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BOOK OF ABSTRACTS

The Fourth International Symposium on Agricultural Engineering



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ISAE-2019
BOOK OF ABSTRACTS

Univerzitet u Beogradu – Poljoprivredni fakultet
IV MEĐUNARODNI SIMPOZIJUM O POLJOPRIVREDNOJ TEHNICI
(The Fourth International Symposium on Agricultural Engineering)
"ISAE 2019 - Book of Abstracts"

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PREFACE

After the three successful International Symposiums on Agricultural Engineering – ISAE, that were held in Belgrade at the Faculty of Agriculture, thanks to our colleagues we are organizing The Fourth International Symposium on Agricultural Engineering – ISAE 2019. Together with the University of Basilicata, School for Agricultural, Forestry, Food and Environmental, Sciences (Potenza, Italy), University of Sarajevo, Faculty of Agricultural and Food Sciences (Sarajevo, Bosnia and Herzegovina), Aristotle University of Thessaloniki Faculty of Agriculture, Thessaloniki (Greece), University of Belgrade, Faculty of Mechanical Engineering, Belgrade (Serbia), Vinča Institute for Nuclear Science, Belgrade, Serbia, Serbian Soil Tillage Research Organisation, Belgrade, Serbia, Institute of Agricultural Economics, Belgrade, Serbia and thanks to the Ministry of Education, Science and Technological Development, Republic of Serbia, support of the AMAPSEEC, RebResNet and BENA, and sponsor and donors, we have managed to organize the presentations of the 44 papers that were submitted to the Scientific Committee of the ISAE 2019 Symposium. We have arranged them in to four sections and categorized them as Original scientific papers, Scientific review papers, Firs (short) communications, Case studies, Professional (Expert paper) and Popular papers. All papers within the Proceedings of the ISAE 2019 were reviewed by the members of the Scientific Committee and kind assistance of some members of other Conference bodies.

Book of Abstracts of the ISAE 2019 International Symposium is organized in four thematic sections. Section I – Sustainable agriculture and biosystems engineering (20 abstracts); Section II – Soil tillage and agroecosystems protection (7 abstracts); Section III – Energy and energy efficiency in agriculture (15 abstracts) and Section IV – Economics in agricultural engineering (3 abstracts).

We wish to thank to all the authors for their contribution to the ISAE 2019 Symposium and to the all the Institutions, Associations, Universities, Sponsors and Donors for the contribution in ISAE 2019 Symposium organization.

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THE MODELING OF THE FRONT TRACTOR PLATFORM FOR CROP SPECTROMETRY

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Abstract: *This paper presents various methods for detecting changes in the condition of crops. The choice of a suitable method or algorithm for the desired crop scouting is crucial for the success of further analysis of the obtained data. Four methods of spectrometry are presented. Beside hand-held sensors, there are described methods of data capture via drones and satellites. Most of the paper belongs to the use of sensors in the composition of agricultural machines. This type of scouting is the most effective when it is carried out simultaneously with the distribution of mineral nutrients and crop protection. The tractor platform, on which the sensors are located, can be either a worn type or a connecting type that allows connection to a tractor in three-point in the conventional way. Except for the aforementioned ways, the sensors can be placed on the roof of the tractor or directly on the working machines. The process of constructing and modeling the front tractor platform is presented in detail in SolidWorks program. Apart from the construction shown, there is a possibility of changing the platform. All foreseen and feasible variants are presented in this paper.*

Key words: *Crop scouting, multispectral sensor, platform design, SolidWorks*

**FLIGHT HEIGHT OF UAS AND OVERLAP OF
IMAGES BY MULTISPECTRAL CAMERA
OPTIMIZATION FOR CROP SCOUTING**

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Abstract: *When preparing a crop scouting mission using UAS, two parameters are set: flight height and overlap of images. In practice, crop scouting is most often done at altitudes of 70 to 100 meters, and the switchover is most often between 50 and 100%. The research question that is dealt with in this paper is whether there is a significant difference in the obtained light reflection indexes and consequently postprocessed vegetation indexes, depending on height and overlap. The flight height of the UAS dictates spatial resolution, and the switching dictates the time resolution of the reconnaissance. The research was carried out on the experimental plot of barley. The missions were consecutive and performed in perfect weather conditions. The sky was clear, and the light was approximately uniform during all missions with variable heights and overlaps.*

Key words: *Crop scouting, UAS, NDVI, maps, overlap, flight height*

INNOVATIVE APPROACH TO TEACHING THROUGH THE IMPLEMENTATION OF A PROJECT BILLETS MAKING MACHINES FOR LAYING FOIL AND PLANTING SEEDLINGS

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Abstract: *Within the Department the Engineering of Biotechnical Systems it came to the idea that students in one subject works on the design process billets making machines for laying foil and planting seedlings. How are constantly measures the relationship between theory and practice which is necessary in an adequate way transfer to students, It was found that students had less practical knowledge and that they sometimes have difficulty applying theoretical knowledge independently. This paper describes the implementation of the real process of designing a machine for making foil layers and seedling planting using the SolidWorks package, with the aim of improving the understanding of materials, theory and practice. Students face multiple challenges at the same time: by mastering the SolidWorks package, by understanding of individual parts and assemblies, production of technical documentation according to standard and the significance of the machine itself in agriculture.*

Key words: *agriculture, practical knowledge, the design process, SolidWorks.*

SMART MACHINES FOR PRECISION AND EFFICIENT FERTILIZING

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Abstract: *Nowadays the increasing of the efficiency of agricultural production and the increasing of crop yields cannot be achieved without modern digital technology and smart machines that are a part of it. With the spread of precision agriculture and the digitalisation next to the power machines the attached equipment is becoming smarter and smarter. Through permanent technological and IT development, it became possible to thoroughly monitor and analyse operating functions and parameters not only for the most important power machines such as tractors, combines and other, but also there are existing solutions for measurement of specific utilisation parameters for other attached equipment. All of these measured and processed data are essential for making well-considered actions related to the production technology and the machine operating. In our work, without completeness, we present smart solutions which are independent from the size of the machine and which are effective tools for the utilization of machines, for the precision machine work. Nowadays, site-specific nutrient application comes to the fore. Thus, accurate determination of the amount of fertilizer applied and precise dosing is essential. With this system cost savings can be achieved through efficient production and avoidance of excess nutrients.*

INO Smart Flow ensures the quality work of the INO FERTI-2 type double-disc mounted fertilizer spreader and the INO VVP 115 vibrational subsoiler with deep fertilizer spreader. The interface to the user is INO SmartAssist

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terminal placed in the cabin of the tractor, which provides all necessary data on the graphic display. User can also change all necessary parameters from tractor cab. Using this smart equipment, the farmer receives necessary information about production technology such as the amount of fertilizer dispensed, the amount of fertilizer in the tank, the speed of work, the size of the cultivated area, the amount of fertilizer that can be used in the tank, the number of hours worked, the battery charge level and the alerts for the machine maintenance.

A common feature of systems described in article is that they can be operated with or without from the tractor's ISOBUS system. The controller can be operated autonomously, using their own system, by the control panel (assistant) which is specially designed for this purpose.

The design of these electrical systems can also be realized by an individual, innovative medium-sized machine manufacturing company, as it is shown in the presented work..

Key words: *smart machines, Precision Agriculture, GPS, data analysing, variable rate fertilizing*

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ANALYSIS OF THE CAUSES OF TRAFFIC ACCIDENTS WITH TRACTORS AND MOBILE AGRICULTURAL MACHINERY IN THE REPUBLIC OF SERBIA

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Abstract: *This paper analyzes the causes of accidents with tractors and other mobile agricultural machines with the possibility of participating in public transport in the Republic of Serbia. The causes and their impact on the consequences related to the number of traffic accidents, as well as their impact on the number of persons who have been casualties in the mentioned accidents were analyzed. Based on the analysis of the causes, it is possible to determine which of the causes is most influential on the number of traffic accidents (with tractors and other mobile agricultural machines) and on the number of people who have been casualties in the mentioned accidents.*

Key words: *causes, traffic accidents, tractor, mobile agricultural machines, Republic of Serbia.*

OCCUPATIONAL CONTACT DERMATITIS IN AGRICULTURAL WORKERS

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Abstract: *Agricultural workers are at increased risk of occupational contact dermatitis (OCD) as long as other handworkers, like painters, builders ,food industry workers etc. It affects workers more often than it is reported. The hands are the most commonly involved organ (80-90%) , even though OCD can present anywhere in the body . Contact dermatitis (CD) accounts for up to 30% of all occupational disease in industrialized nations. CD is the most common occupational skin disorder and represents about 95% of all cases of occupational skin diseases . The impact of this particular disease is vast for both worker's life (personal and professional) and the economy , as it is associated with prolonged sick leaves, increased cost of healthcare, loss of productivity and early job retraining. Allergic contact dermatitis (ACD) is a type IV delayed type hypersensitivity reaction, which means that the worker must first be sensitized to the allergen and develop the symptoms on re-exposure . Some of the most usually reported allergens met in agricultural industry are rubber accelerators , formaldehyde, nickel and methyl-dibromoglutaronitrile (MDGN) . Irritant contact dermatitis (ICD) is the most frequent OCD but it is hard to be distinguished from ACD. Irritants that appear in a rural environment are acids and alkalis. However, ICD may be a result of prolonged use of a tool or gloves, as well as of wet work . Most of the times the clinical presentation is characteristic, but the definite diagnosis is conducted with patch-tests. The preferred stepwise approach is elimination, substitution, engineering control, administrative control of the hazard and personal protective equipment against it. Prevention and early intervention is the key to minimize OCD and improve occupational health.*

Key words: *Occupational Contact Dermatitis, Allergic Contact dermatitis, Agriculture workers, Agriculture work parameters, Protection measurements.*

A REVIEW OF SUPERCOMPUTERS USE IN AGRICULTURE STRUCTURES AND APPLICATIONS

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Abstract: *“Supercomputers“ are computational systems that are used in scientific applications that require the execution of many millions of mathematical operations or the processing of large volumes of data. Because of these requirements, such problems would either be prohibitively long to be completed on a simple desktop or because of limited resources (e.g central memory, storage space) it is not feasible to carry out at all. Supercomputers overcome these constraints using state-of-the-art, state-of-the-art hardware, while taking advantage of computing power from multiple computing units. A supercomputer today is actually a system of hundreds or even thousands of computers (commonly referred to as „nodes“) that communicate with each other using a very fast network and which can cooperatively solve problems at high speed. A supercomputer is a powerful tool for research. A supercomputer today is actually a system of hundreds or even thousands of computers (commonly referred to as „nodes“) that communicate with each other using a very fast network and which can cooperatively solve problems at high speed. A supercomputer is a powerful tool for research. As agricultural structures and applications are getting more complex and their development requires the implementation of many parameters, the need for a more thorough study is required. The use of such powerful computers is therefore necessary to simulate three-dimensional airflows around rural constructions, three-dimensional flows over backward-forward facing step, flood erosion problems, problems of deposition of sludge in river beds and lakes, research on climate change and much more. In this study a review and analysis of the use of such computers in agriculture is presented.*

Key words: *supercomputers, 3d numerical simulation, rural applications*

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GAS EXHAUST EMISSION OF TRACTORS DIFFERNT CATEGORIES

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Abstract. *This work studies four different categories of tractors, with different exhaust norms under real operating conditions in certain field work. It was analysed how different working regime of each of tractors impact on their harmful gas exhaust emission and on which tractor categories that impact is most expessed. The gas exhaust emission will be analysed through nitrogen oxides NO_x, nitrogen dioxide NO₂, carbon monoxide CO, and sulphur dioxide SO₂, mesured with the portable gas analyzer Testo 350.*

Key words: *agricultural tractor, working regime, energy, emissions, environment, ecology*

TECHNICAL ACCURACY OF ORCHARD SPRAYER USED IN INTENSIVE FRUIT AND VINEYARD PRODUCTION IN REPUBLIC OF SERBIA

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Abstract: *The technical accuracy of the machine is a prerequisite for the effective implementation of chemical protection in fruit and grapevine production. The paper presents the results obtained during the control testing of 50 different models of orchard sprayers, with different period of exploitation in growers throughout Serbia that are used in intensive fruit and grapevine production. During the control testing, a large number of parameters were monitored, using standardized methods and test procedures. Comparison of the obtained data was applied to four groups of orchard sprayers (defined by the period of the exploitation). The technical accuracy of the individual orchard sprayer is expressed by the coefficient of the technical correctness (Cta) according to individual marks of the tested parameters of orchard sprayers. Out of the total number of investigated orchard sprayers, 12% of the orchard sprayers are in exploitation for less than three years, while the largest number of orchard sprayers, and 42% is in exploitation for seven years or more. The technical accuracy of Group 1 orchard sprayers was sufficiently high, except for the parameters related to the Measuring regulatory system (Cta = 0.80) and the Nozzles (Cta = 0.86). In Group 2, a decrease in the coefficient of technical accuracy in all parameters was observed with respect to the sprayers from Group 1, which was particularly pronounced for Agitators (Cta = 0.50) and Nozzles (Cta = 0.68). The orchard sprayers from Group 3 are characterized by a low coefficient of technical accuracy for the Nozzles (Cta = 0.37), while Group 4 orchard sprayers have a very low coefficient of technical accuracy in all tested parameters. The level of technical accuracy of the orchard sprayers used in intensive fruit and grapevine production is directly dependent on the period of their exploitation.*

Key words: *control testing, coefficient of technical accuracy, period of exploitation, maintenance of the orchard sprayers, application quality.*

INFLUENCE OF DIFFERENT MILKING SYSTEMS ON HYGIENIC AND MICROBIOLOGICAL QUALITY OF RAW COW MILK

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Abstract: *On majority of farms in Bosnia and Herzegovina milking of cows is performed on mobile and semi-stationary machines, whereas on a small number of farms it is done with stationary machines. Milking conditions in cubicles do not provide satisfactory hygienic conditions in comparison to stationary milking systems. Therefore, the focus of the research was put on establishment of influences of preparation of cow for the milking process, the milking process with different types of systems, and hygienic and microbiological quality of raw cow milk. The obtained results indicate a significantly lower number of micro-organisms in the case of a stationary system ($103,166 \pm 51,291$) in comparison to a semi-stationary ($246,200 \pm 190,047$) and mobile system ($267,500 \pm 235,732$) for mechanized milking. The research also established a difference of contents of microorganisms between average morning ($163,200 \pm 112,718$) and evening ($248,044 \pm 238,051$) milking, where the statistical significance $P < 0.05$. The number of somatic cells with the mobile milking system totaled, $220,400 \pm 228,444$, semi-stationary system $230,600 \pm 215,146$ and stationary system $226,150 \pm 214,445$. The experiment was done with the same cows and balanced feeding. The average number of somatic cells for all three milking systems was of E class and totaled 132,018 SCC/ml. The average number of micro-organisms was outside the E Class and totaled 159,510 CFU/ml. The obtained results lead to the conclusion that the type of milking system affects hygienic quality of raw cow milk, and that it is necessary to invest efforts in education of farmers and better technical equipping.*

Key words: *milking, milk, bacteria, somatic cells, milking system, quality.*

MOVEMENT OF THE SOIL SLICE ALONG THE ROTARY TILLER KNIFE UNTIL REJECTING

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Abstract: *When the tip of the knife achieve the height of the ridge at the bottom of the furrow (h_g) the soil slice is formed, and if the conditions for its sliding with respect to the knife are met, the skating will begin. The dynamics of the soil slice motion, which was presumably located in the middle of the blade, started the relative motion from the resting state by sliding along the blade is analyzed. According to Newton's second law, the relative motion of soil slice along the blade occurs: plastic weight, normal reaction and friction force, as well as transmission and Coriolis inertia forces. The movement of the soil slice across the surface of the knife takes place until the relative coordinate reaches the value of half the width of the knife ($L/2$). At that moment of time when the soil slice rejecting the knife the next phase begins, a slanting shot. The impact the setting angle of the knife γ changing, as a result of the curvature of the blade wings, the length of the relative motion time interval and the relative velocity value at the moment the soil slice is rejected from the blade, is analyzed in detail.*

Key words: rotary tiller, knife shape construction, dynamics, soil slice.

EFFICIENCY OF MECHANISED COLLECTION OF SOYBEAN STRAW

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Abstract: *The importance of soybean (*Glycine max* L.) arises from the quality of its grain (high protein and oil content), so it is one of the most important protein and oil crop in the world. As biomass of agricultural origin is highly acceptable energy source from the environmental point of view, soybean takes part in the production of biofuels, where grain and straw represent raw materials for liquid and solid biofuels. The production of biofuels from grain reduces the amount of grain for food and feed and in recent years attention has been focused to the development of biofuel from the straw. Straw is also an important source of organic matter and has important influence on biological, chemical and physical properties of the soil and should not be considered as waste. The aim of this paper was to determine the actual amounts of straw that can be collected after harvesting soybean using existing mechanization on family farm, round baler with pick-up. The field experiment was set at a location in Velika Barna with three soy varieties, Lucija, Galina and Ika, represented in the crop rotation by domestic farmers. The yield of straw was in the range of 1,824 kg/ha to 2,266 kg/ha and collection efficiency differed between soybean varieties, ranging from 33.3% to 48.9%. The amount of collected post-harvest residues depended on the cultivar, water content of the straw at the time of baling and the construction of combine and baler.*

Key words: *biomass, harvest index, round baler*

THE USE OF A 3D LIDAR SENSOR IN AUTONOMOUS BASED NAVIGATION ON THE FIELD.

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Abstract: *LIDAR sensors provide an efficient way to autonomously navigate robots through various terrain where obstacles can be used as a reference points to avoid them or use them as points that the robot needs to pass. The goal of this work was to test the advantages of using a multi-channel 3D LIDAR sensor (Velodyne VLP 16 a.k.a Puck) to detect this reference points and used them in autonomous navigation mode to drive the robot through two rows of maize. In order to do this two algorithms that were previously developed and were based on the data captured from a two-dimensional LIDAR sensor (Sick TIM310) are now modified to work with multichannel data. The first step is to limit the amount of data captured by the 3D LIDAR sensor, so the unnecessary readings are filtered out based on the height of the points in space. This way some points representing ground are removed, based on the readings of the IMU, depending on the roll and pitch of the robot that changes through the uneven real terrain. The actual points in space that do represent obstacles are then used in the second algorithm that autonomously navigates the robot. The algorithm calculates the offset from the middle of the row depending on the distances of the points on the rows relative to the middle of the row. The results prove that the use of a 3D LIDAR is more efficient if the terrain is not ideal, since the amount of data captured from the obstacles of different heights is higher and therefore more accurate compared to the data of a two-dimensional LIDAR, where the sensor can be tilted to the ground and can detect points on the ground, but not of the obstacles. The adaptation of the previously developed algorithms for two-dimensional LIDAR sensors is therefore possible with the correct hardware and produces a more accurate reading of the environment, needed for successful autonomous navigation.*

Key words: *3D LIDAR, real-time data, autonomous navigation, precise agriculture, navigation algorithm, data filtering*

SELECTION OF OPTIMUM PARAMETERS OF SETTING OF MOTORIZED KNAPSACK SPRAYERS FOR RASPBERRY PROTECTION

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Abstract: *Export of raspberries to the European Market requires controlled application of agro-technology. Winter raspberry protection is of major importance for high and quality yield, which is why proper and quality protection is necessary. On small raspberry fields, application of phytopharmaceuticals is applied with motorized knapsack sprayers. The high-level of use of motorized knapsack sprayers results from its affordable price in comparison to tractor sprayers, bigger range than non-motorized knapsack sprayers, as well as bigger efficiency and effectiveness of work. Farmers on the ground are not familiar with proper handling of this tool, which can result in various unwanted consequences. The aim of the research was to establish optimum parameters of treatment which include speed of movement of the applicator, the position of flow-rate dosing element, quality of protection and loss phytopharmaceuticals in form of drift. The measurements encompassed various speeds of movement of applicator and various positions of flow-rate dosing element. The testing of protection quality was done with water-sensitive papers, which were subsequently analyzed in the GIMP software. The loss of phytopharmaceuticals (drift) was analyzed by using paper towels. The average flow-rate of the nozzle had significant statistical deviations with respect to defined factory norms. The processed measuring results indicate that optimum parameters of setting of motorized knapsack sprayers are 1.20 km/h for the speed of movement of the applicator and position 3 for the flow-rate regulator. Sprayers with such set parameters provided optimum plant coverage and recommended consumption of phytopharmaceuticals. The loss of phytopharmaceuticals (drift) amounted to 84.48 % of the overall amount used.*

Key words: *Motorized knapsack sprayer, raspberry, phytopharmaceuticals, plant protection, water sensitive paper.*

A MODERN SOFTWARE METHODS FOR CORN IRRIGATION

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Abstract: *Increasing global climate change requires the application of modern methods in irrigation of agricultural crops. In this context, the research in this paper was based on the application of modern software and hardware solutions in determining the corn water requirements. Research was carried out at three locations: Srebrenik, Kalesija and Kakanj in Bosnia and Herzegovina. Detailed research of all climate, biological, geographical and soil characteristics was carried out during the vegetation period of 2018 in order to use the results as an input to determine corn water requirements using AquaCrop 6.1 software. In addition to using several software, certain activities were carried out by using an unmanned aerial vehicle (UAV). The corn water requirements during 2018 on three analyzed locations ranged from 405 to 530 mm, the highest value was in Kakanj, and the lowest in Kalesija. When it comes to the monthly level, during almost all months effective rainfall was enough to cover corn needs for the water, the exception is August, when a certain water deficit (56-67 mm) was obtained for all locations.*

Key words: *corn water requirements, smart agriculture, software models, UAV*

ON THE LOSSES OF ALFALFA DURING HAY PREPARATION

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Abstract: *This study is focused to the mass losses evaluation in the process of alfalfa mowing by machine equipped with conditioner. This way, the process can be divided in the two main stages: mowing and chopping. Following the common practice, based on the configuration of production process and machine design, the two kinds of hay losses was measured: losses caused by cutting heights over the optimal value, and those caused by chopping process imperfectness. Obviously, the total loss of hay mass was calculated by simple summation of these two kinds of losses. The minimum evidenced percentage of hay mass losses, caused by an inadequate cutting height, was 1.02% of yield, at the self-propelled machine minimum working speed of 4.76 km/h. higher working speeds of the mowing machine increased the cutting losses up to the maximum value of 1.40% at the maximum mowing speed of 9.95 km/h. The hay mass losses, caused by the imperfectness of the crushing process, expressed an opposite behavior with respect to the mower working speed. This kind of losses ranged from the minimum value of 0.27% at the highest machine working velocity up to the maximum value of 0.39% at the minimum machine speed. The average percentage of total mass lost was 1.54% of hay yield at the average mowing speed of 7.14 km/h.*

Key words: *mowing, losses, alfalfa, cut height, chopping*

FIELD USE AND CALIBRATION OF TWO DIFFERENT TIME DOMAIN REFLECTOMETRY SENSORS

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Abstract: *Time Domain Reflectometry (TDR) is a widely used device for measuring the volumetric soil water content that used irrigation management. Accurate measurement of soil water content is one of the most important factors both in making the right decision in irrigation management and in determining plant water consumption. Soil water content is affected by organic matter, soil texture, and bulk density, so calibration of TDRs in field conditions is necessary. In this study, two different TDR sensors (Buriable Waveguide, 20 cm, Waveguides, 30 cm) used in alfalfa (Medicago sativa) irrigation growing in clay loam soil were calibrated. Experimental data were taken from alfalfa (Medicago sativa) field irrigated with subsurface drip irrigation method in Isparta, Turkey. At the end of the study, there were clear relationships between TDR volumetric water content values and gravimetric samples, in also two probes [$\theta_v = 0.8991 \times \text{TDR} - \theta_v + 3.7951$, ($R^2=0.84$) for Waveguides, 30 cm; $\theta_v = 0.8621 \times \text{TDR} - \theta_v + 2.9332$, ($R^2=0.86$) for Buriable Waveguide, 20 cm]. Our results indicated that “Waveguides, 30 cm” and “Buriable Waveguide, 20 cm” TDR probes are dependable to measure volumetric soil moisture in subsurface drip irrigation condition and could be safely used.*

Key words: *Time Domain Reflectometry, soil water content, irrigation management, sensors, subsurface drip irrigation.*

RESULTS ON THE USAGE OF UAV IN CHEMICAL PLANT PROTECTION

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Abstract: *The usage of UAV - Unmanned Aircraft Vehicle in the precision agriculture creates numerous opportunities for detecting and informing farmers about the current state of cultivated crops, and the quality of the implementation of certain agro-technical operations during production. In recent years, UAV have been used in chemical plant protection, in the application of mineral fertilizers, in the detection of pests, diseases, and other aspects of agricultural production. The importance of the usage of UAV in agricultural production is becoming bigger and more significant, which could, in the long term, affect the more efficient and productive agricultural production, with a significant reduction in the consumption of the inputs of production.*

This study describes two types of UAV used in the chemical plant protection, which were analyzed according to the technical characteristics of the UAV, as well as the precision of the spray coverage of the protective liquid. The precision of distribution of the protective liquid is monitored at different ground speeds and heights during chemical protection. The MG-1 model UAV achieves the best quality of the application of protective liquid at a flight groundspeed of 3 ms^{-1} (largest effective swath of 6.8 m) and a flying height of 2 m (largest effective swath of 7.3 m). The V6A model UAV achieves the best application quality of the protective liquids at a flight groundspeed of 7 ms^{-1} (largest effective swath of 5.8 m), and at a flying height of 2 m (largest effective swath of 5.6 m). The results of the UAV analyzed showed that the uniformity of the application of the protective liquid directly depends on the model of the UAV and its technical characteristics.

Key words: *precision agriculture, application quality, chemical protection, flight ground speed, flying height, tank capacity*

APPLICATION OF MACHINES IN THE PROCEDURE OF DEFOLIATION OF GRAPEVINE

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Abstract: *Modern grapevine production technology involves the implementation of various technological operations, among which grapevine defoliation has an important place. Defoliation is an ampelotechnical measure of removing a certain number of leaves from the cluster zone. Removing the leaves changes the microclimate conditions of the grapevine (light intensity, temperature, humidity, ventilation), which affects the yield, structure of the clusters and the quality of the grapes. Leaves removal can be done manually, with chemical agents (defoliant) and with the use of machines. With development of different technical solutions, different designs of defoliation machines, the productivity of work today is significantly increased compared to the manual removal of leaves, which is still dominant in our region. The technological parameters of grapevine plantations necessary for efficient and rational application of defoliation machines will be presented in this paper. Modern technical solutions and basic operating parameters of machines commonly used in practice will also be presented in this paper.*

Keywords: *defoliation, technical solutions, working parameters, grapevine.*

DEVELOPMENT, APPLICATION AND GUIDELINES FOR NON-DESTRUCTIVE INSPECTION OF AGRICULTURAL PRODUCTS

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Abstract: *The inspection and sorting of agricultural products is a necessary technological operation in the agricultural and food industries. Research in this area shows significant potential in improving the inspection and evaluation of fruits, vegetables, the quality of cereals and other agricultural products, as well as the evaluation of the quality of prepared food products by non-destructive methods. As an integrated system, machine vision has been widely used to test, monitor and control various industrial processes. The increasing and complex performance requirements of modern machine vision systems require their further improvement through the development of new, intelligent solutions. Automatic non-destructive recognition of the qualitative characteristics of different types of bio-products is a constant challenge for researchers, where the imperative is on product and method which is applicable in industrial conditions. In this regard, there is a large number of works with experimental and numerical data collected for different construction solutions and operating conditions. This paper will analyze the development of machine vision as well as its application in agriculture over the last five years. A special part will be guidelines for the direction of further research in the field of optical recognition of agricultural products.*

Keywords: *agriculture, machine vision, sorting, fruit, vegetables*

EFFECT OF MODIFICATION OF AGRI-ENVIRONMENTAL CONDITIONS IN ORGANICALLY MANAGED ZUCCHINI

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Abstract: *The experiments with some methods of zucchini plants and soil covering in ecological cultivation was carried out in 2016-2018. Two kinds of polypropylene PP 50 g m⁻² for the soil mulching were used: PP Agro and PP with 0,1% photoactivator (two years). For the plant covering the nonwoven PP 20 g m² and net hdPE 38 g m² (three years) were used. The control treatment were the plots without mulching and covering. The transplants were planted in four replication during the second decade of May. The plants at the beginning grow faster especially on the covered plots and generated quite bigger number of the flowers then the controled ones. The early yield (1/3 of the harvesting period) was increased with 35% and 22% for PP and net respectively as compared to control. The soil moisture under both of the mulches in the dry period were higher than in noncover soil and after strong rainfall was similar on all plots. The marketable yield gained in 2016 was 21% and 15% higher on the plots mulched with PP and PP with photoactivator respectively in comparison with the nonmulched ones. In the 2017 the difference between all treatments was small and occured only in the case of PP with photoactivator. Content of ascorbic acid and the synthesis of dry mass was analised on the beggining of harvesting period. Progress of the degradation in the period of 2 months shows the deminishing of the PP nonwoven with photoactivator mass with 40% and at the end of vegetation the mass of nonwoven was 52% from the new one. On the end of experiment the analysis of the degradation of applied soil mulching nonwoven was performed by the using measuring of tensile by tensile test machines and by the using estimation of supramolecular structure changes by wide angle X-ray diffraction.*

Keywords: *mulch, direct covers, microclimate, yield, degradation*

PATHOGENICITY METHODOLOGY OF RHIZOCTONIA SOLANI IN CARROT

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Abstract: Carrot (*Daucus carota* var. *sativus* Rohl.) is one of the most popular and commonly consumed vegetables and it is widely planted in the Central Anatolia and Eastern Mediterranean Region of Turkey. Root diseases are among the most important factors limiting carrot production in Turkey. Crown rot causing by *Rhizoctonia solani* is one of the important root diseases. Sometimes, root rot agents are not found to be single on root. In this situation, it is necessary to find the main causal agent of it. In this case, pathogenicity test must be performed on all isolates and, practical and safe methods should be choose. For this aim, disease samples were collected in carrot growing areas in Ankara provinces in Central Anatolia Region. *Rhizoctonia* isolates have been obtained from necrotic lesions on the roots. Isolates identified with the basis of hyphal, colony morphology, anastomosis reaction with known tester isolates. Pathogenicity test such as hypocotyl test and carrot disc method, were conducted with three isolates of *Rhizoctonia solani* AG4 and one isolate of binucleat *Rhizoctonia* . In the results of carrot disc pathogenicity tests, disease severity values of *R. solani* AG-4 isolates and binucleat *Rhizoctonia* were found between 73,00 to 48,00% and 43,50%, respectively. Disease values were determined as 67,00 to 84.50 % and 55.50% in hypocotyl test, respectively. Results of these two methods were almost similar and, both methods in present work determined to be most effective and efficient methods for pathogenicity test.

Key words: Carrot, crown rot, *Rhizoctonia*, pathogenicity test, methodology

CURRENT STATUS AND NEW POSSIBLE CHALLENGES IN SOIL TILLAGE SYSTEMS

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Abstract: *Different soil tillage practices affect soil on many different ways but predominantly on its physical, chemical and biological aspects. Some of the tillage's most influential impacts are: water content and availability, temperature, aeration, structure, density, compaction, nutrient cycling, organic matter transformation and dynamics, organism population and diversity. Intensity of tillage disturbance of the soil determines many causality relations of all soil compounds and influence levels of soil degradation and adaptability for present and future crop production. In different agroecological regions as in very similar agroecological conditions, exist different and sometime very opposite approaches to philosophy of soil tillage which consequently results in significant variation of average crop yields. In spite of many efforts to be replaced with some less degradable soil tillage systems or technique, mouldboard ploughing still remains as main tillage system in Europe. In same time, in some other world regions situation is much better and ploughing appears only sporadically (e.g. Canada, USA, South America, Australia). Reasons for this variability and sometimes very diversified approach in not simple and one-way explaining. Main reasons could be divided in two main groups: Economic and social development (e.g. knowledge, tradition, technics, technology, science) and Agroecological conditions (e.g. climate, soil, water, crop, landscape). In last few decades as a factor which needs to be unavoidable included in every serious calculation and / or plan for successful crop production is climate change. Changes of boundaries of some climatic indicators due to climate change and through its expression, as drought for instance, could drastically affect agricultural production. Regarding this and above-mentioned specifics, today there are*

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different concepts of crop production that exist on global scale. The main concepts that are needed to mention are Conservation agriculture, Sustainable land management and in recent times Climate smart agriculture. Every one of them are cross-connected and includes reduced/conservation soil tillage as one of its most important pillars. Today, every advanced approach to crop production necessarily needs to include site-specific principles (based on agroecological conditions) in application of any measures in crop production, including soil tillage. These approaches need to be in way of reduced or conservation soil tillage systems. Main modern principles of soil tillage imply as main excluding mouldboard ploughing as necessary, less soil tillage trafficking, better organic matter (residue) management, prevention to soil degradation (primarily soil erosion), shallow residue incorporation or their leaving on surface.

Key words: *Soil tillage, soil degradation, modern approaches, crop production*

THE INFLUENCE OF THE MOTION MECHANISM OF TRACTOR AND MOBILE SYSTEMS ON SOIL COMPACTION

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Abstract: *Contemporary plant production crucially depends on the application of modern, often very heavy complex and unfortunately aggressive toward the soil structure, agricultural machinery. Many of widely recognized benefits provided by employing the sophisticated technique of such kind have some less or more serious negative consequences. Among many other negative effects, application of various kinds of mobile systems over the agricultural plots may lead to excessive soil compaction, introducing the additional multiple negative consequences on the plant growth and yield, finally. This paper is intended to provide an unpretentiously limited contribution to the analysis of the agricultural machinery impact on the soil compaction at depths of up to 35 cm in the sunflower production. The cone penetration resistance of the soil was measured in and between the wheels traces of the applied machinery, in the inner part of the test plot and on the headland, in the phases of germination and sunflower harvest. The obtained results indicate, in accordance to expectation, the increased soil compaction under the wheels traces with respect to the non-invading areas. At depth of 5 cm in the sunflower germination stage, the compaction was 33% higher with respect to the appropriate soil layer between traces. Simultaneously, at depth of 35 cm, the soil compression between the wheel traces was smaller for 22% in contrast to the soil invaded by mechanization wheels. The situation was analogue in the harvesting phase. Soil compaction at depth of 5 cm, in the area not directly influenced by wheels, was 18% lower with respect to soil affected by machine wheels.*

Key words: *soil, penetration, resistance, agricultural mechanization, sunflower*

DETERMINATION OF WEED PROBLEMS OF CORN GROWING AREAS (ZEA MAYS L.) IN ADANA/TURKEY

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Abstract: *The aim of this study was to determine the actual extent of weed damage in corn fields and to suggest the most efficient control methods for corn producers in the Adana region. A total of 36 growers in the Adana corn producing districts (Imamoglu, Kozan and Ceyhan) were individually interviewed in the year of 2018. The survey included 30 questions aimed to determine the extent of weed damage and their control methods. Results of the survey exhibited that, i) the majority of growers have been using certified seed, ii) less fertilizer usage in corn production areas, iii) in general, the growers care the cleaning of tillage equipment, iii) at least, the half of the growers do not recognize the weeds in corn areas, iv) the yield loose due to weeds is moderate, and the weeds are more damaging when they are in early stages in corn areas, v) the majority of the growers have been preferred chemical control methods against weeds. The present findings represents important findings regarding the infestation of weeds in corn areas due to lack of knowledge and phytosanitary measures.*

Key words: *Corn, Weeds, Zea mays, Survey, Turkey.*

EFFECT OF RUBBER (*Hevea brasiliensis* L) CANOPIES ON THE GROWTH OF *Canna indica* L.

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Abstract: *This study aims to optimize land use for agriculture by planting Canna indica L, in between rubber trees. This research studied the effect of 7 year-old-rubber canopies on the growth of C. indica compared to those grown on an open area outside rubber plantation in Subang, West Java, Indonesia. This study includes the effect of two years planting of C. indica on the physical, chemical, and microbial activity in the soil, expression of stress gene markers, and the proximate test of C. indica rhizomes. The results showed that plant height, leaves dry weight, and rhizome dry weight were significantly higher ($p < 0.05$) in C. indica grown under the canopy, 173.4 cm, 9.5 g, and 70.8 g, respectively, compared to those grown on the open area, 75.6 cm, 3.39 g and 7.9 g, respectively. The LAR, SLA, LWR, NAR, and RGR values of C. indica grown under the rubber canopy showed characteristics of shade-tolerant species. After two years of planting, the soil water content (kg/ha) was higher in the soil planted with C. indica as compared to the soil under rubber without C. indica, 4617.55 kg.ha⁻¹ and 4298.61 kg.ha⁻¹, respectively. Higher hydrolysis enzyme activity was observed in soil planted with C. indica for both years, 3.70 mgFDAG-1soil dw.h⁻¹ and 4.29 mgFDAG-1soil dw.h⁻¹ respectively, compared to 2.30 mgFDAG-1soil dw.h⁻¹ and 2.35 mgFDAG-1soil dw.h⁻¹, respectively for soil without C. indica. Analysis of gene expression of WRKY15, 18 and 23 showed different patterns between C. indica grown under the canopy and in the open. However, they were not significant. This may be due to the habit of rubber trees to shed leaves during the dry season, which gives the effect of a similar light environment to those in open areas during this period. These results support the recommendation to use C. indica as intercropping plants to utilize the unutilize soil under the rubber trees.*

Key words: *Canna indica; agroforestry; growth analysis; rubber; shade; gene expression*

SOIL TILLAGE ADJUSTED TO CLIMATE CHANGES AND MAIZE GROWING SYSTEM

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Abstract. *Soil tillage is an important component of crop growing system. Nowadays, it has to be aligned with the climate changes, soil type and maize growing technology aimed to produce high, stable and quality yield together with agro-ecosystem prevention. The other measures such as irrigation, fertilization and herbicide application are also important and could contribute to maize grain quality and added nutritional value. No-till systems in semi-arid environments have depended on herbicides and urea to manage weeds and supply plant N needs. However, over time herbicide weed resistance has become a concern that has forced producers to revert to conventional practices. In addition, long-term synthetic fertilizer use has led to stratification of nutrients and pH issues which may result in tillage implementation.*

The long-term experiment has been conducted in Maize Research Institute Zemun Polje for more than 38 years with no-tillage, reduced and conventional systems of soil tillage together with fertilizers application in different rates and under irrigated and rain fed conditions. The system of the conventional soil cultivation is meant autumn plowing at a depth of 20-25 cm and a pre-sowing seedbed preparation at a depth of 10-12 cm; reduced treatment was conducted by rotovator while direct sowing in no-tillage soil system was conducted by special planter John Deere 7200 (John Deere, USA). Fertilizers are incorporated in the autumn before plowing in the amount of 50 kg ha⁻¹ N, 50 kg ha⁻¹ P and 50 kg ha⁻¹ K in both treatments, while the third variant was without fertilization et al. In the spring, before pre-sowing soil

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preparation, the additional amounts of N -180 and 240 kg ha⁻¹ were added in treated plots.

The long-term experiment results showed considerable differences in maize grain yield in dependence on the applied soil tillage system. In average for twelve years, 2005-2016, maize yield was in no-tillage, reduced and conventional tillage of soil, higher by more than 2 t ha⁻¹ in the rain feed -7.0, 8.3 and 10.0 t ha⁻¹ than under irrigated treatment 9.1, 10.5 and 11.9 t ha⁻¹. Under rain feed conditions, during 2016-2018 period, the highest maize grain yield was observed under conventional tillage (9.19 t ha⁻¹) and with fertilizer application in higher amount (8.46 t ha⁻¹). Intensification of soil tillage systems and nitrogen fertilization, contributing to an increase in yield as well as protein content, carotenoids, phytic phosphorus, glutathione and phenols in maize grain. Since the values of analyzed quality parameters in grains did not differ significantly between pre-sowing application of 180 and 240 kg of N, it can be concluded that the optimum amount of N application could be somewhat less than 240 kg ha⁻¹, while the system of conventional tillage in agro-ecological conditions of Zemun Polje most effectively contribute to achieving higher maize yields with better quality.

Key words: *cultivation, maize, tillage, yield*

PREDICTION OF FRUIT FIRMNESS INVOLVING MODERN COMPUTATIONAL TECHNIQUES

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Abstract: *Firmness is an important component for determining the quality of any fruit. In this study, the data obtained for different apple categories were used. Once these experimental data were validated, they were used as dependent variables for the construction of a high predictive power model using the QSPR (Quantitative Structure Properties Relationships) technique. In order to obtain the specified model, the firmness values for the different categories of apples were correlated with the firmness values for other fruit categories and with the Young modulus values. The obtained model was statistically validated, obtaining data in accordance with the experimental data.*

Key words: *firmness, apple, fruits, QSPR technique, Young modulus.*

EXPLOITATION OF THE RENEWABLE ENERGY POTENTIAL IN NORTH GREECE FOR THE DESIGN OF A ZERO ENERGY CONSUMPTION POULTRY HOUSE- CALCULATION AND INITIAL DESIGN

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Abstract: *The poultry industry is mentioning a sufficient development over the last years in Greece. Most of the meat production and egg production is realized in buildings with controlled environment and also with the necessary equipment that is considered essential for all the operations required (feeding, watering, light, egg collection etc). Even the buildings are very well designed and all the operations are performed with satisfactory results one of the main issues for the producers is to minimize the energy cost of the buildings. Up to know, there are very few cases where renewable energy systems are used in order to cover the energy needs of such facilities. In North Greece there is a large potential of geothermal energy and biomass that can be utilized to cover the heating needs of such applications. Also solar energy and wind energy can be used for the electricity needs. In this work the calculation and design of a typical poultry house construction that is consuming zero energy is presented. The case study will be calculated in a way that it can be applied in several areas with the same characteristics and also to examine the technical issues and other problems that might arise for such a project. The scope of the study is to show that such an approach can lead to low cost production, low environmental impact without affecting the internal environment of the building. In order to examine the feasibility of this approach an economical analysis is also performed comparing the proposed structure with the ones already operating with conventional systems.*

Key words: *Poultry, renewable energy, energy consumption, Internal environment, Equipment*

EXPERIMENT OF THE SNCR DENITRIFICATION OF FLUE GASES PRODUCED BY BIOMASS COMBUSTION

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Abstract. *Biomass, as well as any other fuel, emit certain pollutants during combustion, which should not be neglected. The emission of nitrogen oxides (NOx) generated during biomass combustion, especially agrarian one, is one of the key challenges for the use of this fuel. In order to investigate the potential of emitted NOx reduction, the experimental denitrification chamber was designed. The secondary denitrification technique of selective non-catalytic reduction (SNCR) on a synthetic mixture of gasses simulating real flue gasses during biomass combustion was tested. This paper provides a description of the experimental denitrification chamber as well as the experimental results obtained as the function of flue gas temperature, NO concentration, and NH₃/NO molar ratios.*

The optimization of the denitrification process under controlled conditions provided by the experimental denitrification chamber is the starting point for the optimization of the SNCR process on real-scale plants combusting biomass or any other fuels with increased NOx emission.

Key words: *biomass combustion, NOx emission, denitrification, SNCR.*

ENVIRONMENTAL RISK OF UTILIZATION OF BOTTOM AND FLY ASHES FROM CIGAR BURNER BIOMASS COMBUSTION SYSTEM AS A SOIL FERTILIZER

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Abstract: *During the combustion of different types of fuels numerous compounds have been emitted directly into the atmosphere or have been concentrated on the ash particles. In Serbia agricultural biomass has a great potential of use as a renewable energy resource. Biofuels are being increasingly used worldwide in order to replace fossil fuels. Among pollutants which can be emitted, there are many volatile and semi-volatile organic compounds. These compounds are formed due to incomplete combustion or reformed in the flue gas. Their concentrations depend on the fuel composition, combustion conditions and treatment of flue gases before emission. Since some of these compounds, such as polycyclic aromatic hydrocarbons (PAHs) are potentially carcinogenic and toxic, it is necessary to monitor their concentrations in order to optimize the combustion efficiency and to reduce potential environmental risk. Besides, it is imperative to determine major (Ca, K, C, O, H, N), minor (Mg, Na, S, P, Cl) and trace elements (Mn, Zn, Cu, Fe, Mo, B) in ash samples for their suitability for soil amendment and as a soil fertilizer.*

Key words: *agricultural biomass ash; major, minor and trace elements; PAHs; soil fertilizer; environmental risk*

GUIDELINES FOR ORGANIZED AND ENERGY EFFICIENT USE OF BIOMASS AND THE KEEPWARM INTERNATIONAL PROJECT PROMOTION

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Abstract: *This article represents an attempt to improve the use of available biomass for energy purposes. It represents a compilation of the laboratory's long-term experience on projects considering the development of technologies for the application of biomass and other renewable energy sources. The basic guidelines for the adoption of the solution for popularization and the specific application of biomass for energy purposes have been presented through four basic considered issues: Available resources and possible combustion technologies, The concept of construction of the plant, A multidisciplinary approach to the problem and The tendency for more intensive use of biomass in district heating systems through the KeepWarm project.*

Key words: *biomass combustion, DHS, KeepWarm*

COMPARISON OF SEMI-VOLATILE ORGANIC COMPOUNDS CONTENT IN ASHES FROM COMBUSTION OF AGRICULTURAL BIOMASS AND COAL

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Abstract: *During combustion of coal and biomass different compounds have been generated. There is increasing concern regarding the negative environmental impact of CO₂ formed during coal combustion. Biomass, as a source of renewable energy, could play a significant role in the reduction of greenhouse gases concentration. The ashes generated by burning of biomass or coal may pose threat to the environment due to the presence of toxic pollutants, so it is necessary to determine their content in order to estimate the risk. Biomass and coal ashes are not so often characterized for organic compounds such as polycyclic aromatic hydrocarbons (PAHs). Their distribution in ash particles is important because of their toxic and carcinogenic effects to humans and animals. In accordance to this, the determination of PAHs by HPLC/DAD in extracts of ashes from combustion of soybean straw in PKB and coal in Thermal Power Plant was done. In this paper environmental impact of PAHs in biomass and coal ashes was estimated according to their physical and chemical properties.*

Key words: *semi-volatile compounds; biomass ash; coal ash; comparison; HPLC/DAD*

ENERGETIC FEATURES AND BUILDING USE FOR NEW EFFICIENT RURAL BUILDINGS

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Abstract: *The introduction of renewable energy sources and the design of energetically high-performance structures are two of the most important features requested to new building generations. Nowadays, these aspects play an important role in the design of new rural buildings but also in the definition of energetic retrofits of the existing constructions. The total energy consumption of food processing buildings is relevant in fact, and often related to food safety and quality. The research of the most promising strategies in order to design an efficient building is then strictly correlated with the choice of dimensions, wall and roof constructions, glazing, orientation and cooling/heating needs. It is important to recall that the energy behavior of buildings is strongly influenced also by external factor like weather conditions and the effect of climate change increases the complexity to model the building behavior.*

In this context the present paper provides some useful insights into the most important variables to control in order to limit or contain energy consumptions by means of computer energy simulations. The evaluation is performed by considering a case study building with different intended use, desired indoor temperature ranges, and different architectural and materials choice. The main objective of the paper is to identify possible correlations between the energy consumptions and the variables considered in the paper in order to define which are the parameters most influencing the final building energy consumptions.

Key words: *Energy efficiency, energy saving, rural building, cooling system, building retrofit.*

VERY SHALLOW GEOTHERMAL SYSTEM FOR ENERGY EFFICIENCY IN DAIRY BARNs

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Abstract: *In dairy farms, energy is used in several activities, one of the most energy consuming phase is the milk cooling. This operation, necessary to guarantee the safety of the product, takes place in cooling tanks powered by electric energy.*

On the other hand, farms must provide large amount of water for cow daily drinking needs. The water is usually supplied by natural wells or aqueduct, in some cases water temperature can be so low that cows are discouraged from drinking, with consequent risks for animal health and production losses. For this reason, a few heat exchangers have been designed to pre-cool milk, taking advantage from cow drinking water and allowing considerable milk temperature reduction and slight water temperature increase. Even though this operation cannot replace cooling tanks, it reduces the energy needs.

Recent studies have shown the potentialities of the application of shallow geothermal systems to food processing buildings aimed at energy efficiency. Shallow geoexchangers configurations can be used to dissipate excessive heat in the ground. Unfortunately, the dissipation potential of the ground is limited, so a large number of geoexchangers is usually necessary, with related high cost and need of space. A newly developed configuration of spiral geoexchangers with double circuit could tackle this issue, by dissipating the heat partially to the ground and partially to a secondary fluid. For the specific case of barns, a double advantage should be expected since the waste fluid (water), heated up, can be used as cow drinking water.

The aim of this work is to assess the potentialities of the application of the system in a dairy farm. The study uses experimental data from a thermal response test campaign carried on a shallow geothermal system and data for water consumptions of a farm located in Bologna countryside (Italy).

Key words: *dairy barn, geothermal energy, renewable energy, energy efficiency, shallow geoexchangers*

AGRICULTURAL BYPRODUCTS AS RAW MATERIALS FOR INSULATION: THERMAL AND ACOUSTIC CHARACTERIZATION

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Abstract: *The building sector represents the 40% of total energy consumption and 36% of CO₂ emissions in Europe. The recent international agreements and protocols have driven countries to promulgate stricter and stricter laws on building energy performances. To reduce the energy need for the indoor thermal control, several materials and envelope solutions have been developed in the last years.*

The usage of materials based on agricultural byproducts and waste can provide a double benefit since on one side they can be recycled in the proximity of the production area, reducing environmental costs impacts due to transportation and manufacturing and, on the other side, their usage as building material can be considered an avoided emission of CO₂ or properly a carbon storage. However, several agricultural byproducts and waste, due to their organic nature, can be recycled as compost material or can be used for energy production (such as pellets).

The alternative usage of these products in the building sector, in particular as insulation materials, needs however several tests to check their suitability as construction material and to meet law requirements. Among these tests, the material physics property characterization is one of the most important. Based on this need, the present work focuses on the thermal and acoustic characterization of materials considered as waste in the food industry (such as corn cob and cherry stones) but recyclable in building construction. The work specifically aims at identifying its main thermal characteristics and compare them with common market solutions.

Key words: *Energy efficiency, circular economy, rural building, agricultural byproducts, construction materials.*

EFFECTS OF OIL LAYER PLASTERING ON THE PERFORMANCE OF LOCAL EARTHEN CISTERN

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Abstract: *Water scarcity in Enugu State has been the greatest socio economic problem in the rural communities of the state. The people therefore, resort to many ways of harvesting and storing rainwater such as plastering walls of the Earthen Cistern with palm oil. The aim of this study is to investigate the effects of using palm oil as a cistern plastering material. It gives a comprehensive description of rainwater harvesting cisterns for rural water supply in some selected communities in the state such as Enugu-Ezike. This study tries to identify the various types of rainwater harvesting cisterns, their plastering materials with a great emphasis on palm oil as a cistern plastering material. The effects of palm oil as a cistern plastering material are well emphasized in this research. This work presents seven cisterns with different palm oil layers in them. The source of water to these cisterns was by pouring equal volume of water into the cisterns. The first cistern C0 was not plastered with oil and it was used as control. The second cistern C1 was plastered with only one oil layer on its wall. The third cistern C2, fourth cistern C3, fifth cistern C4, sixth cistern C5 and seventh cistern C6 were plastered with two, three, four, five and six oil layers respectively on their walls. A layer of oil plaster consumed 1litre of oil. At C4, the rate of water depletion reduced and at C5 and C6, the rate of water depletion became very negligible as compared to that of C4. Therefore, the fifth cistern C4 with four oil layers gave the best results.*

Key words: *Oil layer plastering, Local earthen cistern, cistern plastering material, Rainwater harvesting, Rainwater storage*

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ENERGY AND EXERGY ANALYSIS OF FUEL CONSUMPTION IN AGRICULTURAL SECTOR – SERBIAN CASE

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Abstract: *Agricultural sector is of great importance to every society. It is also a great user of energy. Based on the relevant statistical data on the use of various energy sources, it can be concluded that diesel is the most used fuel in Serbia today, used to run the agricultural machineries. Therefore, a thermodynamic analysis of energy use in the agricultural sector of Serbia was conducted considering the fuel consumption for a period of 10 years between 2008 and 2017. The paper presents an energy and exergy analysis of the use of energy products for the needs of agricultural mechanization in Serbia. A comparison was made with the available data from other countries.*

Key words: *energy, exergy, agriculture, fuel consumption*

**MANAGEMENT OF RENEWABLE ENERGIES IN THE
CONTEXT OF REDUCING THE POLLUTION AND ENSURING
THE SUSTAINABILITY WITHIN THE CAMPUS OF
BIOTERRA UNIVERSITY IN BUCHAREST**

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Abstract: *Extreme climatic phenomena have become a worrying constant and tend to develop their spreading across the world, including in Romania, where unfortunately these climatic phenomena with devastating effects were not encountered until 10 years ago, being not specific to our climatic history. The effects of global warming are seen everywhere, with the humanity taking a serious stance, as evidenced by the UN Conference on Climate Change in 2015 when about 150 world political leaders participated. Bioterra University provides its contribution to the global warming limitation plan “far below” 2 Celsius degrees by green energy research, materialized in technology investments that have measurable effects on the energy management (obvious results in the energy balance).*

The paper also presents the economic and ecological importance regarding the use of green energy in Romania, taking into account that Dobrogea's region wind potential is the highest in the South-East of Europe, the second in Europe, forcing it to be exploited both in agriculture and in agri-tourism, especially within isolated areas from the point of view of the electro-energetic system.

A good example of this subject is the applicative research within the student's centers of Bioterra University in Bucharest.

Key words: *green energy, global warming, wind potential, agri-tourism, energy management.*

WOOD BIOMASS, ITS USAGES AND ENVIRONMENTAL CHALLENGES IN NIGERIA

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Abstract: *Wood biomass is a source of energy derived by burning wood materials like logs and twigs and is common among the rural dwellers. It is the most common source of fuel. It is a free source of energy and locally available within the vicinity of users; although it is becoming scarce because, it is exploited without afforestation. Wood biomass can be used for commercial purposes in various forms as plywood, paper products, electric poles etc., and to produce some materials like fabrics, medicines, chemicals etc. It can be processed and used to produce fuel – bio fuels, charcoal etc. It is used in building houses and livestock structures. It also generates revenue and employment opportunities. The removal in energy subsidy has pushed the price of commercial fuels to outrageously high levels thus; many people have resorted to the use of wood biomass, which is relatively cheap compared to commercial fuels. This study revealed that about 80 million cubic metres, equivalent to 43.4 x 10⁹ kg (or 43.4 million tonnes) of fuel wood with an average daily consumption ranging from 0.5 to 1.0 kg of dry fuel wood per person is consumed in the country annually for cooking and domestic purposes. The challenges of the usage of wood biomass on the environment include; air pollution, deforestation, desertification, disease, global warming, economic losses, conflict, poverty, death. The possible solutions to the challenges include reduction of population growth, increasing per capita income, use of waste to generate fuel, increasing the standard of management of forest, improve the information base and system monitoring wood biomass, strengthening government and non-government institutions and policies on wood biomass management, creating awareness campaign on afforestation and wood biomass conservation.*

Key words: *wood biomass, usage, environment, challenge, solution*

**THE EFFECT OF CHIA SEED (*Salvia hispanica* L.)
ON BIOACTIVE COMPONENTS AND HUMAN HEALTH**

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Abstract: *Chia seed is a prehistoric seed variety that has become popular in recent years due to its high content of fat, protein and dietary fiber. Chia seeds are seen as a healthy food product that is added to foods in different proportions or found in foods as a component. What attracts the attention of consumers are its beneficial properties to health. In this review, chia seeds, bioactive components of chia seeds, health effects, musilage properties and application areas in food industry are briefly given.*

Key words: *Chia, Salvia hispanica L., seed, composition, bioactive properties, human health*

FREEZE-DRYING CHARACTERISTICS FOR THE CONSERVATION OF BEE POLLEN

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Abstract: *Bee pollen is very important in the nutrition of bees since it provides them with proteins, lipids, vitamins and minerals. Bee pollen also has a significant nutritive value as a supplement to human nutrition. Fresh bee pollen contains a large quantity of moisture which favours development of various microorganisms. In order to preserve pollen from spoilage its dehydration in controlled conditions is commonly performed. In this paper, freeze-drying (FD) was proposed as a conservation method. Results showed that FD is a new drying technology which can increase the drying rate and improve the product quality compared to traditional hot air drying. The current work provides theoretical and technical reference for applying this type of technology.*

Key words: *bee pollen, drying, freeze-drying*

FARM BUILDINGS AS DRIVERS OF RURAL LANDSCAPE SHAPING: A LITERATURE REVIEW

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Abstract: *Farm buildings play a central role for the sustainability of the rural environment. Conceived to host biological production, the farm building constitutes an unique example in the wide epistemological sector of building construction. The birth, growth and development of living vegetal or animal organisms contained inside these volumes raise architectural and technical issues that are totally different if compared to those of other building sectors. Aimed at producing optimal environmental conditions for plants and animals, while at the same time protecting the hygiene and health of workers involved in the daily operations for the care of living organisms at different stages of their development, the rural building constitutes therefore a unique and unrepeatable technological model. The originality of what happens inside the farm building corresponds to what happens outside. The role that the buildings have historically played is strictly connected indeed with the surrounding context, due to the need of the farmer to live in close contact with agricultural land and animal husbandry. While the organization of human beings involved in the activities of the industrial or tertiary sector allowed aggregation in urban centres, the need to live in constant contact with the agricultural production developed a synergetic function of close proximity to the extra-urban land. This aspect led to the spread in rural areas of many examples of buildings used for farming, storage and processing of agricultural products which constitute, at the same time, housing for the farmer and his family. In this way, the activities made by the Man have often strongly influenced the agricultural environment and the visual perception of its landscape. The growing interest towards the role that rural areas may play for a more balanced pattern of modern life, under the currently increasing sensitivity of large segments*

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of the European population about the concept of sustainable development of the built environment, is currently stimulating the valorisation of historical farm buildings, most of them built many decades – or centuries – ago. Designed in order to fulfil their primary agricultural role, they now constitute a widespread heritage, that in some cases possesses an unreplacable architectural value, having its roots in the tradition left by our forefathers, since they had no choice than realize farm buildings and ancillary elements using the local construction material. Even if traditionally based mostly on economic reasons, this building option has very interesting consequences on the current perception of the rural landscape - since the colour of the building is similar to the surroundings - as well on the agricultural environment – this material being, at the end of its useful life, incorporated in the same context. In the present article, a general literature review about the role that farm buildings play on shaping of rural landscape is presented, with a special focus on the wider opportunities enabled by the implementation of new technologies for the survey, analysis and planning of the interactions between farm buildings and rural landscape.

Key words: *Farm buildings; Rural landscape; Environmental sustainability; Geographical Information System; Spatial Analysis.*

NEW PARADIGMS ON THE ECONOMIC EFFICIENCY OF VARIOUS TECHNICAL SOLUTIONS IN AGRICULTURE

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Abstract: *A major change in macroeconomic theory was made by John Maynard Keynes and his numerous disciples. The conclusions of Keynesian researches have revolutionized economic doctrines and twentieth-century society. The emergence of Keynesism was predestined by the Great Depression of the 30s of the 20th century, which completely rejected the conclusions of the classical theory representatives about the self-regulation of the capitalist economy. The Keynesian paradigm is based on the need for state regulation of the main parameters of the economic development of society, the active formation of conditions for attracting investments to guarantee economic growth.*

Key words: *John Maynard Keynes, economic doctrines, paradigm, research.*

EVALUATION OF INVESTMENTS IN GPS GUIDANCE SYSTEMS AT SERBIAN CROP FAMILY FARMS

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Abstract: *According to the results of Agricultural census, which was conducted in Serbia in 2012, structure of farms was very unfavorable because it is dominated by very small farms. The census revealed that 60% of farms use less than 3 hectares, while only 0.29% of farms use more than 100 hectares. Besides, 68% of farms in Serbia have economic size less than 3,999 EUR of standard output and such farms cultivate less than 3 hectares. The question of how to improve economic results of small farms arises. Use of advanced technical solutions (such as precision agriculture technology) could improve profitability, sustainability and competitiveness of farms of all sizes. Nevertheless, size of farms plays significant role in adoption of precision agriculture technologies. Therefore, at the beginning, investments in such technology were economically efficient only for the biggest farms. Nowadays technologies related to precise agriculture are increasingly spreading among farms that cultivate more than 100 hectares. On the other hand, small family farms cultivating less than 100 hectares still do not have satisfying access to technologies related to precision agriculture. Such phenomenon is not present only in Serbia, but also in the EU countries where less than 25% of farmers have an access to such technologies. State subsidies for agriculture are an important incentive for distribution of precision agriculture technologies among small farms. Subsidies for investments in global positioning guidance systems are at the moment available only to farmers cultivating less than 50 hectares (producing cereals, industrial crops and forage plants). These subsidies might speed up introduction of precision agriculture technology resulting in increase of economic performance of small farms. Without state support small farms would*

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have difficulties in future to compete with farms from the EU as well as with big farms operating in Serbia (which have recently increased their investments in precision agriculture). Without systems related to precision agriculture small farms would be not only less profitable and competitive but also unable to fulfill ecological standards in the future.

Having that in mind, the goal of this research is to determine economic efficiency of investments in GPS (global positioning systems) guidance systems on family farms directed to crop production which use less than 100 hectares of arable land. Data for this research are gathered by survey of 30 family farms (operating in the region of Vojvodina) specialized in crop production which cultivate between 10 and 100 hectares. The farms are divided in two groups – first group is made of farms cultivating up to 50 hectares (such farms could use state subsidies for investments in GPS guidance systems) while the second group consists of farms cultivating 50 – 100 hectares (farms of that size are not suitable to receive above mentioned subsidies). Four scenarios concerning investments in GPS guidance system are analyzed in the paper. For all of them break-even number of hectares for various levels of costs savings (which are achieved using precision agriculture technologies) have been determined.

Key words: *precision agriculture, GPS guidance systems, investments, family farms, costs savings, subsidies.*

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