hg, and Ni are frequently found in excessive concentrations at contaminated sites. Metals are non-biodegradable and persist in the environment, posing long-term threats. Crops relatively readily take up many of these metals from the soil, entering the food chain upon consumption by humans and animals. Chronic exposure to metals results in detrimental health consequences, including neurological, renal, and developmental disorders. Several metals are recognized systemic toxins capable of damaging various organs even at low exposure levels. Importantly, prominent environmental and public health authorities classify many of these metals as carcinogens, underscoring their danger to all living organisms.

However, strategies and approaches for on-site salinity amelioration and metal remediation are often very expensive, questionable, and unfeasible, especially on larger open-field scales. Additionally, salinization and metal contamination frequently coincide with other environmental constraints such as drought, waterlogging, and acidity, further exacerbating the threat to food security and ecosystem robustness. Fortunately, a range of well-established, cost-effective ameliorative strategies, such as conservation agriculture, application of natural conditioners, microbial bioremediation, and phytoremediation, can be employed to combat salinity and metal contamination. The fusion of remotely sensed and integrated data on salt-affected and metal-contaminated areas with in-situ and laboratory observations has become more accessible and applicable on substantial scales. This integration serves as a valuable tool for policymakers and stakeholders to implement targeted measures for preventing and controlling ecosystem degradation due to excessive salinity and metal contamination. In addition, advancements

in biotechnology and ecoengineering, exemplified by nanomaterials, marker-assisted breeding, genome editing, and plant-microbial associations, offer promising avenues against salinity and metal contamination. However, knowledge gaps and ethical challenges must be addressed before these solutions can be effectively translated into large-scale agroecosystems.

Plant's Nanoworld: Emerging Extracellular Vesicles and Nanovesicles for Enhancing One Health System

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Abstract

"One Health" approach aims to improve the health of plants, animals, and humans and their environments by recognising the interconnection between them. One recent development that might help to increase the global awareness of this concept is the recognition of a universal communication system between plants, animals and humans based on extracellular vesicles (EVs).

EVs are complex cell-derived submicron sized structures released to the environment in which a liquid compartment is separated from the surrounding by a closed biological membrane. They are ubiquitously secreted by almost every type of cell or organism studied so far. The structure, stability, biocompatibility and spatial crowding of EVs has been evolutionary optimized for an efficient transfer of biomolecules (e.g. proteins, RNAs, lipids and metabolites) to recipient cells. EVs exploit the viral entry mechanisms for cargo delivery, and interestingly, EV secretion mechanism is also exploited by viruses that use the EVs for cellular exit.[1] The highly dynamic release of EVs and their cellular uptake events constitute the base of a wide spectrum of biological activities. The role of EVs in immune regulation, disease development and progression, including viral and bacterial diseases, as well as cancer has been well recognised.[2] Due to the delivery potential, besides diagnosis, EVs are considered as one of the most promising and complex molecular delivery vectors for exogenous substances. Current EV-based therapies relay on the production of EVs by human cells and tissues, like mesenchymal stem cell, dendritic cells, adipose tissue and blood cells however alternative novel resources like bacteria, milk, microalga and plants are also emerging. In the last decade, the research of EVs-MS laboratory at IBBR-CNR (https://evs-ms.com/) focuses on plant EVs and plant derived nanovesicles (NVs) with the aim to establish novel green systems for the production of nanovectors for molecular delivery.[2,3,12–15,4–11]

In this presentation, I will show methods for the isolation and molecular characterization of plant (tomato, citrus fruit, cucumber, ginkgo biloba, etc)-derived NVs as well as methods for the production of plant EVs using plant suspension cell cultures that we setup to translate our findings into biotechnological innovations and human healthcare applications. Today, EV production systems are mainly relying on mammalian cell cultures to satisfy the demand from the pharmaceutical cosmetic industries. Upscaling the cultivation of human mesenchymal cells is economically and technologically challenging. Additional burden is imposed by variability of donors' material, EV heterogeneity and possible contaminations that is currently poorly resolved by downstream purification and poses problems for regulatory clearance. Edible and medical plant cells derived EVs and NVs are societally acceptable as green and renewable, and not introducing human contaminants, moreover they have the appeal of being EU acknowledged natural biologicals.

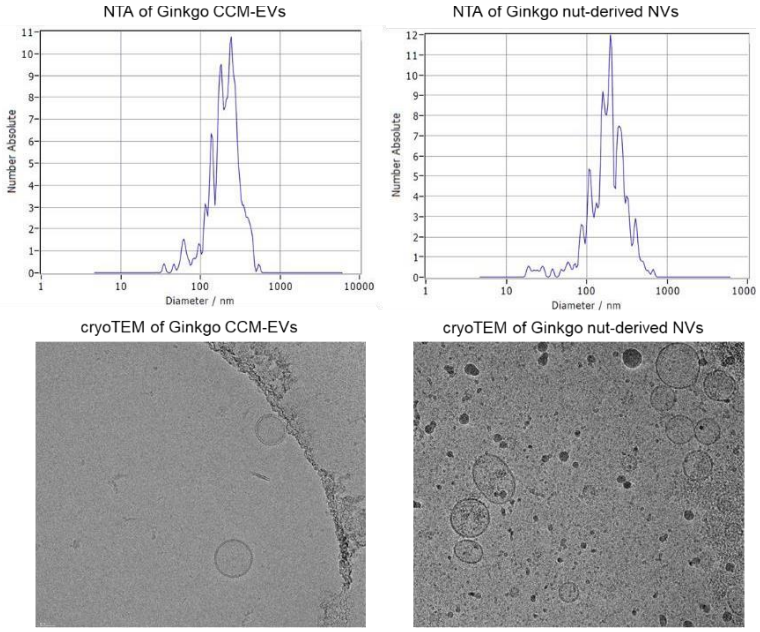
Nevertheless paramural vesicle structures between the plasma membrane and cell wall in plant tissues were observed by transmission electron microscopy (TEM) more than half a century ago, there was a longstanding debate on the capability of plant cells to secrete EVs outside their semi-rigid cell wall. Over the past years, progress has been made in establishing critical roles of the multivesicular bodies (MVBs) and associated membrane trafficking

event in plants. The role of plant EVs in unconventional protein and RNA secretion, plant-microbe interaction, and intercellular and interspecies communication, including plant symbiosis today is widely recognized. So far, two types of EVs have been isolated and studied in plants: apoplastic vesicles from apoplastic washing fluids of Sunflower seeds and Arabidopsis leaf and root secreted vesicles isolated from tomato root exudate. Both apoplasticvesicles and root EVs were found morphologically similar to mammalian EVs. The main difference that apoplastic vesicles are trapped between the cell membrane and cell wall and thus not released directly into the environmentlike root-derived EVs. Only a few studies report on the use of plant molecular farming methods for the productionof plant cell-derived EVs. To fill this gap, we set-up and optimized cell suspension culture of Ginkgo biloba and tomato for EVs production and compare them with the nanovesicles (NVs) isolated from the plant material.

Ginkgo matured fruits were collected from trees in the Piscinola public garden in Naples (2022). Raw kernels (pericarp) were used for the isolation of ginkgo NVs and dissected embryo explants were used for the induction of callus culture. Cell suspension culture (CSC) was setup using white friable ginkgo callus. CSCs were characterized by packed cell volume and cell morphology. CCM from three biological replicates were collected at three different time point of growth curve. Differential and iodixanol gradient ultracentrifugation-based methods were optimizedfor the isolation and the density characterization of CCM-EVs and ginkgo nut-derived NVs. Nanoparticle tracking analysis (NTA) showed the size distributions and the particle concentrations and cryoTEM analyses have revealed the vesicular character of the isolates (Figure 1). Our results show that plant cells secrete EVs into the environmentwhich could be further exploited for future molecular farming. We have isolated more vesicles from the nut homogenate then the CCM. CryoTEM visualized double membrane layer surrounded EVs from ginkgo cell culture. We have further characterized the isolates by protein profiling using SDS-PAGE and mass spectrometry-based proteomics. Moreover, we setup a GC-MS/MS selected reaction monitoring-based analysis for the characterizationof ginkgolides in seed, callus and NVs extracts.

Evidence is accumulating that plant and animal food derived EVs can impact the gut microbiome and by crossing the gut wall epithelium EVs of different taxonomies can enter the systemic circulation. Plants have shaped our human life from the outset by providing food, clothing, shelter, and remedies. With the emerging recognition of world population feeding, global climate change and limited energy resources with fossil fuels, the relevance of plant biology and biotechnology is becoming dramatically important. There is a need to advance our understanding on the role of “EV ubers” of different taxa in the intercellular communication and on how this can be exploited within the “one health” approach.

Figure 1. Ginkgo cell-culture derived EVs and ginkgo nut-derived NVs has an avarage diameter between 100-200 nm based on nanoparticle tracking (NTA) and cryo-TEM analyses. A double layer membrane surrounds CCM-EVs while ginkgo nut NVs are mainly single membrane enclosed.



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Inherited diseases and inherited health: how transgenerational epigenetics can change the processes?

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Abstract

The new research results of the last decade, especially in the field of nutrigenomics and transgenerational epigenetics, encourage us to find those superfoods that can modulate the functioning of our body at the genomic level. Many decades ago, special attention was already given to certain ethnic groups who did not suffer from diseases of civilization or even cancer. They had long, healthy lives. Researchers began to examine the geographical features and the genetic background, but in the end they identified lifestyle, distance from the curses of civilization and nutrition as the cause.

Oases of longevity - The blue zones of our Earth

Author Dan Buettner has been working to identify longevity hotspots around the world for more than a decade. Buettner found five zones and areas he called the Blue Zone, but fortunately there are many more. The five blue zones described by Dan Buetter are: Ikaria (Greece), Okinawa (Japan), Ogliastra region (central area of the island of Sardinia), Loma Linda (California - United States), Nicoya Peninsula (Costra Rica). The other areas and people groups are: Hunza Valley (Pakistan), the Sherpas (Nepal – Himalaya region), the Bama region of China, the Otomini Indians of Mexico and the inhabitants of the Tarahumara tribe, the Vilcabamba Indians of Ecuador, the Jekana Indians of Venezuela, and the Abkhazians in the Caucasus region.

- Blood pressure and digestive problems, high cholesterol, cardiovascular diseases, cancer and diabetes were unknown to the people living here.

- They mainly follow a vegetarian diet and eat little meat. Only Okinawans eat fish. Their diet - compared to Western standards - can be said to be low in calories. They do not consume industrially modified food, sugar, corn syrup, preservatives, artificial flavors or other chemical substances.

What can secondary plant metabolites do to extend our lives?

They have a pleitropic effect, as they are able to increase the activity of some enzymes and have an inhibitory effect on other enzymes. They regulate signaling pathways and down/up regulate expression levels. The development of omics has proven that there really are plant metabolic products that can be responsible not only for the preservation of health, but also for the transmission of health from generation to generation. Human epidemiological studies and feeding experiments on animal models have provided significant evidence that during the critical period of development, imbalances and metabolic disorders occurring during maternal nutrition can permanently affect the health of the offspring and may even appear in the following generations. This "fetal programming" has led to a new hypothesis called the "*Developmental Origins of Health and Disease*" (DOHaD). Common disorders such as obesity, cardiovascular disease (CVD), diabetes, high blood pressure, asthma, cancer, and even schizophrenia are rooted in nutrition during early pregnancy. Various non-Mendelian features of metabolic disease, cancer or chronic inflammatory disorders, clinical differences between males and females or identical twins, and fluctuations in disease course are consistent with epigenetic mechanisms. All of these record fetal and/or lifelong nutritional or stochastic events that eventually translate into a healthy or diseased adult phenotype.

Polyphenols or anthocyanins have been extensively studied in recent years. Hungarian cherry varieties have an exceptionally high anthocyanin concentration, the effects of which have been confirmed in an in vitro tissue model and in vivo animal model.

The effect of Hungarian sour cherry, which is rich in anthocyanins, was tested on hyperglycemia-induced endothelial dysfunction using human umbilical cord vein endothelial cells (HUVECs). HUVECs were maintained under both normoglycemic (5 mM) and hyperglycemic (30 mM) conditions with or without two concentrations (1.50 ng/µL) of anthocyanin-rich sour cherry extract. Hyperglycemia-induced oxidative stress and inflammatory response and damaged vasorelaxation processes were investigated by evaluating the level of reactive oxygen species (ROS) and gene expression of four proinflammatory cytokines, namely, tumor necrosis factor-alpha (TNF-α), interleukin-6 (IL-6), interleukin-8 (IL-8), and interleukin-1α (IL-1α), as well as the gene expression of nitric oxide synthase (NOS) endothelin-1 (ET-1) and endothelin-converting enzyme-1 (ECE-1). It was found that hyperglycemia-induced oxidative stress was significantly suppressed by anthocyanin-rich sour cherry extract in a concentration-dependent manner. The gene expression of the tested proinflammatory cytokines increased under hyperglycemic conditions but was significantly reduced by both 1 and 50 ng/µL anthocyanin-rich sour cherry extract. Further, although increased ET-1 and ECE-1 expression due to hyperglycemia was reduced by anthocyanin-rich sour cherry extract, NOS expression was increased by the extract. [1,2]

Increased permeability of the epithelial and endothelial cell layers results in the onset of pathogenic mechanisms. In both cell types, cell–cell connections play a regulatory role in altering membrane permeability. The aim of our study was to investigate the modulating effect of anthocyanin-rich extract (AC) on TJ proteins in inflammatory Caco-2 and HUVEC monolayers. Distribution of Occludin and zonula occludens-1 (ZO-1) were investigated by immunohistochemical staining and the protein levels were measured by flow cytometry. The mRNA expression was determined by quantitative real-time PCR. The transepithelial electrical resistance (TEER) values were measured during a permeability assay on HUVEC cell culture. As a result of inflammatory induction by TNF-α, redistribution of proteins was observed in Caco-2 cell culture, which was reduced by AC treatment. In HUVEC cell culture, the decrease in protein and mRNA expression was more dominant during inflammatory induction, which was compensated for by the AC treatment. [3]

Anthocyanins significantly elevate the levels of proinflammatory adipokines such as leptin, MCP-1, IL-6, and resistin while decreasing the production of anti-inflammatory adiponectin and IL-10 contributing to the development of tissue inflammation, insulin resistance, and other symptoms of metabolic syndrome. . [4]

The effects of sour cherry extracts on the intestinal microbiota was investigated through carrying out comprehensive feeding trials on the broiler, fish and swine gastrointestinal tract (GIT) microbiota. By the application of novel **next-generation sequencing technologies** we experienced shifts in the composition of the gastrointestinal microbiota towards more resilient communities. Due to the increments in several **probiotics** the general health conditions of the hosts have been improved. The gut microbiota can also provide the host with important, **anti-inflammatory short-chain fatty acids** (SCFAs). By supporting the healthy eubiotic microbiota and protecting the host against developing health threatening pathobiomes anthocyanin were also shown to decrease the abundances of **potential zoonotic** strains in the livestock. [5,6]

We firstly proved that sour cherry matrix can inhibit human salivary amylase activity by binding to the active site of the human salivary amylase enzyme, therefore excluding sugars to bound and therefore inhibiting acidification and

ultimately caries. On the other hand it inhibits Streptococcus mutans to form oral biofilms preventing oral health. We verified that sour cherry matrix rich in anthocyanins (main components: cyanidin-3-O-rutinoside and cyanidin-3-O-glucoside, malvidin-3,5-O-diglycoside) inhibited the human salivary alpha-amylase catalysed hydrolysis competitively. [7,8]

In recent years, research has begun to prove how environmental conditions and daily diet can influence "reversible" inherited epigenetic mechanisms. We now know that transgenerational gene expression can be caused, for example, by changes in DNA methylation patterns at CpG sites, or by key inflammatory genes, or by non-coding RNAs, or by the state of chromatin. These processes regulate cancer, chronic inflammation and metabolic disorders. It has also been shown that inflammation, metabolic stress or diet can alter the activity of theepigenetic system and indirectly or directly alter chromatin structure.

New research results have helped to highlight that anthocyanins, as anti-inflammatory bioactive food ingredients, also regulate epigenome-modifying enzyme activities (acetylation, methylation, phosphorylation, ribosylation, oxidation, ubiquitination, sumoylation).

In our hypercholesterolemic rabbit model experiment, we proved that homocysteine accumulates in the plasma as a result of damage to the transulfuration pathway. Hcy competes with S-adenosylmethionine (SAM; the methyl group donor) for binding to DNMT, which can lead to passive loss of methylation in replicating DNA. High plasma Hcy levels correlate with DNA hypomethylation and atherosclerosis, non alcoholic fatty liver diseas and metabolic syndrome. As a functional food candidate, tart cherry extract can be used as therapeutic epigenetic modulators in lifestyle diseases such as metabolic disorders (diabetes), cardiovascular diseases, asthma/COPD, and rheumatoid arthritis, non alcoholic fatty liver disease and metabolic syndrome. [9]

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Dynamics of phosphorus in the soil-plant-human continuum

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Abstract

Sustainable production of food for increasing world population (8 billion in November 2022) is a significant and multi-faceted challenge. Supplying crops with optimal amounts of phosphorus required for growth and food production is increasingly problematic because of the scarcity and uneven geographic distribution of non-renewable phosphate rock and environmental pollution associated with the inappropriate use of phosphorus fertilizers (e.g. eutrophication).

Rock phosphate is an essential raw material for producing phosphorus fertilizers. Around 70% of the world rock phosphate reserves are concentrated in Morocco and Western Sahara, and there is only a handful of other countries (e.g. USA, China, Russia, Algeria, South Africa, etc.) each sitting on rock phosphate reserves of only a few percent. Such uneven geographical distribution raises a possibility of various geopolitical influences and problems that may hamper the world trade and supply of rock phosphate and/or phosphorus fertilizers. Any disruptions in that trade and supply inevitably result in increased prices of fertilizers, which indirectly means increased food prices as well. For example, the price of rock phosphate has increased by more than 230% since the beginning of 2021.

In addition to uneven distribution of rock phosphate around the world, the total reserves are finite (rock phosphate is a non-renewable resource), meaning that the peak phosphorus (i.e. inability to increase supply further, followed by an unavoidable decline in such supply) is going to occur at some point in the future. While estimates about how far in the future that would occur range from the optimistic (2070-2080) to the pessimistic (by 2025), it is clear we are talking about the not-too-distant future that young people of today are inevitably going to experience.

The phosphorus scarcity arising from the non-renewable nature of rock phosphate on this planet is influenced by a number of factors:

1) Physical (limited Earth resources),
2) Economic (as we approach phosphorus peak, it will be increasingly more expensive to mine rock phosphate due to the depth of the sediments, inferior grade, etc.),
3) Managerial (major flows of phosphorus in global food system are quite complicated and include not just the various uses but also the numerous loss pathways),
4) Geopolitical (as explained above, uneven distribution of rock phosphate reserves across the globe raises a possibility of undue influence of some countries on the world supply and trade) and
5) Institutional (so far, there has not been any explicit national or international policies, guidelines and/or strategies to ensure long-term availability and accessibility of phosphorus to underpin global food security).

Possible strategies that would contribute to global food security regarding rock phosphate/phosphorus fertilizer availability in the future rely on the set of measures dealing with increased efficiencies in (i) rock phosphate mining and phosphorus fertilizer production, (ii) agriculture and (iii) food processing chain, as well as an increased reuse of

various organic sources of phosphorus (manure, biosolids, crop residues, food waste, etc.). Some of these strategies are best illustrated with the examples from EU countries where historic trends of increased food production accompanied by increased fertilization rates (1960-1980) are changing to continually increased food production but with reduced inputs of fertilizers (2001 onwards). The USA is in the period of increasing food production with fertilizer inputs remaining steady. By contrast, predictions are African countries will need to substantially increase their fertilizer usage to meet increasing demand for food.

In conclusion, the need to increase food production for the expanding global population is contingent on a judicious use of the limited (non-renewable) rock phosphate resources should entail increased reuse/recycling of organic sources of phosphorus, enhanced efficiency of phosphorus use in food production, and minimization/avoidance of losses of phosphorus to the environment (to elude eutrophication of surface and ground waters). Changing people's diets may be added to this list (more food can be put on people's plates from a unit of phosphorus in case of the plant-based than meat-based diets, e.g. around 200 times more potatoes (and other starchy roots/tubers) than beef can be produced from 1 kg of phosphorus), but it is a potentially controversial topic.

Poster Abstracts

Determination of the Levels of Potentially Toxic Elements in Baobab Leaves in Sudan

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Abstract

Baobab (*Adansonia digitata* L.) leaves are known for their nutritional value and potential health benefits. However, the presence of toxic elements in plant materials, including baobab leaves, is a concern for human health. This study aimed to determine the levels of potentially toxic elements in baobab leaves in Sudan. Baobab leaf samples were collected from three distinct ecological zones: wetland (WL), plain land (PL), and Rocky land (RL) in the Blue Nile and Kordofan regions, respectively. The elemental analysis was performed using the ICP-MS spectrometer at the Institute of Food Science laboratory, University of Debrecen, Hungary. The concertation of toxic elements significantly ($p<0.05$) varied by ecological zones except Arsenic (As). Chromium (Cr), was 0.5, 0.7, and 0.4 ppm in WL, PL, and RL, respectively. Lead (Pb) was 0.5, 0.4 and 0.4 ppm. Mercury (Hg) was 0.2, 0.08, and 0.2 ppm. Regions did not significantly ($p>0.05$) affect the concentrations of toxic elements except Mercury (Hg). Nonetheless, these values fell within the acceptable thresholds (ppm) established by both international and local standards for toxic metals in food. The outcome of this study emphasizes the necessity to continuously monitor and evaluate harmful components in baobab leaves and other edible plants, especially in regions where these plants are integral to the diet. Furthermore, it is essential to investigate the origin, and factors contributing to the accumulation of toxic elements in baobab plants. This is crucial for ensuring the safety of individuals who rely on baobab leaves and plant-based foods for their nutritional needs.

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Phosphorus in a long-term sewage sludge compost experiment

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Abstract

Phosphorus (P) supply of plants is a key factor of plant production but the price of the P fertilizer is increasing. A good quality sewage sludge compost (SSC) could contain high quantity of P moreover, other macro- and microelements and organic matter (OM) also can be found in it. The effect of regular SSC application on soil and plant parameters have been studied from 2006 in Nyíregyháza. Now, we focus on the P in the soil-plant system. We hypothesised that the P content of SSC could supply the plant demand and, depending on the P rate added to the soil, the plant and soil microbial interaction could improve the P availability and plant condition.

The long-term experiment studies the effects of SSC on soil-plant system at the rates of 0, 9, 18 and 27 t ha^{-1} doses ploughed to the soil every 3rd years. The compost contains sewage sludge (40% m/m), straw (20% m/m), rhyolite (35% m/m) and bentonite (5%m/m), resulted in a complex soil improving and plant nutrient source material for sandy soil. The experiment contains 5 replications of each treatment where the test plants (maize, rye and rye with hairy vetch) are sawn every year in a crop rotation system. To study P in this system, rye was used as a test plant. Soil and plant samples were collected at the end of tillering and ear emergence phases of rye in 2023. Both bulk and rhizosphere soils were sampled. Weight and P content of plant shoot were measured as plant parameters. From soil samples, the acidic and alkaline phosphomonoestherase activities have measured up to now.

Our results showed that SSC improved the plant development resulting in significantly higher green weight of rye in the 18 and 27 t ha^{-1} treated plots. Acidic phosphomonoestherase activity was the highest in the control treatment while the highest alkaline phosphomonoestherase activity was found in the high doses of SSC treatment. Otherwise, the ratio of alkaline/acidic enzyme activities increased with increasing doses of SSC. Comparing the rhizosphere and bulk soil, acidic phosphomonoestherase activity was higher in the rhizosphere than in the bulk soil while the alkaline enzyme activity was a little bit higher in the rhizosphere than in the bulk soil.

The positive results of plant parameters in the SSC treatments in both sampling times are not the consequence of only its P content. SSC is a complex material but the results of plant P content proved its applicability as a good P source for plants. SSC contains OM as a source of P. The soil phosphatases make the OM-P available for plants. Different types of phosphomonoestherases work on different soil pH. Because the pH of soil in the SSC experiment is in the range of 4-7, the acidic and alkalic phosphomonoestherases also work in the soil. The alkaline phosphomonoestherase is produced only by microbes therefore the increasing ratio of alkaline/acidic enzyme activities along with increasing doses of SSC indicating the important role of soil microbes in the P availability.

Multi-temporal surveys for mapping of soil electrical inductivity

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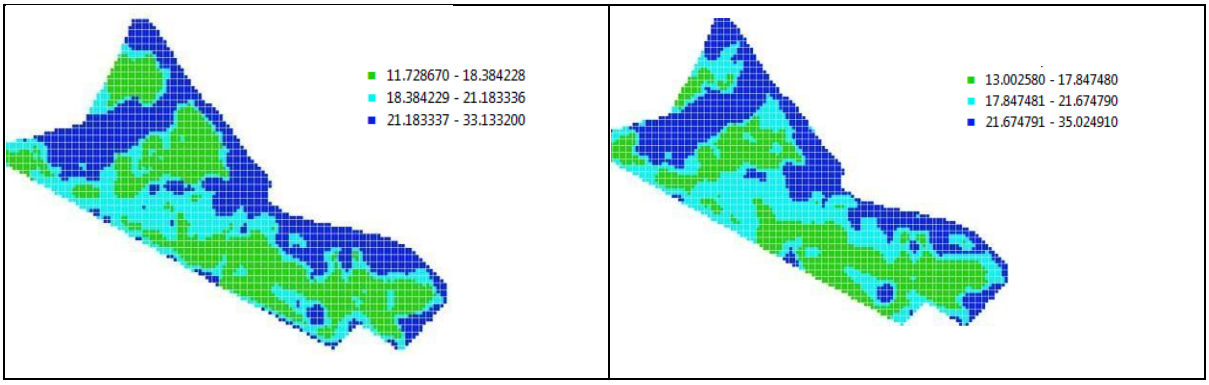
Abstract

The basis for the effective introduction of precision crop cultivation is the definition of differences and heterogeneity within the field.The "soil-based" measurement, according to international literature, is the most reliable method to assess the potential of the crop area and soil spot. The measurement of heterogeneity means the delineation of clusters formed by geostatistical methods, based on physical and chemical differences of various soil parameters.The direct soil mapping by surveys done by geophysical tools is used in several agricultural applications.

The aim of the R&D task was to perform a temporal assessment of the reliability of soil mapping procedures. Soil heterogeneity analysis was conducted on a 44.3-hectare arable land area located in the administrative region of Gyulaj, on brown forest soil (luvisol). Measurements were taken between April 24 and November 2, 2020, using a VERIS MSP-3 device, determining the conductivity of soil layers at depths of 0-30 cm and 0-90 cm, as well as the VIS/NIR values at a 7-10 cm depth. The spacing between adjacent survey lines was 12 meters for both surveys, with towing speeds ranging from 10 to 15 km/h depending on soil conditions and topography. Regarding the instrument, data collection involved measuring average conductivity (mS/m) and reflectance values at 1-second intervals, resulting in an average data point from every 5-7 meters length. The values of each measurement series were associated with RTK GPS coordinates.

In the first step, values outside the measurement range were filtered out of the georeferenced measurement data. The outliers of the individual layers were removed using boxplot, and the normality of the probability distribution was examined using a statistical method (Kolmogorov-Smirnov test). If, according to the test result, the probability distribution of the data set differered from the normal distribution, transformation was performed. The interpolation method used was local kriging (Figure 1.)



1. Figure. **Distribution of EC_a (dS/m) values of the 0-30 cm soil layer**

(*24.04 – 02.11., 2020 Gyulaj, Hungary)*

At the first time of recording, the soil was optimally prepared before sowing, while at the second time it was stubble. The regression coefficient of the two map sets (r2=0.765-0.858) shows a very strong correlation. The different measurement results can primarily be explained by the soil condition.In the fall survey, the soil contact of the Wenner electrodes and the OM sensor were the limiting factors, mainly in the deeper areas.

Inoculation Enhanced morpho-physiological Traits of Chickpea Genotypes in Debrecen, Hungary

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Abstract

Legumes are gaining more attention as protein-rich sources; however, their response to abiotic stresses, which are reportedly increasing globally, remains a main concern for both farmers and researchers. Chickpea is not grown widely in Hungary or in any other neighbouring country, and there is little research on this important legume. We conducted an experiment, together with our partners in Poland, to understand the importance of inoculation for newly sown chickpea genotypes in Debrecen, Hungary. Three chickpea genotypes were sown in a randomized complete block design with 4 replicates. Half of the seeds of each genotype were inoculated and compared to a non-inoculated control. Our results showed that the shoot length, shoot dry weight, chlorophyll-a, chlorophyll-b, pod number per plant, 100-seed weight and seed yield per plant were significantly higher in the plants that were inoculated before sowing. However, root length and root dry weight was not measurably affected by inoculation. There were significant differences in most studied traits among genotypes as well. As expected, the nodules were visually seen on the roots of the inoculated plants of all 3 genotypes, but not of the control plants. It could be concluded that inoculation is vital for better morpho-physiology, yield and yield components of the studied chickpea genotypes. Our future research will engage the influence of different abiotic stresses on the production and the quality of chickpea under different climatic conditions.

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UAV-based Data in Precisional Irrigation Monitoring

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Abstract

In semi-arid and arid regions, including Hungary, the majority of climate scenarios predict rising water scarcity. There is an urgent need to improve advanced irrigation since only 2% of Hungary's agricultural land is irrigated. Developing the foundation for variable rate irrigation for a water-saving precision sprinkler irrigation system on a maize site (85 ha) located on the sandy alluvial cone plain in the Nyírség which is part of the Tisza River Basin was the overall goal of the current research. The year under investigation, 2022, is a historically dry one.

Various field surveys and monitoring in every second week were performed on the site focusing on different sub-areas of the plantation including both irrigated and non-irrigated ones. Meteorological monitoring station data and irrigation data were basic to assess the heat and water heights the crops of both irrigated and non-irrigated areas received. UAV-born vegetation indices and thermal data are raster formats, while LiDAR data are handled as point clouds and 2D point vectors. Field and laboratory measurement data were processed as point vectors and discrete datasets. Pigment analysis (total chlorophyll, carotenoid), wet and dry biomass and dry matter content were measured. Descriptive and comparative analyses of these attributes of the maize field were carried out.

The non-irrigated crop masses suffered the most from drought which affected the biomass production seriously. Its phenological development ended around the 98th day after the sowing. Accordingly, significant differences were detected in terms of crop morphology and temperature characteristics in the two sub-areas. LiDAR and field-measured heights are similar in the first phases but as the non-irrigated crop status declines, and most of the maize dries up and bends the LiDAR data does not provide direct correct height information, hence further processes are suggested in such cases. The time series analysis of the thermal survey is found to be very useful in alarming irrigation needs (56th day after sowing here).

It can be concluded that UAV measurements are a very helpful instrument for precisely surveying the supports on a broad scale and are highly helpful for irrigation support especially in dry years.

Analysis of bioactive components in the pressed fiber of Jerusalem artichoke (*Helianthus tuberosus* L.) varieties

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Abstract

Keywords: Jerusalem artichoke, pressed fiber, protein, photosynthetic pigments, total phenol

The subject of this research is the perennial plant of the *Asteraceae* family, Jerusalem artichoke. It has a wide range of tolerance to environmental factors and has few diseases and pests. It is important to mention that it spreads easily due to the aforementioned properties and is therefore considered as an invasive weed and food crop. It has a very wide range of uses, due to the nutritional parameters of its tubers, which are an excellent source of carbohydrates in the form of inulin, and can therefore be included in the diet of diabetics. It is also a valuable source of protein with a favourable amino acid profile. In addition to the tuber, a significant amount of green biomass is produced during the growing season, which is also of value. Pressed fiber can be produced from the above-mentioned biomass during wet fractionation, which can be used to produce value added products. In addition to being an excellent source of carbohydrates, pressed fiber is also rich in protein and contains biologically active components such as photosynthetic pigments, phenols and flavonoids.

The aim of this research is to investigate the biological values inherent in the pressed fiber obtained by wet fractionation from the green biomass of two Jerusalem artichoke varieties (Tápiói sima, Fuza) set in extensive conditions in 3 replicates for two consecutive years, which covers the spectrophotometric measurement of photosynthetic pigment content, protein content, and total phenolic and flavonoid content.

Among the photosynthetic pigments, the content of chlorophyll-a in the Tápiói sima variety is 3.61 mg/g dw - 4.90 mg/g dw, chlorophyll-b 1.75 mg/g dw - 2.17 mg/g dw, total carotenoids 1.44 mg/g dw - 1.86 mg/g dw, xanthophylls 0.82 mg/g dw - 1.02 mg/g dw. Among the photosynthetic pigments, the content of chlorophyll-a in the Fuza variety is 3.87 mg/g dw - 4.87 mg/g dw, chlorophyll-b 1.77 mg/g - 2.17 mg/g dw, total carotenoids 1.50 mg/g dw - 1.88 mg/g dw, xanthophylls 0.89 mg/g dw - 1.51 mg/g dw. The total phenol content ranged from 34.80 mg/g dw to 39.50 mg/g dw for the Tápiói sima variety, and from 22.33 mg/g dw to 27.5 mg/g dw for the Fuza variety. The flavonoid content ranged from 2.54 mg/g dw to 2.85 mg/g dw for the Tápiói sima variety, and from 2.38 mg/g dw to 2.75 mg/g dw for the Fuza variety. The protein content in the case of the Tápiói sima variety was 25.88 - 35.35 mg/g dw, while in the case of the Fuza variety we measured 33.36 mg/g dw - 38.44 mg/g dw.

Overall, the examination of the pressed fiber of Jerusalem artichoke, which is the subject of the research, can carry information relevant to practice, the results of which may be useful for the food industry in the future, and by using the fibers in the right form, a product with greater added value can be produced.

Biocontrol of aflatoxin contamination and the effect of *Aspergillus flavus* on maize

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Abstract

Maize is ranked the second most important cereal crop in the world with nutritional benefits. However, maize contamination with aflatoxins produced by *Aspergillus* species is a major health threat to humans and animals globally. Depending on the concentration, aflatoxins could also affect the grain quality of maize. This study was therefore, conducted to assess the year effect of aflatoxin contamination in maize and to determine the effect of *Aspergillus flavus* on the protein and starch content of maize. A three-year experiment was conducted in Hungary between 2020-2022. Treatments included; toxinogenic, atoxinogenic and control. Grain content was determined using HPLC technique. Data was analyzed using Genstat. Results show that year did not significantly affect aflatoxin contamination. The aflatoxin contamination levels in 2022 was similarly low in irrigated (0.06 ±0.03ppb) and non-irrigated (0.04±0.06 ppb). Also, aflatoxin contamination did not significantly ($p < 0.05$) affect grain protein and starch content. Starch content in *Aspergillus* contaminated maize ranged was 61% compared to 63% in the control.Protein content *Aspergillus* contaminated maize and control were all close to 12%. The study therefore concludes that year did not affect aflatoxin contamination in maize and aflatoxins incidence did not show any effect on maizegrain quality.

Keywords: *Aspergillus*, Aflatoxins, Maize grain, Year, Protein, Starch.

Histochemical study of the intestine of the common carp (*Cyprinus carpio*) to detect the impact of different feed additives

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Abstract

The study aimed to investigate the effect of different feed additives on the intestine tissue of the common carp (*Cyprinus carpio*). Three feed additives including Bactocell (live lactic acid bacterium *Pediococcus acidilactici* CNCM I-4622 MA 18/5M), Levucell (probiotic derived from the fungus *Saccharomyces cerevisiae* boulardii *CNCM I-1079*) and YANG prebiotic (*Saccharomyces cerevisiae* AQP1260, S. cerevisiae AQP 12988 and *Cyberlindnera jandinii* AQP 12549) were used at the concentration of 1% (100g/ 1 kg of basic diets) in addition to the control (basic feed only). Fish were fed with supplemented diet for 45 days in a recirculation system. The intestine was removed by dissection in a sterile condition, and 5 to 7 cm of the middle part of the mid intestine was carefully removed. The intestine samples were washed using buffer solution and fixed in 10% buffered formalin, then the histochemical laboratory approach was carried out; dehydrated in ethanol and cleaned and embedded in paraffin. To examine the intestine histomorphology, the hematoxylin-eosin stain was carried out on 12 samples (n = 3 fish per treatment) microscope paired with a camera was used to capture images of stained segments. The slides were observed under a light microscope with a magnification of 200x. Twelve villi per chick were randomly and carefully chosen from the cross-section per each individual animal. Then villus length (VL), crypt depth (CD), mucus thickness (ML), total mucosa (TM), villus width (VW), and villus surface area were measured. Results indicated that the villus width in fish treated with YANG was significantly ($p < 0,0001$) higher followed by Levucell, Bactocell, and the control respectively. In addition, the mucus layer was significantly ($p < 0,0001$) higher in fish treated with Bactocell followed by YANG, Levucell and the control respectively. Furthermore, the villus surface area (mm^2) was significantly higher in YANG followed by Levucell and Bactocell respectively.

Effects of allithiamine-rich feed additive on broiler liver structure and function

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Abstract

In intensive animal husbandry, biotic stress factors affect the health status and production parameters of broilers. Appearance of systemic diseases is often caused by damage of metabolic pathways. One of these, transsulfuration pathway play a key role in formation of redox homeostasis. It is closely associated with methionine and folate cycles, glutathione production, cysteine oxidation pathways, and activity of vitamin-dependent enzymes, thus its impairment can lead to development of multiple organ system metabolic disorders. However, it is known from previous studies that supplementation of B-vitamins and folic acid alone is not capable of rectifying the disturbance of cellular redox system.

Our aim is producing an allithiamine-rich feed additive and determination of effective dosage, which can cause positive physiological effects on health and production parameters of broilers.

During the experiment, 300 ROSS308 chickens were divided into two groups. Birds in control group (n=170) were given standard diet, while the members of treated group (n=130) were fed with allithiamine diet in two different dosages. Blood and liver tissue samples were collected at three developmental stages of the animals. Levels of liver enzymes (AST, ALT, GGT, ALP); lipids (cholesterol, triglycerides, LDL, HDL), and homocysteine in plasma were determined by photometry. In histological examination, we measured structural changes characteristic of different developmental stages and effect of feed additive on 5 µm diameter hepatic tissue slices.

To achieve effective dosage, two different allithiamine containing feed was applied. Although there was significant difference in plasma level of HDL between control and treated groups ($p<0,05$; $p<0,005$), and tendency was observed in the other parameters, further dose increase is required.

Hazelnut pollen germination under different temperature conditions

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Abstract

Hazelnut is a monoecious plant with separate female and male flowers that bloom in the winter months. Depending on weather conditions (mostly air temperature), flowering occurs from December to February. As protoandria or protogynia is present depending on weather conditions, in hazelnut production is needed to ensure different varieties whose flowering time overlap to ensure good fertilization. Fertilization of hazelnuts takes place in the spring and germination of pollen is essential to ensure high fruit yield. This paper describes the dynamics of pollen germination of 7 cultivars ('Istrian Oblong', 'Tonda Gentile Romana' i 'Lambert', 'Butler', 'Cosford', 'Mervelle de Bollwiler' i 'Lange landsberger') in three different temperature conditions (8, 15 and 22 °C), each of which represents the conditions that are present during the fertilization period in continental Croatia. Results clearly shows changes in dynamics of pollen germination under changed air temperature conditions. At 8 °C there were no pollen germination noticed after 16 days, while at 15 °C and 22 °C pollen germination is noticed in all studied cultivars after 4 days. No difference in pollen germination ration between 15 and 22 °C was noticed in 'Butler', 'Istrian Oblong' and 'Lange Landsberger', while 'Cosford' and 'Tonda Gentile Romana' showed greater pollen germination at 15 °C and 'Mervelle de Bollwiller' at 22 °C. Pollen of 'Lambert' did not germinate at all. Cultivars 'Cosford' and 'Tonda Gentile Romana' are more suitable for colder spring areas and 'Mervelle de Bollwiller' for warmer spring areas, while 'Butler', 'Istrian Oblong' and 'Lange Landsberger' are most adaptive of all studied cultivars and suitable for areas with wider spring temperature differences.

Key words: *Corylus avellana* L., pollen germination, BK medium

Effect of sowing time and fertilizer treatments on the protein content and protein yield of the white pearl 'Start' bean variety

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Abstract

The role of beans is significant in nutrition. They are an important source of protein and carbohydrates. Beans are ecologically sensitive plants, so their cultivation is increasingly risky due to weather anomalies. The aim of our experiment that was set up in 2015-2017 was to reduce unfavourable weather factors for its cultivation by changing the sowing time, fertilizer dose, and plant density. We thought it important to examine the effect of fertilizer dose and sowing time on the seed protein quantity and protein yield of beans.

The experiment was conducted on sandy soil without irrigation. Plots were arranged in randomized blocks in 4 replications. The experiment was set up in 3 sowing times, 3 plant densities, 3 fertilizer treatments and 3 dry bean cultivars in 10 m^2 plots in Nyíregyháza (Hungary). In this publication, we presented the effects of sowing time and fertilizer treatments on protein quantity and seed protein yield of small-seeded 'Start' bean cultivar at 300 000 germs ha^{-1} also referring to the weather conditions. The protein yield per hectare is also affected by the yield, which depends on the weather. However, even fertilizer can only be effective under favourable conditions. The yield was negatively affected by atmospheric drought that was caused together by temperatures above 25-30 °C during flowering and a lack of precipitation. The effective fertilization needs at least 65% of relative humidity.

The protein content of the seed was calculated from the nitrogen values measured with a Vario-Max CNS analyzer. The evaluation was carried out using Excel and the SPSS 22.0 program package.

Bean is ecologically sensitive plant. This was also reflected in the yield. Weather was favourable for growing beans in 2016-17. In case of favourable weather, the applied fertilizer increased the protein content of the seed, yield thereby protein yield. In 2015 the weather of the 3rd sowing season was quite unfavourable. In this year the proportion of hours with relative humidity above 65% compared to the total flowering time was the lowest during the 3 years. The proportion of critical temperature values was also the highest during the 3 years. The weather conditions proved the strong differences between crop results.

In all three years, the 150% fertilizer treatments of the 3rd sowing period resulted in the highest protein content. In case of favourable weather, the treatment combinations of the 3rd sowing time had higher yield and protein yield, although the significant effect of increasing fertilizer doses was not proved.

In case of favourable weather, we verified a positive, strong significant relationship between sowing time, protein content, yield and protein yield.

Potato and rye plant production without NPK chemical fertilizer based on the Westsik's crop rotation long-term field experiment

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Abstract

The harmful effects of chemical fertilization could damage our environment (soil acidification, changes in availability of microelements, nitrogen and phosphorus pollution of surface and underground waters, etc.), resulting in significant impact on our health. One-sided nutrient supply with some macroelements could change the element ratios of crops and decrease the microelements content of food. High doses of nitrogen fertilization result in an increase in the nitrate content of food, which obstructs the transport of oxygen.

In the present study, we examined the average yield and yield stability of potato and rye over a long period of time without NPK fertilizer. The research was carried out in the Westsik's long-term crop rotation (CR) field experiment established in 1929. The sandy soil of the experiment has low humus content (0.5-1.0%) and acidic pH (pH_{KCl} 3.9-5.2). The experiment includes 14 three-year-long and 1 four-year-long crop rotations. From the 15 crop rotations CRs I, VII, X and XV were selected, where the treatments are as follows: in the CR I we did not apply fertilization, but the soil was fallowed periodically (every 3 year). In the CR VII straw manure (26.1 t ha^{-1}), in the CR X farmyard manure (26.1 t ha^{-1}) and in the CR XV green lupine manure as a second crop were applied. The rye and potato were grown in each crop rotation. The yield data of potato and rye (1931-2022) was analysed by one-way ANOVA ($P<0.05$) followed by the Tukey-test, and then the coefficient of variation of the yield averages were determined, based on the standard deviation and the averages.

The average yield of potato in the farmyard manure (CR X) was significantly higher (11.74 t ha^{-1}) than that without fertilization (CR I, 5.11 t ha^{-1}), in the straw manured (CR VII, 8.68 t ha^{-1}) or in the green manured (CR XV, 8.67 t ha^{-1}) crop rotations. Moreover, CRs VII and XV were also significantly higher than CR I. The average rye yield in CR VII was 1.39 t ha^{-1} which was significantly higher in the CR I and CR XV, while it was significantly lower compared to the CR X. The coefficient of variation of potato yield averages varied between 48 and 58%, while in the case of rye it was between 31 and 39%. The smallest coefficient of variation value was in the CR XV for potatoes and in the CR VII for rye.

A higher yield with farmyard manure was achieved than with straw manure, green manure, or periodical fallowing of the soil. The yield fluctuation was higher in case of potato than in case of rye. Comparing the fertilization methods, the yield fluctuation of rye and potato was the greatest one in the crop rotation without fertilization (CR I). In case of potato, the most balanced yield was resulted by green manure application, while in case of rye, straw manure had the best effect. Based on the results of the Westsik's crop rotation experiment, soil fertility can be maintained for a long time even without NPK fertilization, resulting in sustainable crop cultivation.

Unravelling Factors Affecting Element Concentrations in Sorghum [Sorghum bicolor (L.) Moench] Grain Varieties: Implication for Human Nutrition

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Abstract

Nitrogen fertilizer application can enhance nutrient absorption and utilization in plants such as sorghum. fertilizer dose improves the availability and uptake of crucial elements like phosphorus, iron, zinc, and calcium. These elements play a pivotal role in supporting human health and overall well-being. The study was meticulously crafted to delve into the intricate interplay of various factors affecting the bioavailability of elemental content in sorghum, mainly when cultivated in non-native sorghum sites. Lightness, the exact factor that can be nutrient management, has the potential to impact human diets and nutritional intake positively. In this study, we evaluated findings derived from two sorghum production sites in Hungary: The Research Institute of Nyíregyháza Westsik field (47°58'387" N 21°42'16.2" E) at the University of Debrecen and the Research Institute at Karcag (47°17'27.2" N 20°53'27.8" E) at the Hungarian University of Agriculture and Life Sciences. The study was conducted over two years (2020 and 2021), and the production sites were categorized by distinct soil types (sandy and loam clay), with pH ranges of 7.2 to 7.5 and 4.7 to 4.9. The study was conducted with two levels of N fertilizer: Nitrate (27% N CAN) was applied at 60 kg-1/ha and 120 kg-1/ha for each treatment. Additionally, five diverse varieties at different ripening times were examined: Alföldi 1, ES Föehn (Lidea Seeds) with a red pericarp, ES Albanus, Albita, and Farmsugro 180, all of which were white. We measured various wavelengths corresponding to minerals (P, K, S, Ca, Mg, Na, Fe, Zn, Cu, Mn, Cr, Sr, Al, Mo, B, Ba, and Ni) using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) technology. Additionally, we employed the Kjeldahl method to measure N mineral content. One-Way ANOVA and Two-Way ANOVA tests demonstrated a variance of $P < 0.05$, leading to the acceptance of the study's hypothesis. The results indicated significant differences between soil types and plant varieties. Farmsugro180 and Alfoldi 1 exhibited positive responses to mineral assimilation and accumulation following the administration of N fertilizer, with a significance level of $P < 0.05$. This led to a notable average range, such as P (3299 mg/kg) and Ca (382 mg/kg) in loam clay soil and P (2962 mg/kg) and Ca (456 mg/kg) in loam clay soil, as well as P (3095 mg/kg) and Ca (366 mg/kg) in sandy soil and P (2901 mg/kg) and Ca (428 mg/kg) in sandy soil. We affirmed the dependability and validity of these findings by comparing them to the standard (ES Foehn) variety, which exhibited comparable P concentrations in the two soil types (3095 mg/kg to 3169 mg/kg).

According to research, sorghum is a prospective source of nutrients and essential elements for human consumption. The nutritional value and bioavailability of sorghum could have been considerably enhanced by analysing the impact of fertilisers, responses, and interactions between the various elements and selecting adapted sorghum varieties. Recent data from Hungarian sorghum grain varieties have confirmed the veracity of the findings, in line with the validity of the standard variety (ES Foehn).

Examination the parameters of compost solution depending on the extraction time and temperature

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Abstract

Composting represents an efficient technology that enables the effective utilization of by-products and waste materials. Moreover, it proves to be highly suitable for processing raw materials and converting them into fertilizers that would not be recommended for direct application without undergoing pre-processing. This is particularly crucial in the case of poultry manure, which possesses potentially hazardous properties and necessitates pre-treatment. One increasingly prevalent form of compost is known as compost solution, which involves the immersion of compost in water.

In this experiment, compost solution were created using a product called composted and pelletized poultry litter (CPPL). Four compost:water ratio (CWR) (1/2.5, 1/5, 1/10, 1/20) were applied, along with three different extraction durations (24, 48, and 72 hours) and three distinct extraction temperatures (20°C, 35°C, and 50°C). Since the 1/10 and 1/20 ratios were found to be the best for subsequent applicability and spreadability, their content parameters were measured further. After elimination of the experiment, the most important nutrients (nitrogen content (nitrate and ammonium), phosphorus and potassium) were determined.

The results showed that the nutrient content was highest for all four parameters at the extraction temperature of 35°C. For example, while at 20 and 50°C the NO3- content ranged from 263 to 768 mg/l and from 210 to 534 mg/l, at 35°C it ranged from 498.33 to 2636.67 mg/l, irrespective of the mixing ratio and extraction time. If the extraction temperature is not taken into account, the nutrient content increased with the increase of the extraction time, so that the highest values were measured at 72 h extraction time obviously. The data measured in the present experiment will serve as a basis for subsequent experiments with different indicator plants, investigating the effect of compost when applied as a solution.

Key words: compost solution, nutrient content, poultry litter

Biocontrol of aflatoxin B1 mycotoxin production under drought stress

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Abstract

As a result of climate change and global warming, research of protection against contamination of aflatoxin B1 has increasing importance since feed and food contaminated with aflatoxin cause serious economic damage. Using atoxigenic *Aspergillus flavus* isolates can effectively reduce the contamination of aflatoxin B1 in corn. However, climate changes, especially drought stress, make unpredictable the biocontrol effect on fields. Hungarian *A. flavus* isolates were selected based on their genome sequences and secondary metabolome. An identified atoxigenic and a toxigenic strain were applied in an *in vivo* micro-plot experiment that was conducted for three years (2020-2022) under different environmental conditions on the same corn hybrid [SY Orpheus (FAO 370-390)]. We examined the starch and protein content, mycotoxin contamination and mould count in irrigated and non-irrigated conditions at different N supplementation. The nutrient values responded well to climatic conditions without the effect of the fungal inoculations. The atoxinogenic *A. flavus* used as a biocontrol agent successfully reduced the aflatoxin B1 contamination of corn in 2020 and 2021, but in 2022, and was found to be hindered by the drought stress and the increasing N supplementation. Parallel endemic *Fusarium* contamination proved by fumonisin mycotoxin presence was in negative correlation with aflatoxin B1 contamination. Changing climate modifies the effectiveness of the biocontrol organism that should be considered.

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Fractionated selenium biofortified fresh alfalfa, a novel approach to increase added value in Green Biorefinery's products

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Abstract

In this research, the combination of agronomic selenium fortification and green biorefining in the perennial alfalfa as model crop was investigated. Through biofortification, we can enrich agricultural crops with the valuable trace element in an organic form, which is better for biological benefits. Green biorefinery processing can produce leaf protein concentrate (LPC) with satisfactory protein content for the feed industry, while providing feedstock for a wide range of bio-based industries such as press fibre and plant whey.

Three forms of selenium; selenite, selenate and red elemental selenium, were investigated in small plot (4,4 m^2) field experiment at the Demonstration Garden of the University of Debrecen. First year alfalfa plants at the5-10 leaf phenological stage were spray-applied with selenium at concentrations of 5 and 50 mg/m^2 for selenite and selenate; and 50 and 100 mg/m^2 for red elemental selenium. After the treatment, three harvests were carriedout according to the crop production practice. Fresh biomass was fractionated by green biorefining, alfalfa green juice was thermally coagulated using patented technique and separated by filtration into LPC and plant whey.

The amount of fresh alfalfa varied between 1.8- 2.0 kg/m^2 during the harvests, with 50 mg/m^2 selenate and selenite treatments producing on average more biomass than the control, but not statistically significant. The crude protein content of LPC resulting from the fractionation varied from 38.16-39.89 %, press fibre 10.54-11.73% and plant whey from 1.05-1.18 %. High concentration selenium treatment (50 and 100 mg/m^2) reduced the crude protein content of LPC and fibre by 0.5-1% in average. Selenium accumulation was highest in LPC, followed by fibre and plant whey. The highest selenium content was measured at the first harvest after treatment, with 3349 µg/kg in LPC treated with 50 mg/m^2 selenate, which was reduced to 1053 µg/kg at the second harvest. For other treatments, the rate of decrease was lower.

The results suggest that by choosing the right form and concentration of selenium, the selenium content of perennial green fodder crops can be increased over successive harvests. Selenium enriched LPC, fiber and plant whey can be produced as platform for feed and other industries.

Investigation of biomass growth of *Chlorella vulgaris* microalgae in different nutrient solutions

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Abstract

Chlorella vulgaris microalgae is easy to grow in low-cost nutrient systems and has a faster growth rate and higher biomass production capacity compared to terrestrial energy crops. However, the production and processing costs are still too expensive to make the microalgae competitive in the market. Indeed, this is one of the main problems that the microalgae industry is facing nowadays, but it must be acknowledged that significant improvements have been made over the last decade, therefore it is expected that the microalgae cultivation and utilization are becoming more and more important as a part of the future bioindustry. The remarkable values of *C. vulgaris* lie in its promising extensive applications such as agricultural, environmental, industrial and commercial. Currently, these microscopic organisms are still largely consumed as dietary supplements, but are also considered as a sustainable energy source due to their ability to accumulate large amounts of lipids that can be used for biodiesel production. The aim of the study was to investigate the effect of different chemical media on the biomass growth of *Chlorella vulgaris* microalgae. In order to reveal the above-mentioned connection, several chemical (NH_4^+, NO_3^-, K^+, PO_4^{3-}, COD, pH, electrical conductivity) and biological parameters (chlorophyll concentration, microalgae activity rate) of the nutrient solutions were investigated, as well as their absorbance values in the UV-visible light range. The experiments were carried out for 7 weeks with a regular sampling. The 4 different chemical nutrient solutions were prepared based on the well-known BG-11 nutrient solution considering variable nitrate and phosphate concentrations:

- C - control (BG-11);
- T1 – treatment 1 (BG-11 with increased nitrate concentration);
- T2 – treatment 2 (BG-11 with increased phosphate concentration);
- T3 – treatment 3 (BG-11 with increased nitrate and phosphate concentration).

The results showed logarithmic and linear decreasing tendencies for all the chemical parameters investigated in the samples, while the chlorophyll and carotenoid concentrations represented an overall increasing tendency week by week. The magnitude and direction of the changes were consistent with the biomass growth and microalgae activity rate. The most significant increase in biomass compared to the control was observed in case of the T3 nutrient solution (+58%). In T3 nutrient solution, the initial chlorophyll concentration was 22.3 $\mu g \cdot L^{-1}$ that reached its maximum value of 1,103.65 $\mu g \cdot L^{-1}$ by the end of the experiment. It was concluded that the growth of microalgae can be characterized by an exponential equation, where the maximum achievable chlorophyll concentration can also be calculated. The applied exponential equation is suitable for the determination of the optimal cultivation time for the investigated media that results in lower production costs.

Keywords: N fertilizer, element content, sorghum grains, diverse varieties, healthy diet.

Chemical defence compounds produced by species of the *Poaceae* family

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Abstract

The *Poaceae* family ranks 5th in the number of species in the Angiosperm phylum with approximately 12,000 species. Its species colonise biomes that are landscape-dominant in different continents (steppe, savannah, prairie,pampas). They are the food of herbivores in these habitats. Their various cultivated species provide essential food for humanity and fodder for our farm animals (e.g. cultivated wheat, rice, maize).

Species of this family have also coevolved with their pests and competitors, with both plant species and their natural enemies surviving in a mutually interacting way. During coevolution, plants have evolved different strategies to mitigate damage, in order to repel pests. Morphological and physiological specificities ensure plants' ability to defend themselves.

Of particular importance are the compounds produced by species of the *Poaceae* family to ensure the self-defence of individuals. Some of these compounds are produced continuously by the plant, independently of damage (phytoanticipins), while others are produced in response to damage (phytoalaxins).

The effects of these compounds can be quite wide-ranging: repellents, inhibitors of development, transformation, reproduction, colonisation, infection. Some compounds also build up resistance in uninvaded, uninfected parts of the plant (acquired resistance).

However, the capacity for self-defence can vary within species, and this is of economic importance in relation to differences in resistance between varieties and hybrids of cultivated species.

Cultivars or hybrids with more effective chemical defence show lower levels of damage in their stands, which has a significant impact on the cost of crop protection. Breeding and selection methods can improve resistance, which manifests itself in more effective chemical defenses and significantly reduces environmental stress.

Compounds involved in the chemical defence of species of the *Poaceae* family include a rather diverse group of compounds: without being too exhaustive, these compounds are flavonoids, terpenoids, benzoxazinoids, alkaloids, proteinase inhibitors, oxalic acid, cyanogenic glycosides.

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The Effect of Copper Sulfate on the Turkey Spermatozoa Motility

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Abstract

Risk elements are a much-discussed topic, as with their effects, they act on animal systems or for reproduction. Many of them in this extremely sensitive process causes subfertility and infertile conditions. This study is focused on the effects of copper sulfate on turkey spermatozoa motility using the CASA method. The aim of our study was to investigate the effects of copper sulphate in different concentrations on spermatozoa motility and progressive motility (Table 1, 2). We analyzed the ejaculate of male adult turkey at a temperature of 41°C and in the time interval 0, 30, 60 and 90 minutes. In the experiment concentration 0.05; 0,025; 0.0125 and 0.00625 mg/ml of copper sulfate (M1 – M4) was used and compared with control (K). The most significant decrease motility was observed in the time interval of 30 minutes (50.75 vs. 22.19%). The progressive motility after a relatively short time period, after 30 minutes, in the sample with the highest concentration of copper sulphate versus control shows a significant decrease (25.3 vs. 3.72%). The results of our study show that even a very low concentration (0.05%) of $CuSO_4$ have a negative impact on all parameters of spermatozoa motility.

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Historical and future projected agricultural drought in Hungary (1900-2100): assessment of machine learning and CMIP6 scenarios

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Abstract

Agricultural drought has devastating impacts on crop production in Central Europe, resulting in reduced crop yield and economic loss. This research aimed to use machine learning ML to predict agricultural drought (SPI-3), in Hungary from 1901 to 2100. Thus, three meteorological stations in Budapest, Szeged, and Szombathely were chosen for this analysis.

Using ensemble data from three global circulation models, projections for rainfall, mean, maximum, and minimum temperatures were derived for two socioeconomic pathways (SSP2-4.5 and SSP4-6.0). The research found that droughts have intensified in the recent past and are expected to worsen from 2021 to 2040. Historical data also indicates rising temperatures and decreasing rainfall, leading to increased drought.

Machine learning algorithms were tested, and the Random Forest (RF) model using a combination of rainfall and mean temperature data (RF-SC3) showed the best forecasting accuracy for SPI-3. Therefore, the RF-SC3 model was applied to the other two stations, and it consistently performed well, especially under the SSP2-4.5 scenario.

The study suggests that SSP2-4.5 can offer more accurate drought predictions for the future, aiding in sustainable water management. However, plans are necessary to address the anticipated severe droughts in 2028, 2030, 2031, and 2034. This research highlights the efficacy of the RF model in predicting short-term droughts, which can be pivotal for future drought management strategies.

Study of effect of organic based composites on water and nutrient uptake of tomato in small pot experiment

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Abstract

Hectic rainfall patterns and climatic anomalies in recent years have highlighted the importance and significance of maintaining soil moisture levels to achieve adequate yields and quality. Another problem facing farmers is the constant declining organic matter content of soils. Highly important these statements in the fruit and vegetable growing sector where the shortage or/and excessive water and declined soil organic matter content cause serious damages and yield loss.

To solve these pressing problems, we have developed organic fertilizer-based composites that are capable of preserving soil moisture over the long term and increasing the organic matter content of the soil, simultaneously. (Solanum lycopersicum cv. Mano)

To get information about the effects of developed products on water and nutrient management of soil, and plant growing, a small pot experiment was carried out. In this experiment, SAPs (in synthetic and organic forms and doses) and clay mineral (CM) were mixed with fermented poultry manure (Natur Extra) to study their combined effects on water consumption, nutrient supply and yield. So six treatments with three replications were applied in the experiment. The amount of Natur Extra and CM were constant, while two SAP types and doses were used. In the experiment, brown forest soil with a sandy texture was used at a 60% soil water holding capacity level, provided by daily irrigation.

Water consumption, biomass production, leaf pigments and soil parameters were measured at the end of the experiment.

Statistical analyses were performed using R software in an R Studio user environment (version 4.0.3.).

The least amount of water was added at the control treatment over the three-and-a-half-month period. Manure and other additives increased the water consumption compared to the control. Water consumption was the highest at organic-based SAP treatment. At the end of the experiment, the difference between the highest and lowest water consumption was more than 30%. However, treatments reduced the specific water uptake due to better water utilization.

The highest yields were obtained by the organic-based SAP treatments. Moreover, the WUE value was reduced by half compared to the control. It was found, that plants that used hydrogel developed better than the control plants or when applied only chicken manure. In the trial, there were differences in height, number of branches, leaves and flowers, differences due to the better nutrition regime for plants tested on hydrogel pots. All treatments increased the dry matter production compared to the control. Treatments resulted in more than two- and threefold increases in dry matter mass, compared to the control. Furthermore, SAP treatments had an increasing effect on the dry matter content compared to chicken manure treatment.

Extration of free and bound plyphenols from brans of sorghum bicolor

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Abstract

Sorghum is a drought tolerant, gluten–free cereal, which is known for the abundance of polyphenolic compounds, mainly flavonoids and tannins. It is proved that these compounds have important health benefits as antioxidants, and anti–inflammatory agents. These compounds can be found in the seed walls in a free form or in a bound, esterified form, which affects their digestion and utilization. The use of sorghum is rapidly improving nowadays and there is also a surge of demand for new ingredients in the gluten free market. Our aim was to evaluate the ratio of free and bound polyphenols in two sorghum varieties, and analyse the effect of extraction on the extractable polyphenol amount and their antioxidant activities.

Two red sorghum varieties were included in the research. Brans prepared from the grain of these varieties were extracted three times using methanol:distilled water and acetone:distilled water solvents, then residues were digested using acid and extracted by diethyl–ether:ethyl–acetate solvent four times. TPC, TFC and CTC with antioxidant properties were measured using spectrophotometric methods.

The different solvents had significant effects on the polyphenol content and flavonoid content of free polyphenol extracts, but there was not any difference in terms of antioxidant activities of free polyphenol fractions. In case of bound fractions from different extractions, there were significant differences in all parameters, except for the flavonoid content. The two red varieties significantly differed from each other in terms of total phenol, flavonoid content and antioxidant properties as well. The bound polyphenol content of acetone extracted samples were significantly higher compared to methanol extracts, but the reason for this is require further evaluations. In this work two sorghum varieties rich in polyphenols were identified with the potential to use as a functional food ingredient, and there were significant differences between extraction methods, but further investigation is necessary to specify more extraction factors.

This project was performed with the support of the New National Excellence Program of the Ministry of Culture and Innovation.

Comparison of the Klason lignin content of different beer industry by-products

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Abstract

Keywords: Brewers' spent grain, lignin content, by-product recovery, sustainability

The main objective of the research is to compare the Klason lignin content of different beer industry by-products. Most of the by-products from the brewing industry are brewers' spent grain (BSG). Our research compared three types of brewers' spent grain: barley, wheat and oats.

We aim to recycle the grain sustainably used by beer brewers and upgrade it for the food industry. The technological classification of the fractions of brewers' spent grain is an important parameter for product development. In terms of fibre content, it is important to know the fibre content and substances in the technologically fractioned brewers' spent grain.

The measurements were carried out in the laboratories of the Food Innovation Centre of the Institute of Food Technology, Faculty of Agriculture, Food Science and Environmental Management, University of Debrecen and the Department of Applied Plant Biology, Institute of Plant Sciences.

The raw materials were barley, wheat and oat brewers' spent grain, which were dried, milled and graded by particle size using a sieve analysis. The moisture content of the samples was 9% in all cases. Klason lignin content was determined by two-step acid hydrolysis.

In terms of results, the highest Klason lignin content was found in the wheat-based brewers' spent grain. Overall, all samples contained high levels of Klason lignin, which could positively impact future product developments. Our work aims to raise awareness of the importance of sustainable food production. With our research, we would like to help consumers find their ideal source of fibre, as there is now a growing public awareness of the importance of using sustainable ingredients.

Supported by the ÚNKP-22-3-II-DE-393 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation fund.

Time series data classification with mobile photogrammetric raster clouds

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Abstract

Vehicle-mounted, wide-angle cameras combined with deep learning algorithms are proving to be a powerful mapping tool (e.g. Google Street View). Such tasks include facilitating adaptation to the increasingly common extreme rainfall events attributed to climate change. Repeatable rapid surveys of agricultural parcels have the potential to combine ground and satellite information over large areas, enabling cost-effective planning of cultivation tasks such as more efficient nutrient supplementation, pest management, irrigation water use. In this paper we describe our experience with a photogrammetric data acquisition system (FODAR).

The vehicle mounted Geometer device takes images every two metres along the routes travelled, which can be evaluated on its cloud-based geographic information platform. The geospatial data can then be displayed and evaluated interactively. On-the-move survey control is also provided. A powerful on-board computer can be used to monitor the recording during fieldwork. After the survey, the software automatically converts the recording metadata for cloud-based processing. It is also possible to determine the geographic position of point objects and measure distances and areas. The artificial intelligence used by the system uses deep learning algorithms to recognize and pinpoint with high accuracy on the map various objects on the surveyed road sections, such as traffic signs, but also fire hydrants, sewer covers, stormwater drains and other objects related to urban hydrology.

The use of such equipment in precision agriculture is not yet widespread, despite the fact that due to its vehicle mountability also can be used for mapping of ploughs or orchards and for effective assessment of crop growth. Our aim in using the tool was to build a prototype workflow to evaluate the data set that is expected to become available in the near future.

Patterns in the data, such as vegetation health, that are present in the data and have not been investigated so far, could lead to an increase in the profitability of management decisions by including the near-infrared band in photogrammetric analyses. In contrast to teaching deep learning algorithms, the object detection and image classification itself can be done with relatively little hardware effort, but future trends must be taken into account. For processing a large number of images submitted by cloud-connected vehicles, it may be worth considering a dynamically scalable hardware infrastructure. In addition, objects of agricultural interest identified by the technology could also serve as calibration data for aerial or even spaceborne imagery.

The abstract was funded by European Union's Horizon 2020 "WATERAGRI Water retention and nutrient recycling in soils and steams for improved agricultural production" research and innovation programme under Grant Agreement No. 858375. Project no. TKP2021-NKTA-32 has been implemented with the support provided from the Na-tional Research, Development and Innovation Fund of Hungary, financed under the TKP2021-NKTA funding scheme.

Potassium content in cauliflower from various sales channels in the City of Zagreb

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Abstract

Cauliflower (*Brassica oleracea* var. *botrytis*) is a vegetable rich in minerals, especially potassium. Potassium has a great importance as a biogenic element in human nutrition and the daily potassium requirement of an adult is 2000 mg. The aim of this study was to investigate the potassium content of cauliflower offered to customers and consumers in the markets of the city of Zagreb. Samples were taken in triplicate from three retail chains, three markets and three stores of organic products. After sample preparation, drying, homogenization and digestion in a microwave oven with HNO3 and HClO4, potassium was determined by flame photometry. The dry weight of cauliflower samples varied between 6.20 and 7.93% (7.00 in retail chains, 6.73 in markets and 6.70% in organic products stores). The determined potassium content in dry matter ranged from 3.94 to 5.37 % K DW (4.26 in retail chains, 4.33 in markets, and 4.98 % K DW in organic stores). Potassium content in fresh matter ranged from 496.85 to 880.41 mg K/100 g fresh weight (620.35 in retail chains, 656.83 in markets, and 753.16 mg K/100 g fresh weight in organic stores). By eating 100 g of studied cauliflower, a person can meet 24.8-44.1% of the recommended daily potassium requirement.

Keywords: *Brassica oleracea* var. *botrytis*, daily need, macroelement, minerals, vegetable

Exploring the Potential of Green Walnut Extract in Developing Specialized Bee Products

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Abstract

This study presents a novel solution to the challenges faced by Bees due to global warming through the introduction of a new Bee feed product, the Green Walnut Bee Product. The depletion of natural food sources and the spread of diseases have had a negative impact on Bee populations, affecting agriculture and food security. In response, the study aimed to develop a healthy Bee product that supports Bee conservation and meets the growing demand for healthy foods. The Green Walnut Bee Product is prepared by fermenting green walnut extract with normal sugar and placing it in Beehives. The Bees readily consumed the feed, and the product produced by the Bees was evaluated to have significant health benefits and the potential to produce high-quality, healthy Bee products. The technology can improve Bee health, promote sustainable agriculture, and provide a valuable source of nutrition for humans. It offers a sustainable alternative to chemical-based products and has potential health benefits, including antioxidant, antimicrobial, and Blood sugar-reducing properties in Humans. The study highlights the importance of Bee conservation and the need to address the challenges faced by Bees. The Green Walnut Bee Product can be scaled up for commercial production, providing a new source of income for Beekeepers, promoting Bee conservation, and contributing to the local economy. Overall, the Green Walnut Bee Product offers a promising solution to the problems faced by Bees due to global warming, while also providing a new segment of healthy Bee products for human consumption. The different studies have been conducted like Measurement of macro and Micronutrients, GC-MS, ICP-MS, UVI and Human clinical trials etc. In this poster you will see the standardization of technology including above results.

Keywords- Green walnut, Innovation, Bee Feed, Bee product, Bee conservation etc.

Effect of the year on the yield components of „Szabolcs" triticale (x Triticosecale Wittm.) variety in a nitrogen fertilization experiment

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Abstract

The nitrogen nutrient supply of cereals is one of the important factor in determining the yield quantity and quality parameters, and it can be decisive for the economics of cultivation. Many results have been obtained for the scientific basis of professional fertilizing about winter wheat in Hungary, but there are few experimental results available about triticale. Triticale can be grown using fewer chemicals (fertilizers and pesticids) than winter wheat, its cultivation involves less environmental impact and it is suitable for the production of healthier food raw materials and feed. Since 2013 we have been studying the effect of nitrogen fertilizer on grain yield, yield components and baking quality of *Szabolcs* triticale variety in field experiments at the University of Debrecen, Institutes for Agricultural Research and Educational Farm, Research Institute of Nyíregyháza. Now we studied the effect of nitrogen nutrient applied in different doses and in different phenological stages on the grain yield components of triticale.

The nitrogen fertilizer was applied in the form of Calcium ammonium nitrate (0, 50, 100, 150, 200, 250 kg N/ha) at 3 times (before sowing in autumn, at the time of tillering and at the beginning of earing), divided in different proportions. The fertilizer treatments were set up in a randomized block arrangement with four replicates, the plot size was 1.2 m x 9.2 m, the applied triticale seed dose was 4.5 million germ/ha. We present the results about the *Szabolcs* triticale yield components parameters (number of ears, length of ears, number of seeds per ear, weight of seeds and weight of 1000 seeds) recorded in two crop years with different amount of precipitation. In the spring of the first year the amount of precipitation was average (276 mm in I.-V. months), but the similar period of the second year was characterized by a drought (140 mm in I.-V. months), which determined the utilization of spring nitrogen fertilizer. We detected a significantly positive effect of early spring nitrogen top dressing on the number of ears per meter and the length of the ears with average water supply. The number of grains per ear was increased by all nutrient treatments in every application date, but the effect was statistically verifiable only in the case of treatment applied at the time of earing. The nitrogen fertilizer used before sowing and during the period of tillering had no effect on the seed weight per ear. Nitrogen top fertilizer applied at the beginning of earing resulted in a 3.5-11,4% increase in grain yield per ear, but the differences compared to the control could not be verified statistically. The first top-fertilizer treatment in spring resulted moderate decreasing at the thousand-seed weight, but the second treatment increased this yield component, but in both cases, the differences were not significant. Summarizing our results we found that nitrogen top dressing has a significant effect on the crop yield production of triticale, and its effect strongly depends on the amount of precipitation following its application.

Effect of NaCl-induced Salinity Stress on Some Morpho-Physiological and Biochemical Traits of Two Chickpea (*Cicer arietinum* L.) Genotypes under Hydroponic Conditions

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Abstract

Chickpea (*Cicer arietinum* L.), is the second most important food legume and it is an important source of protein, minerals, fiber, and vitamins in the diets of millions of people in Asia and Africa. The agricultural sector needs to reduce the use of freshwater, which became very scarce and of low quality due to climate change, which can enhance the accumulation of soluble salts in the groundwater, therefore using saline water in the future for agricultural production is unavoidable. The growth of chickpea is very sensitive to salinity and it is among the most susceptible crop species. The research was conducted to evaluate the response of two chickpea genotypes (Elmo and Orion) to different levels (25, 50 and 75 mM NaCl) of salinity stress, based on some morphological, physiological and biochemical traits under hydroponic conditions. The assessment of the impact of NaCl-induced salinity stress was done in a controlled environment room, where the air temperature was maintained as 24/18°C day/night temperature; 10/14 h light/dark photoperiod; 45% relative humidity and 350 µmol $m^{-2}s^{-1}$ light intensity, at the Institute of Crop Sciences, University of Debrecen, Hungary. On the 35th day after imposing of salinity stress, plants samples were collected to estimate the performance of these two investigated genotypes based on some morphological (shoot and root length, shoot and root dry weight), physiological (stomatal conductance) and biochemical (relative chlorophyll content) traits. Increased salinity stress in the growth medium caused a remarkable decline in all the investigated traits for both the studied genotypes. NaCl-induced salinity stress caused significant reduction in shoot and root length, shoot and root dry weight (37.36, 39.59, 57.51 and 68.80% respectively), but it has been noticed that the average reduction percentage was higher in the roots compared with shoots, but the root to shoot ratio was significantly lower under salinity stress (0.304±0.02) compared with the non-saline conditions (0.414±0.02). Salinity stress induced significant reduction in both the stomatal conductance (gs) and relative chlorophyll content (SPAD value) in both the studied genotypes (51 and 46.63% respectively) compared with the control, but these two parameters were significantly higher in the chickpea genotype Orion (335.68 mmol H_2O $m^{-2}s^{-1}$ and 26.24 mmol H_2O $m^{-2}s^{-1}$ respectively) compared with Elmo (299.75 mmol H_2O $m^{-2}s^{-1}$ and 25.43 mmol H_2O $m^{-2}s^{-1}$ respectively). However, it is very essential to assess the genotypic variability of chickpea in response to salinity stress under field conditions, based on more in depth physiological, biochemical and molecular traits to efficiently identify the salt-tolerant cultivars.

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Comparison of chickpea varieties at early maturity stage (R5) under the conditions of Lower Silesia - Poland. Preliminary study

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Abstract

The worldwide temperature-increase and the other fluctuations in the weather conditions are results of the climate change as reported by several studies. The challenge for researchers is to find alternative crop species that are better adapted to the future conditions. Chickpea (*Cicer arietinum* L.) is a very important legume crop consumed all over the world and grown especially in warm climate of Africa, Asia and other countries. A distinctive feature of chickpea is the activity of oxidase, which is expressed under warm stress conditions. The increase of the enzyme concentration reflects on the ability of chickpea to react to stress and acclimate to changing environmental conditions.

A preliminary, explanatory study was conducted in order to assess the usefulness of chickpea in the conditions of south-western Poland. The research was initiated in 2023 in bilateral cooperation with the University of Debrecen. Three chickpea varieties were sown in two different soils: very heavy, clay soil and on light, sandy soil. Seeds of 3 varieties: Amorgos, Orion and Elmo were sown on May 15th at a plant density of 50 seeds per m^2. In the beginning of August (87 days after sowing), 10 plants were collected from each soil and from each varieties variant. Plant weight, the number of branches, the number of pods per plant, the number of unset seeds, and the weight of pods per plant were determined. In addition, the weight of pods and the weight of seeds of 10 pods were determined (tab. 1). On the basis of the weight of pods per plant and the theoretical number of plants per 1 m^2 (50 plants), the yield of pods per hectare was calculated in the R5 phase, which corresponds to the common date of harvesting green peas.

Table 1. Morphological parameters of chickpea varieties in different soil types

Soil type	Variety	ant biomass (g)	anch number	ds number per plant	weight plant^{-1} (	f seeds in pod	retical pods yiel t per ha
Sandy soil	gos	116.6cd	8.9	83.8	50.6ab	48.6a	25.3ab
		49.8abc	8.1	31.5	22.8a	72.1d	11.4a
		110.5bcd	8.2	47.5	63.0b	73.0d	31.5b
Heavy soil	gos	146.3d	9.6	90.1	65.7b	57.2ab	32.8b
		40.4a	5.3	26.9	21.4a	69.1cd	10.7a
		46.5ab	4.6	25.9	22.5a	60.0bc	11.3a

Preliminary results have shown large differences among chickpea varieties. Significant differences were found in the plant biomass, the weight of pods per plant, the percentage of seeds in a pod and the theoretical yield. The variety Elmo (desi type), regardless of the type of soil, was characterized by significantly lower values of the studied parameters.

New thiamine forms in our foods

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Abstract

Over the last decade, there has been increasing attention to the role of H_2S as a third signalling molecule in the body. Several researches have highlighted it is a 'Janus-faced' component with pleiotropic effects, as it can modulate a number of signaling pathways. Both its deficiency and extreme accumulation induce deleterious biochemical processes. There is currently no natural H_2S donor available, so sulphide salts, NaSH and Na_2S, are the most commonly used H_2S donors. However, sulphide salts release H_2S uncontrolled and can cause acute toxicity inorgans. To the best of our knowledge, there are few naturally occurring H_2S donors, such as the allyl group family of compounds. This includes allithiamine, a lipophilic derivative of water-soluble thiamine (vitamin B1). Fujiwara identified this compound in the 1950's in garlic and later in other species of the genus Allium. In recent years, Remenyik et al. (2018) were the first to isolate it from the seeds of Hungarian peppers (*Capsicum annuum*) and developed an extraction procedure and analytical method for its detection. They have developed+ a method for the semi-synthetic and synthetic production of the molecule. The team has investigated its physiological effects in an *in vitro* cell model and is currently conducting studies *in vivo* in animal models. Our results confirm that allithiamine is a H_2S donor-type compound. In my work, I will demonstrate the presence of allithiamine and its other derivatives in different plant samples.

NDWater magnetic technology for irrigation

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Abstract

The purpose of the experiment is to investigate the effect of irrigation water treated with the magnetic force on plant parameters, yield and content parameters. In addition to the theoretical irrigation water requirement, we also used a reduced amount, which mean an 80% irrigation water amount:

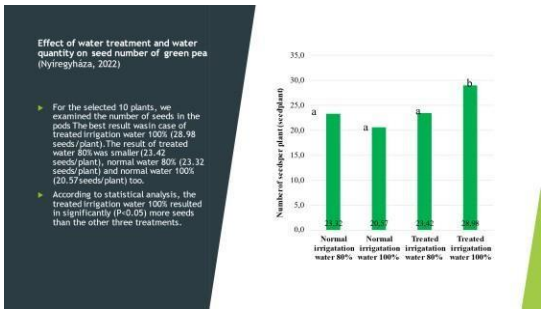
- Normal irrigation: water 100% quantity;
- Normal reduced irrigation: water 80% quantity, ,
- Treated reduced irrigation: water 80% quantity,
- Treated irrigation water: 100% quantity

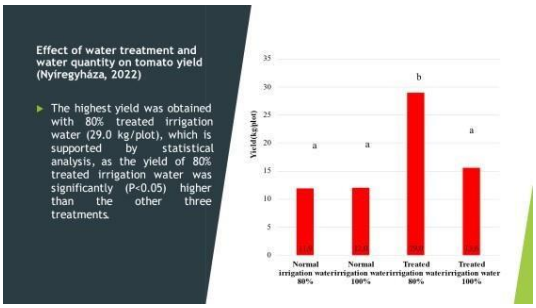
► Two types of plants (green peas, tomatoes) were used in this study. In each treatment, 6 repetitions were set for each plant species. The size of the plot was 1.7 m x 5 m.

► The tested genotype was the Zsuzsi variety for green peas, and the Fokker F_1 hybrid for tomato.

Based on our experience, irrigation with treated water resulted in positive changes in yield, plant size, size and number of individuals in the cases studied.

The research needs further investigation, in which the nutritional values and additional deficit irrigation should be investigated for different crop types.





Role of optimal gut microbiome composition in alleviating stress-induced effects and antibiotic resistance in poultry farming

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Abstract

Over the past 20-25 years, the poultry industry has evolved into a specific protein production system. However, the stress resulting from intensive rearing practices has led to numerous negative consequences, making the optimization of livestock gut microbiome composition crucial for mitigating these effects. Advancements in modern molecular biology methods have brought attention to the impacts of nutrients on gut microbiota. In our study, we extensively investigated the changes induced by feed formulations rich in phytonutrients on the gastrointestinal microbiota of livestock using targeted 16S rRNA amplicon sequencing. Our objective is to examine how the developed feed prototype affects the composition of core microbiomes in raised poultry, community diversity, and the resilience of complex microbial networks. We seek correlations between biological livestock and environmental samples to identify which community constituents, in what proportions and occurrences, may play a role in the development of specific diseases.

Based on our measurement results, it can be asserted that feed additives positively modulated "beneficial" community constituents. Beyond the impact of feed additives rich in phytonutrients, the composition of the microbial community in the poultry gastrointestinal tract is significantly influenced by the age of the birds. Furthermore, due to the presence of multidrug-resistant pathogens in environmental samples from livestock facilities, appropriate transmission risk management measures are of paramount importance.

In summary, while antibiotic use has decreased to varying degrees in most EU countries, Hungary still ranks as the fifth-largest consumer of antibiotics per unit of animal product, particularly in the context of economic livestock. Reducing and substituting antibiotic use through the application of feed additives rich in phytonutrients not only embodies a sustainable and environmentally conscious approach but also serves the production of safe and high-quality poultry meat for consumers.

Determination of melatonin and oxidative melatonin derivatives in sour cherry pulp

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Abstract

Melatonin is an indoleamine compound. Its indole structure contains a 3-amide and a 5-alkyl functional group. Apart from the fact that this chemical structure provides great stability, these groups are responsible for the amphiphilicity of the molecule, so the melatonin molecule can penetrate biological membranes, thus entering any cellular and subcellular compartment. Thanks to this, it is easily distributed in the body and provides effective protection against oxidative stress. During the reaction known as the melatonin antioxidant cascade, compounds with significant antioxidant properties are formed. The best-known metabolites of these are N1-acetyl-N2-formyl-5-methoxykynuramine (AFMK), N1-acetyl-5-methoxykynuramine (AMK), 6-hydroxymelatonin (6-OHM), 2-hydroxymelatonin (2 -OHM) and 5-methoxytryptamine (5MTA). Even in low concentrations, phytomelatonin in its own matrix (as opposed to synthetic melatonin) can enhance its beneficial effects on the human body, which can be indirect or direct. The melatonin concentrations determined for different model plants are inconclusive and difficult to compare, as there is no well-established test protocol.

During the experiment, three Hungarian cherry varieties (Újfehértó fürtös, Petri and Érdi bőtermő) we investigated in the period between industrial and biological maturity, at three sampling times at different times of the day (7 a.m.; 12 p.m.; 3:30 p.m. and 11 p.m.).

Three techniques were used for our measurements. HPLC-FLR and UHPLC-MS were used for melatonin and oxidative melatonin derivatives (N-acetyl-5-methoxyquinuramine (AMK), 6-hydroxymelatonin (6HM), N1-acetyl-N2-formyl-5-methoxyquinuramine (AFMK), 5-methoxytryptamine (5MTA)) determination and antigen-antibody binding ELISA were used to measure the concentrations of melatonin.

Determination of the relative amount of the ASMT/COMT protein responsible for the synthesis of melatonin by Western blot technique, 10% SDS polyacrylamide gel electrophoresis and Western immunoblotting with anti-ASMT/COMT antibody.

Our measurements show that different cultivars accumulate melatonin in different concentrations and that melatonin accumulation is significantly influenced by both ripening stage and time of the day. Besides regulating the circadian rhythm, melatonin has an antioxidant function.

Effect of chicken manure based composite soil conditioner on cucumber growth in small pot experiment

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Abstract

Todays, the main tasks of agricultural scientific sector to conducts researches and develops methods to ensure food safety by protecting the environment and human health while increasing product yield in more environmentally friendly ways. The modern perspective of sustainable agriculture sector concern biological based organic fertilizers. Chicken manure is a kind of organic hazardous waste in increasing amount year by year but it is regarded as a potential fertilizer due to its high nutrient contents. Application of so kind coproducts corresponding to the main aims of Green Deal.

The aim of current research is to enhance soil water management and improve soil organic matter content by using fermented chicken manure composites (CMC).

To evaluate the effects of CMC, a small-scale pot experiment was conducted. In the experiment, two different amendments were used: bentonite and two types of super absorbent polymer (SAP) to improve the properties of chicken manure. Developed, composite products were tested at a brown forest soil with sandy texture and low nutrient contents at two different soil water holding capacity levels (60 w/w % and 70 w/w %). Soil moisture content was set up by daily irrigation. Cucumber (*Cucumis sativus*) was used as an indicator plant in the experiment.

Six different treatments (with three replicates) were applied for this experiment, namely two types of controls (without manure and contains only chicken manure) and four different ratio's combination of hydrogels, and bentonite (in total, 36 small pots are used in the trial).

Subsequent to the experiment, both soil and plant analyses were conducted to evaluate the efficacy of the applied composites. Obtained values of soil and plant analysis then were assessed with ANOVA (single factor) to determine whether the mean differences between six treatments are statistically significant and then Post-hoc (Tukey HSD Method) analysis will be applied to any data set that has $P < 0.05$ and to know which treatments are significantly different from other treatments.

Results from the pot experiment indicated that CMC products showed an encouraging effect with significant differences in the aspect of total wet biomass, soil pH, and chlorophyll content when compared to the control, but there were no significant differences in the aspect of plant length, dry biomass, soil EC, ammonium content in soil and carotenoid content in the plant. It was found that the moisture content of the soil slightly affected the results but its effect was not significant some cases.

Furthermore, the water use efficiency significantly increases in those treatments when hydrogels are used. The usage of composites resulted in the plant requiring higher water consumption, but they also increased the plant biomass weight significantly, which is very important in the calculation and application of irrigation water amount. In general, it can be concluded that chicken manure with the combination of soil additives can improve soil characteristics and plant growth.

Investigating a selection method of protein-rich seeds in white lupin

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Abstract

In the case of cultivated plants, the content value is important. According to the variety description, the protein content of the white sweet lupine (*Lupinus albus* L.) cv. Nelly is between 36-38%, and to increase these values is the one of the main aims of breeding. The examination of the content values requires laboratory background, so inour experiment we tested if the method of Cooke-Stinson (1985) developed for selecting wheat seeds with high protein content could be used to select the protein-rich seeds for further propagation of white lupine.

According to the method by Cooke-Stinson (1985), the wheat grains were soaked in water at a temperature of 0.5 °C for 9-10 days, during which the protein in the seeds absorbs five times as much water as the starch.

In our experiment, we measured 500-500 g of lupine seeds. Before soaking, the moisture and protein content of the samples were measured with the INFRALINE version 3.1 device. The average moisture content was 12.11 (varied between11.4-12.7) %, and the protein content was 40.40 (varied between 9.05-41.23) %.

Soaking took place for 1-7 (daily), 10, and 13 days, in 1-1 liter of water at a 0.5°C temperature. After soaking, the seeds were separated in a sugar-salt solution, which was prepared as follows: 480 g of sugar dissolved in water and filled up to 2 liters, then 420 g of salt dissolved in water and filled up to 2 liters. The prepared two solutions were combined.

After soaking and separation, we determined the mass (g) and ratio of the floating and lower seed fractions, we calculated the amount of water absorption (g) and its ratio to the seed mass (%). After drying, the weight of the two fractions were measured again and the weight (g) of the substances dissolved during soaking and their ratio (%) compared to the original seed weight.

The water absorption depending on the soaking days, and was between 111.8-124.66% of the dryseed weight. As a result of soaking days increased, the proportion of floating pieces decreased from 94.81% to 26.27% based on the dry weight of the seeds. There was a difference of 18-35 g between the seed weight at the beginning and after soaking, which indicate 3.68-7.04 % weight loss occurred during soaking. The weight of the solution was 1.096 g/100 cm^3 on the 7th day and 1.077 g/cm^3 on the 13th day.

The samples soaked for 2, 4, 7 and 13 days were analyzed further. After drying them, the average protein concentration was 41.51% (lower fraction: 41.95%, upper-floating fraction: 41.08%). There was a -0.38-2.68% difference in protein content (absolute value) between the lower and floating fractions, the values of the lower fraction were higher.

Our experience so far does not yet prove to be sufficient to confirm the applicability of the Cooke-Stinson (1985) method used for wheat, for the separation of lupine seeds according to their protein content.

Water2Farm & Sustainable Agriculture

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Abstract

Water2Farm emerges as a pivotal water treatment innovation for agriculture. Addressing multifaceted challenges, it can provide a 10% surge in crop yields and shelf life while a possibility of diminishing food wastage and irrigation water usage by 10%. Engineered for universal compatibility, it seamlessly blends with all irrigation systems, with its organic, non-invasive process fortifying nutrient absorption and reducing chemical dependence.

From an environmental perspective, Water2Farm is transformative. It can augment plants' CO2 sequestration. Economically, it heralds quick ROI, production cost-efficiency, and improved food safety throughout the agricultural chain. Its imminent patent underscores its innovative character, and compatibility with IoT exemplifies its modern relevance.

Recent research on magnetized water (MW) irrigation, particularly in tomatoes, further attests to the potential of such advancements in agriculture. The study delineated MW's potential in amplifying growth, expediting developmental stages, and influencing gene expression, consolidating the case for sustainable farming innovations.

In summation, Water2Farm, buttressed by MW insights, stands as a watershed moment in agriculture, encapsulating productivity, sustainability, and economic proficiency in one comprehensive solution.

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Using Genetics to Reduce Methane Emissions

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Abstract

Reducing greenhouse gas (GHG) emissions from agriculture, amongst other sectors, is a key step to reducing global warming. Methane (CH4), a potent GHG, has an estimated global warming potential 25–35 times greater than carbon dioxide (CO2) over a 100-year period. Although the dairy industry is not the sole source of increasing global CH4 emissions, it has the potential to mitigate emissions and contribute to climate cooling. Genetic selection can help reduce emissions in ruminant animals, and it represents a cumulative and permanent reduction over generations. Research carried out at the University of Guelph has shown it is possible to predict individual animal CH4 emissions for milk-recorded cows using milk spectral (MIR) data applying a machine learning algorithm. This discovery was key for the development of a single-step genomic evaluation for Methane Efficiency (ME) which was officially implemented in Canada in April 2023. Available for the Holstein breed, the evaluation targets reduced dairy cattle methane emissions without impacting production levels. The genomic evaluation was developed using methane data collected from research herds in Canada with the GreenFeed system (C-Lock Inc., Rapid City, SD, USA), and MIR data collected via Canadian milk recording services. The genetic correlation between collected and predicted CH4 was higher than 0.9, suggesting that MIR predicted CH4 is an accurate proxy for collected CH4. Predicted methane had a heritability of 0.23 (0.01). A multiple-trait single-step genomic evaluation was implemented at Lactanet Canada using MiX99 and related software. The model included MIR predicted CH4, together with milk, fat, and protein yield. The official evaluation is expressed as Methane Efficiency, defined as methane production genetically independent of milk, fat, and protein yield, and derived using a recursive model operational tool. The average reliability of Methane Efficiency for genotyped young bulls and heifers is over 70%. Methane Efficiency is an important selection tool, allowing dairy producers to achieve an expected 20% to 30% reduction in methane emissions from their herd by 2050. This national genomic evaluation represents a valuable tool that can help lower the dairy industry's carbon footprint by reducing CH4 emissions without impacting production traits.

Utilizing cultivated crop mixtures to supply a sustainable protein source

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Abstract

In the scheme of green biorefining, grasses and legumes lead the way as the most viable species for large-scale cultivation in areas with a continental climate. Triticale, a regionally preferred fodder crop, is cultivated to a high-yield, while being noted for its substantial protein content. Also common vetch (*Vicia sativa*), is a legume with significant relevance due to its ability to adapt to winter conditions and its suitability for intercropping.

Both vetch and triticale have unique root systems, which allow them to absorb nutrients from various soil layers, thereby preventing the depletion of the upper soil layer only. In particular , Vetch , is a nitrogen fixer. Consequently, a mixture of vetch and triticale reduces the reliance on inorganic fertilizers, which often have detrimental impacts on the environment and crop quality.

In our ongoing study, we are investigating the processing potential of fresh green biomass from triticale and vetch and their mixture, with an emphasis on protein extraction for both animal feed and human consumption. By using wet fractionation techniques on the green biomass, we were able to separate it into green juice and fiber fractions. We then extracted the leaf protein using different methods including microwave coagulation, and indirected/directed fermentation.

The crude protein content of leaf protein concentrates measured with the Dumas technique ranged beetween 41.36 - 68.33 m/m% depending on the coagulation method. The centrifugation-microwave combined coagulation result is the highest protein content (68.33 m/m%), but less leaf protein concentrate could be obtained by this method. The concentration of protein measured with Bradford assay and the average of results ranged from 206,18 to 469,30 mg/g. The highest consentration of protein measured in the triticale sample (2500 rpm centrifuged for 10 minutes).

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Drought Stress and Hydrogen Peroxide Mediated Responses in Spinach (*Spinacia oleracea* L.)

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Abstract

Understanding how crops respond to abiotic stress is of immense importance in terms of climate change, offering key insights to enhance plant resilience. The research aimed to elucidate the impact of hydrogen peroxide (H_2O_2) on water deprivation responses in spinach (*Spinacia oleracea* L. var. Matador). The research was conducted under controlled environmental conditions at the Department of Applied Plant Biology, Institute of Crop Sciences, University of Debrecen, Hungary, using hydroponic conditions. Water deprivation was mimicked by using a polyethylene glycol (PEG 6000) solution. The seedlings were categorized into three distinct treatment groups following the germination process: control, water deprivation (with a 2.5% PEG solution), and 2.5% PEG + H_2O_2 (with a 0.1mM foliar spray from day 15 of sowing for five consecutive days). On the 35th day after sowing, a thorough evaluation was conducted to assess various growth attributes, including root length, shoot length, root volume, fresh and dry weights of root and shoot, SPAD, and biochemical markers such as malondialdehyde (MDA). The seedlings exposed to a 2.5% PEG solution experienced a notable reduction in their growth characteristics compared to the control. This reduction included a 53.2% decrease in root length and a 52.3% decrease in shoot length. This was accompanied by a considerable reduction in root volume (94%), fresh root weight (90%), fresh shoot weight (89.7%), dry root weight (81.2%), dry shoot weight (68.7%), and relative chlorophyll content (measured as SPAD values) (8.9%). Additionally, there was a significant increase of 37.3% in the malondialdehyde content, which indicates lipid peroxidation and cellular damage. The concurrent application of a 2.5% PEG solution and H_2O_2 further worsened the decrease in various growth parameters. Specifically, the root length experienced a decline of 58.7%, the shoot length decreased by 61.7%, the fresh shoot weight was reduced by 92%, and the dry shoot weight exhibited a reduction of 85.4%. However, there was a comparatively smaller decline in SPAD values (5.6%) and a slightly diminished rise in MDA levels (32.8%) compared to the treatment involving 2.5% PEG when H_2O_2 was applied. This research emphasizes the negative consequences of water deprivation induced by PEG on seedlings' growth and their cells' integrity. The concurrent utilization of H_2O_2, although causing a decline in specific growth parameters, but it may mitigate the adverse effects on relative chlorophyll content and lipid peroxidation. Additional investigation is necessary to evaluate the potential of H_2O_2 as a regulator under conditions of water deprivation induced stress in spinach.

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