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I-CRAFT

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Agricultural and Food Technologies**

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4-6 OCTOBER 2023
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**3RD International Conference on
Research of Agriculture and Food
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2023 October 04 & 06 Adana, Türkiye

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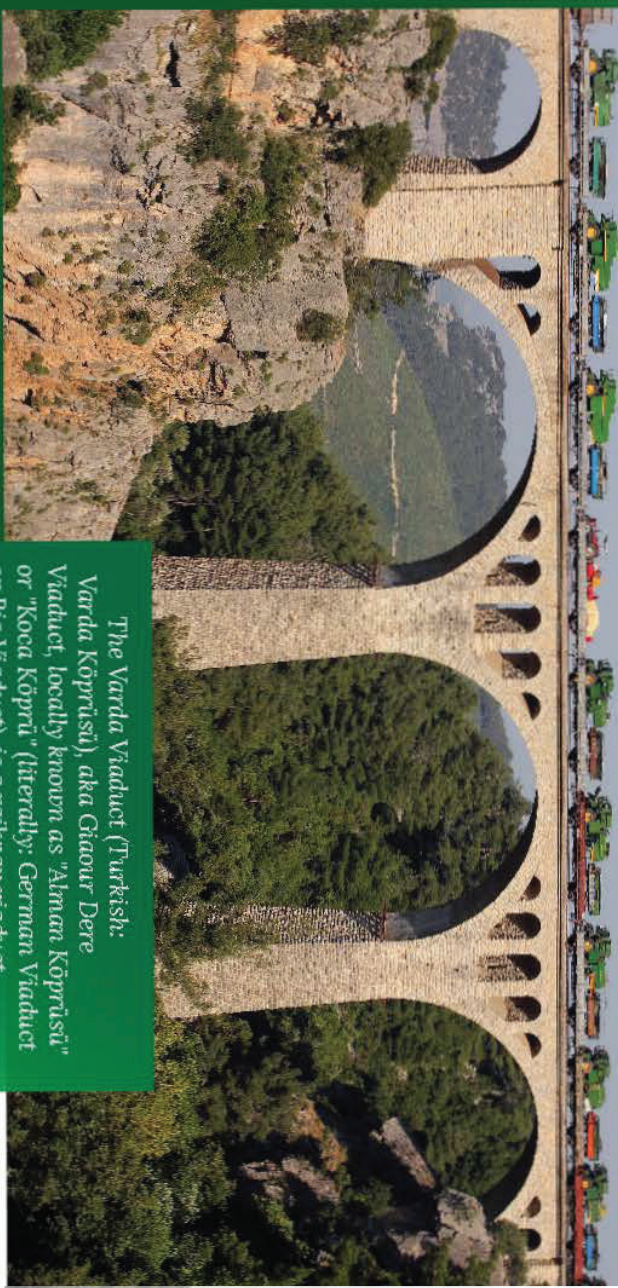


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The primary purpose of the conference is to form a venue to disseminate scientific information on various current and near-future applications of agricultural and food engineering practices and technologies used in the different parts of Turkiye and throughout the world. In this framework, many academicians, researchers, entrepreneurs and manufacturers related to the study area of agricultural and food engineering from Turkiye and other countries will have the opportunity to mutually convey their experiences and ideas to their colleagues and stakeholders. Hence, we cordially invite you to attend this important event.



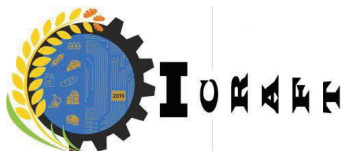
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LETTER OF INVITATION

3RD International Conference on Research of Agricultural and Food Technologies (I-CRAFT-2023)

4-6 October 2023, Cukurova University, Adana, Turkiye

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The conference will be held at Cukurova University in Adana city. Being located in central-south Turkiye, Adana has a population of about two million making it the fifth most populous city of Turkiye. Adana is situated on the Seyhan River and on the Cukurova plains, a very important agricultural area with rich cultural and historical assets. The congress will offer both an academic and a different cultural and historical perspective to the participants and guests.

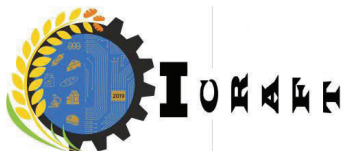
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In this respect, we cordially invite you to attend this exciting conference on topics related to almost every stage of agricultural and food production.

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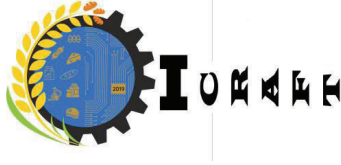
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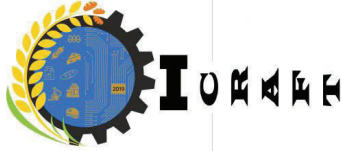
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ABSTRACTS

DEVELOPMENT AND CONSTRUCTION OF A SIMPLE PORTABLE SOIL DRILLING MACHINE

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ABSTRACT

A simple portable soil drilling machine was developed for effective planting of crop seedling in Federal college of Agriculture workshop. The machine was developed and tested, using it to drill 9 holes at a depth of Drilling depth of 320mm, Drilling width of 140mm, and Drilling time of 20 secs/hole. In the department of Agricultural and Bio-Environmental Engineering Technology, Federal College of Agriculture, Akure, Ondo State, Nigeria, this portable soil drilling machine was fabricated and tested. It has given a new dimension of comfort to the operator to work in any soil terrain handling, plantation work, which can dig a soil for just 20secs with a drilling depth of 320mm and a width of 140mm. The simple machine has automatic means of soil digger for increasing and decreasing, drilling force and little man efforts. The machine auger was fabricated with the shaft dimension of length 620mm, 40mm in diameter. The auger thickness was 50mm. The frame length was 800mm and the breadth was 350mm at the top or upper part and 115mm at the bottom part. The machine was found to have an efficiency of 90% and ability to drilling time of 20sec/hole soil with 14% moisture content.

This project focuses on the design, construction and the evaluation of the method of drilling auger capacity and digging forces required to dig the terrain (soil) for light duty planting operational work. The engine shaft drive the auger in a rotational motion, then the operator hold the handle and impacts the rotating auger with the soil terrain, the rotating auger in motion drills out the soil on the contact-dinging spot. The weight of the machine add to the impacting torque of the auger in order to combat the resisting force of the soil, regardless of the soil condition. The engine shaft drive the auger in a rotational motion, then the operator hold the handle and impacts the rotating auger with the soil terrain, the rotating auger in motion drills out the soil on the contact-dinging spot.

Keywords: Development, Portable, Soil Drilling Machine, Crop seedlings

RELATIONSHIP BETWEEN MASTITIS AND BODY CONDITION SCORE IN JERSEY CATTLE

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ABSTRACT

The usefulness, validity and precision of the body condition score has been proven by many studies to evaluate body energy reserves. In general, the body condition score decreases in early lactation because cows allocate energy from their body reserves to support milk production and begin to increase during the remainder of lactation. The excessive loss of energy reserves during early lactation often associated with cows with higher body condition scores at calving often results in impaired health and reproductive performance. A high or low body condition score is also associated with higher incidences of metritis, milk fever, lameness, and mastitis. Positive genetic correlations have been noted between body energy reserve changes and somatic cell count or clinical mastitis. In this study, the relationship between body condition score and mastitis in Jersey cattle was investigated.

Keywords: Jersey, Mastitis, Body Condition Score

USE OF MILK'S ELECTRICAL CONDUCTIVITY IN THE DETECTION OF MASTITIS SCORE IN JERSEY CATTLE

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ABSTRACT

Mastitis is a costly udder disease affecting dairy cattle. Decreased milk yield, treatment and labor costs, decreased milk quality and cow death etc. are some of the factors that make up costs. These losses are caused by subclinical mastitis without visible symptoms. Mastitis can be detected by performing one of the simple screening tests such as electrical conductivity (EC) measurement of milk. Our study evaluated the use of this method for the detection of subclinical and clinical mastitis.

Keywords: Dairy Cattle, Milk, Mastitis, Electrical Conductivity

APIS MELLEFERA MITOCHONDRIAL DNA (MTDNA), A REVIEW PAPER

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ABSTRACT

This review paper presents a comprehensive analysis of the mitochondrial DNA (mtDNA) of *Apis mellifera*, commonly referred to as the Western honey bee. The present study aims to examine the genetic diversity, population structure, and evolutionary history of a species of insect that holds economic significance. This study elucidates the genetic determinants that impact the adaptive capacity, behavioral patterns, and overall well-being of honey bees through the examination of mitochondrial DNA (mtDNA) sequences derived from diverse honey bee populations across the globe. Furthermore, this study examines the potential implications of mitochondrial DNA (mtDNA) research on various aspects of beekeeping practices, conservation initiatives, and the comprehension of honey bee biology. This paper serves as a significant asset for researchers, beekeepers, and conservationists with a keen interest in exploring the genetic characteristics of *Apis mellifera*.

Keywords: *Apis mellifera*, Mitochondrial DNA, Genetic diversity, Population structure, Evolutionary history

THE ESTIMATION OF HERITABILITY OF WEEKLY BODY WEIGHTS IN JAPANESE QUAILS WITH ML (MAXIMUM LIKELIHOOD) METHOD

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ABSTRACT

In this study the heritability of body weights of Japanese quails (*Coturnix coturnix Japonica*) were estimated by using ML (Maximum Likelihood) methods. Firstly the variance components were estimated by using ML method which were later estimated the heritability for weekly body weights. The estimation of heritability of body weights are following:

.....for third week : 0.272 ± 0.066
.....for fourth week : 0.60 ± 0.13
.....for fifth week : 0.312 ± 0.074

Keywords: Body weight, Heritability, Maximum Likelihood Method, Variance Components

AN OVERVIEW ON THE INTERNET OF THINGS (IOT) BASED SMART IRRIGATION SYSTEMS

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ABSTRACT

According to the UN Convention to Combat Desertification (UNCCD), 168 countries will be inundated with desertification by 2030, and nearly 50% of the world population will live in high-water shortage areas. Considering that the agricultural sector uses 69% of freshwater globally, more controlled and efficient irrigation systems, such as drip and sprinkler irrigation, should be adopted to conserve freshwater resources.

In an agricultural context, the Internet of Things (IoT) refers to using sensors and other devices to turn every element and action involved in farming into data. IoT integrates various technologies such as sensors, actuators, wireless networks and web technologies. Smart irrigation systems based on the IoT can help efficiently use freshwater resources. With an IoT-based smart irrigation system, water and fertilizer use for agricultural products can be optimized using control strategies. This study discussed smart irrigation systems based on IoT and some case studies.

Keywords IoT, smart irrigation, WSN, AI, automation

EFFECT OF VERMICOMPOST, MANURE AND MINERAL FERTILIZERS ON ESSENTIAL OIL YIELD AND COMPOSITION OF THYMUS SYRIACUS BOISS

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ABSTRACT

Thymus syriacus Boiss., is a narrowly distributed species from Middle East having high content of carvacrol. In the present study, field experiment was conducted to study the influence of organic and mineral fertilizers on essential oil content and components of *T. syriacus* in East Mediterranean Region of Turkey. The treatments were as follows control (no fertilizer), mineral, vermicompost and manure. In the first year of experiment, control and manure has same significance effect on essential oil while, vermicompost and mineral fertilizer increased essential oil content. Second year of experiment, all fertilizer applications had significantly improved essential oil content compared with control. Essential oil composition was determined with Gas Chromatography Mass Spectrometry Method (GC/MS). Carvacrol and o-cymene were found as main components with their rate depending on the year and application. Carvacrol content were ranged between 62.98-84.56%, while highest content was found at second year vermicompost applied samples. As a result, for essential oil content and components fertilizers application and especially vermicompost organic fertilizers could be use for cultivation of *T. syriacus*.

Keywords Carvacrol, thyme, organik fertilizer, vermicompost

ECO-FRIENDLY PURIFICATION OF HEAVY METAL CONTAMINATED WASTEWATER USING POMEGRANATE PEEL AND CHITOSAN DERIVED FLOCCULANT

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ABSTRACT

This research explores the potential of using pomegranate peels and chitosan as a natural flocculant for pre-treating wastewater to enhance sand filtration and remove heavy metals (Ni²⁺, Cu²⁺, and Zn²⁺) effectively. Active compounds like tannin are extracted and purified from the pomegranate peels, then chitosan and tannin are modified to create a novel flocculant. The synthesized flocculant is characterized and its performance is evaluated through laboratory experiments, analyzing factors such as dosage, pH, and heavy metal concentration. The results of this work can provide a safe, easy, eco-friendly and cheap method of wastewater treatment.

Keywords: Wastewater treatment, Natural flocculant, Chitosan, Pomegranate peels, Eco-friendly

PERFORMANCE ANALYSES OF BASIC COGENERATION PLANTS IN AGRICULTURE AND FOOD PRODUCTION

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ABSTRACT

Energy in agriculture and in food production have vital importance that affect directly the cost and the quality of the products. Micro cogeneration plants are widely used in the World to produce heat and electricity at the same time in a same plant. The aim of this study, to analyze the performance of the production of power and heat for the food production process and the agricultural needs. For that reason, a basic cogeneration plant is taken to analyze the performance by using 1st and 2nd laws of thermodynamics and exergy analysis method. The electric-heat exergy rates, the energy and exergy efficiencies, the combustion chamber and the gas turbine outlet temperatures, the total electric and heat energies and exergies, and the specific works were calculated for various ambient temperatures and for various excess air rates of the basic cogeneration plants fueled with methane. The effects of the various ambient temperatures and the various excess air rates on the performance of the basic cogeneration plants were obtained, discussed and analyzed. For the best performance and for the best working conditions of the basic cogeneration plants in agriculture and food production process and food industry recommendations were done. It was found that, lower ambient temperatures give higher electric efficiency, but lower heat efficiency. However, an optimum excess air rates for the best performance was found at the value 2.3 of the excess air rates of the basic cogeneration plants fueled with methane.

Keywords: performance, cogeneration, exergy

EXERGETIC ANALYSES OF AIR-FUEL PREHEATED COGENERATION PLANTS IN FOOD PRODUCTION

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ABSTRACT

Lower emissions and better performances in food production also affect the cost, the environmental effects, and the quality of the products of the agriculture and food industry. The aim of this study is to investigate and to analyze the exergetic performance of the production of heat exergy and power, to reuse waste heat and to give optimum reaction and to adapt to changing demands of the food production process and agriculture. Because of those reasons, an air fuel preheated (recuperative) cogeneration plant is taken to analyze the exergetic performance and working conditions by using exergy analysis method and 1st and 2nd laws of thermodynamics. Energy and exergy efficiencies, combustion chamber and gas turbine outlet temperatures, electric-heat exergy rates, specific works, and total electric and heat energies and exergies are calculated by taking various environmental temperatures and various excess air rates. The effects of the environmental temperatures and the excess air rates on the exergetic performance of the recuperative cogeneration plants were calculated, obtained, and discussed. For the best exergetic performance and working conditions, some recommendations were done for agriculture and for the food production process. In that study, it is found that, the recuperative cogeneration plants can obtain and give the best solutions and can adapt to changing demands of heat and electric rates. Also, it was found that, lower ambient temperatures give better electric efficiency, but lower heat exergy and electric rates. However, higher excess air rates increase the performance of the recuperative (air fuel preheated) cogeneration plants.

Keywords: Performance, cogeneration, recuperation, exergy

FAST AND CHEAP DETERMINATION OF AMMONIUM IN SOIL FOR EFFICIENT FERTILIZATION

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ABSTRACT

Lower emissions and better performances in food production also affect the cost, the environmental effects, and the quality of the products of the agriculture and food industry. The aim of this study is to investigate and to analyze the exergetic performance of the production of heat exergy and power, to reuse waste heat and to give optimum reaction and to adapt to changing demands of the food production process and agriculture. Because of those reasons, an air fuel preheated (recuperative) cogeneration plant is taken to analyze the exergetic performance and working conditions by using exergy analysis method and 1st and 2nd laws of thermodynamics. Energy and exergy efficiencies, combustion chamber and gas turbine outlet temperatures, electric-heat exergy rates, specific works, and total electric and heat energies and exergies are calculated by taking various environmental temperatures and various excess air rates. The effects of the environmental temperatures and the excess air rates on the exergetic performance of the recuperative cogeneration plants were calculated, obtained, and discussed. For the best exergetic performance and working conditions, some recommendations were done for agriculture and for the food production process. In that study, it is found that, the recuperative cogeneration plants can obtain and give the best solutions and can adapt to changing demands of heat and electric rates. Also, it was found that, lower ambient temperatures give better electric efficiency, but lower heat exergy and electric rates. However, higher excess air rates increase the performance of the recuperative (air fuel preheated) cogeneration plants.

Keywords: Nitrogen, paper-based sensor, fertilization

PESTICIDE RESIDUE AND RESISTANCE PROBLEM IN LEAFY VEGETABLES IN TURKIYE

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ABSTRACT

Leafy vegetables form a highly variable group of cultivars grown for their edible leaves, which are rich sources of minerals and vitamins. Approximately 950 thousand tons of edible leafy vegetables are produced in Türkiye in 2021. There are many diseases, harmful and weed species that cause damage alone or together in the leafy vegetables that are grown in large areas in Türkiye and have an important place for our domestic consumption and export. In order to obtain more and quality products, intensive use of pesticides can be made. Excessive pesticide consumption causes pesticide residues, resistance problems in diseases and pests. In some studies, pesticide residues above the limit are found in 65 % in vegetables whose leaves are eaten in the domestic market in Türkiye. It is an undeniable fact that excessive pesticide use also causes important environmental, human health problems. Agricultural products also appear in both domestic and foreign markets, which cause economic losses in the market. The “Farm to Fork” strategy within the scope of the European Green Deal accepted by the European Commission, and the 50% reduction in pesticide use by 2030, the targets set under the Horizon 2020 Green Deal require serious steps towards pesticide use. This can only be possible with a serious planning and prioritization of alternative methods to chemical control, especially biological control and biotechnical control methods. Adopting "Integrated product management" and "Sustainable Agricultural Production" as the main tools for pesticide use in leafy edible vegetables will lead to healthier results.

Keywords Pesticide, residue, resistance, leafy vegetable, green deal

DILUENT ALTERNATIVES FOR REACTIVE EXTRACTION OF ORGANIC ACIDS FROM AQUEOUS MEDIUMS

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ABSTRACT

Pollutions in the fermentation broths caused by organic acid production is a significant problem. Reactive extraction of organic acids from the aqueous medium is a preferable method comparing with other conventional and insufficient or modern and expensive ways. Major advantages of reactive extraction are wide range of extractants, utilizing at various temperature or pH conditions, higher effectiveness, shorter process times and lower cost and equipment requirements.

Using diluents in reactive extraction processes is also another advantage for decreasing cost, especially. Although different diluents alone cannot be effective enough, concomitant use of an extractant and a diluent may upgrade the process via modifying the physicochemical features such as viscosity, density, surface tension, hydrophilicity/hydrophobicity, polarity, bonding, functional groups, etc.

Diluents for reactive extraction can be inert or active. While the compounds without functional groups are generally inert diluents, other organic compounds are active diluents. Ionic liquids (ILs) that consist of organic cations and organic/inorganic anions can be designed in a broad variety. This type of diluents is choosing for different processes even though their higher prices. Deep eutectic liquids are the newer, green electrolyte class and have some benefit compared by ILs. For example, being less harmful, less expensive, having possibility of produced with different quaternary ammonium and metallic salts in different forms like gels. Vegetable oils can be used to dilute the extractant. Thanks to their hydrocarbon chains in various lengths, these low-polarity organic compound mixtures do not damage to the microorganisms using in the processes. They also keep the efficiency above.

Keywords Reactive extraction, Diluent, Organic Acids

ADAPTABILITY OF DEEP LEARNING: DATASETS AND STRATEGIES IN FRUIT CLASSIFICATION

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ABSTRACT

This review aims to uncover the multifaceted landscape of methodologies employed by researchers for accurate fruit classification. The exploration encompasses an array of techniques and models, each tailored to address the nuanced challenges presented by fruit classification tasks. From convolutional neural networks (CNNs) to recurrent neural networks (RNNs), transfer learning to ensemble methods, the spectrum of approaches underscores the innovative strategies harnessed to achieve precision in fruit categorization. A significant facet of this review lies in the analysis of the various datasets utilized by researchers for fruit classification. Different datasets present unique challenges and opportunities, thereby shaping the design and effectiveness of the models. From widely recognized datasets like Fruits-360 to specialized collections, the review navigates through a plethora of data sources, elucidating how these datasets contribute to the diversity of research endeavours. This insight not only highlights the variety in fruit types and attributes but also emphasizes the adaptability of deep learning techniques to accommodate these variations. By amalgamating findings from diverse articles, this study offers an enriched understanding of the evolving trends and advancements within the domain of fruit classification using deep learning. The synthesis of methodologies and dataset variations serves to inform future research pursuits, aiding in the refinement of accurate and robust fruit classification methods. As the field progresses, this review stands as a valuable compass, guiding researchers towards impactful contributions that enhance the accuracy and applicability of fruit classification models.

Keywords Fruit classification, convolutional neural networks, deep learning

EVALUATION OF BIOETHANOL YIELD POTENTIAL OF DIFFERENT SWEET SORGHUM CULTIVARS GROWN AS A SECOND CROP UNDER EASTERN MEDITERRANEAN CONDITIONS

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ABSTRACT

Sweet sorghum has a high potential for bioethanol production due to its high fermentable sugar content and biomass yield. This research was carried out to evaluate bioethanol yield potential of six sweet sorghum cultivars (ICSV 93046, ICSV 700, Black Amber, White African, Gülşeker, and Red's Red) during summer growing season of 2022 under eastern Mediterranean conditions. Cultivars were significantly differed for brix degree, green herbage yield, juice yield, and juice ethanol yields in the study. ICSV 93046 produced the significantly highest green herbage yield (58811 kg/ha), juice yield (16105 kg/ha), brix degree (19,93 °Bx), and juice ethanol yield (1194 L/ha) and followed by ICSV 700. On the other hand, the significantly lowest brix degree (10,5 °Bx) and juice ethanol yield (322 L/ha) were achieved by Gülşeker. These results suggested that ICSV 93046 was the most suitable cultivar to be grown as a second crop for bioethanol production under eastern Mediterranean conditions.

Keywords: Sweet sorghum, Bioethanol, Cultivars, Mediterranean, Sugar

INTERACTIVE EFFECTS OF NITROGEN FERTILIZATION AND HUMIC SUBSTANCE ON NUTRIENT COMPOSITION OF SWEET SORGHUM

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ABSTRACT

Sweet sorghum seems to be one of the most promising energy crops for arid and semi-arid environments due to its high yield potential and drought tolerance. Assessing the nutrient composition of the crop under different fertilization regimes is crucial to meet growing biofuel and forage demand. A two-year field trial was conducted in a semi-arid Mediterranean environment to evaluate the interactive effects of different nitrogen (100, 150, and 200 kg ha⁻¹) and humic substances (0, 15, 30, and 45 L ha⁻¹) applications on the nutrient composition of sweet sorghum. N, P, K, Ca, and Mg contents of sweet sorghum ranged from 6.10 to 8.65 g kg⁻¹, 1.07 to 1.47 g kg⁻¹, 13.12 to 16.80 g kg⁻¹, 2.68 to 3.83 g kg⁻¹, and 1.55 to 2.16 g kg⁻¹, respectively. Application of humic substances significantly increased the contents of all nutrients considered in the study. Similarly, the contents of all nutrients except for P significantly increased with each increment of nitrogen fertilization level. Application of 30 L ha⁻¹ humic substance provided the highest N, Ca, and Mg contents, while the significantly highest P and K contents were obtained from the application of 15 L ha⁻¹ humic substance. These results showed that combined application of 200 kg ha⁻¹ N and 15 or 30 L ha⁻¹ humic substances may be recommended to optimize nutrient uptake of sweet sorghum.

Keywords: Sweet sorghum, nitrogen, humic substance, nutrient

A STUDY ON QUALITY PROPERTIES OF BLACKTHORN (PRUNUS SPINOSA L.) FRUIT POWDER OBTAINED BY DIFFERENT DRYING TREATMENTS

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ABSTRACT

In this study, the quality characteristics of blackthorn fruit (*Prunus spinosa* L.) powders obtained by convective hot air-drying (HAD) and freeze-drying (FD) treatments were investigated. The drying time was carried out equally (24 h) for both treatments. According to the results, the moisture (%) and water activity of powder samples obtained by HAD and FD treatments were found as 7.51% and 0.2471, 9.13% and 0.2718, respectively. Considering the pH and total ash parameters, there was no statistically significant difference between the powder samples ($p>0.05$). However, both drying processes were effective on the color and changed the L^* , a^* , and b^* values of the powders compared to fresh fruit values. The biological and antioxidant results of the powder obtained by FD treatment were higher than the HAD treatment ($p<0.05$). From this point of view, it was determined that the FD process had a minimal effect on the chemical content of fresh fruit, while the HAD technique applied at 40 °C combined with a fan system did not have an excessive negative effect on these values.

Keywords: Blackthorn, drying, fruit powder, quality.

DETERMINATION OF FIRE INTENSITY AFTER FOREST FIRE BY REMOTE SENSING: MARMARIS CASE STUDY

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ABSTRACT

Forest fires in Turkey are a frequently encountered natural disaster, especially in recent years. After a fire, identifying the plant species to be used in the area and determining the intensity of the fire in the region are important for assessing the area's capacity for natural regeneration. In this process, geographic information systems and remote sensing methods and techniques are commonly used tools for assessing burned areas and fire intensities following forest fires. In this study, one of Turkey's devastating fires, the Marmaris fire, which began on June 21, 2022, is examined. Landsat satellite images, geometrically and radiometrically corrected, were utilized to determine the intensity of the Marmaris fire. As part of the method, the NBR (Normalized Burn Ratio), dNBR (Difference Normalized Burn Ratio), NDVI (Normalized Difference Vegetation Index), and dNDVI (Difference Normalized Difference Vegetation Index) indices were used for burned area detection. As a result of the study, information about the burned areas, fire intensities, and the regenerative capabilities of post-fire vegetation growth has been obtained. Furthermore, suitable pioneer plant species, considering the fire intensity, have been suggested for the restoration of burned landscape areas after the fire. This study is expected to serve as a guide for relevant public institutions and organizations, particularly the General Directorates of Forestry, enabling them to respond most effectively after fires and implement reforestation efforts considering the usage areas and growth capabilities of needle-leaved and broad-leaved plants.

Keywords: Keywords: Disaster management, normalized burn index, post-fire, fire intensity.

OVERDOSE PESTICIDE USE AND ATTITUDES OF CORN PRODUCERS: THE CASE OF CEYHAN DISTRICT OF ADANA PROVINCE

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ABSTRACT

Purpose: Pesticides, which are essential inputs in agricultural production today, have negative effects on human and environmental health, especially when used in excessive doses. In addition to studies examining the toxicological effects of pesticides on human and environmental health, there is also a need for studies examining farmers' pesticide use behaviors to mitigate the adverse effects of pesticides. In this study, excessive pesticide use, risk perceptions, and socioeconomic characteristics of corn farmers were examined.

Design/Methodology/Approach: The research data were collected through a survey method from 125 randomly selected producers in Ceyhan District of Adana Province, where 4.25% of Türkiye's total corn production was conducted in 2023. The data are from the previous production period. Descriptive statistics, factor analysis, and hypothesis tests were applied to the collected data.

Results: 77.60% of the farmers surveyed reported using pesticides at the recommended dose, while the remaining 22.40% stated that they used pesticides at a higher dose than recommended. There is a statistically significant difference between the average ages of farmers who use pesticides at the recommended dose (43.43 years) and those who use pesticides at a higher dose (48.78 years). Similarly, farmers who use pesticides at the recommended dose (15.39 years) have a statistically significant difference in corn production experience compared to other farmers (20.78 years). The average family sizes of the surveyed farmers (6.80 people) do not vary according to excessive pesticide use. Farmers in the research area conduct corn production on an average of 525.60 acres. While farmers who use pesticides at the recommended dose produce on average 607.14 acres, those who use pesticides at a higher dose produce on average 502.06 acres. The land areas where farmers produce corn show statistically significant differences according to excessive pesticide use. There is a significant relationship between farmers' contract farming status, whether they read the pesticide usage guide before application, and excessive pesticide use. Farmers who engage in contract farming and read the usage guide before application have higher rates of pesticide use at the recommended dose. The attitudes of farmers towards pesticide use were examined using a scale consisting of 10 items prepared according to a five-point Likert scale, with satisfactory internal consistency (Cronbach's Alpha = 0.669). As a result of factor analysis, the attitude scale was divided into three sub-components, namely Environmental Risk Perception, Health Risk Perception, and Outcome

Perception, which account for 55.94% of the total variance. Farmers who use pesticides at the recommended dose have average scores of 3.05 for Environmental Risk Perception, 3.46 for Health Risk Perception, and 4.71 for Outcome Perception. In farmers who use pesticides at a higher dose, these values are calculated as 3.22, 3.58, and 4.41, respectively. The differences in Environmental Risk Perceptions and Outcome Perceptions between farmers who use pesticides at the recommended dose and those who use pesticides at a higher dose are statistically significant.

Originality/Value: This study is one of the few studies examining farmers' excessive pesticide use and their attitudes towards pesticides.

Keywords: Pesticide Use, Attitude, Corn, Adana

MANAGING TWO-SPOTTED SPIDER MITE, TETRANYCHUS URTICAE KOCH, 1836 (ACARI: TETRANYCHIDAE) RESISTANCE: SUSTAINABLE AGRICULTURAL STRATEGIES

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ABSTRACT

There are many harmful organisms that have a significant impact on agricultural products. Among these pests, spider mites are one of the most destructive. *Tetranychus urticae* Koch, 1836 (Acari: Tetranychidae), is a polyphagous pest that can feed on many different plant species. Thanks to parthenogenetic reproduction, this mite can rapidly increase its population in a short time. This causes irreversible damage to crops. The most common method used to control this mite is chemical control because of its ease of use and etc. However, over time, synthetic chemicals with the same mode of action, incorrect dosage, uncalibrated plant protection machines, lack of attention to application time, and repeated application of acaricides have led to the emergence of resistance in *T. urticae*. In this paper, to prevent or delay the emergence of resistance, to provide resistance management of resistant populations, harmless to human, animal, and environmental health, non-ecotoxic for macro and micro habitats, with little or no side effects on beneficial insects or pollinator insects; Recent studies on plant essential oils, plant extracts, biological control agents and molecular methods were presented.

Keywords: Bio-agent, essential oil, RNAi, predatory mite.

SPECTROSCOPY AND MACHINE LEARNING IN FOOD PROCESSING: A SURVEY

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ABSTRACT

For food safety, quality control from the foodstuff production to the tasting of foods is needed and should be simple and nondestructive. Recent and notable nondestructive measurements of food and agricultural products are based on optical and spectroscopic techniques. Spectroscopy, meets the requirements of industrial applications for continuous quality control and process monitoring. Hence, this article covers a survey of recent research works, highlighting the application of spectroscopy and machine learning in food processing from bibliographic database. The survey was based on relevant articles, obtained from scientific database and evaluated selected research works based on survey inquires, the assessment included food processing problem addressed (varieties classification, origin identification, adulteration and quality control), types of spectroscopy used, machine learning models applied to solve the particular problem and keyword analysis to show the perspective of the research

Keywords: Agriculture, Spectroscopy, Machine learning, food processing.

EVALUATION OF AGRICULTURAL MACHINERY PRESENCE AND USAGE ACTIVITIES IN TOKAT

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ABSTRACT

In this study, the area of influence of agricultural machinery in Tokat, its districts and the size of the cultivated area were compared. Required number of machineries was evaluated. Thus, the machines were divided into seven groups (Soil Tillage Machinery, Sowing and Planting Machinery, Maintenance and Fertilization Machinery, Plant Protection Machinery, Harvesting Machinery, Combine Harvester, Tractors). Data on the number of cultivated areas and agricultural machinery were taken from the Turkish Statistical Institute. The number of machines, daily working time, annual workable days, effective working capacity, and machine impact area for each machine were calculated separately. Based on this data, the number of machines that should be in each district was determined. As a result, it was determined that the number of Subsoiler, Combi Harrow, Stone Collecting Machinery, Rotary Cultivator, Soil levelling Machinery, Rotary Tiller, Seedling Planting Machinery, Arc Opening Plough, Manure Spreading Machinery, Baler, and Combine Harvester is insufficient in the province of Tokat. It was determined that other machines in the groups were more than necessary. Baler had the highest deficit, while tractor had the highest surplus. The importance of planning in enterprises and the machines that should be prioritized in the production of industrialists have been revealed.

Keywords: Agriculture, Mechanization, Agricultural Machinery, Machinery Evaluation.

EFFECT OF GERMANIUM OXIDE ON THE PROPERTIES OF ALUMINUM CASTING DETAILS IN AGRICULTURAL MACHINERY

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ABSTRACT

The article presents research aimed at improving the properties of aluminum alloy by changing its composition when developing a pump housing part that can be made of aluminum alloys in agricultural machines. In the studies, germanium oxide was included in the composition of aluminum-manganese and aluminum-copper alloys, its effect on the alloy structure and hardness was studied. Scientists from all over the world have conducted many similar studies. In the experiments, the composition of the aluminum alloy included Germanium oxide in the charge in the state of coating with a special aluminum coating. Germanium oxide is part of the alloy in an amount from 0.1% to 0.3%, depending on the weight of the charge and taking into account the Germanium content in the oxide. Microscopic analysis of the cast samples was carried out using an optical metallographic microscope. In addition, the hardness of the samples was measured using an ITV-1-M hardness tester. Based on the results obtained, a graph of the dependence of Germanium oxide in the alloy on hardness was developed. Based on the conducted research, the authors draw their conclusions at the end of the article.

Keywords: Agricultural machinery, pump, aluminum, manganese, copper, germanium, hardness.

DRINKING WATER SAFETY AND COMPARISON OF DRINKING WATER CHARACTERISTICS WITH MULTI-CRITERIA DECISION MAKING (MCDM) METHODS

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ABSTRACT

Food and food security have been a strategic issue for societies throughout human history. Countries tried to be self-sufficient in food, especially in basic foodstuffs. Water safety has become one of the most crucial components in the idea of food safety due to the gradual decrease and pollution of water and water resources, as well as the constant rise in the global population and the need for water. Türkiye seems like a state with lots of water resources. However, due to the drought brought on by climate change, the water needs of the quickly growing population, and the ongoing rise in the amount of water needed in agriculture, the amount of water utilized per person has fallen below the critical level. The problem of drought and water scarcity is expected to deepen in the coming years. In this context, it is seen that the number of enterprises in the packaged water market will increase day by day and the water market will continue to grow. Consumers make a brand choice by looking at the mineral values or the price written on the water bottles. Although many factors are effective in brand selection, many consumers tend to make decisions by looking at the pH value. Not only the pH value but also the minerals in the water have indispensable effects for human life. Therefore, in order to raise awareness of consumers in their preferences, a model was created in which the healthiest water brand is determined by evaluating the properties of bottled water with the standard deviation based MAUT, one of the Multi-Criteria Decision Making (MCDM) methods.

Keywords: Food security, Water security, MCDM, Standard Deviation, MAUT.

OPTIMIZATION OF THE PARAMETERS OF THE PNEUMATIC FEED MECHANISM FOR PRECISE CLUSTERED SOWING

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ABSTRACT

Sowing in a clustered way. It is analyzed that precise sowing provides a given placement of plants over the area and makes it possible increase productivity, to reduce labor costs for thinning plants, seed consumption and operating costs of the aggregates. Data are presented on the mechanization of sowing row crops in Uzbekistan, on the main advantages and disadvantages of the applied mechanical and pneumatic planters. It is noted that industrial pneumatic feed mechanisms do not meet the increased quality requirements for clustered sowing of cotton seeds in Uzbekistan and are one of the factors limiting the widespread introduction of intensive technology. An analysis is given of the need to develop a pneumatic feed mechanism for precise sowing of row crops in a clustered way for the soil and climatic conditions of Uzbekistan and the justification of its parameters. The data on the study of the technological process of sowing and the refinement of the parameters obtained in analytical calculations are presented. According to the results of experimental studies and tests, the correctness of the theoretical premises and the performance of the experimental feed mechanism were checked. The optimization of the main parameters and operating mode of the feed mechanism for precise sowing in a clustered way has been carried out. The data obtained in the experiments were processed using the PLANEXP program developed for the Personal Computer and regression equations were obtained that adequately describe the evaluation criteria. Therefore, to ensure maximum accuracy of sowing cotton seeds and perform the required quality of work at aggregate operating speeds of 1.66-2.24 m / s, the number of revolutions of the sowing disc should be 23.87-27.62 rpm, and the installation height of the feed mechanism should be within 9.02-9.24 cm. With these values of the factors, criterion Y1, i.e. the number of seeds in the cluster is 3.03-3.28 pieces, criterion Y2, i.e. the distance between the clusters is 14.00-15.57 cm, and criterion Y3, i.e., the length of the clusters is in the range of 0.95-1.12 cm, which meets the agrotechnical requirements.

Keywords: Pneumatic planter, optimization, agrotechnical requirement, crop, cotton, technological process.

EFFECTS OF MORINGA OLEIFERA UTILIZATION ON MEAT QUALITY IN JAPANESE QUAIL

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ABSTRACT

Moringa oleifera, with its many parts, is a plant rich in nutrients such as protein, fiber, vitamins, minerals and antioxidants. Many studies on Moringa Oleifera have been conducted to examine the effects of moringa added to the ration on performance and welfare parameters, but studies on the effects on meat quality have been limited. This study was conducted to investigate the effects of Moringa Oleifera utilization on meat quality in Japanese quail diets. In the study, no moringa powder was added to the ration in the control group, 2% moringa powder was added to the ration in Moringa-1 group, 4% moringa powder was added to the ration in Moringa-2 group and 6% moringa powder was added to the ration in Moringa-3 group. Japanese quails were fattened for 5 weeks and 10 quails, 5 female and 5 male quails from each group and 40 quails in total were slaughtered at the end of the experimental period. Texture Profile Analysis (TPA) was performed to determine meat quality. TPA analysis, which gives information about the textural properties of meat; variables related to hardness, adhesiveness, springiness, cohesiveness, gumminess, chewiness and resilience were analyzed. When the effects of the addition of Moringa oleifera powder to the ration on meat quality between the groups were examined, it was determined that hardness 0.64 stickiness 0.90 flexibility-spreading 0.09 stickiness 0.72 gumminess 0.80 chewability 0.78 and durability values were 0.34. Regarding the meat quality depending on the gender factor, hardness value was 0.73, stickiness value was 0.67, elasticity-spreading value was 0.79, stickiness 0.45, gumminess 0.55, chewiness 0.53 and durability values were 0.47. When the meat quality was analyzed depending on the group-sex interaction, hardness 0.05, stickiness 0.33, elasticity-spreading 0.30, stickiness 0.17, gumminess 0.05, chewability 0.05 and durability 0.16 were found. As a result of the statistical analysis, the variables related to TPA were found to be insignificant at 0.05 level of significance, although the values found in group, gender and group-gender interaction were different ($P>0.05$). As a result, the addition of Moringa oleifera powder to the ration between 2% and 6% had no effect on meat quality.

Keywords: Meat quality, Texture Profile Analysis (TPA), Moringa Oleifera, Ration, Japanese Quail.

ASSESSMENT of FACTORS INFLUENCING URBAN DEVELOPMENT; A CASE STUDY of NIĞDE ÖMER HALISDEMİR UNIVERSITY CAMPUS

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ABSTRACT

Our cities have been rapidly developing both vertically and horizontally in recent years due to the increasing urban population, advancing technology, and the desire to utilize urban investment areas. The direction of urban development is determined by many factors such as social, cultural, economic, and transportation, which influence and shape the cities' growth. In addition to these factors, structures with high usage attractiveness such as hospitals, shopping malls, sports complexes, and university campuses play a significant role in directing the development of the city. This study evaluates the impact of Niğde Ömer Halisdemir University Campus on the direction of urban development and determines whether it has the potential to accelerate urban transformation and urban sprawl. In the study, the university's historical process was evaluated, and breakpoints where the number of students, faculties, and departments increased in campus development were determined. Based on these breakpoints, the direction of urban development in Niğde city was evaluated using geographic information systems (GIS) and satellite images from the specified dates to assess the development direction of residential areas.

Keywords: Urban Development Direction, Niğde Ömer Halisdemir University Campus, Urban Transformation, GIS, Historical Process.

CONSTRUCTION AND EVALUATION OF THE WIND TUNNEL TECHNIQUE FOR ESTIMATING AMMONIA VOLATILIZATION FROM LAND

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ABSTRACT

Agriculture is mainly responsible for ammonia (NH₃) volatilization. Among all agricultural activities, Livestock and especially animal manures are the most important sources of NH₃ emissions. Manure application which not only exacerbate greenhouse gas emissions, but also leads to eutrophication of water bodies. Many studies have shown that surface application of manure can lead to large ammonia losses and run off, on the other hand that tillage can substantially reduce these losses. It is necessary determine ammonia flux from manure-amended soils to improve management manure handling practices for minimizing agriculture's impact on the environment. From this point of view, we used one of the direct measured method to determine this volatilization. The objections of this work were: i) The design, construction, physical calibration, and operation of the little wind tunnels. ii) Recover ammonia loss from bovine Slurry by little wind tunnel method. iii) Determine the effect of slurry application depth on ammonia emission. The little wind tunnel system consisted of plastic canopy covering the treatment area (2 m long by 0.5 m wide). By was using a fan, it was imitated the natural wind speed in the test area (1-1.5 m/s). Nitrogen losses were measured with this method in surface application, 50 mm and 100 mm subsurface. In the surface application, the highest ammonia emission was observed. It was approximately 66% higher in compared to another methods. There is significantly (P=0.05) different in the ammonia emission, between the surface apply method and injection manure in soil methods. But There isn't any significantly different between ammonia emission amount in injection subsurface methods (100 mm and 50 mm deep).

Keywords: Liquid manure, wind tunnel, Nitrogen loss, liquid manure application, Sustainable cropping

IMAGE PREPROCESSING TECHNIQUES APPLIED ON NIR IMAGES FOR FRUIT BRUISE DETECTION

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ABSTRACT

This study investigates the transformative potential of image preprocessing techniques when applied to near-infrared (NIR) images for early bruise detection. It emphasizes the nuanced selection of filters to retain essential image features while accentuating bruise characteristics. Filters as noise-reduction tools, rendering bruises more visible without erasing critical details. Subsequently, the limitations of conventional edge detection filters were examined such as Sobel, Prewitt, and Canny, which excel in outlining fruit edges but fall short in delineating bruises. Adaptive thresholding methods were introduced, exemplified by Otsu's, showcasing their capacity to distinguish objects from backgrounds while acknowledging their challenge in preserving crucial edge pixels. Image enhancement techniques, such as Histogram Equalization, Contrast Stretching, and Sigmoid Correction, enhance fruit edge visibility and elevate bruise detection. In the frequency domain, filters such as Ideal Lowpass, Bandpass, and Highpass were harnessed to accentuate diverse bruise types. The Butterworth filter was introduced, capable of concurrently highlighting all relevant features, a pivotal innovation in comprehensive bruise detection. Through extensive experimentation and analysis of NIR images of various fruit varieties, including plums, peaches, and apples, our findings underscore the significance of tailored preprocessing techniques for optimal fruit bruise detection. These insights offer promise for agricultural industries and quality control processes seeking to enhance fruit quality assessment.

Keywords: Image processing, near-infrared (NIR) images, bruise detection

MICROWAVE-ASSISTED FOAM MAT DRYING OF KUMQUAT PUREE AND INVESTIGATION OF SOME PARAMETERS

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ABSTRACT

Kumquat puree, with the initial moisture content of 81.02 ± 0.8 (w.b) on wet basis, were dried using two different methods, microwave, and fan assisted hot air microwave (FAHA) until moisture content of kumquat was reduced to average of 25.02 ± 1.35 w.b. Microwave trials at 1.8 , 3.6, and 5.4 Wg⁻¹ lasted for 51, 19 and 12 min, respectively. FAHA trials at 1.8 , 3.6, and 5.4 Wg⁻¹ at 100 °C and 1.8 , 3.6, and 5.4 Wg⁻¹ at 150 °C lasted for 46, 38, 18, 15, 12 and 11 minutes, respectively. For foam drying, Soy protein (1%) and Maltodextrin (1%) were used as foaming agent, and carboxymethyl cellulose (1%) was used as foam stabilizer. After the drying trials, dried kumquat was powdered.

The scope of this study, a comparison of measurements of moisture with that of the predicted results was made, obtained from 13 thin layer drying models. Further, drying rate, color parameter and energy consumptions were compared for each trial. For all microwave and FAHA trials, Külcü et. al. (Unpublished) model was the most appropriate models depending on lowest chi-square value and root mean square error values. Color and specific energy consumptions (SEC) were categorized by using (SPSS) and chosen the best efficiency condition for drying as considering SEC. The most suitable drying process according to SEC was obtained at 5.4 Wg⁻¹ microwave drying method with value of 1.94 Whg⁻¹.

Keywords: Foam drying, microwave drying, pumpkin, color, modelling.

METHODS OF BLACKBERRY PROPAGATION IN VITRO CONDITION

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ABSTRACT

Blackberries are one of the most important berry species belonging to Rosaceae family. It can be grown throughout many temperate regions in the world because of its wide adaptation ability. Although it originated in Europe, today most of the common cultivars have North American origin. Also expansion of its production last 25 years especially in Europe and the USA, blackberry has become the fourth berry in the fresh berry market after strawberries, blueberries and raspberries.

Blackberry has rich fruit content in terms of vitamins, polyphenols, minerals, and antioxidants, especially gallic acid and rutin. Many researches have proved that its high nutrient composition has a positive effect on human health prevention of various diseases. It has an important role in the fresh and processed market. It can be used as a processed product like individually quick frozen, bulk frozen whole fruit, including ice cream, juice, jam, marmalade and cake.

Blackberry breeding studies have been ongoing for over 100 years to increase yield and fruit quality, thornless cane, to improve disease insect resistance and cane management and primocane fruiting. In vitro propagation is an alternative method to introduce new cultivars quickly into the market and to provide disease-free planting material compared with traditional methods. The purpose of this study is to summarize Blackberry propagation methods in vitro conditions.

Keywords: Rubus, Blackberry, in vitro propagation.

EVALUATION POSSIBILITIES OF DIFFERENT PARTS OF POMEGRANATE, A HISTORICAL FRUIT AND ITS EFFECTS ON HEALTH

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ABSTRACT

Today, with the faster development of science and technology, people have started to pay more attention to healthy living and consuming foods that are beneficial for human health. In this context, the value given to fruit species has become increasingly important and the importance of plants whose seeds are consumed has increased, as well as colorful fruits and vegetables. Pomegranate is a fruit grown in many countries of the world, especially in the Mediterranean climate, and its economic value has been increasing in recent years. This fruit has gained great nutritional importance not only because of its flavor but also because it contains many antioxidant substances and phenolic compounds that are beneficial to human health. There are nearly fifty pomegranate varieties registered in our country. These pomegranate varieties range from sweet to sour, from small-fruited to large-fruited, and from hard-seeded to soft-seeded in terms of skin color and fruit color. In recent years, the use of pomegranate parts such as peel, seeds, and flowers in cosmetics and food industry has become widespread and studies on the antioxidant properties of different parts of pomegranate have attracted interest. The aim of this review is to investigate the health effects of pomegranate fruit, different parts of pomegranate, and products made from pomegranate.

Keywords: Human health, nutrition, pomegranate, processing

POTENTIAL STATUS OF PERSIMMON (DIOSPYROS KAKI L.) IN TURKEY AND ITS IMPACT ON HUMAN HEALTH

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ABSTRACT

Anatolia is the gene center of many fruit species grown in the world and is also very rich in terms of fruit species and varieties. Diospyrus kaki L., known as persimmon, is one of these fruit species. Considering Turkey's ecological conditions, persimmon has a great potential for production. In recent studies, the potential health effects of persimmon have been cited as an important factor, increasing the popularity and consumption of persimmon. In addition, persimmon has become the center of attention in recent years due to the attractive orange color of the fruit, its distinctive taste and structure, rich in antioxidants and phenolic compounds. In this review study, it was aimed to increase awareness of the production potential of persimmon grown in Turkey by revealing its production potential, and to shed light on decision-makers in future production planning by providing information in terms of economic importance and health.

Keywords: Human health, persimmon, production, Türkiye.

ANALYSIS OF THE TECHNOLOGY OF SOWING RICE BY SEEDLING METHOD AND METHODS FOR ITS SOLUTION

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ABSTRACT

This article presents a brief analysis of the state of rice cultivation, the main advantages and disadvantages of seedling rice planting, analyzes the prospects for rice cultivation and mechanization of this process in Uzbekistan. Measures are indicated to fully meet the needs of the population in this product and reduce imports in Uzbekistan by giving special attention to the placement of varieties adapted to soil and climatic conditions with high-quality grain and high yields, the development and implementation of highly efficient resource-saving agricultural technologies in their cultivation. The factors influencing the decline in the efficiency of rice growing for the Central Asian region are analyzed. The purpose of the use of technical means for planting rice in seedlings is substantiated. The technical characteristics are given, a comparative analysis of the technological process, the main design advantages and disadvantages of machines for planting rice is made. Data on the physical and mechanical properties of soils used for rice crops, as well as on the main varieties of rice grown in the region are presented. After analyzing the agro-technical requirements for sowing rice in seedlings, a technical solution that improves the technological process of transplanting machines of the PA-600D-R and RF-455 brands (Korea) is proposed. The results of research on the development of the design of a planting device with optimal parameters and the possibility of using it for planting rice in seedlings for the soil and climatic conditions of Uzbekistan are presented. A mathematical model of the machine is built and its optimal values are determined. Using special programs such as Kompas 3D, 3D Max, MS Word, MS Excel and a number of other programs, 3D and 2D models of parts of the rice planter planting device were prepared. The analysis and results of the studies carried out will allow using the obtained data in improving the design of the planting device. The use of a machine equipped with such devices when sowing rice in seedlings will significantly reduce the consumption of seeds, irrigation water, shorten the growing season, reduce weediness and, as a result, increase grain yield.

Keywords: Technological process, climatic condition, machine, parameter, planting device.

COMPARISON OF SHEEP AND GOAT COLOSTRUM FATTY ACIDS

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ABSTRACT

The quality and content of colostrum are very important factors in pup mortality. Colostrum is the first food that provides for the growth and development of the offspring and their immunity against diseases. Colostrum composition is affected by many factors, such as calving season, number of lactations, length of dry period, maternal diseases, age, and breed. In this study, Awassi sheep and Saanen goats raised in Adana, where Mediterranean conditions are dominant, formed the animal material of the research, and these animals were kept in semi-intensive conditions in the subtropical Mediterranean climates. In the study, the fatty acids of sheep and goat colostrums were determined by a gas chromatography device. As a result of the analysis, 26 fatty acids were determined in Awassi sheep and 27 fatty acids in Saanen goats. Erucic acid was not detected in Awassi sheep. Colostrum fatty acids with the highest percentage in both breeds are Oleic acid (Awassi sheep: 36.32%, Saanen goat: 25.68%) and Palmitic acid (Awassi sheep: 28.15%, Saanen goat: 29.20%). Σ SFA ratios were higher in Saanen goat colostrum, and Σ MUFA and Σ PUFA ratios were higher in Awassi sheep.

Keywords: Colostrum, fatty acids, gas chromatography.

PROSPECTS FOR THE USE OF SOYAN CAKE IN THE PRODUCTION OF RYE AND WHEAT BREAD

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ABSTRACT

In this paper, an analysis was made of the use and consumption of soybean meal. Studied organoleptic, physico-chemical, functional and technological indicators of soybean cake. The safety of the use of cake in the production of bakery products has been established. Due to its economic value, reduced price, and high content of nutrients such as protein, fiber, carbohydrates and antioxidants, the use of soybean meal in the production of rye-wheat bread has been explored by partially replacing wheat flour.

Keywords: soybean cake, rye-wheat bread, waste-free production, recycling, resource conservation.

ANALYSIS OF COW SWEAT VOLATILE CHEMICAL COMPOUNDS IN GAS CHROMATOGRAPHY MASS SPECTROMETRY (GC-MS) DEVICE AND THEIR IMPORTANCE IN HEAT DETECTION

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ABSTRACT

Analysis of cow sweat volatile chemical compounds in Gas Chromatography-Mass Spectrometry (GC-MS) device and Oestrus detection in cows is very important for the profitability of dairy cattle production. Because one of the main goals of cattle breeding is for each cow to give birth to a healthy calf every year, The correct timing of insemination depends on the cow's correct oestrus detection. Knowing the signs of estrus that are specific to the estrus period of animals is very important for the early and accurate detection of estrus. There are many kinds of methods for detecting estrus. One of the alternative methods to the methods developed to detect estrus in animals is the detection of volatile chemical compounds (pheromones) secreted from animal sweat only during the estrus period. In this study, the analysis of volatile chemical compounds in cow sweat using a gas chromatography mass spectrometry (GC-MS) device and their importance in heat detection will be focused on.

Keywords: Sweat, oestrus, pheromone, GC-MS, cow.

JUSTIFICATION OF COMMERCIALIZATION OF EXPORT-ORIENTED HARVESTING APPARATUS FOR INTENSIVE PROCESSING OF COTTON BOXES

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ABSTRACT

In the conditions of operation of cotton harvesters with apparatus a two-time bush processing, such agrotechnical indicators as the loss of raw cotton and the dependence of the completeness of its collection on the degree of ripening of the crop do not meet the requirements of state standards. With a single pass of the machine, the completeness of cotton harvesting ranges from 75-83%, losses on bushes reach 15-10%, and with a two-time bush harvest – respectively 78-86% and 12-7%. In high-yielding fields (40 kg / ha and more), these indicators are too greatly deteriorating. The low cotton harvest and its high losses are largely explained by the high sensitivity of such apparats to the readiness plants of cotton plants and the agrophone of the cotton field for machine harvesting, the extensive nature of the processing of the opened boxes and the insufficient duration of the time the interaction of the latter with the working organs of the apparatus. One of the ways to intensify the impact of the working organs on the opened boxes and increase the time of interaction of the latter in the technological cycle working of the apparatus is to increase the multiplicity of processing cotton boxes. Therefore, the development of design documentation, the manufacture of industrial samples, trialing, preparation for commercialization and the organization of serial production of a cotton harvesting apparatus for intensive processing of cotton boxes (IPCB) is an important innovative task.

Keywords: Cotton, technological cycle working, agrotechnical indicators, cotton plant, harvesting apparatus

RESULTS OF FRONTAL PLUG TESTS COMBINED WITH ACTIVE WORKING BODY

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ABSTRACT

Article data on the average moisture and hardness of the soil before the tests are carried out. The combined plow with an active working organ developed in field tests 630C was added to the Claas ARION tractor, the theoretical and working depth, working speed were determined and the principle of operation was presented. The obtained results show that all the quality parameters of the plow with an active working organ, i.e. coverage width, processing depth, completeness and depth of burial of plant residues, soil compaction quality and the height of irregularities on the surface of the plow fully meet the agrotechnical requirements. given. The developed combined frontal plow with an active working body reliably performed the specified technological process compared to the plow with a passive working body and O'P-4/5-40, and its results are presented. Research of the results reliability of research modern style and measure from tools used without held, combined frontal plug active the work bodies parameters theoretical in terms of in justification higher math, theoretical of mechanics main the rule and methods action done, experiences to the results mathematician statistics methods with processing given, theoretical and practical studies of the results mutually adequacy, done studies based on work developed active the work organ the field of tests positive results and to practice current done with explained.

Keywords: Hardness, tractor, plug, tools, bottomless box

FIELD TESTS OF A CULTIVATOR THAT PROCEEDS BETWEEN ROW SOILS IN VINEYARDS

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ABSTRACT

The article presents the results of theoretical and experimental testing of the machine made as a result of the research on the basis of the scheme and parameters of the cultivator, which processes the soil between rows and rows of vines with a low cost, including vine rows with soil hardness varying between 1.4-1.8 mPa, the circumference of the bushes and The required tractor power is 21.53-35.09 kW when the resistance changes in the range of 12.41-16.37kN when moving the range of working speeds in the range of 1.45-1.8 m/s.

In the tillage system, it is important to loosen the rows between the vines without overturning them. Gray soil soils in Uzbekistan have different mechanical composition and are very poor in humus. Cultivation of the vineyard soil at a depth of 20-25 cm for many years leads to the formation of a plow heel, as a result of which the water-physical properties of the soil and the development of the root system deteriorate, which negatively affects the growth and yield of the plant. The leaves of the vines turn yellow, they drop their leaves early, the amount of fruits that can be obtained decreases, and accordingly the percentage of fruits that fall to the ground increases. A decrease in the water permeability of the soil prolongs the irrigation time, as a result of which water is used inefficiently. Deep softening improves the water permeability of the soil and, accordingly, increases the coefficient of effective plant use of moisture entering the soil.

Keywords: Tillage system, cultivation, aggregate, fruits, cultivator.

IMPROVEMENT METHODS OF FEEDING OF AQUACULTURE

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ABSTRACT

For stable, sustainable provision of the country's population with a variety of fish products, a scientifically sound strategy for the development of the fishing industry is needed, which consists in optimizing aquaculture cultivation technologies. The priorities of the development of aquaculture are the use of resource-saving technologies and equipment, reduction of losses during fishing, transportation, processing and sale of products, and efficient use of aquatic biological resources. This article presents material on the use of modern technologies in the distribution of feed for proper nutrition of fish.

Keywords: Nutrition of fish, equipment, biological resource, proper, fishing industry.

IMPACTS OF AVERAGE TEMPERATURE AND PRECIPITATION CHANGES ON AGRICULTURE IN TURKEY: EXAMPLE OF SSP3-7.0 SCENARIO

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ABSTRACT

Climate change is a major threat to agriculture in Türkiye. The country has already experienced an increase in temperature and a decrease in precipitation, and these trends are expected to continue in the future. The increase in temperature is likely to lead to changes in crop yields, and the decrease in precipitation is likely to increase the risk of droughts. These changes could have a significant impact on the agricultural sector, which is a major source of employment and income in Türkiye. This paper examines the impacts of climate change on agriculture in Türkiye. The SSP3-7.0 scenario and data from CMIP 6's coupled models are used in this study's climate projections. The study also makes use of earlier information from 1951 to 2020.

The paper finds that the annual mean temperature in Türkiye has been increasing steadily since 1951. The rate of increase has been accelerating in recent decades while there is no significant trend in annual precipitation in Türkiye over the period 1951-2020. However, the trend lines show that the rate of change in annual precipitation has been accelerating in recent decades. According to this study, Turkey's mean temperature will rise by 1.5°C from 2040 to 2059. The study also predicts that during the same time period, Turkey's average precipitation will fall by 10% to 20%. The paper concludes that the increase in temperature and the decrease in precipitation are likely to have a significant impact on agriculture in Türkiye. The paper recommends that the government take steps to mitigate the impacts of climate change on agriculture, such as developing drought-resistant crops and building infrastructure that is resilient to flooding and drought.

Keywords: Drought, Changing climate conditions, Agricultural policies, Agricultural production

UNVEILING CLIMATE CHANGE IMPACTS ON AGRICULTURAL SUSTAINABILITY: INSIGHTS FROM THE UNITED STATES

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ABSTRACT

Climate change poses significant threats to agricultural systems, necessitating a comprehensive understanding of its impact for effective adaptation strategies. This study examines the influence of climate change on agriculture in the United States, primarily focusing on temperature shifts and precipitation variations. Utilizing historical data and climate projections, we analyze trends in mean temperature and precipitation patterns from 1950 to 2020. The results indicate a noteworthy increase in annual mean temperature over the years, attributed to climate change. This rise in temperature has multifaceted implications, including heat stress in crops and exacerbation of drought conditions. The study also explores the complex relationship between precipitation patterns and climate change, highlighting regional variations and potential shifts in future precipitation trends. By projecting data under SSP 1-1.9 emission scenario, we assess potential changes in mean temperatures, hot days, and precipitation for 2040-2059 periods.

In conclusion, this study sheds light on the interplay between climate change and agricultural systems, emphasizing the need for adaptive strategies to secure food production and mitigate potential risks. The findings underscore the urgency of proactive measures to safeguard agricultural sustainability and resilience in the face of evolving climatic conditions.

Keywords: Climate change, agriculture, temperature trends, precipitation patterns, adaptation strategies, heat stress, drought, food security, greenhouse gas emissions, resilience

THE RELATIONSHIP BETWEEN DRY MATTER INTAKE AND THE AVERAGE DAILY GAIN

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ABSTRACT

The productivity of animals is closely related to the quality of the diet and of dry matter intake. Dry matter intake (DMI) is a factor that needs to be assessed before an animal's diet can be calculated correctly. Purebred bulls of the Kazakh white-headed breed in the amount of 70 heads of 7-8 months of age were selected for the experiment. By the end of the test, the bulls were about 11-12 months old. The average weight of the bulls when put to the test was 248.47 ± 2.46 kg, at the end of the test their average weight was 319.7 ± 3.44 kg. It is worth noting that the largest average daily increase was 2.46 ± 0.05 kg, which was in a bull that consumed 6.26 kg of dry matter per day, while the lowest average daily increase was 0.36 ± 0.05 kg, which was in a bull that consumed 5.67 kg of dry matter.

Keywords: bulls; beef, live weight; average daily gain, dry matter, dry matter intake

ASSESSMENT OF GROWTH AND DEVELOPMENT OF HYBRID DUCKLING OFFSPRING

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ABSTRACT

Currently, for agricultural enterprises of all ownership forms in the Republic of Kazakhstan, issues related to improving breeds, crosses, and lines of waterfowl remain important. Additionally, technologies for housing and feeding that enhance the survival and productivity of poultry are of great significance. The use of the genetic resources of domestic poultry breeds in breeding work, as well as the preservation of rare and endangered populations, holds special importance due to their high adaptive qualities in terms of both the quality and quantity of the obtained products, and their suitability for local feed and eco-climatic conditions. As a result of conducted research, an assessment of the quality of paternal and maternal lines of crosses from local duck populations in the Northern region of Kazakhstan has been performed, and indicators of growth, development, and survival of the obtained hybrid offspring have been studied. The conducted research has established that the "Ansar" crossbred ducklings exhibit higher growth energy along with a 94% survival rate of the offspring in early age.

Keywords: duck; growth; development; line; cross selection; safety

CHEMICAL COMPONENTS OF DIFFERENT SOLVENT EXTRACTS OF ASCLEPIAS CURASSAVICA L. AND ANTIBACTERIAL EFFECT OF THE EXTRACTS ON TOMATO PATHOGENS

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ABSTRACT

The use of environmentally friendly and sustainable agricultural methods in the control of diseases and pests is of great importance. In both conventional and organic agricultural production systems, the utilization of various plant extracts as part of integrated pest management has gained significance in recent years. The chemical constituents of various solutions derived from the flowers, leaves, and roots of the *Asclepias curassavica* L. plant were investigated, along with the possibilities of utilizing these solutions in the control of tomato plant pathogenic bacteria. As a result of the analysis, acetic acid in 60% and 80% ethanol solutions, as well as acetic acid methyl ester in 60% and 80% methanol solutions, were detected in the flowers, leaves, and roots. The effects of *A. curassavica* flower, leaf, and root extracts, prepared using three different solvents (water, methanol, and ethanol), were investigated on eight different pathogenic bacteria (*Agrobacterium tumefaciens*, *Clavibacter michiganensis*, *Dickeya zeae*, *Pectobacterium caratovorum*, *Pseudomonas phaseolicola*, *Pseudomonas tomato*, *Pseudomonas viridiflava*, and *Xanthomonas euvesicatoria*) that cause diseases in plants. Several main compounds such as acetic acid, acetic acid methyl ester, Furfural, 2-Furanmethanol, 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-, Glycerin, Benzo furan, 2,3-dihydro- and 5-Hydroxy methyl furfural were identified as analyzed by GC-MS with different concentrations of ethanol and methanol solutions used for the flower, leaves and root of *A. curassavica* plants. The flower extract prepared with 80% ethanol exhibited a higher inhibition zone (ranging from 1.5 mm to 5.3 mm) in all pathogens, compared to other applications. The successful suppression effect of *A. curassavica* flower extracts on this disease is promising, especially in organic farming areas. Additionally, since it is environmentally friendly and sustainable, it can be included in integrated control methods to prevent the loss of productivity caused by diseases.

Keywords: *Asclepias curassavica*, Methanol, Ethanol, *Clavibacter* sp, *Pseudomonas* sp, *Xanthomonas* sp.

IMPACT OF HEAT STRESS ON SUCROSE METABOLISM OF WATERMELON

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ABSTRACT

High temperatures (HT) are currently a significant issue for crop production, and strategies for maintaining high crop yields and quality under HT stress are crucial agricultural objectives. The changes in sugar metabolism during HT stress were examined in watermelon cv. Crimson Tide leaves. The leaves obtained from plants were subjected to 35, 40, 45, 50, 55 and 60°C. Heat-stress tolerance (HST; LT₅₀, defined as temperature causing half maximal percent injury based on electrolyte leakage), hydrogen peroxide (H₂O₂), sucrose (Suc), reducing sugars and starch contents and some sucrolytic enzyme activities in leaf samples held at each temperature stage for 30 minutes were determined. The indicators of HST; rate of injury and H₂O₂ content, rose with increasing temperatures, most noticeably between 50-55°C. As a result, the LT₅₀ value was determined to be 53.84°C. The Suc content increased almost 2-fold between 50-55°C. The reducing sugars and starch content sharply decreased with HT up to 50°C comparing to the control, however both increased almost 2-fold between 50-55°C. The activity of sucrose synthase (SuSy), alkaline-invertase (INV) and acid-INV enzymes reduced as the temperature rose. Between 50-55°C acid-invertase activity has dropped by about half. The findings revealed that sugar metabolism contributes significantly to HST.

Keywords: Carbohydrate metabolism, *Citrillus lanatus* L., high temperature stress, soluble sugars, sucrose-related enzymes

EFFECTS OF PUTRESCINE AND SPERMINE ON POLLEN GERMINATION LEVELS OF SOME OLIVE CULTIVARS

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ABSTRACT

Olive has been expanded in Mediterranean basin since 6000 years and Türkiye is one of the most important olive producers in the World. Pollen quality of olives depends on genetic and environmental factors. Especially temperature has negative effects on pollen germination and tube growth of olive which directly affects fruit set. Recent studies showed that polyamines play important roles on signalling process of flower initiation, flower development, blooming periods and especially on temperature balancing of plants.

In this study, it is aimed to determine the effects of putrescine and spermine on pollen germination levels of 8 olive cultivars. Arbequina, Gemlik, Halhali, Karamani, Kozan yerli, Saurani, Sayfi and Şami olive cultivars were used as material. In the study, 5 spermine doses (0,25mM, 0,125 mM, 0,025 mM, 0,05 mM and 0,005 mM) and 5 putrescine doses (0,20 mM, 0,10 mM, 0,05 mM, 0,025 mM and 0,1 mM) added to basal germination medium (15% sucrose + 1% agar + 100 ppm Boric acid) were tested for determining the effects on pollen germination of olive cultivars. Basal media was used for Control treatment. Pollen viability level was also determined for controlling the pollen quality.

As a result of the study, it was determined that pollen viability levels were differed between 31,61% (Arbequina) and 80,69% (Şami). In terms of pollen germination media, pollen germination levels were increased with lower putrescine and higher spermine levels. In Sayfi olive cultivar, while pollen viability rate was 42,74%, pollen germination was 0,00% in control treatments. However, pollen germination was increased for Sayfi olive cultivar with 0,20 mM and 0,10 mM putrescine (3,64% and 3,40%, respectively) and 0,25 mM, 0,125 mM and 0,05 mM Spermine (12,56%, 4,73% and 3,40%, respectively).

In conclusion, pollen germination capacity was significantly influenced from cultivars but not have much significant effects in terms of polyamine treatments. However, polyamine treatments were increased the low germinated cultivars. So, polyamine treatments reveal the potential of the pollen especially in low-germinated pollens.

Keywords: Pollen, Polyamine, Climate change, Quality, Olive

MORPHOLOGICAL CHARACTERISTICS AND MILK COMPONENTS OF LOCAL YELLOW BREED COWS

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ABSTRACT

In the United Nations Convention on Biodiversity, genetic resources are defined as "genetic material of present or future value". In order to meet the basic needs of humans, 40 of the 50,000 mammal and bird species known in the world have been domesticated and 7616 livestock breeds belonging to these species are considered as genetic resources. Turkey is one of the most important gene centres of the world. However, today many gene resources are under protection due to the threat of loss. It is estimated that these genetic losses will negatively affect world agriculture in the near future. For this reason, there has been a significant increase in studies and efforts for the conservation of animal genetic resources in the world in recent years. Taking this need into consideration, it was aimed to determine the morphological characteristics and milk components of the domestic yellow breed, which has adapted to harsh conditions and still contributes to its breeders by grazing extensively in traditional breeding, in barns in winters and freely in highlands in summers. For this purpose, the study was carried out in 2018 within the scope of the 2018 roughage support project of the Adana metropolitan municipality in the village of Gürümze, Fekke District, Adana Province, where the local yellow cows registered within the scope of the Domestic Animal Genetic Resources Protection Project. For the morphological characteristics of the cows, the determinations made by the researcher on site and camera shots were used, and the milk composition was made using the MilkoScan FT120 (FOSS) milk analyser. The skin colour of the local yellow cows bred in the region varies from dirty yellow to red and cinnamon colour. They were found to have small build and short horns. Although the height of the rump is higher than the cingulum, it is seen that the back line is straight. Horn colour is blackish dark. Around the eyes, side parts of the face, neck, shoulder blades and tail tip are darker. The tip of the snout is dark coloured up to black, and there is a slightly lighter coloured, sometimes dirty white ring around the nose and mouth compared to the body. The inner sides of the legs are light coloured. Hoof colour is dark grey or black, close to black. The average total solids, SNF 9.64, fat 2.15 and protein 3.53 were determined as 11.67, 9.64, 2.15 and 3.53, respectively. However, it is understood that there is significant variation when minimum and maximum values are considered.

Keywords: Native Yellow Breed, Milk Composition, Morphological Structure

KNOWLEDGE LEVEL AND EXPECTATIONS OF ANIMAL BREEDERS OF MOUNTAIN VILLAGES OF ADANA AND MERSIN PROVINCES ON COOPERATIVES

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ABSTRACT

In this study, the perspectives of the breeders living in mountain villages on cooperatives and their expectations from cooperatives will be tried to be determined. This research was carried out in the form of a questionnaire survey with 80 breeders engaged in animal husbandry in Adana and Mersin mountain villages between March and July 2023. Firstly, a literature study was conducted and survey questions were prepared through preliminary breeder interviews. The main population of the research was determined on a voluntary basis from people who are engaged in animal husbandry in the mountain villages of the region. The questionnaires prepared for this purpose were applied through face-to-face interviews. The survey questionnaire forms were designed in a way to meet the objectives of the research, primarily socio-demographic structure and co-operative membership, view of the co-operative and expectations from the co-operative in the questionnaire, and the survey questions were arranged in subheadings not exceeding 20 minutes. When asked what is the most important thing you pay attention to in a co-operative, 45% of the respondents said the activities of the co-operative up to that day. When asked which of the following would bother you the most in a co-operative that you are considering becoming a member, 75% of the respondents said corruption. The high rate of this answer at the level of 75% can be explained by the fact that the breeders have had negative experiences and rumours. This situation can be considered as the reason why the breeders are cold towards co-operative membership. Among the 27 questions asked about the respondents' perspectives on co-operative management, only 5% of the respondents strongly disagreed with the question "I do not have difficulty in providing quality, cheap, timely and reliable raw materials to my business" and the rate of those who disagreed with 13 questions was between 5% and 40%. The most important expectations of the respondents from the co-operative are justice in management and transparent management by 75% of the respondents. As a result, it is understood that organising training and information meetings by taking into account the reservations expressed and experiencing successful examples with on-site examination will yield useful results.

Keywords: Mountain Villages, Breeders, Farm animals, Cooperative, Expectations

OPTIMUM INSULATION THICKNESS CALCULATION OF EXTERNAL WALLS OF COMMERCIAL POULTRY FARMS

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ABSTRACT

In the study, the optimum insulation thickness was calculated for the external walls of large-scale commercial chicken farms for laying hens, broilers, and chicks. The study was conducted for farms in Balıkesir province, which is one of the important poultry farming centers in Turkey. The reason why the optimum insulation thickness for external walls is taken into account is that the external walls are the building element with the highest surface area where the most heat loss occurs. External wall insulation thickness of poultry farms was calculated based on life cycle cost analysis and degree-day method. It is accepted that natural gas, coal, fuel oil, LPG, and electricity are used as fuel to heat the farms in winter, and electricity is used to cool them in summer. While determining the degree-day values used for the optimum insulation thickness calculation, sun-air temperature, and wet bulb temperature were used. The solar radiation coming to the vertical surface in different directions for the external environment and dry bulb temperature values are considered to calculate the solar air temperature. As for the wet bulb temperature, relative humidity and dry bulb temperature values are considered. The optimum insulation thickness calculation of the external walls of the poultry farm was considered only in the winter period, in the summer period, and in the winter + summer period together. Additionally, in the study, when different fuels were used for the external walls of poultry farms, the difference in energy consumption between insulated and uninsulated cases was determined and the energy-saving potential was calculated. For the poultry farm, the external wall component was brick, and the insulation material was expanded polystyrene. In the study, calculations were made by taking the humidity value of the chicken coops as 75% and temperature as 17 °C for laying hens, the humidity value as 70% and temperature as 18 °C for broiler chickens, and the humidity as 65% and temperature as 30 °C for chicks.

Keywords: Poultry farm, external wall insulation, energy consumption, poultry humidity and temperature values

INVESTIGATION OF HEAT LOSSES AND EXERGY ANALYSIS IN GREENHOUSES WITH DIFFERENT COATINGS

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ABSTRACT

In the study, heat losses from polyethylene and glass-coated greenhouses were calculated and compared. Energy losses and exergy losses were also determined. In greenhouses; Heat losses occur through absorption, radiation, external surfaces, soil, indoor airflow, and evapotranspiration. In the study, the heat conduction coefficients, emissivity, absorbance, and radiation transmittance of the greenhouse covering materials, polyethylene, and glass, were taken into consideration. The study was conducted for a sample greenhouse in Balıkesir province. In the greenhouse, heat loss due to conduction and radiation from the soil depending on soil properties and depth, heat loss due to indoor airflow depending on the amount and speed of air exchange, and heat loss by evapotranspiration depending on plant characteristics were also calculated. Finally, in addition to heat losses, exergy losses calculated according to the second law of thermodynamics were also determined. While calculating the heat losses from the coatings, outdoor temperature, solar radiation and wind values in Balıkesir province were taken into account.

Keywords: Greenhouses, greenhouse coatings, heat loss, energy consumption, exergy analysis

RELATIONSHIPS BETWEEN HEAT SHOCK PROTEINS AND YIELDS IN CATTLE

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ABSTRACT

Adaptation to different climatic environmental conditions on the basis of species and races varies greatly. Adaptation, in a broad sense, can be defined as the adaptation of organisms to environmental conditions flexibly within their genetic structure and species boundaries in order to sustain their lives and the continuation of the generation. In a narrower sense, it would not be wrong to define adaptation as a collection of hereditary traits or traits that increase the chance of an organism to live and reproduce in a particular environment. Such changes are morphological, observable as well as physiological or cellular. It is now recognised that events at the cellular level play an important role in the adaptation of organisms to their environment. In this sense, heat shock proteins, which are also called stress proteins, are still the subject that is still trying to be understood. Heat shock proteins are a group of proteins found in all living organisms and cells. The most prominent response to heat stress is the family of proteins called heat shock proteins (HSP), which were first discovered in cells due to high fever.

Molecular markers can be used as reference points in breeding for identification, manipulation and hybridisation to improve genetic potential in cattle. Therefore, the overall improvement in animal species is greatly aided by the use of molecular markers. Selection of animals resistant to heat stress is an effective way to improve the productivity of cattle at high environmental temperature. Based on molecular weight and biological functions, HSPs are classified into HSP 110, HSP100, HSP90, HSP70, HSP60, HSP40, HSP10 and small HSP families, of which the development of thermo-tolerance is mainly associated with HSP70 and HSP90 in cattle species.

In this article; the structure and physiological roles of heat shock proteins, which are an important research topic with increasing temperatures, and current studies in cattle are reviewed.

Keywords: Heat Shock Proteins, Gene, Heat Stress, Cattle Breeding

INVESTIGATION OF POTENTIAL CHALLENGE OF SPEED BREEDING IN A COMMERCIAL COTTON BREEDING PROGRAM

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ABSTRACT

Due to the changing environmental conditions, the production of alternative solutions for cultivating plants with commercial value is among the agricultural strategies of the countries. For this reason, the 'Maraspoli' cotton genotype, which has commercial value in Türkiye, was subjected to field and speed breeding trials to understand the potential of the speed breeding technique against possible negative risks that may occur due to environmental factors in the cultivation of cotton plants. The 'Maraspoli' cotton genotype was obtained by the Eastern Agricultural Research Institute (Türkiye) in 2022. This genotype has a fiber fineness of 4.9 mic, a fiber length of 33.4 mm, a fiber break thickness of 32.9 g/tex, an average mass yield of 503 kg/da and a fiber yield of 197-22 kg/da. This study investigated how many days the vegetation period of 'Maraspoli' in the field can be completed by going from seed to seed in a speed breeding system. In the Speed breeding study, a total of 586 lux light, including red light of 343 lux, green light of 69 lux, and blue light of 174 lux, was given until the flowering period of the plant. Also, conditions where the temperature is 24°C, the humidity is 70%, and the photoperiod is 22 hours light and 2 hours dark during the day and night were applied. A simultaneous field experiment was also set up to compare the speed breeding experiment results. As a result, it has been found that it can go forward two and a half generations in a year. Thus, it has been determined that it is possible to obtain faster and safer products with the speed breeding technique. In the future, speed breeding techniques will also have the opportunity to be used for the production of many different plant species and genotypes.

Keywords: Cotton, genotype, maraspoli

DETERMINATION OF THE CONTENT AND QUALITY AGRICULTURAL TECHNIQUES REQUIRED FOR THOUSAND HECTARES OF COTTON AREA

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ABSTRACT

The article presents a normative method for substantiating the composition and quantity of tractors and agricultural machinery required for 1000 hectares of cotton in the soil and climatic conditions of the Republic of Uzbekistan. For the substantiation of the composition of machines (plough, disc harrow, seeder, cultivator, cotton harvester, etc.), modern equipments were selected to perform the agro-technical measures (ploughing, leveling, sowing, harvesting, etc.) identified in the technological map of cotton cultivation. In substantiating the required number of specific machine required for performing specific agricultural measure or practice per 1000 hectares, its productivity of one shift determined during testing, the duration of the shift, the number of shifts, the daily productivity, the duration of the agricultural measures and practices, the volume of seasonal work were used as arguments.

Keywords: cluster, agricultural measures, one shift, daily and seasonal productivity of machines, number and duration of shifts, normative number per 1000 hectares, composition and number of machines

HARDENING OF GEAR TEETH DEPENDING ON THE CONCENTRATION OF ABRASIVE PARTICLES IN THE TRANSMISSION OIL

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ABSTRACT

The article deals with the issues of determining the life and limiting concentration of abrasive particles in the oil of transmission units, depending on the type of hardening of gear teeth. Resource was determined after volume hardening, hardening by current of high frequency and cementation by hardness of gears materials, on the friction machine on the samples which have been made of gears material, working in oil with abrasive particles, considering coefficient of acceleration at test. Maximum allowable concentration of abrasive particles in machine oil, were estimated on the basis of expression for calculation of wear rate, providing the set life, maximum allowable wear depending on modulus of gearing, hardness of gearing material, size of abrasive particles, geometrical and kinematic parameters of gearing.

Keywords: Resource, limit concentration, abrasive particles in oil, transmission units, type of hardening, gear teeth, volume hardening, high frequency current hardening, cementation, hardness of materials, gears, friction machine, specimen, test acceleration factor.

ESTIMATION AND CLASSIFICATION OF PHYSICAL PARAMETERS DIFFERENT CROP SEEDS BY SOFT COMPUTING TECHNIQUES

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ABSTRACT

Determining the seed type is very important for the correct identification of genetic material. Some plant seeds cannot be classified based on their visual diversity or small size by experts. Therefore, in this study was to develop a simple, accurate and rapid using different soft computing techniques that estimates physical parameters.

The current investigation was devoted to determining some properties, such as physical dimensions, surface area, sphericity, density, stiffness of tomato, eggplant and pumpkin seeds. The methods using in this study are (1) Multible layer perceptron (MLP); (2) Generalized regression neural network (GRNN), (3) Adaptive Neuro-Fuzzy Inference Systems (ANFIS). Different statistic parameters such as coffecient of determination (R^2), root mean square error (RMSE), mean absolute error (MAE) are used to evaluate performance of the methods. These selected the best models predicted for plant seeds which can be used in the soft computing techniques determined alternative approach to estimating the physical properties of estimation and clasification tomato, eggplant, and pumpkin seeds.

Keywords: Soft computing techniques, best model, tomato, eggplant and pumpkin seeds

ISSUES OF AGRICULTURAL SPECIALIZATION IN THE ARAL SEA REGION

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ABSTRACT

The content of the article is aimed at reducing the economic losses caused by the Aral Sea problem by further improving the specialization of agriculture, based on the potential of the Aral Sea region. At the same time, based on the share of agriculture in GDP, it is aimed at increasing the share of agriculture in economic growth, using the existing conditions wisely. Through the specialization of agriculture, we will be able to overcome the current problems by creating an integrated system that effectively uses the available resources in the country. These insights are based on scientific evidence and statistical observations. The priority of the practical work on the Aral Sea in our country will be to improve the living standards of the population through the efficient use of inefficient land.

By building agricultural specialization with modern technologies, we will be able to effectively address important issues in the Aral Sea region. The measures taken in recent years also mean that the Aral Sea issue is one of our priorities at the national level.

Keywords: Aral Sea potential, agricultural specialization, Aral problem, economic losses, gross domestic product, economic growth, available resources, a structural complex, current issues, opinions, scientific basis, statistics observations, priorities, living standards of the population, modern technologies, important issues, priority tasks

DETERMINATION OF VIRUS DISEASES IN SOYBEAN PRODUCTION AREAS IN ÇUKUROVA

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ABSTRACT

Viral diseases in soybean cause serious economic losses by affecting the development and productivity of the plant. Soybean mosaic virus (SMV) is one of the important viruses that reduce the production quantity and quality in soybean production areas in the world. Bean pod mottle virus (BPMV), another economically devastating viral disease in soybean cultivation, causes yield losses exceeding 60% in mixed infection with SMV. Tobacco ringspot virus (TRSV) is one of the viral agents that is commonly seen in soybean and can cause product losses ranging from 25-100%. Since there is no chemical control of viruses, it is important to detect viral agents correctly and take cultural precautions. In this study, the presence of Soybean mosaic virus, Bean pod mottle virus, Tobacco ringspot virus, Cucumber mosaic virus and Alfalfa mosaic virus in soybean production areas in Çukurova (Adana, Osmaniye, Mersin and Hatay) was investigated using serological and molecular methods. For this purpose, surveys were carried out in the soybean production areas of Adana, Osmaniye, Mersin and Hatay provinces between May and November 2022. A total of 152 soybean samples were taken, 90 from Adana province and districts, 20 from Osmaniye center and districts, 32 from Tarsus district of Mersin province, and 10 from Antakya district of Hatay province. As a result of the serological and molecular analyses, 3 soybean samples from Adana province Yüreğir district, 6 soybean samples from Mersin Tarsus district, 3 soybean samples from Osmaniye province Toprakkale district, and 2 soybean samples from Osmaniye center were found to be infected with SMV.

Keywords: Soybean, Soybean mosaic virus, Bean pod mottle virus, Tobacco ringspot virus, Cucumber mosaic virus, Alfalfa mosaic virus

CHARCOAL ROT DISEASE (MACROPHOMINA PHASEOLINA) IN SOYBEAN PRODUCTION AREAS

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ABSTRACT

Soybean (*Glycine max* (L.) Merr.), a species of the legume family, is one of the most important industrial plants. As the ideal of a healthy life has taken its place on the agenda in the world, soybean consumption and utilization opportunities have increased, as in other products, and this has encouraged the increase in soybean production amount and cultivation areas. Soybean oil has an important place after sunflower and olive oil in reducing Turkey's oil deficit. The soil-borne disease of *Macrophomina phaseolina*, which causes of Charcoal Rot disease, is one of the most important plant diseases of soybean, as it limits production in soybean growing regions in our country and threatens all development periods of the plant. The disease is a soil-borne fungus and appears in moist soils. The disease occurs especially in water-stressed plants and at high temperatures, causing over 50% crop loss. In addition to reducing yield, charcoal rot can change the content of soybean seeds and affect nitrogen fixation. Due to the high variation among isolates of this pathogen due to its soil origin, there are no commercialized domestic soybean varieties resistant to this disease yet. Management strategies to control Charcoal rot disease include; these include scheduling planting dates and irrigation to reduce soil inoculum densities of the pathogen, crop rotation, encouraging rapid and vigorous plant growth, and alleviating mid-season drought stress. Since these strategies generally cannot provide effective and sustainable control in the control against the disease, the use of resistant varieties has come to the fore in recent years as the most effective, economical, environmentally friendly and sustainable method.

Keywords: Soybean (*Glycine max* (L.) Merr.), *Macrophomina phaseolina*, soil borne disease

AN EVALUATION ON THE EXAMPLES OF MOBILE SMART AGRICULTURE APPLICATIONS IN TÜRKİYE

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ABSTRACT

The technological process of agricultural mechanization has evolved over time from mechanical, hydraulic and pneumatic structures to electrical-electronic and mechatronic systems. With the addition of digital and information technologies in recent years, agricultural mechanization tools have had functions as time independent, non-spatial and unmanned. Agricultural production technologies are now equipped with integrated systems with the Internet of Things, cloud informatic, image processing, micro-chips and micro-controllers, wireless data transmission and mobile-portable devices.

Today, during the production process, physical, biological or chemical data detected through sensors from plants, animals, soil and atmosphere are uploaded to computers and cloud informatic technologies as big data sets. The data stored, processed and reported here is presented to decision makers or beneficiaries via mobile devices connected to the internet. Basically, with mobile applications developed on online platforms, databases can be connected and accessed using various programming languages; then, the requested data can be analyzed and reported. All these systems work integrately.

Within the scope of this study, examples of mobile-portable applications used in the field of smart agriculture in the world and in our country were generally examined. In addition, technological and sectoral applications on mobile smart agriculture in our country have been compared. Currently, common application examples of the Ministry of Agriculture and Forestry, agricultural machinery manufacturers, some private sector companies, municipalities and mobile communication companies, which produce these technologies and provide them for the end users, agricultural producers, have also been researched in this context. In the literature reviewed, various online internet applications of service providers that produce or market mobile technologies in our country were also discussed, and the technical parameters of the functions offered were examined. In addition to these, the strengths and weaknesses of the current portable-mobile applications and the smart agricultural technologies in the agricultural production process have been tried to be analyzed in terms of our country's conditions.

Keywords: Smart agriculture, farm machinery technologies, mobile smart farming applications

..... INVESTIGATION OF GENOTYPE AND ALLELE DISTRIBUTION OF PPARGC1A-T19C LOCUS IN HOLSTEIN CATTLE

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ABSTRACT

This study aims to investigate the genotype and allele distribution of the PPARGC1A-T19C locus in Black Pied cattle. The PPARGC1A gene plays a critical role in important metabolic processes such as adaptive thermogenesis, gluconeogenesis, skeletal muscle fiber type change, mitochondrial biogenesis and adipogenesis. It also has a key role in the activation of many hormone receptors and transcription factors. In this context, it stands out as a potential candidate gene for milk traits of cattle. In this study, genotyping was performed by PCR-RFLP method using 50 Black Alaca animal samples. 205 base pair PCR product was treated with BsuRI cutting enzyme and genotypic difference was revealed. Two different genotypes, TC and CC, were identified. Genotype frequencies were found to be 30% (TC) and 70% (CC). Allele frequencies were 15% (T) and 85% (C). In conclusion, these results can be used to understand the genetic diversity within the breed and to develop more effective selection strategies in genetic breeding programs of the breed.

Keywords: Black Pied, PCR-RFLP, PPARGC1A, Allele frequency

EGG QUALITY CHARACTERISTICS OF SUSSEX CHICKENS REARED UNDER THE HOUSING CONDITIONS OF CUKUROVA UNIVERSITY FARM

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ABSTRACT

This work was conducted to determine the egg quality characteristic of Sussex multi-purpose chickens reared under the housing conditions of the Cukurova University Farm. A total of 81 Sussex chickens from the Poultry and Research Unit of Cukurova University were used in this study. The internal and external quality egg quality were determined using 30 eggs on both the 28th and 33rd weeks of egg production cycle. The egg quality parameters measured were the egg weight, shape index, shell thickness, shell weight, breaking strength, Haugh unit, yolk color and albumen pH. The egg weight, albumen index, yolk index and Haught unit were 57.89 ± 3.99 g, 9.44 ± 2.07 , 43.22 ± 3.57 and 84.85 ± 8.87 respectively. The shape index, shell thickness, shell weight, shell breaking strength and albumen pH were 75.32 ± 2.11 , 0.338 ± 27.84 mm, 5.903 ± 0.645 g, 3.825 ± 1.065 kg/cm² and 7.84 ± 0.18 respectively. The yolk color, L, a, b and E values were 55.85 ± 7.02 , 13.91 ± 3.33 , 47.18 ± 7.90 and 74.99 ± 5.96 respectively. It was concluded that the internal and external egg quality parameters of Sussex chickens reared under the housing conditions of the Cukurova University Farm were between the normal range.

Keywords: Cukurova farm, chicken, Sussex, egg, egg quality, housing conditions, poultry

THE IMPERATIVE OF ESTABLISHING A CURRENT SOIL DATABASE UTILIZING GIS: A CASE STUDY OF TÜRKGELDİ AGRICULTURE ENTERPRISES

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ABSTRACT

Soil, an indispensable component of agricultural production, undergoes alterations due to various land uses. These changes can either enhance or deteriorate soil properties. Understanding the current soil characteristics is essential for promoting sustainable land use practices. Accurate data about soil attributes is paramount in the planning and management of agricultural land, as it forms the foundation for informed decision-making. A crucial step in land use planning involves comprehending and presenting the current state of soil properties. These properties, encompassing both physical and chemical aspects, provide valuable insights into the land's suitability for specific uses. While the specific attributes needed may vary based on the scope of planning, a fundamental understanding of soil composition is essential for general land use considerations. In any agricultural enterprise, a comprehensive understanding of soil properties is a prerequisite for achieving sustainable and productive operations. This study focuses on Türkgeldi Agricultural Enterprise, a significant player in Turkey's agricultural landscape. Using Geographic Information Systems (GIS), the study quantitatively assesses the soil properties of their land holdings and generates a series of thematic maps. These maps serve as valuable resources, particularly for professionals in the field of soil science and land use planning. Furthermore, this study highlights the significance of creating an up-to-date soil databank. Such a repository would not only include dynamic soil properties but also vital plant nutrient data that may have been overlooked in a study report prepared approximately 40 years ago. This omission underscores the need to continuously update our understanding of soil conditions, as it directly impacts the sustainability and productivity of agricultural businesses.

Keywords: Soil database, soil survey, soil maps, GIS

RESPONSE OF COWPEA (*VIGNA UNGUICULATA* L.) TO APPLICATIONS ORGANIC AND CHEMICAL FERTILIZER APPLICATIONS ON GRAIN YIELD AND YIELD COMPONENTS

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ABSTRACT

Grain of cowpea are used for human diet and its grain contains high protein, minerals and vitamins. Cowpea was also used as hay, silage, green forage, grain fodder for feed livestock. The experiment was conducted under irrigated conditions in the experimental area of Field Crop Department, Faculty of Agriculture, Cukurova University, Balcalı, Adana, Turkey. The growing period covered throughout 2021 and 2022. The field experiment was organized in split plots based on randomized complete blocks design with three replication. Two registered cultivars (Karagöz ve Akkız) were used as a research material. In this experiment the main plots were cultivars and sub-plots were application of fertilizer. Treatments were: control (no fertilizer), solid leonardite, liquid leonardite, basal chemical dose + solid leonardite, basal chemical dose + liquid leonardite, basal chemical fertilizer + additional N fertilizer. Basal chemical dose was application of 40 kg N ha⁻¹ and 100 kg N ha⁻¹ P₂O₅ (Di ammonium phosphate or DAP) before sowing as recommended chemical fertilizer. Addition chemical dose was application of 80 kg N ha⁻¹ (Ammonium sulfate) over the basal dose at the seedling stage. Rhizobia inoculant was not applied during the field experiment. Akkız seed yield was significantly higher in application of liquid leonardite fertilizer and the combination of basal chemical fertilizer + liquid leonardite fertilizer with 1656 and 1533 kg ha⁻¹ respectively, compared to other treatments. The grain yield in the control plot was the lowest in both cultivars. As a result, applying liquid leonardite fertilizer into the soil before sowing can be useful for grain production in cowpea.

Keywords: Chemical fertilizer, cowpea, cultivar, grain yield, leonardite

THE EFFECT OF BIOREACTOR USE ON IN VITRO CLONAL PROPAGATION OF CHESTNUT (CASTANEA SATIVA) MICROSURMS

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ABSTRACT

Chestnut (*Castanea Sativa*) is a fruit species that has a natural distribution in many regions of Anatolia and its economic cultivation is widespread mainly in the Aegean, Black Sea and Marmara Regions. However, serious chestnut losses are experienced especially due to the damages caused by ink disease, chestnut cancer and root rot. The reproduction of breeding material varieties and rootstocks that are effective against diseases and pests can only be made possible by developing vegetative propagation systems that can meet the demand for these breeding materials. In this study, explants from young and mature tissues of the same 50-year-old chestnut tree were cultured in Plantform™ and commercial RITA® Bioreactor system containing MS½N and GM medium containing 0.22 µM BA and 0.44 µM BA 3% sucrose and 0.6.5% (gr/l) difco agar. For rooting, 1cm long shoots were immersed in 1mg/ml IBA solution for 1 min and kept for one month in hormone-free GD medium. In the study, RITA® bioreactor gave better results than both plantform and semi-solid medium in terms of shoot quality, average shoot number and shoot length in explants. In terms of explant characteristics, young tissues gave better results than mature tissues. In terms of rooting, 80% rooting was observed in young tissues, while no rooting was observed in shoots taken from mature parts.

Keywords: Chestnut, Bioreactor, micropropagation, Plantform™ , RITA®

THE POTENTIAL OF BIOINOCULANTS IN ENHANCING THE MUSHROOM PRODUCTIVITY

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ABSTRACT

Nowadays, environmentally friendly and sustainable food production is gaining importance. The most crucial factor in achieving the goal of sustainable food production is by limiting the chemicals that pose risks to human and environmental health, such as fertilizers and pesticides. One of the methods used to reduce chemical application in agriculture is bio-inoculants. Bio-inoculants are formulations consisting of microorganisms such as bacteria and fungi. They can potentially increase agricultural productivity and control pests and diseases.

Mushrooms are among the sustainable foods that stand out with their high nutritional values and medicinal properties. However, the excessive use of chemicals in producing some edible mushroom species may make their consumption risky despite the mushroom's rich nutritional and medicinal values. The application of biological agents intended to replace chemicals may provide a significant advantage to the mushroom industry. *Azotobacter*, *Bacillus*, *Paenibacillus*, and *Pseudomonas* are the most critical bacteria genera used in mushroom cultivation. In general, they increase the mycelial growth of mushroom species while exhibiting competition against harmful molds and stimulating the mushroom yield. On the other hand, using microorganisms instead of additive materials in the mushroom-growing media is a highly new and exciting issue in the sector of mushroom cultivation.

This study provides a view of the possibility of using bio-inoculants to enhance mushroom yield through the agency of growth encouragement and their potential as biocontrol agents to control pests and diseases in mushroom cultivation.

Keywords: *Agaricus bisporus*, bacteria, biological agents, *Pseudomonas*

A RESEARCH ON THE DETECTION OF SOME PHYTOCHEMICAL PROPERTIES IN THE FRUITS OF PASSIFLORA SPECIES

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ABSTRACT

Passiflora belongs to the Passifloraceae family and is native to South Africa. Due to its health benefits, it has become widely produced in tropical and subtropical regions. This fruit garners attention, especially for its rich nutritional content, aroma, and taste. Passiflora has gained popularity in the Mediterranean region of Turkey, particularly in recent years. It stands out for its ease of maintenance, yielding twice a year, and high economic returns. Additionally, passiflora is used as an ornamental plant in landscaping arrangements due to its showy flowers and is often referred to as the "passion flower" or "clock flower". In this study, the fruits of *P. edulis* and *P. caerulea* species were examined for their phytochemical properties, such as DPPH, total phenol, sugar, and organic acid. DPPH (2,2-diphenyl-1-picryl-hydrazyl-hydrate) and total phenol were analyzed using a spectrophotometric method, while sugar and organic acid were analyzed using HPLC.

Keywords: Passiflora, dpph, total phenol, sugar, organic acid.

EVALUATING THE IMPACT OF EXOGENOUS CHITOSAN AND/OR γ -AMINOBUTYRIC ACID DIPPING ON POSTHARVEST QUALITY AND BIOCHEMICAL CHANGES OF 'FAZLI' MANGOES DURING RIPENING AT AMBIENT CONDITIONS

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ABSTRACT

The mango fruit experiences swift metabolic transformations upon ripening, which subsequently curtails its shelf life and market appeal. The study assessed how climacteric 'Fazli' mangoes respond to external treatments of 1% chitosan (CT) and 5 mM γ -aminobutyric acid (GABA), either separately or in combination, during their ripening process under standard ambient conditions ($20\pm 1^{\circ}\text{C}$ and 60-70% RH) over a 12-day period. The treated fruit retained quality and delayed senescence as shown by greener peel, higher firmness, MSI, and titratable acidity (TA), but lower total soluble solids (TSS), TSS/TA ratio, pH, weight loss, and browning than the control. Total phenol (TPC), flavonoid contents (TFC), vitamin C (only pulp), endogenous GABA, chlorophyll content and free radical scavenging capacity (FRSC) in both peel and pulp decreased during ripening and was higher in treated fruit than the control. All treated fruit exhibited lower polyphenoloxidase (PPO), and hydrolytic enzymes including polygalacturonase (PG), pectinmethylesterase (PME), xylanase, and α -amylase but higher antioxidant enzymes like peroxidase (POD), superoxide dismutase (SOD), ascorbate peroxidase (APX), catalase (CAT) and phenylalanine ammonia lyase (PAL) activities in both peel and pulp than control. In addition, the combined treatment of CT and GABA was more effective to retain the quality and delay senescence. It is concluded that postharvest dipping in 1% CT or 5 mM GABA, both individually and in combination delayed ripening and retained quality of 'Fazli' mangoes via enhancing fruit antioxidant system and inhibiting degradative enzymes for 12 d of storage.

Keywords: Mango, quality, γ -aminobutyric acid, antioxidant, enzyme, postharvest

AN IMPROVED PISTACHIO DETECTION APPROACH USING YOLO-V8 DEEP LEARNING MODELS

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ABSTRACT

Pistachios are an agricultural product widely used in the food industry. It is very important that pistachios are presented to the consumer in good quality on time. At the same time, whether the shells of pistachios are open or closed is an important criterion from a commercial industrial point of view. Pistachios with their shells open have a high unsaturated fat content, a high maturity level and an expensive market value. In this study, the open or closed status of pistachios was determined by using Artificial Intelligence-based deep learning models. For pistachio detection, 423 image data belonging to the Pesteh dataset were classified using models of the YOLOv8 algorithm, which detects objects using convolutional neural networks. The data set is divided into 80% training, 10% validation and 10% testing. The performances of the models were evaluated with precision, recall, F1 and mAP score metrics. The highest test mAP value of the YOLOv8 algorithm, which was run with image data consisting of pistachios, was obtained with the YOLOv8-m model with 94.8%. The YOLOv8-m model achieved a very successful result with 49.6 MB weight size, 11.0 ms inference time value and 0.33 hours training time value. In addition, the model's fast classification performance and small file size facilitate its applicability in the industrial field. The results show that the classification and detection of open and closed shell pistachios has been successfully carried out with YOLO models.

Keywords: YOLOv8, Pistachios Detection, Deep Learning, Artificial Intelligence.

CO² EMISSION

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ABSTRACT

Land-use change is among the main factors contributing to climate change. Natural soil cover has been often completely or partially replaced in conditions of residential areas of megalopolis. Moscow is the biggest European megalopolis with huge total area of lawn ecosystems with regularly replaced topsoil due to active procedure of its environmental control and high rates of active mineralization processes. Urbanization is a land use change pathway, conjugate with a rapid growth of urban territory and irreversible change of soil features and functioning. Greenhouse gases' emissions (primarily CO² emission) and carbon sequestration are among important soil functions. Principal field experimental research was designed at the Ecological Experimental Station of the Russian State Agrarian University – Timiryazev State Agricultural Academy. a field experiment conducted with the study of 3 factors of stability of organic carbon in the soil: the ratio of peat and mineral substrate, the composition of the mineral substrate and the composition of the herbal mixture. This paper aims to analyze the impact of different soil constructions on daily CO² emissions from urban lawns. We concluded that Daily dynamics of soil CO² emission studied lawn variants depends on soil moisture and temperature of the surface air layer and upper soil horizons. Organic matter and biological diversity in the lawn soil under construction contributes to the daily stabilization of the soil regimes of temperature, humidity, carbon state of soils and CO² emissions from the soil.

Keywords: CO², soil biological processes, daily dynamics

INDOOR HYDROPONICALLY GROWN MINI-COS LETTUCE: MITIGATING TIP BURN THROUGH FOLIAR CALCIUM APPLICATION REDUCTION OF TIP BURN BY FOLIAR CALCIUM APPLICATION IN INDOOR HYDROPONIC MINI-COS TYPE LETTUCE CULTIVATION

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ABSTRACT

Hydroponic systems provide a highly advantageous environment for the cultivation of green leafy vegetables. Among these advantages, there is a significant acceleration in harvest compared to conventional farming methods, the attainment of high yields, enhanced leaf coloring, increased nutritional content, and improved sweetness, all of which are crucial factors. However, a particular issue known as tipburn is encountered when cultivating especially Yedikule (Romaine) type lettuce in hydroponic systems. This study focuses on investigating various calcium dosages applied via foliar spray to mitigate tipburn on Thespian and Suntred lettuce varieties (green and red Romaine types). Different calcium dosages were employed for both lettuce varieties.. In this experiment, various parameters were examined for both lettuce types, including plant height, root length, stem diameter, plant age, and dry weight, as well as root dry and fresh weight, macro and micronutrient content, and dry matter, along with total yield. The results obtained indicate that the combined application of foliar calcium and adequate ventilation effectively mitigates tipburn. This research emphasizes the significance of such a combined approach in preventing tipburn in hydroponically grown lettuce, specifically Thespian and Suntred varieties..

Keywords: Lactuca Sativa , spraying doses, calcium, yield, dry matter

COMPARATIVE ASSESSMENT OF THE CLIMATOLOGICAL CONDITIONS ON THE BIOLOGICAL ACTIVITY OF AMPELOCENOSES SOILS CULTIVATED IN THE WINE-GROWING REGIONS OF THE SOUTHERN COAST OF CRIMEA AND THE EASTERN PART OF THE NATIONAL PARK "FRUSKA GORA"

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ABSTRACT

Successful implementation of soils ecological functions largely depends on the state of the soil microbiome, which provides a wide range of nutritional, regulatory and supporting ecosystem services. Due to the increased sensitivity of soil microbiota even to the initial manifestations of anthropogenic load, parameters of soil microbial community can serve an important criterion for assessing soil health in ampelocenoses.

The soil microbial community immediately responds to the presence of pollutants: total microbial biomass, soil microbial biodiversity, activity of soil enzymes, soil respiration and processes affecting the cycles of basic biogenic elements are inhibited. The benefits of determining the soil respiration parameters and the ecological physiological indices calculated on the basis of these parameters are the possibility of an integrated comparative assessment of soil microbes' responses to the agricultural ecosystem management system, the reliability and recognition of the scientific community, and the availability of standardized and relatively simple methods for determining these microbes.

The historical wine-growing regions of the Southern coast of Crimea and the eastern part of the National Park "Fruska Gora" of the Autonomous Province of Vojvodina of the Republic of Serbia were selected as such areas. The main objective of this study was to conduct a comparative assessment of the influence of climatic conditions of the two wine-growing regions based on the calculation of climatic indices on the biological activity of soils of ampelocenoses cultivated using conventional and organic farming systems.

Soil CO₂ flux is characterized by high temporal and spatial heterogeneity. The most significant influence on the magnitude of CO₂ emission from soils is exerted by climatic conditions, soil, and vegetation cover characteristics, as well as oxygen concentration in the root zone. Within one ecosystem, soil respiration is largely determined by its temperature and moisture. For example, during the growing season, soil CO₂ fluxes from soil are strongly correlated with soil temperature, especially under conditions of optimal moisture, whereas at low soil moisture content there is a significant suppression of flux rates. The most stable indicator is total summer soil emission, which depends on the amount of precipitation, especially in the spring-summer period, and is negatively related to the mean annual air temperature.

Previously, methods for determining soil respiration parameters and calculating ecological physiological indicators were used to study the ecological condition of ampelocenoses on the northern Black Sea coast, depending on the agricultural system used by vineyards.. To assess the agroecological state of soils under conventional and organic vineyards, which largely determines the yield and quality of grapes, soil microbial respiratory activity, microbial biomass and ecophysiological status of the microbial community were used as integral indicators. On the other hand, the influence of local agroclimatic factors, primarily in contrasting temperature-humidity conditions, on the state and functions of the soil microbiome in the areas of grape cultivation is of interest description here.

Keywords: soil microbiome, ampelocenoses, vineyards

SPRING WHEAT YIELD PREDICTION WITH EMPIRICAL REGRESSION MODELS USING DIFFERENT BIOMASS PARAMETERS

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ABSTRACT

Global climate change leads forces changing of main agrometeorological resources. Agroecosystems state and productivity becomes point of maximum attention. In many countries cereals are the basis of national food security and precise grain yields forecasts become inevitable. Forecasts are an important link in the decision support system of agricultural holdings, so the requirements for their accuracy and timeliness are increasing. Two approaches are currently used to make yield forecasts: empirical regression models and biophysical models of vegetation growth. Empirical models relate yields to meteorological data, biomass characteristics and do not require many input parameters. However, the performance of such models is highly dependent on data availability and quality. Crop growth models provide biophysical parameters of crops: yield, biomass, water content, etc. Examples of such models are World Food Studies (WOFOST), implemented within the European Crop Growth Monitoring System (CGMS), EPIC (Erosion Productivity Impact Calculator) and CERES (Crop Environment Resource Synthesis) models. Leaf Area Index (LAI) is a key variable that functionally reflects biophysical features of forest and agricultural plantations, material, and energy exchange in photosynthesis processes. Reliable assessment of LAI is of great importance for monitoring and analyzing various biophysical processes in agroecosystems, forecasting plant growth and productivity in specific microclimatic conditions. LAI is a complex index representing the unilateral leaf tissue area per unit land surface area (m^2/m^2), quantitatively reflecting the projective cover of natural ecosystems or agroecosystem crops, as well as the tree canopy closure. Several methods have been developed to measure LAI, including direct contact methods (destructive and non-destructive) and indirect methods involving passive optical measurements and active remote sensing techniques. The aim of the ongoing study was to establish a model of spring wheat yield from the dynamics of leaf area index (LAI) and projective cover considering phenological phases according to the Zadoks scale. LAI was estimated by instrumental methods using AccuPAR LP-80 and LI-COR LAI 2200C. The study was conducted in the field plots of the Russian State Agrarian University. The experimental field was preliminarily divided into 81 square plots, where plant heights, LAI were determined every week and RGB camera imaging was performed for subsequent assessment of projective coverage of crops in the ImageJ software. Plant height was measured using a measuring tape: at the tiller emergence phase - from the soil surface to the upper leaf bend; at the onset of earing - to the top of the ear. The average height of all plants from the site 0.25 m * 0.25 m was used as an

indicator. Digital images for further calculation of crops projective coverage were taken by RGB camera with 14 MP resolution of a cell phone from a height of 1.2 m. It should be noted that at late observation periods the upper parts of plants partially protruded beyond the frame, which significantly reduced the accuracy of determining the projective coverage of crops. We compared the projective coverage data obtained using ImageJ with yield and with measured height during the tillering-tubing phase to see how effectively yield and biomass could be predicted. We calculated that there is a relationship between projective cover and height in tillering phase $R^2 = 0.39$, while in the tube emergence phase there is a very weak linear relationship as indicated by the corresponding correlation coefficient $R^2 = 0.15$. Hence, we can predict biomass from projective cover data during early developmental phases. The LICOR LAI 2200C can predict yield during the flowering phase, but there is generally a weak relationship between LAI and yield, while the AccuPAR LP-80 predicts yield well during the flowering phase and is also less effective during the other periods. The AccuPAR LP-80 ceptometer, despite its cheaper price segment than LICOR, is more suitable for measuring LAI in the early phases of development.

Keywords: climate change, crops, agrocenoses, productivity, modelling.

SPRING WHEAT BIOMASS ESTIMATION BY PROXIMAL AND REMOTE METHODS IN CONDITION OF ACADEMICAL FIELD OF CENTRAL RUSSIA

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ABSTRACT

Remote and proximal methods becoming increasingly popular, allowing to obtain information on the condition of crops and to predict their further development. The aim of the study was to carry out the evaluation of spring wheat biomass parameters by proximal and remote methods at different phenological phases. The research was conducted at the agroecological station of K.A. Timiryazev Russian State Agrarian University-MTAA. Territorially the object is in the north of Moscow city, Russia. The area of the field is 2 hectares. Spring wheat was planted in early June 2022, and observations were made throughout the growing season. Sod-medium and weakly podzolic soils are common at the site. The experiment is located in the Central region of Russia typical zone. The cultivated sod-podzolic soils are characterized by light loamy granulometric composition of the accumulative-eluvial part of the profile with significant variation of organic matter content in the arable horizon 1.9-2.6 %. The experimental plot was divided into 81 quadrats for the convenience of study planning and evaluation of monitoring results. Direct measurements of wheat height, LAI, projective cover, and some vegetation indices (VEG, VARI, r, g, b, GLI, TGI, etc.) were used to estimate wheat biomass. Remote sensing data for calculating vegetative indices was acquired using a DJI Phantom 4 RTK drone every week during the growing season

The results of the study showed a correlation between the measurement of projective cover by proximal and distance method. According to the data at tillering phase, the coefficient of determination $R^2 = 0.47$, and at the tube emergence phase $R^2 = 0.48$, indicating that there is a relationship between the methods. According to the summary data for predicting height, leaf surface index and yield of wheat, the remote method using RGB camera gives results comparable to proximal methods. The relationship between the estimated wheat indices is strongly influenced by the phase of plant development. Thus, the highest correlation coefficient is observed in the relationship between the height parameter and all vegetative indices ($R^2 \geq 0.49$), and the correlation coefficient between LAI and vegetative indices was $R^2 \approx 0.36$, when in the phase of tube emergence, the relationship between LAI and indices was $R^2 \leq 0.36$. At the same time, all the vegetative indices evaluated by us, showed similar Pearson correlation coefficients at all phenological phases, indicating their interchangeability. At tillering phase, the highest correlation coefficient was observed in the relationship between plant height parameter and indices: R, G, B, g, b, RGBVI, RGVBI, GIL, TGI, ExG and NDYI, where $R^2 \geq 0.49$. Hence, these indices can be applied to predict plant heights.

The projective coverage has an average predictive power comparable to LAI data.

Keywords: climate change, crops, vegetative indices, proximal methods, remote sensing.

EXAMINING LIMITATIONS AND FUTURE DIRECTIONS IN CLIMATE CHANGE SIMULATION MODELS

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ABSTRACT

Climate change refers to significant alterations in long-term climate conditions. If greenhouse gas emissions continue to rise, there is a high probability of exceeding the 1.5°C and 2° thresholds of global warming throughout the 21st century. This situation poses a serious threat to the agriculture sector and can lead to a decline in agricultural production and a reduction in product quality. Additionally, intensive farming practices can decrease the resilience of agriculture. This study aims to examine the effects of climate change on the agriculture sector, explain the concept of modeling and the parameters that can be measured, provide guidance on how modeling studies on alfalfa, and similar crops can be improved by identifying their shortcomings. The modeling method is used in many different fields by creating abstract representations of real-world objects or events via a mathematical equation, writing algorithm, or simulation. Parameters used in alfalfa modeling include yield, growth, carbon, water, nitrogen balance, climate effects, and other factors. However, these models have shortcomings such as the need for more comprehensive data collection and testing, the requirement for more parameter adjustments, the inability to address various crops and different growth cycles, the lack of simulation of crown and root roles in growth, sensitivity in measuring soil and input factors, limited testing and research, inaccuracies in automatic classification, the absence of growth and yield simulation models, and the lack of deep learning techniques. Addressing these shortcomings is crucial for achieving more reliable and effective results in the agricultural sector. Strengthening models and addressing these deficiencies have the potential to lead to more robust and sustainable solutions in agriculture.

Keywords: Alfalfa, Modeling, Climate Change

THE ROLE OF NUTRITION-SENSITIVE CLIMATE-SMART AGRICULTURE IN ENSURING GLOBAL FOOD SECURITY

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ABSTRACT

Climate-Smart Agriculture (CSA) is a sustainable farming approach that attempts to maximize resource utilization, improve long-term agricultural sustainability, and prevent environmental degradation while improving agricultural income and production. Nutrition-Sensitive Agriculture (NSA) revolves around the connections between agriculture, food systems, and health, with the goal of ensuring that agricultural practices contribute to better nutrition and well-being. This research focuses on the deployment of a Nutrition-Sensitive Climate Smart Agriculture (NSCSA) method in order to better understand its potential benefits for global food security and nutrition. The research methodology comprises a thorough analysis and review of existing literature on CSA, NSA, and NSCSA policies and practices. To address the complex concerns of food security and nutrition in the context of climate change, the article emphasizes the significance of incorporating nutrition considerations into CSA policies and initiatives. The findings further highlight the importance of multi-stakeholder collaboration and knowledge sharing in implementing and scaling up nutrition-sensitive CSA initiatives. In conclusion, the study reveals that nutrition-sensitive CSA has the potential to help achieve sustainable development goals such as food security, nutrition, and climate change mitigation and adaptation.

Keywords: Climate-Smart Agriculture, Nutrition-Sensitive Agriculture, Nutrition-Sensitive Climate Smart Agriculture, Agricultural sustainability, Food security, Agricultural practices

COMPARATIVE ANALYSIS OF DIFFERENT-AGE VINEYARDS IN FRUSKA GORA NATIONAL PARK, IN THE AUTONOMOUS PROVINCE OF VOJVODINA, REPUBLIC OF SERBIA, ON THE CHARACTERISTICS OF LATERAL MIGRATION OF MOBILE SULPHUR

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ABSTRACT

Since ancient times, sulfur has been used as a natural insecticide against parasites, plant fungicide, wine preservative, bactericide and antioxidant. Since about the middle of the 20th century, sulfur, along with copper compounds, has been used as an inorganic contact fungicide and low hazard class acaricide in plantation and horticultural agroecosystems. The advantages of sulfur over alternative organic fungicides include its low cost, availability, high efficiency, low risk of resistance development, and rather low toxicity. Sulfur and sulfur-based preparations are widely used all over the world even in organic and biodynamic viticulture. Meanwhile, the widespread and long-term use of sulfur-containing pesticides, especially for the treatment of vine plantations, often leads to sulfur accumulation in the upper parts of the soil profile.

Sulfur entering the soil with pesticides and agrochemicals is accompanied by its active inclusion in biogeochemical migration flows with changes in the chemical form, nature and duration of element deposition, its mobility and bioavailability. Up to 98% of its gross sulfur content is located in the soil in organic form as part of plant residues and humus. Bioavailability of the element is provided by the processes of mineralization of its organic compounds to mobile sulfate forms with the participation of soil microorganisms. The biogeochemical cycle of sulfur in ampelocenoses is also significantly influenced by climatic factors and practiced agro-technologies. In case of growing grapes in arid conditions and without irrigation, the applied sulfur accumulates in the surface layer of soil until the onset of the rainy season [3]. At high soil humidity, sulfates saturate the soil solution and acquire the ability to migrate, which is especially important when vineyards are located on sloping landforms. In this case there are ecological risks of contamination of adjacent environments. Few studies indicate that sulfur in vine plantations is subject to leaching from the root layer, mainly in regions well supplied with moisture and when irrigation is used. Thus, intensive leaching of sulfate ion has been observed in the warm and humid climate of the Apulia region in southeastern Italy [4] and in irrigated vineyards in northern California [5].

The extremely insufficient number of works, both in Russia and abroad, devoted to quantitative assessment of accumulation and migration of mobile sulfur in soils of ampelocenoses located on sloping lands predetermined the subject of the research presented in this work. The aim of the work

was to ecological and geochemical assessment of lateral distribution of mobile sulfur in the transit landscape of slopes of different exposure and steepness under different-aged vineyards on the example of the historical wine-growing region around the Fruška Gora National Park in the Autonomous Province of Vojvodina, Republic of Serbia.

Data on the content and lateral migration of mobile sulfur in brown forest residual carbonate (Eutric Cambisols/ Haplic Cambisols) soil of autonomous and transit landscapes under vineyards in the Autonomous Province of Vojvodina, Republic of Serbia are presented. The content of mobile sulfur in horizons 0-5 and 5-15 cm was highly contrasting from very low (less than 5 mg/kg) to high (more than 35 mg/kg) depending on the age of vineyards, landscape features of their location and applied cultivation systems. The content of mobile sulfur in the lateral structure of elemental landscapes under old (more than 200 years) vineyards with high slope steepness increased from trans-eluvial facies of upper parts of slopes to lower transaccumulative facies. In an industrial vineyard of intensive type, 15 years old, the absence of inter-row sodding and the arrangement of rows along a long slope with a complex shape contributed to increased migration. Migration flows and accumulation of mobile sulfur in transaccumulative elemental landscapes can cause deterioration of quality characteristics of produced wine materials and contamination of adjacent environments.

Keywords: mobile sulfur, lateral migration, vineyard, slope, Autonomous Region of Vojvodina, Republic of Serbia

IMPACT OF SMART IRRIGATION SYSTEMS AND WATER MANAGEMENT ON CLIMATE CHANGE

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ABSTRACT

As a result of the rapid and unconscious consumption of existing natural resources in the world, climate change is accelerating negatively. It should be remembered that changing of climate has the potential to threaten the security of water, food and energy systems. One of the main problems causing this is improper water management. In this article, the effects of smart irrigation systems, which are a product of climate-smart agriculture and water management for the changing climate in the world, are reviewed in the literature and the effects of these systems on climate change are discussed. The aim of the study is to provide appropriate solutions against climate change. Water management is basically about being conscious of saving by making more use of irregularly used water resources and reducing wastage to zero in both agriculture and drinking water. Climate-friendly agriculture is practices that ensure sustainability in agriculture with climate resilience. Smart irrigation is a technological irrigation system applied to remotely control irrigation with artificial intelligence and minimize water waste. Considering that water resources will deplete more rapidly over time in the fight against climate change, necessary measures should be taken to minimize this loss.

Keywords: Climate change, water management, smart irrigation systems, climate-smart agriculture, nature-based solutions

SPATIALLY-TEMPORAL DISTRIBUTION OF MOISTURE CONTENT AND DYNAMICS OF GREENHOUSE GAS EMISSIONS FROM UPPER SOIL HORIZONS IN FLOODPLAIN FALLOW LANDS OF BASHMAKOVSKY DISTRICT OF PENZA OBLAST

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ABSTRACT

In the Penza region there are more than 1'300 thousand hectares of fallow lands potentially suitable for agricultural producers, which is 31% of the total area of the region. More than 300 thousand hectares of land have not been used for more than 20 years, and their territory is covered with forest. These areas are mostly young deciduous forests that produce large amounts of oxygen and absorb carbon dioxide, which the world's climate agenda is fighting as a major greenhouse gas. Soils where young forests form - sequester carbon dioxide in the soil and thus reduce emissions. How much it makes sense to raise fallow land in terms of climate change and which areas produce the most carbon dioxide from the soil is a research question for more than one year. In addition to vegetation, factors such as soil moisture and temperature influence the flow of gases from the soil. Soil moisture is one of the main indicators that affects soil quality and land yields, which leads to greater economic benefits, as well as one of the main factors in the growth of greenhouse gas fluxes from soil to the atmosphere. During the monitoring of greenhouse gas fluxes emission, we can make a preliminary conclusion that forest areas and natural ecosystems mostly deposit carbon dioxide, as the amount of available carbon increases due to a greater increase in vegetation biomass. Areas that are used in agriculture produce more nitrous oxide and methane, but less carbon dioxide, which is associated with the specifics of fertilizer use on active fields.

Keywords: fallow land, greenhouse gas fluxes, soil moisture, reclaimed land

AGROECOLOGICAL ASSESSMENT OF THE ADAPTATION OF THE SOWING PERIOD OF SPRING WHEAT TO THE SHIFT OF THE SUMMER MAXIMUM OF PRECIPITATION DUE TO GLOBAL CLIMATE CHANGES

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ABSTRACT

The accelerated global climate changes characteristic of the XXI century in the conditions of the Chernozem regions of the European part of Russia are accompanied by a steady trend of growth in the sum of active temperatures with a less unambiguous trend for an increase in the amount of precipitation that varies greatly from year to year for the year and for the growing season of spring wheat. Annual precipitation amounts often deviate from their average annual values by 30-35 %. Precipitation deficit in the main periods of development of spring durum wheat can exceed 50%, which sharply reduces the intensity of its production process and yield. The yield of spring durum wheat in the years with a contrasting amount of precipitation of its growing season often differs by 2-3 times, significantly reducing the investment attractiveness of this crop in arid areas with increased seasonal and annual precipitation dynamics. In recent years, in many areas of the arid part of the forest-steppe and steppe zones, there has been a recurring shift from year to year of the second summer maximum of precipitation for 2-2.5 weeks – in the second half of July. With traditional sowing dates in late April-early May, this negatively affects the formation of yields with the loss of the most critical phenological phases of the development of spring wheat from the zones of favorable moisture for them. In addition, later precipitation, after the period of the main grain filling, already has a weak effect on yield, but often provoke the rapid development of weeds, which significantly worsen the phytosanitary condition of crops and grain. Along with this, a pronounced prolonged cold snap is increasingly observed in April and/or May, which creates an unfavorable background for the previously popular shift of the sowing period to earlier dates. Our research carried out with the support of project No. 075-15-2021-1030 of the Ministry of Science and Higher Education of Russia, provides an agroecological assessment of the adaptation of the sowing period of spring wheat to the shift of the summer maximum of precipitation to a later period in the conditions of the central part of the Orenburg region, where the seasonal contrast of periods of intense precipitation and prolonged drought is particularly significant – in a continental climate conditions. The research was carried out in 2022 and 2023 in the experimental fields of the Orenburg Research Institute of Agriculture (Federal Scientific Center for Biological Systems and Agrotechnologies) with heavy loamy ordinary Chernozems. Based on the results of the analysis of limiting agroecological factors of durum development differentiated by the phenological phases of the development of durum spring wheat

and of the seasonal dynamics of precipitation observed in recent years, recommendations were developed for shifting the traditional sowing period, and field experiments were conducted with the traditional and later sowing period for two varieties of spring durum wheat against the background of minimal and relatively increased use of mineral fertilizers (in triple repetition of the laying of experimental plots). The results obtained showed a statistically significant increase in yield by 2.5–5 dt/ha at later dates of wheat sowing in all variants of the experiment with two zoned varieties and two levels of fertilizer application – at the same level of technological costs. Moreover, in all variants of the field experiment in dry 2023, the increase in crop yield from the adaptive shift of the sowing period turned out to be significantly higher than from an increase in the use of mineral fertilizers, positively affecting the overall profitability of spring durum wheat production, its predictability and attractiveness for investors in agricultural projects. Higher wheat yield contributes to the accumulation of organic carbon in the soil and creates good prerequisites for the wide use of higher-quality seeds and advanced agricultural technologies for growing spring durum wheat in agroecologically problematic regions of arid forest-steppe zone. Similar shifts of the second summer maximum of precipitation are observed in the neighboring Samara and Saratov regions, that actualizes similar studies there too.

Keywords: Agroecological assessment, Agroecological modelling, Agroecologically optimized agrotechnology, Chernozem region, Farming profitability, Global climate changes, Spring durum wheat

NUTRITIONAL VALUE AND QUALITY ASPECTS OF WHEAT PRODUCED AND CONSUMED IN ALBANIA

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ABSTRACT

Wheat and its flour-processed products constitute an essential part of Albanian's diet. Nutritional importance is connected with its role as an important source of microelements to humans and its flexibility to be processed in a wide range (e.g., bread, pasta, pastry, baked products). Global wheat markets have become increasingly demanding concerning all aspects of wheat quality. Albania has a long tradition of wheat production, connected with politics in the past decades.

This study has evaluated the grain quality analysis: protein, gluten, starch, and sedimentation index to wheat produced in the country by Near-infrared spectroscopy (NIRS). It is a non-destructive method widely used based on electromagnetic wave interactions of molecules in the analyzed matrix. Fifty-six wheat samples were collected from agricultural regions during the harvesting season 2023. Protein content varied in the interval 9.6-15.0%, with an average of 12.7%. The gluten content is 19.4-37.5%, with an average of 27.5%. Starch content varied in the interval 66.3 -71.5 %, with an average of 68.9%. The sedimentation value was 21.1-57.8, with a mean value 37.6. Finally, the moisture level varied at 9.8-12.5%, indicating no wheat sample exceeded the threshold max level of 14.5%, in accordance with national and EU food legislation.

Keywords: Wheat, Near-Infrared, quality parameters, protein, starch, gluten, Albania

FATTY ACID COMPOSITION IN PISTACHIO

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ABSTRACT

Pistachio (*Pistacia vera* L.), is an important food source for human health. It has nutritional content rich in protein, fat, fatty acids, fiber, vitamins and minerals. Such as other nuts, pistachio oil is rich in unsaturated fatty acids. Pistachio is rich in omega fatty acids such as n-3, n-6, n-9, it is known to be beneficial in decreasing cholesterol by increasing HDL level in blood plasma. Oleic acid (C18: 1) and palmitoleic acid are the main component of unsaturated fatty acids in pistachio. It has fatty acids such as linoleic acid and alpha linoleic acid among polyunsaturated fatty acids and myristic acid, palmitic acid, stearic acid among saturated fatty acids. Gas chromatography-flame ionization detector (GC-FID) is generally used for the analysis of fatty acids in foods. The main component of unsaturated fatty acids contained in pistachio is oleic acid (C18: 1) and the variety varies between 51.6% and 81.17% according to the origin. Linoleic acid (C18:2) content, which is a polyunsaturated fatty acid, varies between 15% and 30%. Stearic acid content of saturated fatty acids varies between 0.8% and 3.5%. This review provides information about the properties and current status of the fatty acids in pistachios.

Keywords: HDL, GC-FID, Oleic Acid, Linoleic Acid

INNOVATIVE APPROACH OF BIODEGRADABLE MULCHES IN SUSTAINABLE AGRICULTURE FOR CROP PRODUCTION AND ENVIRONMENTAL CONSERVATION

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ABSTRACT

The use of biodegradable plastic mulches in place of conventional plastic mulches in agriculture has been suggested as being more ecologically friendly. However, a number of obstacles, including concerns about performance and cost, have inhibited their implementation. In this study, we set out to determine the impact of biodegradable film mulches on plant production, crop yield, sustainability, nutrient supply, environment, cost-effectiveness, pros and cons with innovative approach. The material and method used in this study include the application of a literature review on biodegradable mulch (BDM) film. According to our findings, the biodegradable film mulch greatly outperformed the plastic mulch in terms of soil health, water use, nutrient availability, and microbial activity. These results imply that biodegradable film mulch has the potential to decrease plastic waste in agriculture while increasing soil health and crop output. In conclusion, using biodegradable film mulch with using innovative approach in agriculture might be an effective means to alleviate the environmental problems brought on by conventional plastic mulches..

Keywords: Mulch, Biodegradable, Innovative Approach, Agriculture, Environmental Conservation

EVALUATION OF THE EFFECT OF DIFFERENT DOSES OF BIOCHAR APPLICATION ON THE YIELD OF SOYBEAN CULTIVAR SCULPTOR IN THE CONDITIONS OF AGROECOLOGICAL STATION OF K.A. TIMIRYAZEV

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ABSTRACT

In the conditions of the academic fields of the Timiryazev Academy (Moscow, Russia), an experiment was conducted to evaluate the impact of biochar on soybean cultivar Sculptor. Plots of 0.25 ha were laid on arable sod-podzolic soils, the doses of biochar application were 3 kg/, 1 kg/ and control variant without application. The plots were established in triplicate. The results of the studies showed an improvement in a number of soil properties at 1 kg per m², with more plant biomass, more stem pods per plant. With application of 3 kg per m² - development of soybean variety Sculptor did not have the necessary effect, at the first stages soybean developed rapidly, but later only slow development of weed plants was noted. On the reference plots plants had a smaller biomass compared to the variant with the application of 1 kg per m². Application of biochar to soybean crops shows a positive effect on yield and biomass of plants at the application dose of 1 kg per m²

Keywords: biochar, soybeans, agroecology, carbon neutrality

IN SILICO ANALYSIS OF RHIZOCTONIA SOLANI ANASTOMOSIS GROUPS AND GENETIC DIVERSITY OF AG-4 POPULATION BASED ON ENZYME PROFILES

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ABSTRACT

Rhizoctonia solani is a destructive fungal pathogen, leading to serious yield losses in a wide range of plant species worldwide. *Rhizoctonia* species are classified into anastomosis groups (AGs) according to the number of nucleus and the reaction of hyphal compatibility between different isolates. However, the classification of AG groups based on conventional methods is difficult, time-consuming, and requires expertise. In this study, in silico analyses of digestion patterns of ITS (internal transcribed spacer) region fragments of *R. solani* AG groups for different restriction enzymes were performed using DNASTAR software (DNASTAR Inc., Wisconsin, WI, USA). Also, genetic diversity within AG-4 isolates was analyzed with phylogenetic groups based on digestion profiles of single or double enzyme combination. Different *R. solani* AGs were grown for 10 days at 23±1°C, and mycelial mats of each isolate were collected by scraping with a sterile spatula. Total DNA was isolated by using the method described by Edel (1998) with minor modifications. ITS region of different AG groups was amplified with specific primer pairs and sequenced in both directions with the same primers. Computer-simulated restriction analysis on the resulting sequencing data was carried out to differentiate *R. solani* AG groups. Also, PCR products belonging to AG-4 isolates were digested with different restriction enzymes, visualized on agarose gel, and scored as the presence (1) or absence of each restriction fragments (0). Phylogenetic analysis was performed with the neighbor-joining (NJ) method by using NTSYS program. The results indicated that the same AG groups were phylogenetically related and distinguished with different enzyme profiles in silico analysis. Also, the isolates of *R. solani* AG-4 clustered into three groups in silico analysis, and these results were confirmed by the enzyme profile on agarose gel. This approach provided accurate and fast discrimination of *R. solani* AG groups and closely related subgroups.

Keywords: hyphal compatibility, in silico analysis, restriction enzyme digestion, *Rhizoctonia solani*.

WATER CONSUMPTION AND CONTROL IN FARM ANIMALS

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ABSTRACT

Water is vital for farm animals, as it is for all creatures. Water consumption in animals varies depending on factors such as species, age, production type, yield, environmental temperature, feed consumption, feed type, ration composition and water quality. Failure to provide sufficient quantity and quality of water causes deterioration in the health of animals, decrease in productivity and product quality, and even death. Approximately 80% of the Earth's surface consists of water, and 97% of this water found in seas and oceans. The rate of fresh water is below 3% and only 0.5% is usable. However, with the increasing population and agricultural irrigation activities, access to water resources is becoming more difficult day by day. For this reason, studies have been focused on the controlled use of water, which is essential for the continuity of life, in both plant and animal production. This study includes information about the importance of water for farm animals, water quality and control of water consumption.

Keywords: Water, milk, meat, yield, quality

AGROECOLOGICAL ASSESSMENT OF SPATIAL VARIABILITY OF CARBON CONTENT IN THE CONDITIONS OF DISTURBED SOD-PODZOLIC SOILS

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ABSTRACT

The carbon cycle relates to photosynthesis of plants and the stock of organic matter in the soil, which is an important factor of fertility. An important link in this cycle is the mineralization of organic matter by microorganisms to carbon dioxide, with its subsequent release into the atmosphere. Soils with high humus content have a greater biological activity. This is expressed in a greater number of microorganisms, diversity of their species composition, in the intensity of CO₂ flux and in the increase of enzyme activity. Assessment of organic matter dynamics is one of the most important actual tasks of modern ecology and agroecology. Irrational use of soils and lack of fresh organic matter supply is the cause of humus reduction, which can affect the quality and quantity of grown products. Classical methods of soil carbon content assessment are labor-intensive and time-consuming, as well as have a number of other disadvantages and often can not be used to observe the dynamics of this indicator, and the comparability of results with methods based on remote sensing data remain insufficiently studied.

Spatial variability of soil carbon in the conditions of disturbed sod-podzolic soils of Russian State Agrarian University academic fields was investigated. A comparative analysis of the results of organic carbon determination using the Walkley-Black method (colorimetric method), the Dumas dry combustion method (using CN Vario El Cube analyzer) and the remote method using the Valeeva method (Valeeva, Aleksandrova, Koposov, 2016) was performed using the spectrum values of the red channels obtained by RGB cameras mounted on the DJI Phantom 4 drone (RGB Camera). For laboratory analysis, 100 soil samples of arable horizon were collected at regular grid points with RTK georeferencing.

Correlation analysis revealed a fundamental relationship between all the methods used to estimate soil carbon content. The correlation between the Dumas dry ashing method and potassium dichromate oxidation was 0.24 (for n = 100, significant 0.195 p<0.05), allowing comparison at the trend level. The highest correlation (R = 0.39 (for 100 samples) was observed between data obtained using the Dumas method and the Valeeva-Alexandrova approach, indicating that it can be used to estimate soil carbon dynamics from RGB images.

Analysis of the spatial distribution of total carbon within the study plot, with an area of 2.19 ha, showed significant heterogeneity and variation from 1.15% to 5.71% (Dumas method) in the period before the start of sowing (June 2022), while the scatter of values for organic carbon lay within the

range of 1.02-3.75%. It should also be noted that there is linear relationships ($R = 0.63$) between total carbon and micro-relief, which is reflected by the drone-derived digital elevation model.

UAV monitoring surveys were conducted monthly during the vegetation period of plants in the plot with further conversion of red channel values (8 bits) to carbon content using the formula: $H = 9.45 - 0.05 * R$. Thus, the analysis of carbon dynamics covers 4 months: May, June, July and August. The estimation result shows maximum carbon accumulation in July (Kruskal-Wallis Criterion ($p < 0.01$)) with further decrease in August.

To summarize, in addition to the revealed high spatial heterogeneity of the content of total and organic carbon in the study area, its clearly expressed dynamics during the vegetation period is noted.

Keywords: spatial heterogeneity; sod-podzolic soils; agroecological assessment; total soil carbon content; UAV remote sensing

ECOLOGICAL ASSESSMENT OF THE AFTEREFFECT OF PHOSPHOGYPSUM ON THE STABILIZATION OF THE CARBON BALANCE OF THE REGENERATED TOPSOIL OF DEGRADED SOD-PODZOLIC SOILS

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ABSTRACT

Against the background of global climate changes, agroecological problems of erosion and agrogenic degradation of intensively used arable soils have become more acute. The increased intensity and duration of less frequent spring and summer precipitation forms increased surface runoff and provokes accelerated erosion development with the loss of the most humus-rich fine-grained particles from topsoil. The dry periods, that replace them, longer than before, activate the processes of mineralization of soil organic matter and plant residues, further reducing humus reserves in topsoil. Dishumification is accompanied by disaggregation and over-compaction of soil horizons with a decrease in their porosity and ability to quickly absorb precipitation, that often leads to further running of agrogenically accelerated erosion. This problem is most acute in the case of old-arable sod-podzolic soils with initially low humus content and small thickness of their sod horizons. The accelerated development of their erosion is often accompanied by a sharp drop in soil fertility and the need for bioremediation, as in the case of man-made disturbance of these soils in the zone of impact of construction and transport projects. Lime-containing ameliorants are traditionally used to improve the structure and to stabilize the carbon balance of sod-podzolic soils. Their principal disadvantages are the high cost of commercial ameliorants and the often-fixed increased content of heavy metals in using lime-containing industrial waste. Our research carried out with the support of project No. 075-15-2021-1030 of the Ministry of Science and Higher Education of Russia, provides investigation the influence of industrial waste in the production of phosphorous fertilizers - phosphogypsum on the stabilization of the carbon balance of the regenerated topsoil of degraded sod-podzolic soils. Phosphogypsum is traditionally used for reclamation and neutralization of the alkaline reaction of the Solonetzic soils but in recent years there have been published papers with positive results of its application on sod-podzolic soils – without their significant acidification. The scheme of the micro-plot field experiment with plots of 4 m² (2 m x 2 m) included control variant (without the use of phosphogypsum), variants with an increasing doses of phosphogypsum (1.5, 3.0, 4.5 and 6.0 t/ha) and with the use of phosphogypsum in combination with compost from bird manure (in doses of 4.5 t/ha + 2.0 t/ha and 6.0 t/ha + 2.0 t/ha), which were added to the peat-sand soil-ground (with a weight ratio peat to sand of 1 to 3) traditionally used in phytoremediation projects applied in a 15 cm layer to the surface of erosively degraded sod-podzolic soils. The research was carried out on the territory of the Agroecological Station of the Field

Experimental Station of the Russian State Agrarian University - Moscow Timiryazev Agricultural Academy in summer of 2023 with an extremely high amount of precipitation (604 mm from May to August, that is 2 times more than the average long-term precipitation for this period). The study showed no signs of erosion and disturbances in the operation of the local hydrographic network, even during the most intense rains. The use of phosphogypsum in a dose of 3.0 t/ha contributed to the significant accumulation of organic carbon in the topsoil of the studied sod-podzolic soils – in comparison with the control. The use of a combination of phosphogypsum with compost additionally increased the intensity of carbon accumulation. The average intensity of soil CO₂ emissions essentially decreased in the variant with the use of phosphogypsum at a dose of 3.0 t/ha and in the variant with the use of phosphogypsum (4.5 t/ha) in combination with compost (2.0 t/ha). The positive balance in the soil-plant system was obviously adjusted too, that gives a significant positive assessment of the aftereffect of the use of phosphogypsum on the stabilization of the carbon balance of the regenerated topsoil of degraded sod-podzolic soils already at a dose of 3.0 t/ha. In combination with compost from bird manure at a dose of 2.0 t/ha, the aftereffect of the use of phosphogypsum essentially increases, that indicates good prospects for the validation of this technology as a natural climate project.

Keywords: Aftereffect of phosphogypsum, Ecological assessment, Ecological modelling, Erosion control, Regenerated topsoil, Soil degradation, Phytoremediation project

ALGORITHM OF ALLOCATION OF AGRICULTURAL LAND OCCUPIED BY WINTER CROPS

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ABSTRACT

In Russia, many lands that are legally classified as agricultural land are in reality fallow. The paper proposes an algorithm for the allocation of agricultural land occupied by winter crops based on the variation of normalized relative vegetation index (NDVI). The problem was solved on the example of the Rostov region, a one of the main producers of agricultural products in Russia. Cereals in Rostov region cover about 70% of the sown areas, most of them are winter wheat. A series of MODIS satellite data for the period March-August 2020 with a spatial resolution of 1 km was used for calculations. Data on climatic conditions for the growing season were obtained from the meteorological station Rostov-on-Don (Rostov region, Russia). Crop yields were taken from the Database of Indicators of Municipalities. Image acquisition and processing were realized on the Google Earth Engine platform. The paper analyzed the dynamics of the NDVI index for the territory of the Rostov region. NDVI was the lowest in March and had maximum in May with a decrease by August. For the period from March to August 2020, the minimum and maximum NDVI was found for each pixel. Where there was a large difference in NDVI values during this period, agricultural fields were considered to be located there. Then, from all agricultural fields, those where NDVI index took values between 0.2 and 0.5 in March and April were selected, i.e. the fields were occupied by winter cereal crops (winter wheat). In this way, the sites where winter cereals were grown were obtained. Based on the assumption, that winter crop yield prediction at the districts level could be accurate only if the ratio of fields with winter crops precited correctly, the algorithm was decided to verify based on winter crop yield data from each districts of Rostov region. A statistically significant linear relationship with a correlation coefficient of 0.57 between the values of winter wheat yield according to national statistical data on districts of Rostov region for 2020 and the average NDVI values for districts for the selected fields occupied by winter wheat in this period was revealed.

Keywords: remote sensing; winter wheat; crop modelling; geostatistics

FACTORS AFFECTING MEAT QUALITY IN FARM ANIMALS

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ABSTRACT

Meat has been one of the basic nutrients since the first day of humanity. As food, meat consists of the muscle and fat found between the bones and skin of animals. It has an important place in human nutrition due to the protein (amino acids), fatty acids, minerals (iron and zinc) and vitamins (especially B12) it contains. Due to these nutrients, vital activities such as growth and development of people, regeneration of cells, repair and growth of tissues, formation of vital fluid blood, functioning of the systems in the body, development of immunity and reproduction are ensured. As in the other animal products, there are factors such as species, breed, feeding, environmental temperature, stress, rearing or processing that affect meat yield and quality in farm animals. In the current study, similar biotic and abiotic factors affecting the meat quality of farm animals are discussed.

Keywords: Meat, quality, protein, growth, mineral, vitamin

INVESTIGATION OF GOOSE BREEDING IN TURKIYE BY LINEAR AND NONLINEAR REGRESSION MODELS

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ABSTRACT

In this study, the change in the number of geese breeding in Turkiye over the years was examined by linear and non-linear regression models. Among linear and non-linear regression models, linear, quadratic, cubic, logarithmic, and inverse regression models were used. R^2 and MSE values were taken as criteria for comparing the models. As a result of the study, the cubic regression model with the highest R^2 value and the lowest MSE value was found to be the best fitting model for the number of geese. According to the cubic regression model, the number of geese in Turkiye in 2023 and 2024 was estimated to be 1849304 and 2107588, respectively..

Keywords: Regression, Modelling, Goose

DETERMINATION OF YIELD AND YIELD COMPONENTS IN SAFFLOWER (*Carthamus tinctorius* L.) CULTIVARS UNDER ÇUKUROVA ECOLOGICAL CONDITIONS

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ABSTRACT

The study aimed to determine the suitable safflower cultivars in Çukurova ecological conditions. In the 2019 growing season, the experiment was carried out in randomized completed blocks experiment design and 3 replications in the Çukurova University Faculty of Agriculture Field Crops experimental field. Linas, Olas, Asol, Dinçer, Balcı, Göktürk, and Hasankendi varieties, which are registered in our country, were used as research material. Plant height, number of side branches, number of trays, table diameter, 50% flowering days, ripening days, grain yield, thousand seed weight, bark ratio, oil ratio and oil yield characteristics were investigated.

According to the data obtained, plant height, table diameter, grain yield, thousand-grain weight, oil ratio, and oil yield were statistically significant, side branch number, number of heads, 50% flowering days, ripening days and bark ratio were statistically insignificant. As a result of our study; Olas varieties, the highest grain yield, the highest oil ratio, and oil yield as a promising variety can be found in Çukurova conditions safflower cultivation.

Keywords: Safflower, *Carthamus tinctorius* L., yield, oil percentage, cultivar

A CASE STUDY: HOW SUGARCANE SHAPED MAURITIUS ECONOMY AND CULTURE, FROM 19TH CENTURY COLONIAL TRADE TO TODAY'S SUSTAINABLE ENERGY PRODUCTION

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ABSTRACT

A small, exotic, multicultural island in the middle of the Indian Ocean, Mauritius gives the impression of paradise on Earth. Graceful palm trees, white sandy beaches, blue lagoons, and endless fields of green sugarcane help to strong its romantic image. After he visited Mauritius in 1896; American novelist Mark Twain, said his famous quote: "Mauritius was made first and then heaven; and heaven was copied after Mauritius.

Keywords: India, Mauritis, Palm, Tree

THE CONCEPTUALIZATION OF AGRICULTURAL RESIDUES: UNLOCKING POTENTIAL FOR SUSTAINABILITY

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ABSTRACT

Agriculture has been a cornerstone of human civilization for millennia, providing sustenance, raw materials, and livelihoods. However, it also generates vast amounts of agricultural residues, often overlooked but holding immense potential. These residues, ranging from crop stubble to fruit peels, are typically considered waste. However, as the world grapples with the challenges of sustainability, there is a growing need to conceptualize agricultural residues differently – as valuable resources that can contribute to environmental, economic, and social well-being. The conceptualization of agricultural residues as valuable resources rather than waste is a crucial step towards a more sustainable future. By harnessing the potential of these residues through innovative technologies and practices, we can reduce environmental impact, enhance economic opportunities for farmers, and contribute to a circular economy. It is time to view agricultural residues not as a problem but as a solution on our journey towards a more sustainable and resilient world.

Keywords: Biomass, renewable energy, residue

GENOMIC SELECTION IN ANIMAL BREEDING

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ABSTRACT

Genomic selection aims to determine the reproductive values and characteristics of offspring in a certain population with the help of high density markers. Today, classical breeding methods go through long processes in terms of labor and time. Genomic breeding methods accelerate this process and reduce labor and time. In classical breeding management, it may be necessary to go through a long process to increase the efficiency of a trait. Genomic breeding methods are economically costly compared to classical breeding methods. With developing technology, determining the parents of future generations occurs faster than classical breeding methods. There are many methods for performing genomic selection. Marker-assisted selection is one of these. In both methods, it is of great importance to use selection in animal husbandry, that is, to determine the parental lines of future generations and to obtain high productivity. The aim of the current study is to compare classical selection methods and genomic selection methods.

Keywords: Farm Animals, Breeding, Selection, Genomic Selection, Animal Science

A DIFFERENT PERSPECTIVE ON AGRICULTURAL PRODUCTS WITHIN THE SCOPE OF WATER FOOTPRINT INTENSITY

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ABSTRACT

Water is one of the most basic requirements for the sustainability of life on Earth. However, global climate change threatens this important resource by deeply affecting water resources and the water cycle. The sustainability of food production also depends on the proper management and protection of existing water resources. Therefore, it is important to know the amount of water required for agricultural production on a product basis and to prepare basin-based production plans taking into account water resources. The concept of water footprint (WF), which is used to express the amount of water consumed directly and indirectly in the process from the supply chain of goods and services to the end user or the extent of water pollution it causes, is presented as an important tool in water management. Nowadays, the WF calculations of agricultural products are also one of the most widely studied topics. In this study, Water Footprint Intensity (WFI) is calculated for some agricultural products and the WF of these products is evaluated through economic indicators and a different perspective is tried to be presented to the readers.

Keywords: Sustainability, Water Footprint Intensity, Agricultural Products

A RESEARCH ON METAL AND METALLURGICAL PROPERTIES OF CHISEL TILLAGE MACHINE TINES

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ABSTRACT

Reduced tillage forms a subgroup of conservation tillage. In this system, chisel or disc tools are generally used for primary soil tillage, and milling machines, disc tools or cultivators are used for secondary soil tillage and seedbed preparation. The entire area is tilled so that the plant residues are on the soil surface and prone to the surface. It provides significant fuel and energy savings compared to conventional tillage due to less machine traffic. In order to ensure sustainability, conservation tillage (using a chisel instead of the plow that works by turning the soil) as an alternative to conventional tillage and the development of agricultural tools and machines used for this purpose have gained great importance. Chisel is a soil cultivation tool widely used in stubble destruction and conservation tillage system. It is known that the chisel provides significant savings in terms of fuel consumption compared to the plow. For a chisel construction that can operate at an optimal level, the basic requirement is to have optimal material quality, optimal weight and optimal cost. In this research, the physical and chemical processes of chisel tines produced as cast steel were examined. It is of primary importance that it provides minimum fuel consumption with its optimal chemical content, easy mounting to the chassis, unbreakable model structure and angles. A casting and agricultural machinery company that helped with the study was visited and the GS-52 steel casting process, which is widely used for chisel tines in our country, was examined and tensile, yield and rupture tests were performed. As a result, it has been observed that a better construction can be created by changing the chemical content of GS-52 steel. Different trials to be carried out as the continuation of the research will help determine the optimal structure of the chisel tines.

Keywords: Reduce tillage, Chisel tines construction, Material quality

DESIGN OF A WATER PUMP-SOLAR SOURCE SYSTEM FOR DRINKING WATER SUPPLY

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ABSTRACT

Proper organization of the drinking water systems provided to the population, monitoring and management of their activity with the help of modern technologies is an effective way to save drinking water. In this article, the energy saving and continuous supply can be achieved by designing an energy-efficient, modern and solar-powered GRUNDFOS SP 17-8 pump instead of the old submersible pump designed to provide drinking water to individuals in Khavos district of Syrdarya region.

Keywords: water consumers, electricity, solar panels, pump, well, solar potential, current, voltage, power, supply

THERMAL ACCLIMATION DURING EMBRYOGENESIS; EFFECT ON PRE AND POST HATCH PERFORMANCE OF COMMERCIAL BROILER CHICKENS; A REVIEW

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ABSTRACT

This work reviews the effect of thermal acclimation during embryogenesis on the pre and post hatch performance of broiler chickens. Genetic selection and improvements for faster growth and breast muscle production has rendered commercial broiler chickens more susceptible to heat stress. Chickens do not have sweat glands thereby resulting to other methods of stress adaptation such as conduction, convection, radiation, panting, and reduction of feed intake during high temperature periods. This leads to several physiological changes which negatively affect production and welfare performance especially in tropic and humid regions. Epigenetic thermal acclimation during embryogenesis is a strategy that could enhance embryonic development and the adaptive responses of broiler chickens to post hatch environmental stimuli. Epigenetic thermal acclimation involves the exposure of embryos to a certain higher temperature for certain duration of time from embryonic age (EA) 10 or 11 during which the hypothalamus-pituitary-adrenal (HPA) and hypothalamus-pituitary-thyroid (HPT) axis are developed enough to withstand thermal exposure. The available literature revealed that the exposure of embryos to thermal challenge improved embryonic development, increased hatchability, and adaptive response of broiler chickens to post hatch heat challenge however, exposure to extreme higher temperature or for a longer duration could negatively affect development. It is therefore recommended exposure of embryos to a higher temperature between 1-1.7 °C for 3-6 hours could be sufficient to improve the pre and post hatch performance of broiler chickens.

Keywords: Epigenetic, broiler, incubation, performance, thermal acclimation

COMPARISON OF ACTUAL EVAPOTRANSPIRATION BY THE GOOGLE EARTH ENGINE EVAPOTRANSPIRATION FLUX (EEFLUX) TO THE METRIC MODEL USING REMOTE SENSING DATA AND IN-SITU CLIMATE OBSERVATIONS

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ABSTRACT

Actual evapotranspiration (ETa) is essential data in developing water budgets and calculating irrigation water requirements in large-scale irrigation schemes. Nowadays, remote sensing (RS)-based surface energy balance models help us estimate ETa with high resolution when compared to direct methods that focus only on a single point in a field. This study aimed both at estimating ETa by Mapping EvapoTranspiration at high Resolution with Internal Calibration (METRIC) and Google Earth Engine Evapotranspiration Flux (EEFlux) platform and comparing reference evapotranspiration based on the Penman-Monteith equation (ETo) with ETa by the METRIC and EEFlux in a sub-catchment (A=9495 ha) under irrigation, located in the Lower Seyhan Plain (LSP), Turkiye in the 2020 hydrological year. For this purpose, 16 Landsat 7 and Landsat 8 images, local climatic data acquired from two meteorological stations in the catchment, and CFSv2 gridded global data were used. Results showed a good agreement between ETa-EEFlux with ETa-METRIC. Moreover, a strong correlation was found between ETo and ETa-METRIC ($r=0.93$ and slope close to 1 and RMSE value of 0.74 mm day^{-1}) if compared to the relationship between ETo with ETa-EEFlux. The results show the potential of applying the METRIC model and EEFlux for mapping ETa over a large-scale irrigation scheme.

Keywords: Evapotranspiration, remote sensing (RS), METRIC, Google Earth Engine, EEFlux, Akarsu Irrigation District

THE DIFFERENCES OF ELECTRICAL RESISTANCE VALUES OF VAGINAL MUCUS (ERVM) IN YEARLING AND MATURE SAANEN GOATS

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ABSTRACT

It has been reported that during the oestrous cycle, an increase in the volume of cervical mucus occurs due to the influence of high oestrogen concentration on vaginal vasodilation, leading to a decrease in the electrical resistance of vaginal mucus (ERVM) as the goat approaches estrus. The present study aims to understand the differences between yearling (n:14) and mature (n:22) Saanen goats when continuous measurements of ERVM were taken by using the digital Draminski® device (Draminski Electronics, Poland). Oestrus was synchronized using intravaginal sponges and the ERVM measurement was taken every 6 hours right after the sponge removal until insemination. The results indicate that ERVM measurements for mature Saanen goats were significantly lower at 0, 6, 12, 30, 36, and 42 hours compared to those of yearling Saanen goats. Additionally, within the yearling Saanen group, there was a significant difference between the measurement taken at the 18th hour and the measurements taken at other time points. Furthermore, as goats approached estrus, the differences in ERVM measurements between mature and yearling Saanen goats disappeared. Based on these results, the ERVM values in yearling Saanen goats can be reliably used for predicting time of estrus, while a more cautious approach should be taken for mature Saanen goats.

Keywords: Yearling and Mature Saanen, Goat, electrical resistance of vaginal mucus

UNVEILING THE DIVERSITY OF FIRM4 AND FIRM5 GROUPS FROM HONEY BEE GUT MICROBIOTA IN TÜRKİYE

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ABSTRACT

The honeybee, scientifically known as *Apis mellifera*, exhibits a consistent colonization pattern in its bacterial gut community, characterized by the presence of nine distinct groups of bacteria. Investigating the microbiota in honeybees is economically significant due to the substantial value associated with managed bee colonies. Therefore, it is crucial to gain a comprehensive understanding of the diversity and functionality of this microbiota.

The main aim of this study is to analyze the sequencing of the V3-V4 partial region of the 16S gene in lactobacilli strains. Specifically, the investigation focuses on Firm4 and Firm5, two out of the nine identified groups isolated from the honey gut of the honeybee.

Utilizing metabarcoding analysis targeting the 16S V3-V4 partial gene, various *Lactobacillus* species were identified, including *Lactobacillus apis*, *L. kullabergensis*, *L. helsingborgensis*, *L. iners*, *L. delbrueckii*, *L. helveticus*, *L. amylolyticus*, *Lactobacillus* sp. wkB8, *L. jensenii*, *L. acidophilus*, *L. kefirano-faciens*, *L. crispatus*, *L. gasseri*, *L. acetotolerans*, *Lactobacillus* sp. C25, *L. johnsonii*, and *Lactobacillus* sp. koumiss. These identifications were based on the quantity of reads obtained during the analysis for each respective species. The readings for strains classified under the genus *Lactobacillus* within the gut microbiota of honeybees vary from 2% to 29% relative to the total number of readings.

While it was previously known that the honeybee gut microbiota consisted of a limited number of groups, this study reveals that the groups identified as Firm4 and Firm5 are represented by 17 different strains and species in Turkey.

Keywords: Türkiye, honey bee, gut microbiota, *Lactobacillus* sp., 16S metabarcoding, microbial diversity

SUITABLE CHEMICAL ANALYSIS METHODS FOR DETERMINING PLANT AVAILABLE NITROGEN IN AEGEAN REGION

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ABSTRACT

The objective of this study was to determine the most suitable chemical analysis methods to be used in determining plant available nitrogen in the Aegean Region soils. In the first year of the study, soil samples were collected from 100 different points to represent different soil types. Measured soil properties were grouped by cluster analysis and 15 soils were selected for using in pot experiment. A factorial experimental design with 4 replications was performed with corn plant in the greenhouse. Nitrogen was applied to the soils at 4 different doses (0, 100, 200 and 300 mg kg⁻¹). Correlation coefficients were determined between the biological plant criteria and nitrogen analysis methods. Statistically significant relationships were found at the level of 1% between the dry matter weight and Mba-Chibogu ($r=0.674^{**}$), and fenoldissulfonic acid ($r=0.651^{**}$) methods. Statistically significant correlations were found at the level of 1% between plant nitrogen content and Mba-Chibogu ($r=0.839^{**}$), and inorganic nitrogen extracted with KCl ($r=0.801^{**}$), and fenoldissulfonic acid ($r=0.749^{**}$) methods. Statistically significant correlations were found at the level of 1% between nitrogen uptake and Mba-Chibogu ($r=0.874^{**}$), and inorganic nitrogen extracted with KCl ($r=0.819^{**}$), and phenoldissulfonic acid ($r=0.792^{**}$) methods. It was recommended that Mba-Chibogu, inorganic nitrogen extracted with KCl and phenoldissulfonic acid methods can be successfully used.

Keywords: potentially available nitrogen, inorganic nitrogen, nitrogen analysis method, corn

EFFECTS OF MEALWORM (*TENEBRIO MOLITOR* L.) LARVAE SUPPLEMENTATION TO ALFALFA HAY AT DIFFERENT LEVELS ON IN VITRO GAS AND METHANE PRODUCTION

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ABSTRACT

It is estimated that animal product consumption will increase by 60-70% by 2050. Although meeting the increasing consumption pushes the search for more resources, the sustainability of feed resources has become a difficult issue for many reasons such as the limited availability of these resources, the environmental effects of production, climate change, and the food-feed-fuel race. For this reason, searching for alternative sources instead of traditional feed sources has become more important. Studies on the use of edible insects as alternative feed have gained momentum in recent years. Although the use of insects in animal feeding is seen as promising, there are many parameters that need to be investigated. This study was conducted to determine the effects of adding different levels of mealworm (*Tenebrio Molitor* L.) larvae to alfalfa hay on in vitro gas and methane production. For this purpose, mealworms were added to alfalfa hay at the rate of 0.5%, 1%, and 1.5% of the dry matter. In the study, rumen fluid was obtained from the slaughterhouse (2 healthy beef cattle). In the study, gas production was found to be higher in the groups supplemented with mealworms ($P_L < 0.05$, $P_Q < 0.05$). Similarly, in vitro organic matter digestibility and net energy for lactation increased in groups supplemented with mealworm larvae compared to the control ($P_L < 0.05$, $P_Q < 0.05$). While metabolic energy values increased linearly with the addition of mealworms, the quadratic effect was found to be insignificant. The effect of mealworm addition to alfalfa hay on in vitro methane production was found to be insignificant ($P > 0.05$). As a result, it was determined that the use of mealworm larvae as a feed additive in ruminant feeds could increase the digestibility of alfalfa without affecting methane production. Additionally, mealworms may increase the sustainability of ruminant feeding. However, it is recommended that these results be supported by in vivo studies at different levels.

Keywords: edible insects, ruminant, feed, gas production, methane

EFFECT OF ORGANIC AND CHEMICAL FERTILIZER APPLICATIONS ON YEDIKULE LETTUCE (*LACTUVA SATIVA* L.) YIELD AND CHLOROPHYLL CONTENT

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ABSTRACT

This study, yedikule organic and chemical fertilizers applied to lettuce plants from the base to determine the effects of fertilizers on plant yield and plant chlorophyll content In 2020, Erciyes University Agricultural Research and Application It was carried out in the field. Solid vermicompost as organic fertilizer in the study (100 kg da-1) is preferred, while 15 - 15 - 15 as chemical fertilizer compound base fertilizer was preferred. 16 plants were planted in each plot. Lettuce plants were planted with a row spacing of 25 cm above the row and 50 cm between the rows. Plant height (cm), plant width (cm) and plant fresh weight (g/plant) as well as chlorophyll content of plant leaves (SPAD) were analyzed. Examination As a result, it was determined that chemical fertilizer application had a positive effect on plant wet weight and organic fertilizer application had a positive effect on chlorophyll content.

Keywords: Organic fertilizer, Chemical fertilizer, *Lactuca Sativa*, Chlorophyll, Yield

AGROECOLOGICAL ASSESSMENT OF THE EFFICIENCY OF UTILIZATION OF QUAIL MANURE IN THE RESTORATION OF DISTURBED SOD-PODZOLIC SOILS WITH THE FORMATION OF A STABLE HERBAGE

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ABSTRACT

The most acute environmental problems of our time include large volumes of manure and bird droppings produced annually at large livestock complexes, which are potential raw materials for valuable and agroecologically attractive organic fertilizers, but are very narrowly localized, that seriously complicates the logistics of their application and requires the development of the best available technologies for environmentally safe and cost-effective their use. At the same time, the sod-podzolic soils dominating in the Non-Chernozem zone of the European part of Russia are characterized by a low thickness of the humus-accumulative horizon and low reserves of humus (organic matter), which quickly fall with intensive agricultural use and soil anthropogenic degradation. Along with this, against the background of rapidly developing global climate changes characteristic of the XXI century, there is a fastly growing interest in more intensive, but environmentally safe agricultural use of these lands with a relatively stable humidification regime and a growing amount of active temperatures from year to year.

Quail poultry farms producing nutritionally valuable meat and eggs belong to the actively developing direction of animal husbandry in central Russia, where with the growing welfare of a significant part of the population, the demand for higher-quality food is steadily growing. Herewith, quail manure is characterized by an increased content of macro- and micro-elements of plant nutrition, which makes it especially attractive for use as compost for the restoration of degraded sod-podzolic soils with the formation of a stable herbage. Moreover, at the same time, the tasks of reducing greenhouse gas emissions into the atmosphere can be evidently solved, which is extremely important for slowing down the processes of global climate change and can bring additional funding to projects for the restoration of degraded lands.

Our research carried out with the support of project No. 075-15-2021-1030 of the Ministry of Science and Higher Education of Russia, conducted in the vegetative experiment of the Laboratory of agroecological monitoring, ecosystem modeling and prediction and on the Station of the Field Experimental Station of the Russian State Agrarian University - Moscow Timiryazev Agricultural Academy in the autumn period of 2022 and in the summer period of 2023. To restore degraded sod-podzolic soils, a peat-sand substrate enriched with compost from quail manure without an additional mineral component and with the addition of phosphogypsum to stabilize organic compounds of

compost was used. To form a stable productive herbage, a grass mixture with the following composition was used: red fescue (*Festuca rubra*) (80%), meadow bluegrass (*Poa pratensis*) (10%), ryegrass pasture (*Lolium perenne*) (40%). The vegetation experiment showed the maximum increase in plant biomass and the height of the herbage in the variant with the combined use of compost and phosphogypsum: respectively, 30% and 24% higher than the control with a peat-sand substrate. The use of compost at a dose of 2 t/ha together with phosphogypsum at a dose of 4.5 t/ha contributed to a significant reduction in daily soil CO₂ emissions in the late autumn period: up to 3 times when compared with the use of compost alone and up to 2 times when compared with the control. A multiple decrease in the level of soil emissions was also observed in the case of methane. In the summer, there is an increased intensity of soil CO₂ emissions in the variants with compost, but with a significantly (multiple) more active increase in grass biomass growing, we can talk about the atmosphere carbon sequestering nature of the technology of utilization of quail droppings during the restoration of disturbed sod-podzolic soils with the formation of a stable herbage.

Keywords: Aftereffect of compost, Ecological assessment, Ecological modelling, Erosion control, Regenerated topsoil, Soil degradation, Phytoremediation project

THE CHEMICAL, MICROBIOLOGICAL PROPERTIES AND ANTIBIOTIC RESISTANCE OF LACTIC ACID BACTERIA ISOLATED FROM COW, GOAT, DONKEY, BUFFALO AND HUMAN MILK

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ABSTRACT

Milk is the sole food of newborn mammals. A child's brain cells develop most rapidly in the first seven years, forming the total brain potential. Breast milk is the only food that can meet all the nutrient requirements of a newborn baby for at least 3 months. However, in recent years, milk of different species for human consumption continues to replace breast milk for medical reasons, personal preference, health, sustainability, or modern lifestyle, and the working mother model. Ninety percent of the milk available in the market is cow's milk and 10 percent of the milk consists of other milk types. For this reason, especially in infant nutrition, the search for the closest milk to human milk continues. In addition to growth and development, milk has many important properties in the life cycle due to its protein and peptide structured elements such as immunoglobulins, enzymes, enzyme inhibitors, growth hormones, other hormones, growth factors, antibacterial agents, fatty acids, vitamins, and minerals, which are physiologically important. The aim of the study was to compare the physico-chemical and microbiological properties of the milk types in the diet range and to evaluate their level of closeness to breast milk. Milk Samples, Human, sheep, goat, buffalo, donkey, and cow milk was obtained in a different city, in Türkiye. FT-120 (Milkoscan, FOSS, Denmark) was used for physicochemical analyses. Microbiological analyses were performed by counting total mesophilic aerophilic organisms, E.coli, Coliform, and lactic acid bacteria. Lactic acid bacteria were tested for resistance to 10 different antibiotics. The dry matter content of sheep, goat, buffalo, cow, camel, donkey, and human milk was 17.74, 14.32, 14.29, 12.41, 10.65, 3.80, 8.82%, respectively. In protein amounts, cow milk with 4.23% was followed by sheep milk with 3.39%, buffalo milk with 3.31% and cow milk with 3.29%. Lactose amounts were found to be between 4-80% and 4.90%, with the highest 6.33% in sheep milk and 6.01% in human milk, with other types of milk having approximately similar amounts. When different animal milk compositions were analyzed, the highest fat content was found in sheep (6.34), goat (5.3), buffalo (4.80), cow (3.51). Lactic acid bacteria isolates were mostly susceptible to tetracycline, penicillin, kanamycin, streptomycin, rifamycin, ciprofloxacin gentamicin, chloramphenicol, and teicoplanin antibiotics..

Keywords: Milk types, human, microbiological properties, chemical properties, antibiotic resistance

BIOCONTROL POTENTIAL OF ENTOMOPATHOGENIC NEMATODES ON SPODOPTERA LITTORALIS (BOISDUVAL) (LEPIDOPTERA: NOCTUIDAE)

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ABSTRACT

Spodoptera littoralis (Boisduval) (Lepidoptera: Noctuidae), commonly known as the Egyptian cottonworm is a formidable agricultural pest, wreaking havoc on a wide range of crops, including cotton, maize, vegetables, and various other agricultural plants. Control measures often involve the use of pesticides, biological control agents, and integrated pest management strategies to mitigate the economic and ecological impact of this destructive pest. Research continues to focus on developing more sustainable and environmentally friendly methods to manage and control *Spodoptera littoralis* populations in order to protect global food and fiber production.

In this study, the efficiency of the entomopathogenic nematode species *Steinernema feltiae* and *Heterorhabditis bacteriophora* against the larvae of *S. littoralis* was evaluated. After 72 hours, a concentration of 400 IJs/Petri dish for *S. feltiae* caused up to 95.5% mortality. At the lowest concentration (50 IJs/dish), *S. littoralis* larvae were more sensitive to *H. bacteriophora* than *S. feltiae*. The data indicated that 200 IJs for *H. bacteriophora* was the most effective concentration for all stages of larvae, since the mortality rate was 100%.

Keywords: Entomopathogenic nematodes, *Spodoptera littoralis*, *Steinernema feltiae*, *Heterorhabditis bacteriophora*, Biological control

ANTIMICROBIAL ACTIVITY OF MEDICINAL AROMATIC PLANT: MELISSA OFFICINALIS, STYRAX OFFICINALIS, ECHINOPS RITRO, ELAEAGNUS ANGUSTIFOLIA PLANTS

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ABSTRACT

Under the name of natural products, extracts of medicinal aromatic plants (MAP), fruits, oils, essential oils, cosmetics, health, medicine, food, energy, phytotherapy have become the first products in all areas of our lives. It is important for the health, cosmetics and food industry that TAP is trending in scientific research as well as traditional. The aim of this study was to investigate the antimicrobial activities of TAP for use in functional foods and feeds. Two kinds of solvent extracts (ethyl alcohol and water) of different organs (whole, seed, fruit, leaf) of *Melissa officinalis*, *Styrax officinalis*, *Echinops ritro*, *Elaeagnus Angustifolia* plants were obtained Çukurova. The antimicrobial activity of these extracts on pathogenic Gram-negative such as *Klebsiella pneumonia* (ATCC700603), *Salmonella Paratyphi A* (NCTC13) *Pseudomonas aeruginosa* ATCC 27853, *Escherichia coli* (ATCC 25922), Gram-positive such as *Staphylococcus aureus* ATCC 29213, *Basillus subtilis* B-354, *Listeria monocytogenes* (ATCC7677) mould such as *Aspergillus niger* 10 ph k7and *Aspergillus niger* ATCC 1015 yeast such as *Saccharomyces cerevisiae_sauch_VL1* strains *Saccharomyces cerevisiae_zymaflores* was investigated by agar well diffusion test. It was found that water and alcohol extracts of TAB plant (alcohol extract was more effective) had antimicrobial effect on *Salmonella*, *staphylococcus*, *Aspergillus niger* and other pathogens.

In this study, alcohol extracts of the research plants were found to be more effective on microorganisms than water extracts.

Keywords: Medicinal aromatic plant, antimicrobial activity, Gram negative, Gram positive, mold and yeast

ANTIOXIDANT PRODUCTION FROM MEDICINAL AROMATIC PLANTS

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ABSTRACT

Antioxidants are molecules that prevent cell damage by preventing the formation of free radicals or by scavenging existing radicals and generally carry phenolic function in their structure. The most important factors determining the place of antioxidants in human health are their chemical structures, solubility, structure/activity relationships and their availability from natural sources. It is necessary to extract an antioxidant-rich concentrate from a variety of edible plants to use these molecules in nutraceuticals, creams and functional foods. Purification of antioxidants from medicinal and aromatic plants by acid hydrolysis, column chromatography, conventional solvent extraction are popular methods. There are about twenty analytical methods developed to measure the antioxidant capacity of purified antioxidant content. The extraction of phenolic antioxidants in column chromatography includes Folin-Ciocalteu and ABTS methods respectively. For example, this method is used in the extraction of antioxidants from black mulberry (*Morus nigra*). Each antioxidant fraction of the black mulberry obtained is quantitatively determined in terms of its chemical components by HPLC (high performance liquid chromatography). Antioxidant extraction from annual wormwood (*Artemisia annua* L.) plant, sub and supercritical fluid extraction methods, sub/supercritical fluid extractions, subcritical water, subcritical ethanol and supercritical CO₂ methods are accepted. Free radical scavenging method (DPPH), total antioxidant capacity (CUPRAC) and total phenol content (FOLIN) methods are applied to determine the antioxidant capacity of the extracts. For example, the antioxidant activity of rosemary Rosemary plant is usually analysed by DPPH (2,2-diphenyl-1-picrylhydrazyl) method.

Keywords: Antioxidants, Production Method, medicinal aromatic plants, natural products.

EFFECT OF BIOCHAR APPLICATION ON NUTRIENT UPTAKE AND ROOT GROWTH UNDER DEFICIT IRRIGATION CONDITIONS

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ABSTRACT

Soil moisture is involved in managing water resources, selecting irrigation schedules, and dissolving and transporting plant nutrients. In particular, soil moisture is crucial for plant growth. However, due to irregular rainfall and insufficient irrigation water, the soil's available moisture decreases. With the decrease in moisture content, the uptake of plant nutrients also changes. This study investigated the effect of biochar material application to the soil on some nutrient contents (Na, Ca, Mg, K, P, Fe, Zn) and plant root weight under deficit irrigation water conditions. In the study, 4 different biochar (B0: no biochar, B1: 0.5% biochar w:w, B2: 1% biochar, B3: 2% biochar) and 3 different water regimes (I100: full irrigation, I75: 25% deficit irrigation, and I50: 50% deficit irrigation) were applied. At the end of the study, Ca, Mg, P, Fe, and Zn contents in plant leaves were determined to be high in biochar treatments. Potassium (K) content decreased with biochar application. Zn content decreased with the decrease in the amount of irrigation water applied, while Ca, Na, P, P, K, and Fe content increased. Dry and wet root weights were higher in biochar treatments (B1, B2, B3) compared to the control (B0). As a result, biochar material was found to be effective in plant nutrient uptake and root development under water deficit conditions.

Keywords: Irrigation, biochar, plant growth, *Capsicum annum*

BIOCONTROL POTENTIAL OF ENTOMOPATHOGENIC NEMATODES ON SPODOPTERA LITTORALIS (BOISDUVAL) (LEPIDOPTERA: NOCTUIDAE)

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ABSTRACT

Spodoptera littoralis (Boisduval) (Lepidoptera: Noctuidae), commonly known as the Egyptian cottonworm is a formidable agricultural pest, wreaking havoc on a wide range of crops, including cotton, maize, vegetables, and various other agricultural plants. Control measures often involve the use of pesticides, biological control agents, and integrated pest management strategies to mitigate the economic and ecological impact of this destructive pest. Research continues to focus on developing more sustainable and environmentally friendly methods to manage and control *Spodoptera littoralis* populations in order to protect global food and fiber production.

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Keywords: Entomopathogenic nematodes, *Spodoptera littoralis*, *Steinernema feltiae*, *Heterorhabditis bacteriophora*, Biological control.

FULLPAPERS

The potential of bioinoculants in enhancing the mushroom productivity

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Abstract. Nowadays, environmentally friendly and sustainable food production is gaining importance day by day. The most important factor in achieving the goal of sustainable food production is limiting the use of chemicals that pose risks to human and environmental health, such as fertilizers and pesticides. One of the methods used to reduce the use of chemicals in agriculture is the use of bioinoculants. Bioinoculants are formulations comprised of microorganisms such as bacteria and fungi. They have potentials to increase the agricultural productivity and to control pests and diseases. Mushrooms are among the sustainable foods that stand out with their high nutritional values and medicinal properties. However, the excessive use of chemicals in the production of some edible mushroom species may make their consume risky, despite rich nutritional and medicinal values of the mushroom. The use of biological agents replacing chemicals can provided a great advantage to the mushroom industry in this regard. *Azotobacter*, *Bacillus*, *Paenibacillus* and *Pseudomonas* are most important bacteria genera used in mushroom cultivation. Generally, they increase the mycelial growth of mushroom species while exhibiting competition against harmful molds and stimulate the mushroom yield. On the other hand, use of microorganisms instead of additive materials in the mushroom growing media is highly new and interesting issue in the sector of mushroom cultivation. The aim of this study is to provide a view of the possibility of use of bioinoculants in enhancing the mushroom yield through the agency of the growth encouragement, and their potential as biocontrol agents to prevent various diseases in the mushroom cultivation.

Key words: *Agaricus bisporus*, Bacteria, biological agents, *Pseudomonas*

1 Introduction

Nowadays, the use of sustainable techniques in agricultural production has started to gain value with the understanding of the negative effects of chemicals such as pesticides and fertilizers on environment and human health. In this process, biological approaches, in particular the use of growth-promoting bacteria and fungus to enhance plant growth and yield, are widely used worldwide as one of the most environmentally friendly and sustainable techniques.

Many of the bacteria inoculated into the plant rhizosphere are known to have a positive effect on plant growth [1]. Today, these bacterial species can be used in organic agriculture. Beneficial microorganisms not only support plant growth, but also contribute to the protection of crops from the effects of diseases and pests. Although biological agents to replace chemicals have long been used in various fields of agriculture, it is a newer topic for the mushroom cultivation sector.

All living organisms have close relationships with microorganisms throughout their life cycle [2]. The continuous interaction between human, plants, the environment and microorganisms ensures ecological balance and sustainability. Microorganisms, collectively referred to as microbiomes, can associate with hosts in a beneficial, detrimental, symbiotic or opportunistic manner and affect positively the growth and development of hosts [2, 3].

Mushrooms are valuable food sources due to their high nutritional value and medicinal properties

and they are widely consumed worldwide. World mushroom production was 44.207.117 tons in 2021 [4]. The largest mushroom producer is China with 41 million tons, followed by Japan, Poland and the United States. Button mushroom (*Agaricus bisporus*), oyster mushrooms (*Pleurotus* spp.) and shiitake (*Lentinula edodes*) are the most commercially produced species [5]. Total mushroom production in the world is expected to continue to increase in the next years.

Mushrooms cannot photosynthesize and therefore are described as heterotrophic. They need external nutrients for mycelial development, pinhead formation and fruitbody development [6]. Therefore, most cultivated mushrooms are saprophytic species. They degrade lignocellulosic contents by secreting various lignocellulosic enzymes to break down substrates and in this way they can grow on lignocellulosic substrates [7].

Mushrooms are grown on composts and substrates rich in microorganisms, where a wide range of mutually beneficial interactions as well as competition between bacteria and fungi are established [8].

In mushroom cultivation, the growing medium mainly consists of two different groups: basal substrate and additive materials. In addition to these, auxiliary materials such as CaCO₃ and CaSO₄ are added to

regulate the texture and pH of the growing medium [6]. As a basal substrate, agricultural and forestry wastes

that are the easiest and cheapest to find in the region where mushrooms will be grown are preferred. The most commonly used basal substrates are straw types, sawdust and cotton wastes. These materials are rich in lignocellulosic content such as cellulose, hemicellulose and lignin, but low in nitrogen. Therefore, in order to achieve the desired yield, additives with high nitrogen content such as cotton meal, rice bran, various meal such as corn meal, etc. should be added to the growing medium [9].

Cultivated mushroom species are basically grown on 2 different substrates prepared in different ways;

- 1) Fermented-pasteurized substrates (*Agaricus bisporus*)
- 2) Steam sterilized agricultural and forestry waste mixtures (*Lentinula edodes*, *Hericius erinaceus*, etc.) [10].

Different substrate materials used in the preparation of mushroom growing media affect mushroom yield [11-13]. Therefore, growing media formulas used in mushroom production sector should be improved depending on the mushroom species.

Identification of the microbial communities involved in the processes of the mushroom production process can help to entirely understand the functional structure of these microbial communities and their impact on mushroom growth and biological efficiency (BE%). Nowadays, many researchs have focused on the impact of microbial communities on mushroom yield and substrate quality [3, 14, 15].

The aim of this study was to review the possibility of using microorganisms in mushroom cultivation to increase mushroom growth and yield, and their potential for use as biocontrol agents to protect from pests and diseases in mushroom cultivation.

2 Microorganisms growing naturally in mushroom compost and growing media

Mushrooms are produced in microorganism-rich composts and growing media where a wide range of mutually beneficial as well as competitive interactions between bacteria and fungi are established [8]. Fermentable substrates are produced by composting various animal manures such as chicken and horse and plant material such as wheat straw [10].

There is a rich diversity of microorganisms in compost, which play important roles in digesting the lignocellulosic content of mushroom growing media, minimizing competitor organisms in the growing media and triggering fruitbody formation [16, 17]. *Agaricus bisporus* is the most important species grown on fermented substrates worldwide, where microorganisms play an important role in pinhead formation and fruitbody development [18]. In the

pasteurization and maturation phase of *A. bisporus* compost preparation, the amount of bacteria belonging to the order *Bacillales* increases in connection with the high ammonia emission. The role of the natural microbiota during pasteurization and maturation is to provide to the elimination of ammonia in the compost [18]. In oyster mushroom growing media, the main part of bacterial species detected belonged to the genera *Paenibacillus* and *Bacillus*, while the majority of fungal species belonged to the genera *Wallemia* and *Verticillium* [19]. The interactions between bacteria and fungi in the natural structure of the growing media and cultivated mushrooms may not always be positive, and some bacterial and fungal species can cause various diseases and cause significant yield losses [20]. Expanding research on such microorganisms and identifying bacterial and fungal antagonists against various pests could be helpful in increasing mushroom yields.

Several factors such as temperature, oxygen, humidity, substrates used in growing medium preparation and C/N ratio are known to influence the type and amount of microbial communities present in growing media [21]. Analysis and search of microbial diversity in mushroom compost will supply important knowledge for the preparation of effective growing media and an important contribute to mushroom production sector.

3 Bioinoculants that can be used to increase mushroom productivity

The presence of beneficial microorganisms in substrates used in mushroom cultivation promotes mycelial growth and pinhead formation. Many researchs have suggested the use of beneficial microorganisms to improve the productivity of edible mushrooms, especially product quality and uniformity [22, 23, 24].

The preparations used to promote yield in mushroom cultivation are usually nutritional supplements based on rich protein mixtures added to compost or cover soil [10]. There are also a variety of commercial preparations prepared from microorganisms that are used in mushroom cultivation to protect the crop against diseases and pests, as well as to provide the nutritional needs of the mushroom, stimulate host growth or increase disease resistance. For example, fungi are used as insecticides to control fungus flies or two strains identified as *Bacillus subtilis* QST 713 and *Bacillus amyloliquefaciens* MBI 600 to control green mold disease. There is no commercial formulation available on the market for mushroom growers based solely on microorganisms that promote mushroom growth. Therefore, the selection and identification of new bacterial isolates for increased mycelial development and mushroom yield in an environmentally friendly approach and their commercialization into

commercial preparations could make significant contributions to the mushroom growing industry. In general, the association of mushroom mycelia with beneficial bacteria present in the mushroom compost results in an initial increase in the rate of hyphae elongation followed by stimulation and formation of primordia [25]. Some bacteria present in mushroom compost or soil cover secrete some biologically active compounds such as phytohormones. These compounds secreted by the bacteria can promote mycelial growth and mushroom yield [26].

Azotobacter, *Bacillus*, *Paenibacillus* and *Pseudomonas* have been reported to be used as biosupplements in mushroom cultivation [10]. The addition of these bacteria to mushroom growing media can potentially promote the growth and fruiting of *Pleurotus* spp. and *Agaricus bisporus* mushrooms [27].

Microorganisms can be used to increase mushroom yields and shorten the production process in mushroom cultivation. The interactions identified between beneficial microorganisms and mushroom are as follows:

1. shortening the composting process to facilitate the degradation of lignocellulose while improving the quality of the substrate [18].
2. promoting mycelial growth in mushroom growing media/compost by releasing nutrients [28, 29]
3. Stimulation of fungal pinhead formation [30].
4. In truffle species and other mycorrhizal fungi, promoting the growth of mycorrhizal fungi by stimulating the establishment of symbiotic associations [31].

Many bacterial species provide fungal substrate benefits to fungal mycelia and affect fruiting and BE of fungi. Preparations from some microorganisms can also produce phytohormones such as auxin, cytokinin and ethylene that stimulate mycelial growth [32].

IAA secreted by *Pseudomonas* sp. P7014 plays an important role in promoting the growth of mycelial growth of king oyster mushroom (*Pleurotus eryngii*) [33,34]. Kim et al. [22] reported that *Pseudomonas* sp. P7014 promoted the growth of *P. eryngii* in bottle cultures. A positive interaction was reported to occur during co-cultivation of *Pleurotus florida* and fluorescent *Pseudomonas* bacteria [15].

Bacteria are also involved in the degradation of cellulose by secreting cellulase, providing nutrients to the mushroom mycelium [35]. Actinobacteria has an important role in the biodegradation of cellulose and lignin [36]. Kues and Liu [37] and Hultberg et al. [38]

reported that laccases have important functions in stimulating mycelial growth and pinhead formation. Actinomycetals are abundant in the medium during the thermophilic stages of compost preparation and can degrade lignin and cellulose. *Bacillus* are the most abundant bacteria in composting process and can provided to the breakdown of lignocellulosic materials in the process due to their thermotolerance properties [39, 40].

Chen et al. [41] reported that *Bacillus cereus* isolated from *P. eryngii* promoted the mycelial growth rate by 1.15 times. Young et al. [42] reported that the application of the actinobacterium *Microbacterium humi* in the covering soil during the cultivation of *A. subrufescens* contributed to shorten the time to harvest up to 26 days and increased the mushroom yield up to 215%. Ekinci and Dursun [43] reported that composts supplemented with bacteria and organic fertilizers increased mushroom yield and quality in *A. bisporus* cultivation.

Bacillus subtilis increased mushroom yield when applied at lower concentrations [44]. Addition of *Pseudomonas* sp. P7014 to cultures resulted in earlier initiation of primordia compared to the control of *P. eryngii*. Similarly, Young et al. [45] reported a significant increase of 64% in *Agaricus blazei* yield when two bacterial isolates were inoculated with *Exignobacterium* sp. Mohammad and Sabaa [46] reported an increase in mushroom yield (26.6%) when inoculated with *Pseudomonas putida* compared to uninoculated sets.

Cho et al. [15] determined that inoculation of isolated fluorescent *Pseudomonas* spp. from the mycelial surface of *P. ostreatus* exhibited positive effects on pinhead formation and fruitbody development. Similarly, inoculation of *Actinobacteria* and *Glutamicibacter arilaitensis* into the growing substrate of *Pleurotus florida* mushroom resulted in increased mushroom yield and BE. Kumar and Narian [23] reported that *Glutamicibacter arilaitensis* MRC119 bacterial isolate used in oyster mushroom production increased mushroom yield by 28% and BE by 58%. The study showed that the bacteria were strictly attached to the mycelial surface and as a consequence increased mycelium growth. This relation between mushroom mycelia and bacterial cells has an important role in stimulating mycelium growth through beneficial secretions from both sides [23].

Ascomycota, especially the thermophilic fungi *Chaetomium thermophilum*, *Malbranchea sulphrea*, *Thermomyces lanuginosus* and *Torula thermophila* (*Mycothermus thermophilus*) support the growth of *A. bisporus* [47].

It was noted that inoculation of covering soil with *Bacillus subtilis* and *Alcaligenes faecalis* exhibited significantly higher yield compared to non-inoculated [48]. Çetin et al. [49] also reported the productive effect of various bacteria on the yield of *A. bisporus* mushroom, which increased by 8-40%.

Complex carbohydrates in the structure of mushroom growing substrates are degraded by beneficial bacteria into simple sugars, which can easily be taken up by oyster mushrooms. This effect of bacteria on the growing medium may lead to good mycelial development and increased mushroom yield [14].

4 Use of biocontrol agents for the control of fungal parasites

Although the microbiome naturally present in compost and covering soil, bacteria such as *Bacillus* and *Pseudomonas*, produce antifungal and insecticidal compounds, the natural microbiota is not generally effective in suppressing mycoparasites, especially at low temperatures and conditions of high disease pressure [3]. Therefore, the control of diseases and insects that occur during mushroom production relies on the application of chemical pesticides and insecticides as well as integrated pest management programs [50].

However, the reports on the effects of overuse of chemicals on human health and the emergence of resistant strains [51] support the thesis of developing new sustainable strategies for the conservation of mushroom crops. Several natural biomolecules such as aromatic plant extracts have been tested to reduce fungicide dependence. But, studies have shown that these extracts have variable efficacy in inhibiting fungal diseases in agricultural crops and sometimes even have detrimental effects on the plants [52]. On the other hand, promising results have been obtained that the use of bacterial species as an alternative against fungal diseases in agricultural crops can be a potentially sustainable solution to these problems. Several species of bacteria belonging to the genus *Bacillus*, naturally present in covering soil, show a selective inhibitory effect on fungal diseases and their application to compost or cover soil can prevent green mold and losses due to this disease [53, 54].

Numerous species or strains of *Bacillus* have been developed as commercial products because they are not normally considered human pathogens. *Bacillus* species have a number of desirable properties, such as rapid growth, ability to thrive in inexpensive culture media, production of various antifungal substances and some plant nutrients. In addition, preparations prepared from *Bacillus* are resistant to unfavorable environments and can be stored for a long time [55]. The actinobacterium *Streptomyces flavovirens* A06, isolated from a Phase I substrate, was described to be effective in controlling green mold disease while minimizing production losses and showed no

deleterious effects against the host mycelium of *A. bisporus* [56].

Chittihunsa et al. [55] reported that BI 01-SU1, a *Bacillus* isolate, was very effective against *Trichoderma* sp. in *Lentinula edodes* and *Pleurotus sajor-caju*, reducing infection by 58.23% and 80%, respectively. Bacterial strains isolated from compost, covering soil,

A. bisporus fruitbody and wild mushrooms were also effective against bacterial diseases such as brown spot (*Pseudomonas tolaasii*) and internal stripe necrosis (*Ewingella americana*) [57, 58]. Similarly, bacteria isolated from the fruitbodies of *A. bisporus* exhibited broad-spectrum antimicrobial activities [35].

5 Limiting factors related to the use of biocontrol agents

The mechanisms by which bacterial agents inhibit disease and pests in mushroom cultivation are still poorly characterized. Due to limited knowledge of the ecology of the mushroom crop and the difficulties of producing a reliable microcosm in the laboratory, there are also significant challenges in translating results from in vitro to in vivo. Often successful results obtained in vitro may not translate into crop productivity [54, 58].

Determining the timing and doses of bacterial applications for different mushroom species are important issues. For this purpose, the use of molecular markers and the application of functional imaging techniques to monitor the behavior of the biocontrol agent in a growing media will be useful.

Suitable formulations of bioactive compounds, the timing and the dose of application are important points to be determined for different mushroom species. For this purpose, it is necessary to apply tools to monitor the behavior of the biocontrol agent in a growing media, such as the use of molecular markers and the application of functional imaging techniques to monitor the distribution of bacteria.

6 Conclusion and Recommendations

Microorganisms can be used in mushroom cultivation as an environmentally friendly alternative to chemical preparations to increase mushroom yields. Further investigation of microbial communities that help or inhibit fruitbody formation may provide important insights into mushroom cultivation practices. Understanding the microorganisms that associated with mushrooms may contribute to the development of methods that will make possible to improve both yield and mushroom quality. A deeper understanding of bacteria-fungus interactions can support the development of strategies to increase both the

profitability and sustainability of the industry in the medium and long term.

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Comparison of actual evapotranspiration by the Google Earth Engine Evapotranspiration Flux (EEFlux) to the METRIC model using remote sensing data and in-situ climate observations

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Abstract. Actual evapotranspiration (ETa) is essential data in developing water budgets and calculating irrigation water requirements in large-scale irrigation schemes. Nowadays, remote sensing (RS)-based surface energy balance models help us estimate ETa with high resolution when compared to direct methods that focus only on a single point in a field. This study aimed both at estimating ETa by Mapping EvapoTranspiration at high Resolution with Internal Calibration (METRIC) and Google Earth Engine Evapotranspiration Flux (EEFlux) platform and comparing reference evapotranspiration based on the Penman-Monteith equation (ETo) with ETa by the METRIC and EEFlux in a sub-catchment (A=9495 ha) under irrigation, located in the Lower Seyhan Plain (LSP), Turkiye in the 2020 hydrological year. For this purpose, 16 Landsat 7 and Landsat 8 images, local climatic data acquired from two meteorological stations in the catchment, and CFSv2 gridded global data were used. Results showed a good agreement between ETa-EEFlux with ETa-METRIC. Moreover, a strong correlation was found between ETo and ETa-METRIC ($r=0.93$ and slope close to 1 and RMSE value of 0.74 mm day^{-1}) if compared to the relationship between ETo with ETa-EEFlux. The results show the potential of applying the METRIC model and EEFlux for mapping ETa over a large-scale irrigation scheme.

Keywords: Evapotranspiration, remote sensing (RS), METRIC, Google Earth Engine, EEFlux, Akarsu Irrigation District

1 Introduction

Actual Evapotranspiration (ETa) is a crucial input for the water cycle, developing water budgets and calculating net irrigation water requirements, agricultural water management, and hydrological modelling, among others. The typical character of all direct methods is to compute ETa at a point scale such as the soil water budget approach, lysimeters, eddy covariance, and scintillometer. Therefore, these techniques generally fail to show the ETa variations in the field [1] if compared to the remote sensing (RS)-based surface energy balance models [2, 3, 4]. Among RS-based surface energy balance models is the Mapping Evapotranspiration at high Resolution with Internalized Calibration (METRIC) model [5-6], which is one of the more widely used to estimate ETa in operational irrigation practices at a large scale. As known commonly, the METRIC model applies principles and techniques that originated with the Surface Energy Balance Algorithms for Land (SEBAL) [7].

The METRIC model has been applied to estimate ETa in different regions of the world using satellite images with ground truth data. The accuracy of ETa by the METRIC model was compared to ETa measured by the lysimeter, the Bowen ratio, and eddy covariance towers for several crops in a range of locations of the world with errors ranging from 3–20% [5, 8, 9]. These results proved a good agreement between ETa by the METRIC model and ETa by the direct method. However, the applying

METRIC model requires well-trained experts who have good experience dealing with RS data and selecting the anchor pixels, i.e., hot and cold pixels. Furthermore, this model study consumes time to estimate ETa for one image [10]. For this reason, automated calibration algorithms for the METRIC model were designed to reduce the errors that might happen to the users. For example, the R-METRIC was applied based on the METRIC model over a large irrigation catchment, i.e., Akarsu Irrigation District (AID) in Turkiye [2, 4], which automatized hot and cold pixel selection that decreased the possibility of human error [11].

The fact is that automated calibration algorithms for the METRIC model require several data such as satellite images, cloud mask, digital elevation model (DEM), local climate data, soil type map, and land cover map/land use or cropping patterns, among others. These data need to make some pre-processing before applying the METRIC model, and thus consume time for the users. For this reason, the Earth Engine Evapotranspiration Flux (EEFlux) application has been designed and developed on the Google Earth Engine (GEE) platform based on the METRIC model [6] to save time and money. Moreover, this platform can quickly produce ETa at 30 m spatial resolution with other products such as surface temperature (Ts), normalized difference vegetation index (NDVI), DEM, and albedo.

ETa estimation by the EEFlux and METRIC model at a 30 m resolution scale can be useful for hydrological applications as well as agricultural water

management and water balance calculations at large-scale irrigation catchments. However, as reported by many researchers [2, 4, 5, 7], research results need some sort of justification and/or validation. The novelty of this study is to compare the ETa by the EEFlux product with the ETa-METRIC model for checking the accuracy of the EEFlux product over AID during the 2020 water year. Therefore, the aim of this paper is to a) compare the ETa values from EEFlux with the METRIC model to assess the utility and accuracy of EEFlux products, and b) find the relationship between ETa by the METRIC model and EEFlux with reference evapotranspiration, i.e., ETo, by FAO-Penman-Monteith approach. Furthermore, this methodology can be generalized for checking ETa which is produced by EEFlux to the METRIC model and ETo in a range of climate locations and zones of the world.

2 Materials and Methods

2.1 Study area and meteorological data

The study area, Akarsu Irrigation District (hereafter, AID, A=9495 ha) is situated in the Lower Seyhan Plain (LSP) as part of the southeastern Mediterranean region of Türkiye (Figure 1). The AID has been irrigated for more than 60 years and is located between 36° 57' 32" and 36° 50' 43" N latitudes and 35° 40' 22" and 35° 28' 42" E longitudes. The study area is characterized by warm and rainy in the winter season while dry and hot in the summer season due to the Mediterranean climate type dominating in the LSP. The annual daily average, minimum, and maximum air temperatures are 18.9°C, 9.0°C, and 31.0°C, respectively

[4]. The mean annual precipitation of the basin is around 650 mm [12]. Local climatic data acquired from L8 and Cotlu meteorological stations -installed in the study area- were used for the METRIC model while EEFlux used CFSV2 gridded weather data globally. In turn, hourly and daily climate data (temperature, wind speed, solar radiation, relative humidity, and precipitation) were subjected to quality control (QC) checks such as gaps in the data, outliers, constant values, jumps, etc., before using them to cover the 2020 water year. Water year in Türkiye has been defined as the period, with a length of 365 days, between October 1st of one year and September 30th of the next.

2.2 Remotely sensed data

To perform the METRIC model by using local meteorological data acquired in the study area, in total 16 clear-sky Landsat satellite images were downloaded from the USGS website (<http://earthexplorer.usgs.gov>) (path 175, row 34) and used in this research. On the other hand, EEFlux is based on the Google Earth engine, which can use 16 Landsat images in the cloud through (METRIC-EEFlux (eeflux-level1.appspot.com)). The type of Landsat images used in this research is Landsat 7 and Landsat 8 with 30 m by 30 m spatial resolution. General characteristics of the Landsat satellite images are given in Table 1. The cloud mask was applied by the Environment for Visualizing Images (ENVI) software program for two satellite images in January and February 2020, i.e., DOY 28 and DOY 60 as seen in Table 1.

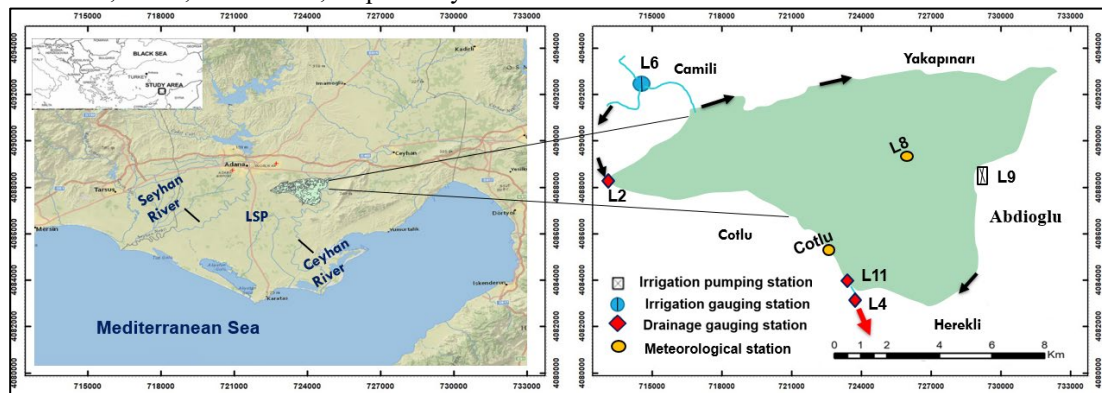


Fig. 1. The study area is located in the southeastern Mediterranean region of Türkiye. Meteorological stations are L8 and Cotlu located in the study area. L6 and L9 stand for irrigation water input locations; L2 and L11 stand for drainage water input locations, and L4 drainage output at the outlet of the catchment.

Table 1. Availability of Landsat 7, and Landsat 8 scene information in the 2020 water year: names of scenes, acquisition dates, and overpass local time.

Image	Day of the year (DOY)	Landsat scene	Satellite	Cloud cover (%)	Acquisition dates	Overpass local time (AM)
1	273	LC81750342019273LGN00	Landsat 8	0	30.9.2019	11:16:02.5052379
2	297	LE71750342019297SG100	Landsat 7	16	24.10.2019	10:59:54.3561211
3	321	LC81750342019321LGN00	Landsat 8	4	17.11.2019	11:16:01.7353690
4	353	LC81750342019353LGN01	Landsat 8	1	19.12.2019	11:15:58.3225900
5	28	LE71750342020028NPA00	Landsat 7	67	28.1.2020	10:55:13.3874493
6	60	LE71750342020060SG100	Landsat 7	66	29.2.2020	10:53:33.8472536
7	68	LC81750342020068LGN00	Landsat 8	2	8.3.2020	11:15:36.2460760
8	108	LE71750342020108SG100	Landsat 7	6	17.4.2020	10:50:52.5176873
9	148	LC81750342020148LGN00	Landsat 8	4	27.5.2020	11:15:08.7684079
10	180	LC81750342020180LGN00	Landsat 8	1	28.6.2020	11:15:26.9694210
11	196	LC81750342020196LGN00	Landsat 8	1	14.7.2020	11:15:33.4238989
12	212	LC81750342020212LGN00	Landsat 8	0	30.7.2020	11:15:37.9038700
13	228	LC81750342020228LGN00	Landsat 8	0	15.8.2020	11:15:42.0945460
14	244	LC81750342020244LGN00	Landsat 8	0	31.8.2020	11:15:50.3682170
15	260	LC81750342020260LGN00	Landsat 8	1	16.9.2020	11:15:56.5028510
16	300	LE71750342020300SG100	Landsat 7	8	26.10.2020	10:38:56.1154274

2.3 EEFLUX and METRIC model

EEFlux-METRIC product and METRIC model were applied to estimate actual evapotranspiration (ETa, hereafter, ETa-EEFlux and ETa-METRIC) for each pixel and the whole study area (Eq. 1) using Landsat satellite imagery and climatic variables acquired by hourly CFSv2 operational analysis [13] and ground-based hourly weather data from L8 and Cotlu weather stations in the study area at the time of satellite overpass, primarily based on [5-6].

$$LE = R_n - G - H \quad (1)$$

Where LE stands for latent heat, R_n is net radiation, H is sensible heat, and G is soil heat flux. All the fluxes are in the unit of watt per meter square (i.e., $W m^{-2}$). EEFlux was performed by the Google Earth engine, while the standard METRIC model was through the R-METRIC model using a water package in the R program [11] and LandMOD ET mapper-MATLAB [14-15]. Reference evapotranspiration (ETo) in $mm day^{-1}$ unit was applied by the FAO-Penman-Monteith approach [15-16]. Further information on the EEFlux-METRIC and METRIC model and equations, i.e., ETa calculation, are given by [6, 10, 15].

In this study, the difference between ETa-METRIC and ETa-EEFlux was statistically assessed by using a simple linear regression approach over the AID at the satellite image acquisition dates. Furthermore, root mean square error (RMSE) and coefficient of determination (R^2) were applied in this research for statistical inference.

3 Results and discussion

3.1 EEFlux vs. METRIC comparisons

In this paper, EEFlux was applied to estimate ETa using CFSV2 gridded weather data over the study area. On the other hand, in the METRIC model, ETa was estimated by employing the R-METRIC and LandMOD ET mapper-MATLAB to drive spatiotemporal ETa data using local ground truth data at satellite image acquisition dates over the AID. For example, Figure 2 shows the daily ETa and land surface energy balance (SEB, i.e., LE , R_n , H , and G) components as an example on 15.08.2020 which coincides with the day of the year (DOY) 228. Finally, the ETa values by the EEFlux and METRIC model were compared with ETo values at the satellite image acquisition dates.

The variation of ETa-METRIC, ETa-EEFlux, and ETo by the FAO-Penman-Monteith method [16] in the study area was presented in Figure 3 at the time of the satellite overpass. As seen in Figure 3, the ETo values were slightly higher than ETa-METRIC and ETa-EEFlux together, except on DOY 353, DOY 28, DOY 228, and DOY 244. These results can be interpreted by the K_c , i.e., the $ETrFi$ value in the METRIC model, which is greater than 1.0. This fraction in the METRIC model considers all factors of climate, soil, and plant types together. Therefore, this fraction is a more representative value as compared to the standard K_c values documented by Allen et al. [16].

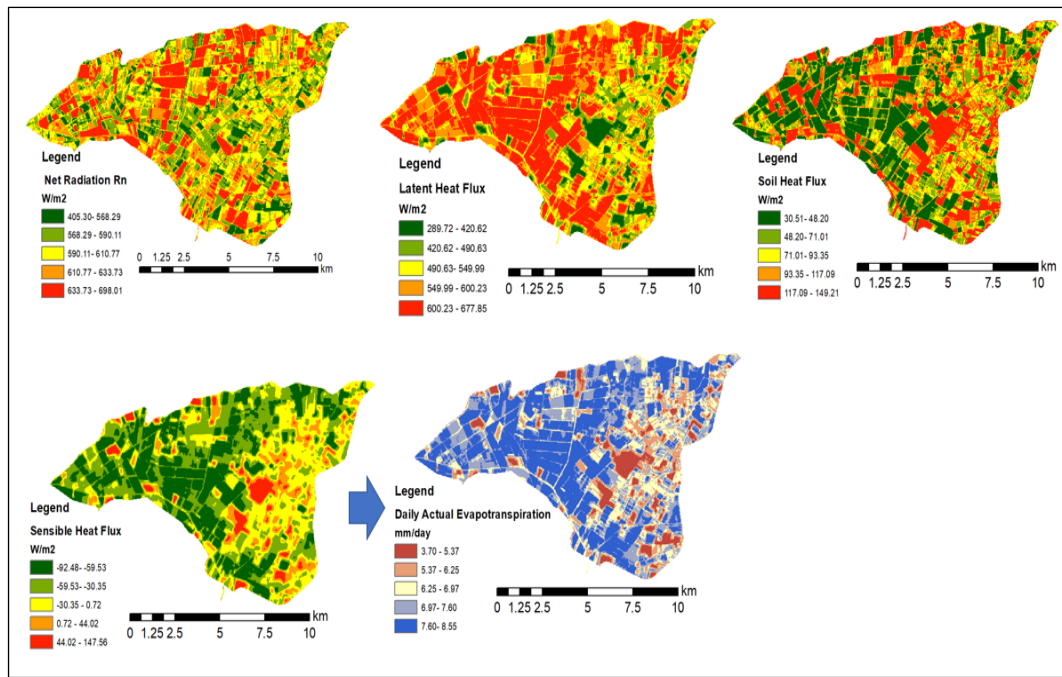


Fig. 2. Spatial distribution of ETa and SEB fluxes over the irrigated catchment on DOY 228 (August 15, 2020): Net radiation (Rn, top left), latent heat flux (LE, top mid), sensible heat flux (H, top right), soil heat flux (G, bottom left), and Actual evapotranspiration (ETa, bottom mid) in the unit of $mm\ day^{-1}$ for ETa and $W\ m^{-2}$ for all SEB.

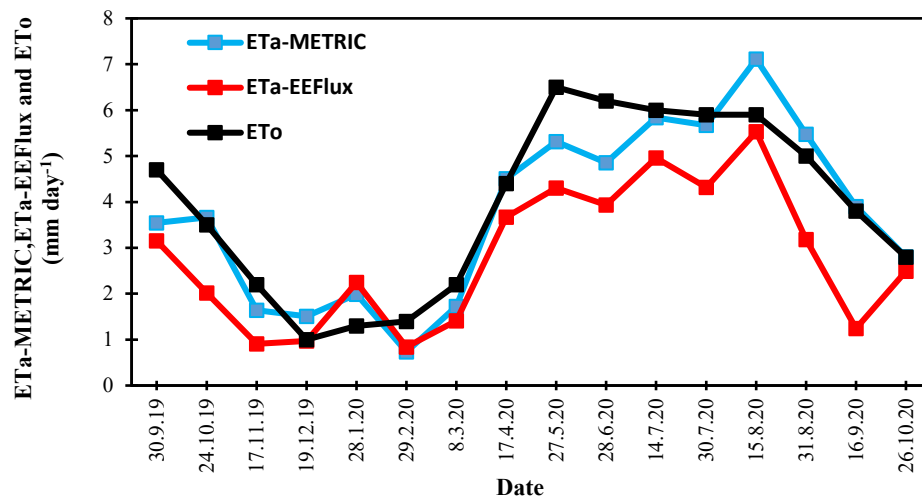


Fig. 3. Temporal variations of areal mean daily ETa values, acquired by the EEFlux and METRIC approach with ETo, at the time of satellite overpass over the AID.

3.2 Linear Regression Analysis

In this study, linear regression analysis has been applied to assess the relationship between ETa-METRIC and ETa-EEFlux over the study area (Table 2). The comparison between ETa-METRIC and ETa-EEFlux was drawn through a scatter diagram over the study area (Figure 4). Similarly, we applied the same method to find the linear relationship between ETo and ETo-EEFlux, ETo with ETa-METRIC and ETa-EEFlux, and calculate RMSE for each linear model as shown in Table 2. As seen

in Table 2, the agreement found between ETa by METRIC and EEFlux, and ETo by the FAO-Penman-Monteith with ETa through METRIC model and EEFlux are considered a good indicator of strong correlation and similarity in algorithm performance between EEFlux and METRIC. A strong correlation was found between ETo and ETa by the METRIC with R^2 and slope close to 1 and RMSE value of 0.74 if compared to the relationship between ETo with ETa-EEFlux (Table 2).

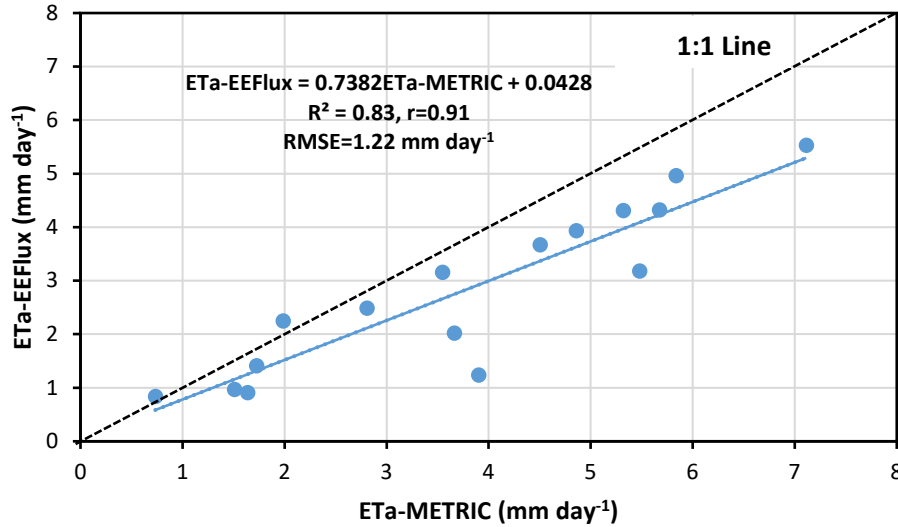


Fig. 4. Comparison between ETa-EEFlux and METRIC models for agricultural fields located in AID in the 2020 water year.

Table 2. Performance statistics of ETa by the METRIC model, EEFlux, and ETo by the FAO-Penman-Montieth over the study area.

	Linear Model	RMSE (mm day ⁻¹)	R ²	r
ETa-METRIC and ETa-EEFlux	ETa-EEFlux = 0.7382* ETa-METRIC + 0.0428	1.22	0.83	0.91
ETo and ETo-EEFlux	ETo-EEFlux = 0.979* ETo + 0.3583	0.73	0.88	0.93
ETo and ETa-EEFlux	ETa-EEFlux = 0.7023*ETo + 0.0679	1.42	0.77	0.88
ETo and ETa-METRIC	ETa-METRIC = 0.9142*ETo + 0.1798	0.74	0.86	0.93

4 Conclusions

This research presents the first attempt to compare the ETa by the EEFlux and the METRIC model with ETo in the study area using RS data (Landsat 7 and Landsat 8) coupled with local and global climatic variables during the 2020 water year. EEFlux results show a good agreement with METRIC for the entire study area. In addition, a strong correlation was found between ETo with ETa by the METRIC model as compared to the relationship between ETo with ETa-EEFlux. It can be concluded that ETa maps generated by the METRIC model and EEFlux can be used in hydrological modelling

practices, the development of water budgets, and agricultural water management at the catchment level.

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Relationships Between Heat Shock Proteins and Yields in Cattle

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Abstract. The temperature, which has been rapidly increasing recently with global warming, causes negative effects on agricultural areas, including the livestock sector. Heat stress resulting from hot and humid environments has negative effects, including on animal performance such as live weight, average daily live weight gain and growth rate. Among farm animals, dairy cows are highly sensitive to high temperature and humid environments, which have a significant impact on milk production, productivity and reproductive performance. The present review is an attempt to signify the importance of heat shock proteins in livestock adaptation during heat stress. The cellular and molecular responses in livestock are very crucial as it may lead to identification of confirmatory biomarker for heat stress in livestock. Thermo-tolerant gene expression and elevated heat shock protein (HSP) levels are observed to be the ultimate response through which the cell survives the heat stress. The HSPs have chaperonic activity ensuring the folding, unfolding and refolding of stress-denatured proteins. The components of heat shock response include heat shock factors (HSFs), heat shock element (HSE) and HSP.

1 Introduction

The temperature, which has recently increased rapidly with global warming, still continues to cause deterioration in agricultural areas, including the livestock sector. High temperature and humidity cause significant losses in the productivity of farm animals. Heat stress resulting from hot and humid effects has adverse effects on animal performance, including body weight, average daily gain and growth rate. Among farm animals, dairy cows are highly sensitive to high temperature and humid environments, which have a significant impact on milk production, productivity and reproductive performance [1].

According to data from the World Meteorological Organization, global temperatures are expected to rise between 3 °C and 5 °C this century [2]. Researchers stated that by 2050 most of the world will have median temperatures that are warmer than recorded temperatures in summer [3]. Accordingly, they determined that heat stress days/year (temperature-humidity index, THI > 68) increased from 5 to 17 over a 30-year period in Hungary [4]. Some researchers also state that under global warming scenarios, heat stress on high-yielding dairy cows will be an increasing concern for dairy producers in Europe [5]. It emphasizes the necessity of developing appropriate adaptation strategies to minimize the negative effects of temperature increase on livestock in the Mediterranean basin [6]. It has been stated that in the future the number of days exceeding the THI threshold value in the southern regions of the United Kingdom may increase from an average of 1-2 per year to over 20 per year by 2100 [7]. Increased milk yield makes cows more sensitive to heat stress; Therefore, it has been reported that heat stress will become a significant problem even if there is no climate change [8].

One of the main factors limiting the development of animal production in tropical regions is climatic conditions. Heat stress is directly related to animal welfare, growth, reproduction and health in cattle. Adaptation mechanisms differ between cattle breeds. Due to their long-term adaptation to tropical climates, *Bos indicus* breeds are better adapted to regulate body temperature in response to heat stress than *Bos taurus* breeds. Thermoregulation is the balance between heat production and heat loss mechanisms responsible for maintaining a relatively constant body temperature when animals undergo morphological, physiological and genetic changes under adverse thermal conditions [2].

It has been reported that when THI increased from 72.1 to 83.6 in subtropical regions, the daily milk yield of Holstein cows decreased by an average of 0.88 kg/day [9]. Dairy cows with high productivity levels lose the ability to regulate body temperature at relatively low air temperatures of 25–29 °C. It has been shown that high-yielding cows are much more sensitive to heat stress than low-yielding cows. It has been suggested that the thermoregulatory physiology of dairy cattle has changed due to intense selection for milk production. Cows that produce more milk have larger body size and larger gastrointestinal tracts that allow more feed to be digested. This results in more metabolic heat and reduces the cow's ability to maintain normal temperature under heat stress conditions. He concluded that milk yield, feed consumption and metabolic temperature increase shift thermo-neutrality to lower temperatures [10].

It has been stated that an increase in daily milk yield from 35 kg/day to 45 kg/day leads to a higher

sensitivity to thermal stress and reduces the threshold temperature for heat stress by 5 °C [11].

Considering that heat stress affects the feeding behavior of dairy cattle, it is assumed that the susceptibility of dairy cows to metabolic disorders (acidosis/ketosis, etc.) may also be affected [12]. At the same time, heat stress is associated with changes in milk composition, somatic cell counts (SCC) and mastitis frequencies. In addition to these negativities, heat stress causes a significant loss of profits between \$897 million and \$1500 million per year in the United States. [13].

Biomarkers are substances that indicate biological states or are indicative of a change in protein state in gene expression. Such markers are used to evaluate animal husbandry's adaptation to stress conditions. Biological markers are used to identify cattle with high genetic value in terms of economic characteristics. Molecular markers are used as reference points in breeding to more accurately determine genetic potential, detect hereditary defects, and create appropriate hybridization programs. Therefore, taking care of the general improvement in animal species, its use greatly helps. Selection of heat-resistant animals, effective propagation of the expansion of herds at high environmental temperatures. It is known that Bos Indicus breeds have more heat tolerance than Bos Taurus breeds. Systems and use of heat-tolerant genotypes in cattle are a major concern in a climate scenario that could have major heat impacts on livestock [13].

2. Heat Shock Proteins (HSPs)

It is now understood that events occurring at the cellular level play an important role in the adaptation of living things to their environment. In this sense, "heat shock proteins (HSPs)", also called stress proteins, constitute the topic that is still being understood. HSPs are a group of proteins found in all living things and cells. The most prominent response to heat stress is a family of proteins called HSPs, which were first discovered in cells associated with high fever [15].

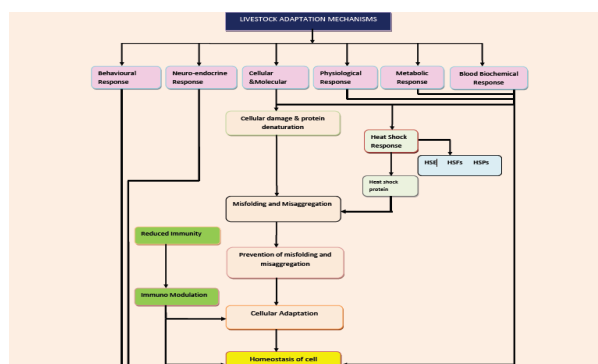


Fig. 1. Adaptation of farm animals [13].

2.1 Cellular Responses to Heat Stress

Cellular homeostasis is achieved by balancing the net growth and death rate. Cells cope with adverse conditions by upregulating certain groups of genes and other perturbations. One of the main consequences of heat stress is protein damage, leading to perforation of unfolded proteins. To achieve this, it increases the expression of chaperone proteins that help refold misfolded proteins and alleviate protein aggregation. A set of genes that are activated under adverse conditions encode HSPs. By helping to stabilize partially unfolded proteins, HSPs assist in the assembly of proteins across intracellular membranes. It is the response of cells to thermal disturbances and the repair or destruction of damaged proteins [17].

2.2 Types of heat shock protein

Based on molecular weight and biological functions, HSPs are classified into HSP 110, HSP100, HSP90, HSP70, HSP60, HSP40, HSP10 and minor HSP families, and their thermotolerance development is mainly associated with HSP70 and HSP90 in bovine species. HSP70, namely HSP70-1 and HSP70-2, are reported to be the most abundant and temperature sensitive [13]. HSPs are multigene families ranging in molecular size from 10 to 150 kDa and are found in all major cellular compartments. They allow cells to adapt to gradual environmental changes and are considered to play important roles in environmental stress adaptation and thermal homeostasis [14].

2.3 Properties of heat shock protein

Thermo-tolerant gene expression and elevated HSP levels are observed to be the cell's ultimate response to sustain the action of HS, making it a perfect biomarker for this condition. HSP is one of the most abundant cellular proteins, also under non-stress conditions. One of the primary ways scientists around the world determine the severity of heat stress (HS) is through the expression of HSP. Overexpression of HSPs protects against hyperthermia, circulatory shock and cerebral ischemia during extreme temperatures (heat stroke); this demonstrates the central role of HSP in cytoprotection. HSPs have chaperonic activity that enables the folding, unfolding, and refolding of proteins denatured by stress. Hydrophobic protein sequences released by denaturation bind to HSPs that would otherwise interact with other neighboring proteins, resulting in loss of protein function. Thermotolerance is defined through genomic studies in both beef and dairy cattle as a more quantitative trait influenced by genomic regions in the target gene that are important for thermoregulation [13].

2.4 Relationship of heat shock proteins to the immune system

Glucocorticoids modulate the activation of "T" cells by directly interacting with NF κ B transcription frequency as well as proto-oncogene (FYN) and lymphocyte-specific protein tyrosine kinase (LCK) compartments. This effect is intensified by glucocorticoid-induced leucine zipper (GILZ), which can also inhibit NF κ B. Additionally, GILZ disrupts mitogen-activated protein kinase (MAPK) pathways. In this way, glucocorticoids affect the proliferation of T cells. However, some studies on PBMC, focusing mainly on T lymphocytes, have been performed in vitro and HS has been simulated by incubating them at a higher level. The impact on changes in cortisol in this species is not taken into account. However, it has been explained that increasing the incubation temperature increases HSP synthesis. Additionally, expression of HSPs such as HSP70 and HSP90 (as shown in PBMC) shows in calves exposed to heat stress. These proteins are chaperones that have a protective role against stress, mainly by maintaining protein folding.

Expression of HSP is induced during stress through heat shock transcription factor 1 (HSF1). Glucocorticoids can modulate HSP expression, for example, by binding HSP70 and HSP90 to their receptors. When "T" can, the effect of HSP70 activation is suppressed due to the potential use of contaminating recombinant proteins, but HSP70 appears to negatively terminate "T" responses to a variety of stimuli. A study has shown that HSP70 can interfere with NF κ B-dependent signals. However, peripheral blood mononuclear cells (PBMC) from high-producing cattle present higher HSP fractions and greater cell proliferation under heat stress (HS) compared to the control group [15].

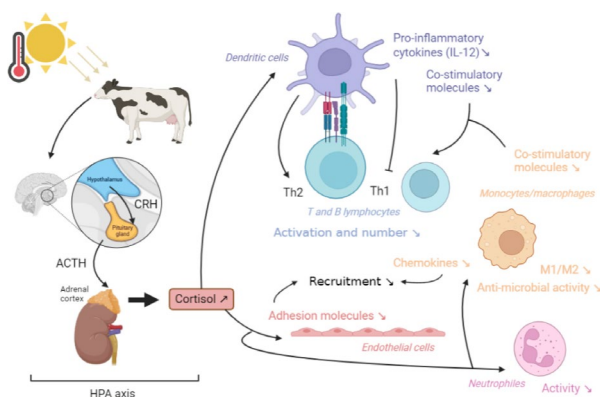


Fig. 2. Possible mechanisms linking heat stress, cortisol secretion, and immunosuppression. CRH = corticotropin-releasing hormone; ACTH = adrenocorticotropic hormone; HPA = hypothalamic-pituitary-adrenal; IL-12 = interleukin 12; Th1, Th2 = helper T-cells of type 1 and type 2; M1, M2 = macrophage phenotypes M1 and M2. [15].

3. Heat shock proteins in cattle

HSPs play an important role in an animal's metabolism, and changes in their expression can result in amino acid oxidation, increased glucoses, decreased fatty acids metabolism, and metabolism activation. The HSPD1 gene encodes the HSP60 protein, plays an important role in the immune response through the induction of inflammatory response, acts as an immune complement agent and biomechanical. The HSP60 protein also helps many newly synthesized proteins reach their native form and allows the correct folding of denatured proteins under stress conditions. HSPA1A encodes the HSP70 protein, which is involved in the regulation of cell proliferation, heat tolerance and apoptosis. HSP90 protein, encoded by the HSP90AA1 gene, is a heat shock protein that is abundant and conserved in eukaryotic organisms. It is very important for adaptation to stress, temperature tolerance, protein amounts, signal distribution and antiapoptotic effect in mammals. Differential expression of HSPs under thermal stress may partially explain the relative stress tolerance of *Bos indicus* compared to *Bos taurus* cattle breeds [2].

Bos indicus cattle survive and perform better under heat stress than breeds adapted to temperate conditions or their crosses due to the high prevalence of the heat shock protein gene. Genetic differences in thermotolerance at the physiological and cellular level have been documented by numerous studies on the *Bos indicus* and *Bos taurus* cattle breeds. At the cellular level, mammals respond to heat stress by transcriptional activation of a set of proteins known as heat shock proteins (HSPs). Among the members of the HSP family, HSP70 and HSP90 are the most abundant proteins in eukaryotic cells. HSP90 act as important molecular chaperones that are constitutively expressed as a result of heat or stress induction [16].

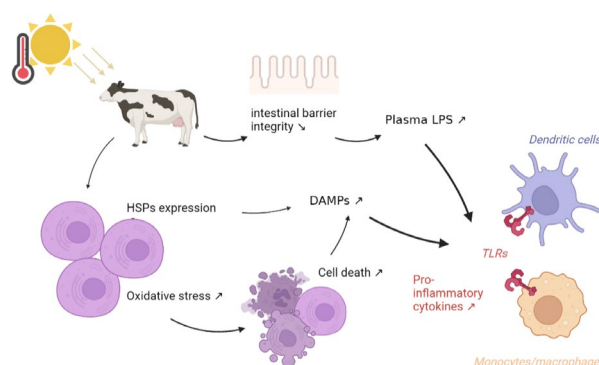


Fig. 3. Possible mechanisms linking heat stress and proinflammatory cytokine production. HSP = heat shock protein; DAMP = damage associated molecular pattern; TLR = toll-like receptor [15].

Conclusion

Environmental changes and advances in nutritional management partially alleviate the impact of heat stress on animal performance during warm seasons. However, long-term strategies need to be developed for adaptation to climate change. Differences in thermal tolerance that exist between cattle species provide clues or tools to select heat-tolerant animals using genetic tools. The cellular response is one of the primary pathway by which Livestock tries to cope up with the heat stress challenges. This is the pathway that helps the cattle to survive the stress condition. the end product of this pathway is the synthesis and release of HSPs. In this context, the use of molecular markers for cattle species that are sensitive to environmental changes can be used as a reference point in breeding for identification, manipulation and crossbreeding to improve genetic potential.

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Cooperative Knowledge Level and Expectations of Livestock Breeders in Mountain Villages of Adana and Mersin Provinces

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Abstract. In this study, we will try to determine the perspectives of growers living in mountain villages on cooperatives and their expectations from the cooperatives. This research was conducted as a survey with 80 breeders engaged in animal husbandry in Adana and Mersin mountain villages between March and July 2023. Research survey forms were prepared with survey questions not exceeding 20 minutes. When asked what is the most important thing they pay attention to in the cooperative, 45% answered the question of the cooperative's activities to date. Which of the following would bother you the most in a cooperative you are considering becoming a member of? 75% responded to the question by saying corruption. Among the 27 questions asked about the participants' perspectives on cooperative management, only 5% said they strongly disagree with the question "I do not have difficulty in supplying quality, cheap, timely and reliable raw materials to my business", and the rate of those who said they disagree with 13 questions ranged from 5% to 40%. Respondents to the survey answered 75% of their most important expectations from the cooperative by saying "fairness and transparent management in management."

1 Introductions

The number of cattle in Turkey will be 17,023,791 in 2022; The number of small cattle is 56,265,750. Despite this animal potential, the fact that live animals and animal products are imported increases the controversy. At this point, the situation of the growers and the need for organization are clearly expressed, but the level of organization of the growers and the success level of the existing organizations are also insufficient. The most important reasons for the decline in livestock farming in recent years are the high input costs of livestock enterprises and the fact that breeders have come to the point of giving up production because they cannot make a living from animal production. Preventing these negativities reveals the need for growers to reduce their input costs and improve their marketing opportunities to increase their income. Today, it is thought that the number of cooperative partnerships worldwide is around one billion. According to the 2013 World Cooperative Database Report; It is stated that the total sales transactions of 2032 cooperatives in 56 countries are 2578 billion dollars [1].

Cooperatives are a globally accepted organizational model due to their contributions to the economy, and are an important tool for growers, especially in product marketing and input supply. Cooperatives, based on solidarity, strengthen social solidarity and integration, allowing people to become more economically independent and to use the country's resources more effectively and consciously. Thus, it contributes to the elimination of imbalances in income distribution and the establishment of social solidarity and tolerance [2].

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Cooperatives provide favorable conditions to their partners in the market for livestock products and production inputs. Because the majority of livestock

enterprises in Turkey consist of small-scale family enterprises [3]. This situation causes the producer to not be able to plan the production amount and ensure price stability on his own in the face of the intense supply of the market, and as a result to make a loss, and likewise, in the face of intense demand, he cannot raise the price alone and cannot receive the reward of his labor [4]. By training their partners on technical issues such as breeding, breeding, product processing and production, cooperatives provide technological developments and advances in animal production to members in a shorter time, resulting in increased efficiency and cost savings [5;4].

The functionality of the economic, social and perhaps political benefits that Turkey expects from organization in animal production depends on the economic, organizational and legal framework of organization being provided with a solid and healthy structure. One of the most important points in this process is that members truly believe in the benefits of cooperatives and voluntary participation is essential [6]. Organization in general and cooperatives in particular become an important tool of economic development [5]. In his research in England, [7] determined the degree of commitment of farmers to cooperatives by testing a number of socioeconomic criteria. In the research, it was determined that the commitment of older farmers whose enterprise size was below the average was higher than that of young farmers whose enterprise size was above the average.

[8] determined that 81.4% of agricultural enterprises were in debt, 20% of these debts were from organized credit sources and 80.0% were from unorganized credit sources. [9] determined that farmers were not aware of cooperatives, and the reason for this was that cooperative education studies were neglected. [10] in his study titled "A Research on the Development Possibilities of Dairy Cattle Breeding in Ödemiş District

of İzmir Province"; The current situation and development opportunities of dairy farming in Ödemiş district of İzmir province were revealed, and in the study it was stated that the most important problem of dairy farmers in the district is the lack of organization. [11] in their research titled "The Role of Cooperatives in the Development of Animal Production: The Example of Kırklareli Central Erikler Village Agricultural Development Cooperative"; It has been concluded that the age, income of the member operator of the cooperative, the amount of milk delivered to the cooperative, reading publications about cooperatives and finding the cooperative successful have a positive effect on the realization of the members' expectations from the cooperative.

It has been observed that the members' experience in animal production and their failure to read the cooperative articles of association before becoming a member of the cooperative negatively affect the realization of the members' expectations from the cooperative.

[12] it is emphasized in the research that cooperative partner relations are weak and self-help awareness among growers is not formed. [13] determined that the partners lack cooperative knowledge and have a weak interest in cooperatives, while cooperatives are effective in providing agricultural inputs.

[14] Compared the business structures and activity results of egg farming enterprises that are partners and non-partners of cooperatives and reports that cooperative growers provide inputs at lower prices than non-partners and the price of eggs they receive is higher. In the research conducted by [15] in two forest villages of Western Anatolia, the social and economic structures of two villages with a successful and unsuccessful Village Development Cooperative were compared and the characteristics of the farmers participating in the cooperatives at different levels in the two villages were determined. In the research; It has been stated that there is no difference between those who participate in cooperatives at different levels in terms of age, professional experience, family size, type of authority in the family, education level, level of adoption and application of modern agricultural technologies and awareness level of cooperatives, however, it has been revealed that there are significant differences in terms of social status, level of modernization and level of social participation.

[16] To cooperative partners; It was determined that it contributed 4.54% - 16.67% in input supply and 12.47% in milk prices, and also increased producer income by 61.36%. [17] In his research titled "The Effects of Cooperatives on Dairy Cattle Breeding Enterprises in Circassian District", conducted a survey in 30 cooperative partners and 47 non-cooperative dairy cattle enterprises. According to the results of the research, net profit, pure revenue and profitability rates were determined to be higher in dairy cattle farms that are partners of the cooperative than in dairy cattle farms that are not partners of the cooperative. However, growers' awareness of cooperatives makes a significant difference in organizations providing the expected

benefits. In this study, it was aimed to determine the perspectives of growers living in the mountainous parts of Adana and Mersin provinces on cooperatives and their expectations from the cooperatives.

2 Material and Method

This research was conducted as a survey with 80 breeders engaged in animal husbandry in Adana and Mersin mountain villages between March and July 2023. Mersin Province, located within the Mediterranean Basin, constitutes approximately 2% of Turkey's total surface area with a surface area of 1,585,300 hectares (<http://www.mersin.gov.tr/tarim>). Agricultural production is carried out in 21% of the province's surface area (329,666 hectares). In terms of live animal value, Mersin province ranks 24th with 3.4 billion TL. The number of livestock in Adana varies according to the geographical situation, climatic conditions and agricultural character of the province. Since all areas in the plain parts are devoted to cultivation, mostly livestock farming is done. Livestock and poultry are raised in places close to the city center, and sheep and goats are kept in mountainous and forested areas (<https://adana.tarimorman.gov.tr/>). When we look at the Adana province in general, the highest increase was realized in cultured cattle with an increase rate of 344% in the last 5 years of data. There was a 47% increase in hybrid cattle and a 6% increase in domestic cattle. There has been a 67% decrease in the number of buffaloes in the last 5 years. When we look at the Adana province in general, goats have made the highest progress with an increase of 181% in the last 5 years of data. There was a 51% increase in sheep (local). There has been a 36% decline in the number of sheep (merino) in the last 5 years. Throughout Turkey, there has been an increase of 47% in the number of goats, 13% in sheep (domestic) and 50% in sheep (merino) numbers.

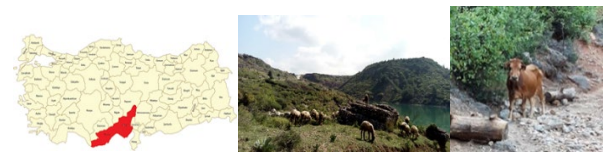


Fig.1 Location and images of the provinces where the study was conducted

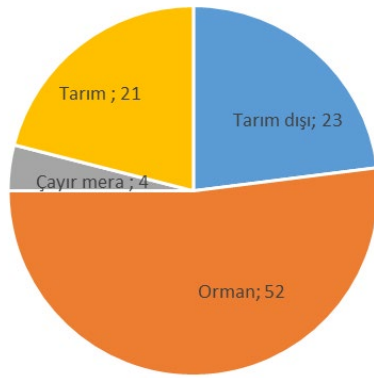


Fig.2 Mersin province land asset distribution (%) (<http://www.mersin.gov.tr/tarim>, 2023)

The population of Mersin province is 1,916,432 people according to 2022. This population consists of 958,642 men and 957,790 women. The population of Adana increased by 10,733 compared to the previous year. The population of Adana is 2,274,106 by 2022. This population consists of 1,137,455 men and 1,136,651 women.

There are a total of 164 cooperatives in Adana province, including 129 Agricultural Development, 23 Irrigation Cooperatives, and 12 Aquaculture Cooperatives, which are still continuing their legal activities. There was 1 cooperative establishment within the 12-Month Period of 2013.

In Mersin province, there are 241 active cooperatives (28,829 number of partners), 66 inactive cooperatives (4,617 number of partners) and a total of 307 cooperatives (33,446 number of partners).

The main axis of the research was determined on a voluntary basis from people engaged in animal husbandry in mountain villages. The surveys prepared for this purpose were applied through face-to-face interviews. In order to meet the research objectives, the research survey forms were arranged under subheadings including questions about socio-demographic structure and cooperative membership, perspective on the cooperative and expectations from the cooperative, and the survey questions were arranged in a manner not exceeding 20 minutes. The prepared questions were first applied to a group of volunteers, and after the clarity of the questions was determined, the necessary corrections were made and applied to the target audience.

The results of 80 participants who responded to the surveys were evaluated using the SPSS (for Windows 6.01) statistical program.

2. Findings

The distribution of the answers given to the survey regarding age, gender and education status of the growers living in the mountain villages of Mersin and Adana provinces regarding their perspectives on

cooperatives and their expectations from the cooperatives are summarized in Table 1.

Table 1. Distribution of answers given to the age, gender and educational status of the research participants

Gender	Number	%	Age	Number	%
Female	16	20,0	26-35	8	10,0
Male	64	80,0	36-46	32	40,0
			47+	40	50,0
Education	Number	%	Cooperative Membership	Number	%
Primary School	4	5,0	Exist	8	10,0
High school	12	15,0	Absent	72	90,0
Secondary school	36	45,0			
University	28	35,0			

80.0% of the participants in the research are male, 50% are 47 years old and over; It is understood that 45% are secondary school graduates. It is interesting that 90% of the survey participants do not have cooperative membership.

Researchers state that the age of the partners has a significant and negative impact on partner-cooperative relations at the 10% significance level and that young farmers have more relationships with their cooperatives. However, the fact that only 10% of the 26-35 age group is considered young in this study and the lack of cooperative membership may affect the results [18].

In a research titled "Analysis of Factors Affecting Cooperative Membership in Cattle Enterprises: Example of Thrace Region"; In his study on the factors affecting cooperative membership in cattle enterprises, it was determined that the producer's age, experience, income earned outside of livestock farming, the number of animals he owns and the amount of support he received were significantly effective in breeders becoming members of the cooperative [19]. They state that farmers' education levels, their participation in agricultural training and their involvement in cooperative management effectively determine their level of knowledge about cooperatives [20]. Although 45% of the growers participating in the research were secondary school graduates and 35% were college or university graduates, they viewed the cooperative negatively, suggesting that regional differences and negative experiences were effective. In addition, the result of the survey conducted by the researchers from the western regions where animal husbandry is highly developed and from the cooperative partners affects the result [20]. In our study, the fact that 90% of the growers do not have any cooperative membership supports this finding.

The distribution of land holdings and animal numbers of the survey participants is summarized in Table 2. It has been stated that breeders also have beehives and poultry in addition to these animals, but they are not on a commercial scale.

Table 2. Distribution of survey participants' land holdings and animal numbers

Land asset (Da)	Number	%	Forage Crop Planting Area	Number	%
0-2	12	15,0	No	56	70,0
5-10	40	50,0	1,00	4	5,0
30	20	25,0	Unanswered	20	25
50	4	5,0			
5000	4	5,0			
Number of cattle	Number	%	Number of small cattle	Number	%
No	56	70,0	8,00-50	9	45,0
7,00	4	5,0	51,00-100,00	2	10,0
10,00	4	5,0	101-200	2	10,0
42,00	4	5,0	201-400	3	15,0
70,00	4	5,0	400+	4	20
200+	8	10,0			

It was understood that 50.0% of the participants of the research have 5-10 acres of land, 70% do not have a Forage Crop Planting Area, 70% do not have cattle, but all of them have small cattle. Livestock farming in the region is generally carried out in a small and scattered manner as a family business under primitive conditions.

It is stated that capital availability and high productivity are two very important factors in the participation of small-scale growers in the market [21].

The distribution of the answers given by the respondents regarding their perspectives on cooperative management is summarized in Table 3.

Table 3. Survey participants' perspectives on cooperative management

Who should have cooperative management?	Number	%
State	48	60,0
Notables of the region	0	0
Private sector	12	15,0
State + Private sector	16	20,0
My relatives	4	5,0
What is the most important thing you pay attention to in the cooperative?	Number	%
Unanswered	4	5,0
Sayings of people around me	12	15,0
Activities of the cooperative to date	36	45,0
Contribution of the cooperative	28	35,0
I do not know the cooperative members and managers.	0	0
My relatives' membership status in the cooperative	0	0
The issue that bothers you the most in the cooperative?	Number	%
Unfair management	12	15,0
Corruption	60	75,0
People I don't like becoming members of the cooperative	4	5,0
I do not understand that I cannot benefit from the cooperative	0	0
I have to pay for cooperative membership	0	0
Unanswered	4	5,0

To the question of who should manage the cooperative, 60.0% of the participants answered by saying that it is the state. When asked what is the most important thing they pay attention to in the cooperative, 45% responded by saying the activities of the cooperative to date. Which of the following would bother you the most in a cooperative you are considering becoming a member of? 75% of them answered the question by saying corruption. The high rate of this answer, at 75%, can be explained by the negative experience and feelings of the growers. This situation can be considered as a reason for the breeder to be cold towards cooperative membership.

They report that education level, participation in agricultural training and taking part in cooperative management are effective factors on considering knowing cooperative principles [20]. In their study titled Analysis of partner-cooperative relations in agricultural development cooperatives in Samsun Province, they report that agricultural experience, partnership duration and reading the Cooperative Law No. 1163 positively affect the relations between partner-cooperatives, while the age of the partners negatively affects the relations between partner-cooperatives [18].

Table 4. Survey participants' perspectives on cooperative management

Questions	Absolutely I agree	I agree	I'm undecided	I do not agree	I strongly disagree
I believe that cooperative formation will contribute to our regional animal husbandry.	10	70,0	20,0		
I think that growers who produce cooperatively have more advantages than those who produce individually.	15	70,0	15,0		
I think that cooperative formation will contribute to the rise of production standards.	5	70,0	25,0		
I believe that cooperatives will contribute to me in terms of technical information and documents during the production process.	15	40,0	45,0		
I am fully aware of the duties and services of cooperatives.	15	40,0	45,0		
One of the most important services of the cooperative is to provide consultancy services to its partners.	10	55,0	35,0		
One of the most important services of the cooperative is the supply of cheap and	10	55,0	35,0		

high-quality raw materials to its partners.					
One of the most important services of the cooperative is to provide long-term and low-interest loans to its members.	10	50,0	40,0		
I have no difficulty in supplying quality, cheap, timely and reliable raw materials to my business.	25,0	40,0	15	15	5

Questions	Absolutely I agree	I agree	I'm undecided	I do not agree	I strongly disagree
I can access all kinds of information, documents and documents that will contribute to my production whenever I want.	15	70,0	15		
The main reason why I joined the cooperative is to benefit from the credit opportunities it provides to its partners.	5	55,0	25,0	15	
I do not have any difficulties in marketing the products I produce.	5	45,0	10	40,0	
I think that the products I produce find buyers in the market at the price they deserve.	10	50,0	25,0	15	
I think the products I produce are much better than the products packaged and sold in the market.	35	45,0	20		
By selling the products I produce, I can keep my family living at the standards they deserve.	15	45,0	10	30	
I believe that I received financial reward for the effort I spent in the production process.	25	35,0	20	20	
It makes me happy to see the products I produce sold on market shelves.	30,0	45,0	20	5	
I preserve the products I produce in a way that does not pose any risk to food safety until I put them on the market.	45,0	35,0	15	5	
I've heard the word Agricultural Sales	15	60	5	15	

Cooperative at least once before.					
I fully know the duties and services of Agricultural Sales Cooperatives.	20	40,0	25	15	

Questions	Absolutely I agree	I agree	I'm undecided	I do not agree	I strongly disagree
I believe that an agricultural sales cooperative to be established in our district will contribute to regional animal husbandry.	15	70	10	5	
The prerequisite for a successful cooperative is that its partners trust each other.	15	70	15		
In order for me to trust a cooperative and want to join it, I must get to know the cooperative management.	30,0	50,0	15	5	
The sustainability of a cooperative depends on gaining the trust of its members.	25	45	30		
Even though I don't trust it, I would like to be a member of a cooperative that I believe will benefit.	20,0	60,0	10,0	10,0	
My most important expectation from the cooperative is justice and transparent management in management.	15,0	75,0	5,0	5,0	
I would like to know what processes my product that I will deliver to the cooperative has gone through, and where it was sold and for how much.	15,0	75,0	10,0		

Questions	Absolutely I agree	I agree	I'm undecided	I do not agree	I strongly disagree
I think the products I produce are much better than the products packaged and sold in the market.	35	45,0	20		
By selling the products I produce, I can keep my	15	45,0	10	30	

family living at the standards they deserve.					
I believe that I received financial reward for the effort I spent in the production process.	25	35,0	20	20	
It makes me happy to see the products I produce sold on market shelves.	30,0	45,0	20	5	
I preserve the products I produce in a way that does not pose any risk to food safety until I put them on the market.	45,0	35,0	15	5	
I've heard the word Agricultural Sales Cooperative at least once before.	15	60	5	15	
I fully know the duties and services of Agricultural Sales Cooperatives.	20	40,0	25	15	

Questions	Absolutely I agree	I agree	I'm undecided	I do not agree	I strongly disagree
I believe that an agricultural sales cooperative to be established in our district will contribute to regional animal husbandry.	15	70	10	5	
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In order for me to trust a cooperative and want to join it, I must get to know the cooperative management.	30,0	50,0	15	5	
The sustainability of a cooperative depends on gaining the trust of its members.	25	45	30		
Even though I don't trust it, I would like to be a member of a cooperative that I believe will benefit.	20,0	60,0	10,0	10,0	
My most important expectation from the cooperative is justice and transparent management in management.	15,0	75,0	5,0	5,0	

I would like to know what processes my product that I will deliver to the cooperative has gone through, and where it was sold and for how much.	15,0	75,0	10,0		
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From Table 4, the rate of those who responded that they are fully aware of the duties and services of cooperatives was determined as 40%. The rate of those who say that they think that the products I produce find buyers at the price they deserve in the market is 60%, while the rate of those who say the opposite is 40%. The findings made at this point indicate that these differences occur because growers have the opportunity to sell directly and by order in this region. Among the 27 questions asked about the participants' perspectives on cooperative management, only 5% said they strongly disagree with the question "I do not have difficulty in supplying quality, cheap, timely and reliable raw materials to my business", and the rate of those who said they disagree with 13 questions ranged from 5% to 40%. . 75% of the respondents answered that they agree with the question "My most important expectation from the cooperative is fairness and transparent management in management."

In the research, they state that the first purpose of farmers in becoming partners in the cooperative is to provide input, and that the cooperative principle that farmers know best is "Cooperation between cooperatives", while the principle that they know least well is the principle of "Autonomy and independence" [20]. In another study, when the effect of the agricultural development cooperative partnership on the agricultural income of the partners is questioned, they report that the biggest income increase is in the partners with strong relationships [18].

Conclusion

In sustainable economic development, everyone from producers to consumers must be involved in the process. In this sense, taking into account the reservations, holding training and information meetings regularly, transparently and with wide participation, and experiencing successful examples through on-site examination will yield beneficial results.

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