6th International Workshop for Young Scientists
BioPhys Spring 2007

BPS

BOOK OF ABSTRACTS

Institute of Agrophysics
Polish Academy of Sciences
Lublin, Poland

and

Czech University of Agriculture
in Praque, Czech Republic

Lublin, Poland, 17 - 19 May 2007

European Union

Institute of Agrophysics
Polish Academy of Sciences

neighbourhood PROGRAMME PL-BY-UA

Conference is carried out as part of „The Interregional Research and Education Centre in the Institute of Agro in Lublin" project co-financed by the European Union from the European Regional Development Fund as part Neighbourhood Programme Poland-Belarus-Ukraine INTERREG IIIA/TACIS CBC 2004-2006.

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INTRODUCTION

Dear friends and colleagues,

This year the 6th International Workshop for Young Scientists "BioPhys Spring 2007" will be held in Lublin on 17-19 May 2007. Each year we alternate the place of workshop between Prague and Lublin to facilitate participation of young researchers from broader region of neighbouring countries. The workshop is oriented on deeper insight into the physical processes occurring in biological, agricultural and food systems. The workshop combines two basic tasks of international meeting: exchange of professional experience and integration of young people from different countries. The important activity of the event is also meeting of members of PMA LABS - Free Association of Labs Developing Physical Methods in Agriculture and Life Sciences due to development of cooperation and inviting new laboratories.

We cordially invite young scientists up to age of 35 year to participate in the BPS 2007 Workshop and to present results of your research in biological physics and/or in life sciences using the physical methods. The workshop is organised as an opened English spoken event without any fee. The contributions will be published in the book of the BPS 2007 Workshop. Papers can be submitted for publication in *International Agrophysics*, *Research in Agricultural Engineering*, and/or *Scientia Agriculturae Bohemica*.

It is my pleasure to invite you to spend a few days of May 2007 in friendly atmosphere between young people in Lublin.

Prof. Dsc Józef Horabik

LECTURES

ROLE OF WATER CONTENT IN FOOD AND PRODUCT TEXTURE

Jiří Blahovec

Department of Physics, Technical Faculty
Czech University of Agriculture, Prague
165 21 Prague 6 – Suchdol, Czech Republic
e-mail: blahovec@tf.czu.cz

Water is very important component forming practically all the important properties of the agricultural products, foods and biological objects. Among the properties, the important role is played by mechanical properties including the viscoelastic ones. These properties are controlled mainly by temperature and the strain rate but water plays the role of the main plasticizer in the controlling mechanisms. The relative simple theories were developed for deformation of the soft homogeneous substances and character of the theories is discussed in this paper.

Moreover, the role of water in the real agricultural products is structurally and concentration dependent. This role can be well described by sorption properties expressed by the well known sorption isotherms. The applicability of the GAB theory for description of the sorption phenomena in food and biological products is also discussed.

COMPACTION EFFECTS ON SOIL PHYSICAL PROPERTIES AND PLANT GROWTH

Jerzy Lipiec

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
e-mail: j.lipiec@ipan.lublin.pl

Soil compaction is a result of forces on the soil and its resultant reaction, namely partial or complete failure of matrix structure when its strength is overcome by stress. Increasing size of agricultural implements is a significant cause of induced soil compaction and deterioration of soil structure. Examples of compaction effects on soil physical properties and plant growth and functions. Soil compaction decreases total pore space and the contribution of larger pores and makes the soil less heterogeneous. Changes in pore-size distribution by soil compaction influence several aspects the soil. Measurements of soil strength, aeration, water, thermal and structural characteristics are identified as the main behavioural properties influencing the quality of the soil after compaction. Geostatistical analysis is useful to characterize spatial variability of some characteristics (e.g. penetrometer resistance, thermal properties, and soil structure) as related to soil compaction. An increase in soil compaction level results in a greater concentration of roots in the surface soil and in a lower rooting depth. The plant roots in severely compacted soil are charcterized by a higher degree of flattening, tortuous growth, distorted epidermal cells and radially enlarged cortex cells. Approaches with split root systems between soil of varying bulk density revealed that reduced root growth and water uptake in compacted soil can be partly compensated for in favourable local environments. Possible mechanisms of the root response and root-shoot relations as affected by soil compaction are presented. Final crop yields on compacted soil largely depend on weather conditions and initial soil compactness.

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MULTISCALE MODELLING OF GAS AND WATER TRANSPORT PHENOMENA IN FRUIT TISSUE

Bart Nicolai, Quang Tri Ho, Hibru Kelemu Mebatsion, Bert Verlinden, Pieter Verboven*

BIOSYST-MeBioS, Catholic University of Leuven
Willem de Croylaan 42, B-3001 Leuven, Belgium
*e-mail: bart.nicolai@biw.kuleuven.be

Fruit such as apple and pear are often stored under controlled or modified atmosphere conditions. However, too low an oxygen partial pressure in combination with too high a carbon dioxide partial pressure may cause off-flavours and storage disorders during storage. Excessive moisture loss may lead to shrivelling of the fruit and a corresponding decrease of commercial value.

In vivo measurement of gas and moisture transport inside the fruit is not trivial because their concentration is not necessarily uniform – for example, the oxygen concentration in the fruit center may be much smaller than just beneath the skin. Also, most measurement techniques are invasive and disturb the local gas or moisture gradients or have insufficient spatial resolution. Alternatively, mathematical models can be used to predict the local gas or moisture concentration inside the fruit. The advantage of such an approach is that in silico experiments can be carried out to evaluate the effect of many storage conditions and fruit parameters on the local gas or moisture concentration.

In this presentation we will discuss gas and moisture transport models of increasing complexity. We will start with simple lumped models based on Fick's first law which are applicable when the internal resistance to flow is small compared to the skin resistance. If this is not the case, continuum type models can be used advantageously. Such models combine diffusion transport with respiration kinetics and allow the prediction of the local gas and moisture concentration. They, however, fail to explain microscopic gas gradients which are important for understanding phenomena such as fermentation related physiological disorders. Multiscale models are basically a hierarchy of models which describe the transport phenomena at different spatial scales in such a way that the submodels are interconnected. Typically, in silico experiments are carried out at a predefined spatial scale to compute apparent transport parameters which are then used in a model which operates on a more coarse scale. This procedure is iterated over all scales until the macroscopic continuum scale is reached.

The different models will be illustrated by some examples including gas transport in pear and moisture diffusion through apple cuticle.

INTEGRATED COMPUTER SYSTEM SUPPORTING INVESTIGATION OF SELECTED PROPERTIES OF CEREAL GRAINS WITH RESPECT TO DESIGN AND MANAGEMENT OF DRYING AND STORAGE SYSTEMS

Jerzy Weres

Department of Applied Informatics, Institute of Agricultural Engineering
Agricultural University of Poznań
ul. Wojska Polskiego 28 60-637 Poznań, Poland
e-mail: weres@au.poznan.pl

An integrated computer system was developed to support investigation of selected properties of agri-food and forest products with respect to design and management of drying and storage systems. The system was composed of six modules dedicated respectively to:

1) 3D geometry data acquiring for investigated objects, based on a developed image analysis system,
2) simulating grain kernel drying, based on developed finite element inverse and direct models,
3) visualizing 3D models of investigated objects and presenting temperature and moisture content changes in time and space,
4) managing databases related to cereal grain drying,
5) computing drying air properties, simulating technological processes of drying and estimating performance of various drying systems and driers,
6) selecting appropriate equipment and conditions for drying cereal grains, based on a developed decision support system.

The problem domain was analyzed according to the UML 2.0 standards, the software was implemented in C++/CLI and C#, and the system was statically and dynamically tested on a basis of appropriately designed test cases, relevant to products exemplified by cereal grains.

DETERMINATION OF APPLE TEXTURE USING ACOUSTIC EMISSION

Artur Zdunek

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
e-mail: a.zdunek@ipan.lublin.pl

Sound is important property of texture used by consumer for food quality evaluation. Most of the sound created during eating is bone-conducted. In this research a contact acoustic emission (AE) together with puncture test are used for observation of changes of apples quality during storage.

Three varieties of apples stored in different conditions (shelf-life, cold storage and control atmosphere storage) were used. Apples were punctured using the 11.1 mm probe, pushed till 8 mm into apple flash with the speed 20 mm/min. Acoustic emission signal was recorded together with puncturing using newly developed head with AE sensors. For all varieties and storage conditions, sensory evaluation was performed to obtaining a score of crispness, crunchiness, mealiness, juiciness, hardness and overall texture.

Table 1. Correlation coefficient of acoustic descriptors and mechanical parameters with shelf-life storage time.

Elstar						
	Days	*Ln(AE events)*	*Ln(AE energy)*	*Ln(AE mean amplitude)*	*Ln(Firmness) [N]*	*Ln(Toughness) [J]*
Days	1					
Ln(AE events)	-0,802	1				
Ln(AE energy)	-0,893	0,948	1			
Ln(AE mean amplitude)	-0,904	0,917	0,993	1		
Ln(Firmness) [N]	-0,803	0,831	0,898	0,877	1	
Ln(Toughness) [J]	-0,843	0,884	0,924	0,905	0,977	1
Gloster						
	Days	*Ln(AE events)*	*Ln(AE energy)*	*Ln(AE mean amplitude)*	*Ln(Firmness) [N]*	*Ln(Toughness) [J]*
Days	1					
Ln(AE events)	-0,541	1				
Ln(AE energy)	-0,661	0,782	1			
Ln(AE mean amplitude)	-0,697	0,632	0,941	1		
Ln(Firmness) [N]	-0,403	0,154	0,355	0,364	1	
Ln(Toughness) [J]	-0,413	0,253	0,39	0,37	0,965	1
Jonagold						
	Days	*Ln(AE events)*	*Ln(AE energy)*	*Ln(AE mean amplitude)*	*Ln(Firmness) [N]*	*Ln(Toughness) [J]*
Days	1					
Ln(AE events)	-0,81	1				
Ln(AE energy)	-0,9	0,894	1			
Ln(AE mean amplitude)	-0,878	0,834	0,988	1		
Ln(Firmness) [N]	-0,82	0,768	0,861	0,832	1	
Ln(Toughness) [J]	-0,822	0,775	0,87	0,841	0,991	1

Both mechanical parameters and acoustic descriptors significantly and logarithmically decreases during the shelf-life storage (Table 1). There is positive significant correlation between them. However, acoustic descriptors, like AE events and EA energy, are more sensitive for the shelf-life storage than the mechanical ones. It is visible as higher correlation coefficients for the AE descriptors. The high correlation with days of the shelf-life storage shows that puncturing of fresher apples causes more sources of AE or/and a higher stress in the sources in a moment of cracking. During ripening, a failure mode changes in apples from cell wall rupturing to cell debonding. Thus, decrease in number of AE events and AE energy can be related to changes in the way of cracking propagation.

Fig. 1 shows correlations of AE events and firmness with crispness. This is significant positive correlation for both values. Similarly, AE events correlates better with all sensory attribute (not shown in the abstract) than firmness from puncture test.

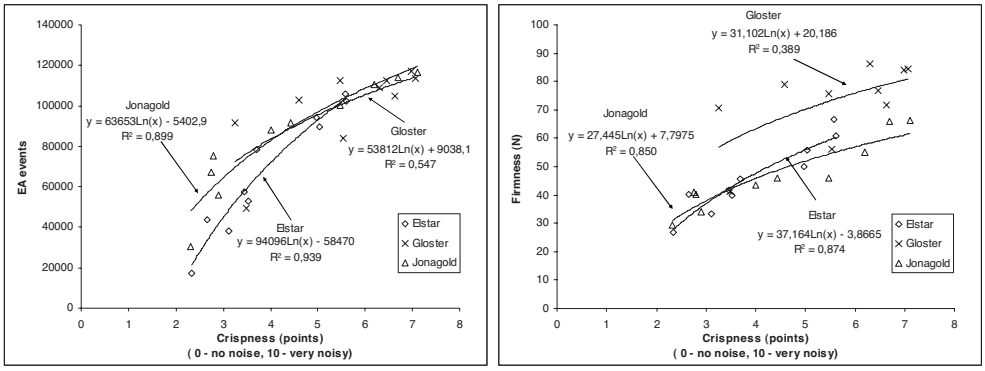

Fig.1. Correlations of AE events and firmness with crispness for three varieties of apples.

Conclusions

- Acoustic emission descriptors provide better evaluation of changes in apples quality during storage than firmness and toughness.
- Acoustic emission descriptors allow more precise instrumental evaluation of apples sensory attributes than puncture test.

Acknowledgements

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ORAL CONTRIBUTIONS OF YOUNG SCIENTISTS

FIELD MONITORING OF WATER CONTENT, SALINITY AND TEMPERATURE OF SOILS

Olga V. Alokhina[1], Wojciech Skierucha[2], Andrzej Wilczek[2]*

[1] KarpenkoPhysico-Mechanical Institute of the National Academy of Sciences of Ukraine
5 Naukova str., Lviv 79601, Ukraine
[2] Institute of Agrophysics Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: o.alokhina@ipan.lublin.pl

Knowledge of the soil physico-chemical parameters, such as moisture, salinity and temperature enables evaluating water reserves, plant nutrients and their movement in the soil profile as well as soil heat capacity. Monitoring of soil moisture becomes a real issue at the moment, when weather anomalies connected with the abundance or shortages of water are reported. Values of water content in the upper soil layer together with other soil parameters that do not change rapidly in time, feed and verify existing models of mass and energy transport in the soil and are necessary for interpretation of satellite data.

The study presents a field monitoring system of soil moisture, electrical conductivity (salinity) and temperature measured by an integrated reflectometric probe. This probe measures dielectric permittivity of surrounding medium, which is highly correlated with its moisture, in the frequency of hundreds of megahertz and therefore the results are not influenced by soil salinity. The monitoring system includes a wireless data logger based on GPRS technology that communicates with the Internet server for storing data and measurement control. The data, protected by individual user login and password, can be accessed from Internet browser. At present, the work on the system concentrates on improving existing sensors by introduction of identification, conversion and computation facilities as close as possible to the measured object, as well as providing the sensors with a short range wireless communication.

The described measurement devices developed in the Institute of Agrophysics PAS in Lublin represent current trends of modern measurement systems characterized by low power consumption, large internal memory for data storage and possibility to control the measurement process from any place in the world using Internet or radio link in cases when the access to the monitoring object is limited. The indispensable condition that monitoring systems must fulfill is the provision of a friendly software user interface and data security in the sense of minimization of data loss risk and blocking the access to data from the not

validated users. The hardware and software modifications follow the continuous technology development in sensing devices and communication. The progress of monitoring techniques is directed to: minimization of ground sensing devices and creation of self-organizing networks as well as collection and analysis of satellite pictures covering large areas of the Earth. The both directions of development are complementary and they add value to each other. The data generated by ground sensors are used for the calibration of satellite pictures and the information from satellites helps to find especially important areas for application of accurate ground sensors.

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ESTIMATION OF CONDITION OF DRAINED PEAT SOILS OF BREST POLESYE

Alexandra Antoniuk

The Polesie Agrarian Ecological Institute of the National Academy of Sciences of Belarus
204, Moskovskaya str., 224020 Brest, Belarus
e-mail: ant_sash@rambler.ru

Degradation of the soils is one of the most actual environmental problems of Belarus. Display of various forms of soils degradation is connected with features of use of territory, breache of norms and rules of rational use and protection of soils resources.

Such situation has developed as a result of a long state soils policy, which purpose was expansion of the area of the agricultural grounds. This priority was a substantiation for large-scale development and involving of new soils in agricultural revolution.

Now, the one of perspective directions of activity in struggle against soils degradation is development of the objective biodiagnostics, which include the definition of criteria of degradation degree and necessary diagnostic parameters (physical and chemical, biological, phytocoenotical).

The purpose of our researches was the creation the system of biogenic and ecological-botanical parameters, which allow to estimate a condition of drained, degraded peat soils of Brest Polesye.

The object of researches was peat-gley and peat-marsh soils of farm «Ascending Dawn» of Brest region. Degraded soils came to 27% and were sow with long-term grasses.

Influence of degradation processes on features of physical and chemical properties and dynamics of enzymatic activity has been revealed. Biogenic resources of drained peat soils are calculated. The complex of botanical and energy parameters of structure and efficiency of phytocenosis is developed.

In result of the analysis of biogenic processes in peat soils we can estimate a degree of transformation and degradation of peat-marsh soils. Mechanisms of these processes can be tracked on enzymatic reactions of a microbial complex, which confirm by regression models. It enables to predict in further negative ecological tendencies and to adjust the level of organic weight in peat soils and to improve their efficiency.

THE SURFACE AREA BROWN AND GRAY-BROWN PODZOLIC SOIL FORMED FROM SAND OBTAINED FROM WATER VAPOUR ADSORPTION DATA

Piotr Bańka, Izabela Krzemińska*

Institute of Agrophysics Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: p.banka@ipan.lublin.pl

The principal physical methods for measuring specific surface area of soils or soil constituents are electron microscopy and X-ray diffraction (the crystallographic or geometric surface area). The majority of chemical methods are based on measurement of adsorption of polar and nonpolar gases or vapours. The adsorbable compounds used to determine specific surface area are chosen on the basis of their molecular properties. Polar adsorbates are water vapour, ethylene glycol or ethylene glycol monoethyl and they used to measure the total surface area. Typical nonpolar adsorbates are nitrogen, argon, krypton and they are used to measure the external surface area. Nitrogen is commonly used as the adsorbate because it interacts weakly with a broad array of surface functional groups and therefore permits for the determination of exposed area of soil.

The aim of are study was the investigation the surface area of soil formed from sand.

Our investigations were carried out on the 112 brown and the 17 gray-brown podzolic soil samples.

The specific surface area of investigated soil samples was measured according to Polish Standard PN-Z-19010-1. Before the adsorption measurement the soil samples were dried in a vacuum chamber with the concentrated sulphuric acid until the weight of samples reached constant values. The soil sample of the weight equal approximately to 3g was put into the glass vessel and was placed over sulphuric acid solution. The sample was equilibrated with water vapour during two days. The amount of adsorbed water vapour was computed as the difference between the weight of the sample with water and the dry sample (dried in an oven at 105°C). The relative water pressures were obtained from the density of sulphuric acid solutions. Fife levels of relative pressure were selected in range of 0.034 to 0.352. The adsorption measurements were replicated three times keeping the temperature constant, T=20°C ± 0.5. The variation in replicated data did not exceed ±5% at the lowest vapour pressure and ±1% at the highest vapour pressure. The surface area of soil samples was evaluated from adsorption-desorption isotherms in the BET range of relative water vapour pressure, using the Brunauer-Emmett-Teller (BET) method.

The specific surface area of the investigated brown soil are in the range from 1.872 to 21.4 $m^2 \cdot g^{-1}$ and for gray-brown podzolic soil are 3.6 to 25.344 $m^2 \cdot g^{-1}$.

SELECTED THERMOPHYSICAL PARAMETERS OF APPLE PRODUCTS

Monika Božiková

University of Agriculture in Nitra, Faculty of Agricultural Engineering
Department of Physics
Tr. A. Hlinku 2, 949 76, Nitra, Slovakia
e-mail: Monika.Bozikova @uniag.sk

This article deals with thermophysical properties of selected fruit and fruit products. If we want to protect high standard of quality during the processing and storage of apples products we need to know physical parameters which can evaluate the quality of apples products. The most important are mainly thermophysical, mechanical parameters and parameters which can determine the structure of materials. The article presents results from thermophysical parameters measurements of selected apple products.

For our measurements were used transient methods – Plane source (PS) and Hot wire method (HW). Transient methods represent a large group of techniques where measuring probes, i.e. the heat source and the thermometer, are placed inside the sample. This experimental arrangement suppresses the sample surface influence on the measuring process which can be described as follows. The temperature of the sample is stabilized and made uniform. Then the dynamic heat flow in the form of a pulse or step - wise function is generated inside the sample. From the temperature response to this small disturbance, the thermophysical parameters of the sample can be calculated. The article presents thermophysical parameters measurements of apples and apple products which are biological materials with non - uniform structure in microscopic and macroscopic meaning. Biophysical and physiological processes are realised within biological materials. Heat transfer can not be isolated from the solid transfer and from the heat – moisture transfer. It means that specification of biological materials is difficult to determine, but for protection of apple and apple products quality it is necessary to know its thermophysical properties as one of very important parameters.

We measured relations between temperature and thermal conductivity and thermal diffusivity heat during the temperature stabilization in temperature range (6 – 28)ºC by using HW and PS method. The results of measurement shows that temperature, moisture content and structure have significant influence on thermophysical parameters of apples products.

SELECTED PHYSICAL PROPERTIES OF MODEL CELL WALL MATERIALS

Justyna Cybulska[1], Krystyna Konstankiewicz[1], Els Vanstreels[2], Bart Nicolai[2]*

[1]Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin 27, Poland
[2]BIOSYST-MeBioS, Katholieke Universiteit Leuven
Willem de Croylaan 42, B-3001 Leuven, Belgium
*e-mail: j.cybulska@ipan.lublin.pl

The most important factor affecting the quality of plant foods is texture. The textural properties, thus mechanical properties of fruit and vegetables depend to a large degree on the cell walls of parenchyma cells. Very small dimensions of the cells and thickness of the primary cell walls cause difficulties in study of the properties of the natural plant cell walls. In order to investigate and simulate an influence of different polysaccharides on mechanical properties of cell wall is necessary to develop a model plant cell wall material. The structure of cellulose network produced by *Acetobacter xylinus* is thought as very similar to the cell wall cellulose network. Therefore bacterial cellulose can be used as a main structural element in artificial cell wall.

Research on influence of different physical and chemical factors on mechanical properties of model cell wall materials have not been carried out. Application of model materials to designing of preservation and technological processes is necessary to investigate how these materials will behave in conditions which occurs in industry and storage practice. One of the most significant parameters which decide on quality of plant foods is humidity.

The aim of this work was developing of model cell wall material, which microstructure and chemical composition is adequate to natural cell wall and simultaneously its geometrical dimensions are large enough to carrying out mechanical tests. Additionally, an influence of storage humidity conditions on mechanical properties of model cell wall material was examined.

In this experiment a model artificial cell wall was obtained. Composite materials based on the bacterial cellulose supplemented with another cell walls polysaccharides were prepared. Microscopic observations were performed in order to compare the model material with the natural cell walls structure. The uniaxial tensile test for the materials stored in different relative humidity conditions were carried out.

Microscopic observations shown that structure of natural and model cell wall materials was similar. Significant differences were found in the micromechanical properties of the different cell wall analogues. It was shown that storage

in different humidity conditions had a influence on the mechanical properties of the materials.

Among the model cell walls obtained in this experiment material composed form bacterial cellulose, xyloglucan as a source of hemicelluloses and pectin can be considered as the most representative natural apple cell wall analogue. Chemical analysis confirmed that this composite characterised similar chemical composition to natural apple cell wall composition. Microscopic observations shown cellulose microfibrils chaotically arranged in hemicellulose/pectin matrix.

The geometrical dimensions of model bacterial cell walls materials enabled to test mechanical properties. Uni-axial tensile test was applied to investigations of mechanical properties of the materials. Supplementation of bacterial cellulose by cell wall polysaccharides (pectin and hemicellulose) and increase of storage relative humidity caused decrease of secant modulus.

Model cell wall material can be used to simulation of external factors influence on cell wall physical properties and to simulation of processes which occurs on interface in natural plant tissue.

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STUDY OF AGING AND FRESHNESS OF FRUITS AND VEGETABLES BY THE SPATIAL-TEMPORAL SPECKLE CORRELATION TECHNIQUE

Lyudmyla Frankevych[1], Artur Zdunek[2]

[1]KarpenkoPhysico-Mechanical Institute of the National Academy of Sciences of Ukraine
5, Naukova str., Lviv 79601, Ukraine
e-mail: dep24@ipm.lviv.ua, luda@pavlo.org.ua
[2]Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin 27, Poland
e-mail: a.zdunek@ipan.lublin.pl

Introduction

Noninvasive testing of fruit and vegetable quality becomes an important condition of the human vital activity. This method allows us to define such important operational characteristics, as a storage period, a freshness level of fruits and vegetables, their transportation and preservation conditions and also mechanisms of cell ageing under influence of various external factors.

Recently, new laser scattering technologies were proposed for measuring the bioactivity level of botanical objects. The experimental results obtained with a help of these technologies have shown that the loss of humidity over time leads to the cell drying and to the decrease of cell particle mobility.

As against to known technologies, we have offered the spatial-temporal digital speckle correlation technique, which allows us to study time characteristics of biological surfaces with an area of a few square centimeters.

The aim of this research is application of the spatial-temporal digital speckle correlation technique for monitoring of quality changes of apples during shelf-life.

Correlation coefficient

To study the dependencies of correlation coefficient as a function of a botanical specimen ageing the digital speckle patterns of these specimens were recorded. Correlation coefficient is obtained by dividing this speckle patterns into M by N fragments and using the following equation:

$$C_{m,n}^{k\tau} = \left| \frac{\left\langle \left(S_{ij}^{t_0} - \left\langle S_{ij}^{t_0} \right\rangle \right) \cdot \left(S_{ij}^{t_0+k\tau} - \left\langle S_{ij}^{t_0+k\tau} \right\rangle \right) \right\rangle}{\sigma_{ij}^{t_0} \cdot \sigma_{ij}^{t_0+k\tau}} \right| \qquad (1)$$

where i,j is the pixel number in the m,n^{th} fragment of the digital biospeckle pattern; i=1,…,I; j=1,…,J; m=1,…,M; n=1,…,N; S_{ij} is the i,j^{th} pixel intensity;

k is the number of a biospeckle pattern; τ is the interval between two adjacent frames containing recorded biospeckle patterns; $\sigma_{ij} = \sqrt{\left\langle \left(S_{ij} - \left\langle S_{ij} \right\rangle \right)^2 \right\rangle}$ is the variance.

Due to homogeneity of biospeckle properties of each fragment of surface, the intensities of all correlation peaks have changed similarly. Therefore, the coefficient may be defined by using the equation:

$$C^{k\tau} = \left| \frac{\left\langle \left(S^{t_0}_{im,jn} - \left\langle S^{t_0}_{im,jn} \right\rangle \right) \cdot \left(S^{t_0+k\tau}_{im,jn} - \left\langle S^{t_0+k\tau}_{im,jn} \right\rangle \right) \right\rangle}{\sigma^{t_0}_{im,jn} \cdot \sigma^{t_0+k\tau}_{im,jn}} \right| \tag{2}$$

where im=1,…I,…,$2I$,…,MI; jn=1,…,J,…,$2J$,…,NJ.

Experiment and results

A device for the experimental consists of a He-Ne laser, an optical system for making laser ray wider and parallel, transition rings, a digital camera Sony XCD-710CR and a PC with software for image recording and correlation coefficient calculation. A time series of images of laser spot reflected from an object are taken. 25 images are taken with a time interval 15 Next, the correlation coefficient is calculated from the set of images.

24 apples were bought as one batch at local grower. Apples were stored in controlled atmosphere for 5 months prior to experiment. In laboratory material was stored in room conditions for 12 days and every second day measurements were performed. The graphical dependencies of the cross-correlation coefficient versus time of ageing were obtained. These dependences will be analyzed in order to find their changes with storage period.

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CELL STRUCTURE PARAMETERS OF THE POTATO TUBER PARENCHYMA TISSUE

Marek Gancarz

Institute of Agrophysics, Polish Academy of Sciences
ul. Doswiadczalna 4, 20-290 Lublin, Poland
e-mail: marko@ipan.lublin.pl

The microstructure has a big influence on the physical properties of tissue and defines usefulness of varieties to kind type of processing. Appoint of parameters describe the microstructure after harvest can be use in selection for further processing. Parameters of cellular structure for outer core of the potato tuber tissue were determined and presented in this paper. Tubers of six varieties: Bartek, Syrena, Tajfun, Triada, Ursus and Velox were tested. Cylindrical samples 10 mm in diameter and 1 mm thick were taken out from outer core. Images of the tissues without preparation were taken with optical confocal microscope. Technique elaborated earlier by the author was used to obtain images containing number of cells sufficient for statistical analysis.

As the result of analysis following average parameters of the cells surface were determined as: area A[μm^2], elongation E and distribution of them. Examinations have shown differences in size and shape of outer core cells that characterized examined varieties. The biggest mean value of cell surface area was obtained for Tajfun variety and the smallest for Triada variety. The cells of the Ursus variety ware most elongated and the cells of the Bartek and Triada varieties had smallest elongation.

Table 1. Mean values of the measured parameters for 6 varieties.

			Variety			
Parameter	Bartek	Syrena	Tajfun	Triada	Ursus	Velox
Area 10^3 μm^2	22,7	20,3	24,5	18,1	21,3	20,7
ci	0,8	0,5	0,6	0,6	0,6	0,5
E	0,32	0,33	0,34	0,32	0,35	0,33
ci	0,01	0,01	0,01	0,01	0,01	0,01

A – cell surface area, E – cell elongation, ci – coefficient intervals

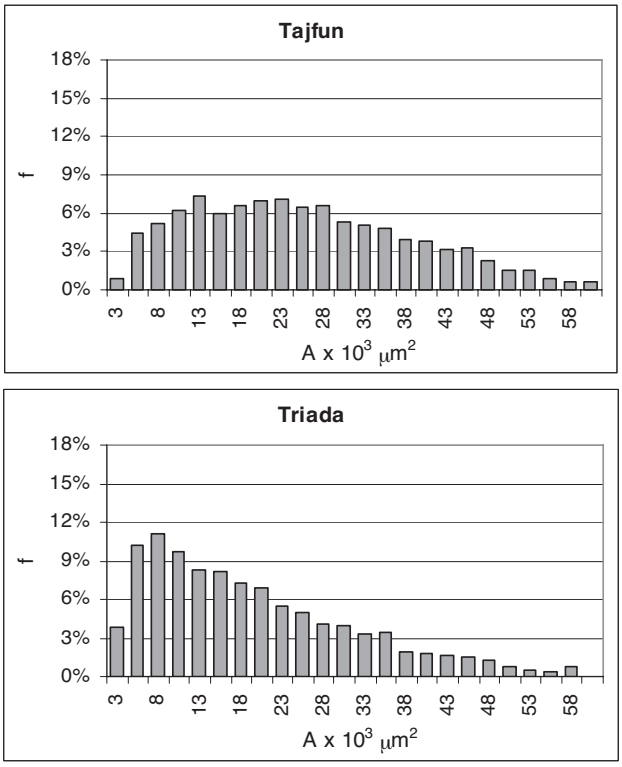

Figure 1. Sample distributions of cell surface areas for Tajfun and Triada varieties, f – frequency, A – area

Keywords: parameters of cell structure, parenchyma tissue of potato tuber, optical confocal microscope, image analysis

INFLUENCE OF HUMIC ACID (HA) ON *PISUM SATIVUM L.* LEAVES AND ROOTS ULTRAWEAK BIOLUMINESCENCE (UWBL)

Andrzej Gawlik, Dorota Gołębiowska*

Department of Physics, University of Agriculture
ul. Papieża Pawla VI 3, 71-459 Szczecin , Poland
*e-mail: gawlakggg@wp.pl

Influence of HA (applied in the form of spraying) on UWBL of leaves and roots of *Pisum Sativum* of variety Ramrod was studied. HA were extracted from low peat with 0,1 [mol dm^{-3}] NaOH. For spraying, solution of HA with concentration of carbon 0,01 [g C· dm^{-3}] in Michaeilisa buffer with pH 7,8 was used. $1cm^3$ of sprayed solution for one plant was applied started from 3rd week of plants growth. The plants spraying with Michaelis buffer only, without HA, were a control. All plants rise, started from January by 12 weeks in greenhouse, in conditions: (60-70) % of soil moisture and at the natural light. Whole experiment was repeated two times in the two weeks time distance. Every experiment was finished when plants attained 71 upgrowth phase in graduation BBCH (Biologische Bundesanstalt Bundessortenamt and Chemical industry).

UWBL from leaves and/or roots surface of *Pisum sativum* pants was measured by measuring system with photomultiplier K14FQS50 made by VEB Carl Zeiss and equipped by complete of limit filters tacked a spectral distance (340-720) nm. Measurement of UWBL from leaves and roots started after 45 min. of its incubation in obscurity. Leaves were tacked out from the level of 4 –5 internode, counting from apex of plant. Roots were cut and ranged on measured platter in this way that they covered closely part of platter surface. Then the whole surface was covered by screen with 1 cm^2 of aperture. Intensity of UWBL, from roots and leaves, were collected from the same surface. It permitted to compare the results. All data were elaborated with Statistica 7,1.program.

Comparative analyses of intensity and spectral composition of emitted light was made. Our results demonstrated that intensity of UWBL of leaves decreases under the influence of HA and the same of roots increase with comparison to control. Intensity of UWBL from roots is 4 to 5 times greater than the same from the leaves. We estimated also spectral composition of UWBL. Intensity of UWBL originated both from leaves and roots decreases statistically significatif under influence of HA in the (627-643) nm and (663-684)nm ranges of spectra. UWBL of roots under influence of HA increases in all short wavelength (345-435) nm range of spectrum when for leaves in the (486-504) nm and (523-541)nm spectral bands. The band (486-504) nm may be originated from oxidation of lipids and/or recombination of superoxide radicals. Emission in (523 to 541) nm range was observed from mitochondria [2,3]. Band emission

(627-643) nm is may be connected with oxygen dimmer radiant transition from singlet to triplet state. UWBL in the spectral range (663-684) nm is probably originated from exited prophyrins cycle [3].

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ATTEMPT OF AUTOMATIC X-RAY IMAGE ANALYSIS FOR DETECTION OF CEREAL GRAIN DAMAGE

Jarosław Grodek, Stanisław Grundas*

Institute of Agrophysics , Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: jgrodek@ipan.lublin.pl

Damage of grain, understood as the lack of continuity of its cells and/or tissues, may appear in result of action of external or internal forces affecting grain or in result of hidden infestation by pests, what takes place inside of the kernel, causing reduction of grain quality. ImageJ software (NIH) combined with X-ray imaging system may be used for identification of damaged kernels and for construction of rapid and accurate procedures for estimation of internal structure of grains and its quality. Image processing and segmentation based on macro language of ImageJ software is presented in this paper.

Keywords: ImageJ, roentgenogram, image analysis, cereal grain

Physical properties of cereal grain and knowledge of physical state of material let to design effective and accurate technological processes. Possibility of monitoring of processes of material's transformation in final product is necessary element of control according to rules of EU directives.

As the one of the most important plant materials, cereal grains supply a big part of human being energetic needs. Cultivation of common wheat covers acreage of circa 200 millions of hectares and plays a predominant role in the grain trade in global.

Among factors affecting quality of grain moisture content (MC) is the most significant. It shapes strength of kernels and resistance on destructing forces: internal –caused by gradient of moisture; and external – originated in harvest process and post harvest processing of ripen grain. MC also affects activity of the pests and pathogenic microorganisms and their development in storage bins. Changes of MC lead to origination of inner cracks, typical kind of grain's damage of endosperm [1, 2, 6]. Inner cracks reduce strength of grain. Kernels become more susceptible to damage in harvesting and post-harvest processing. Storage pests cause losses of weight of mass of grain and contaminate material by excrements and dead bodies [3, 5]. It enforces gradation of pathogenic microorganisms.

X-ray method is a reference one for study of physical state of grain. As non destructive method lets to examine internal structure of object and apply other methods of examination to object for better recognition of processes and factors

affecting of materials quality. Combined methods deliver information of physical state of grain.

Roentgenograms are the result of interaction of photons of radiation with substance. Photons of radiation are passing through, scatter or are absorbed by matter. According to Bouger-Lambert-Beer's law photons of radiation trespassing through the sample are absorbed by material [4]. Discontinuities of object are presented at the roentgenogram as the collection of points with brightness values lower than points representing non-destructed structures.

Analogue technique is expensive and time consuming and rapid methods of X-radiation detection should be used. Development of screening technology opens new horizons for modernization of X-ray technique. Digital detectors convert X-rays to the signal read directly by PC. Conversion is two-step process. First, photons of X-rays are converted to visible ones which are detected by optical detectors. Detectors can be used for construction of on-line systems of internal structure examination.

Resolution is one of the most important parameters of image. Digital direct roentgenogram has lower resolution, about 1000 dpi (a specially adapted devices offer results close to analogue version, circa 2000 dpi), limitation of spatial resolution of digital roentgenograms depends on semiconductor technology and materials for scintillators.

Digital Image Analysis (DIA) was used in many branches of science. Among software for image processing and analysis the attention should be paid to ImageJ (NIH Images). ImageJ (http://rsb.info.nih.gov/ij/) is written in JAVA and can be run on every computer platform (Linux, Mac OS 9, Mac OS X, Windows, and the Sharp Zaurus PDA). ImageJ and its Java source code are freely available and in the public domain, no license is required. It can operate on 8-bit grayscale or indexed color, 16-bit unsigned integer, 32-bit floating-point and RGB color images, supporting data types as TIFF (uncompressed) or as raw data, GIF, JPEG, BMP and ASCII and many other formats using plugins (info taken from http://rsb.info.nih.gov/ij/features.html).

Roentgenograms have poor contrast and low dynamic of image. Automatic image processing and analysis needs enhanced, preprocessed images. Enhancement of roentgenograms scanned on flatbed scanner is done with use of normalization, histogram equalization or gamma correction. Scanning process causes origination of artifacts oriented orthogonally according to direction of scanning. Direct or indirect formed digital roentgenograms are free of this defects but signal to noise ratio (SNR) has lower values. Noise reduction can be done by application of Noise/despeckle operation –with median filter (3x3).

IA PAS carried out experiments to constitute procedure of rapid and accurate image processing, analysis of identification of character of damage in cereal

grains. Micro focal X-ray apparatus “Elektronika 25” was used. Flat films (Kodak 150 X) were used as detectors. Kernels (30 pieces) were fixed on special glue-paper in size 6x7 cm, next X-rayed with soft X-radiation at 20kV and 60 μA for 2 min time of exposition. Negatives were developed and scanned on HP ScanJet 4c/T flatbed scanner with 75 dpi resolution and stored on HDD of computer in tiff format. Each discontinuity of object was represented on roentgenogram as the collection of points with lower brightness value than points representing non-destructed structure. Subtraction of image of destructed kernel from image of non-destructed one or approximation’s of image of non-destructed kernel let to extract maps of damage of object. Scanned images were enhanced by normalization, which is a process of changes of brightness values of pixels in picture to specified band. Next median filter was applied to reduce noise. It is typical for processing roentgenograms to use median filter, because of not decreasing the edge contrast of image objects. Processed image was filtered with mean filter. First step of features extraction was subtraction of median-filtered image from median and mean filtered image. Next threshold operation was applied to result image and particle analysis carried out. Binary image was used for damage map generation to visualize level of damage. Result of particle analysis was saved in xls format for further statistical analysis.

577 kernels were used for testing accuracy of automatic method for detection of damage in grain. Kernels were randomly chosen from samples of sound kernels and infested by granary weevil. 4 periods of infestation was used (5, 10, 15, 20 days) what assured occurrence of early stages of development of pest. Roentgenograms were analyzed according to procedure of proposed method. Table 1 presents results of analysis of number of infested kernels by use of automatic method. As the reference the human observations were used. Correlation coefficient was equal r=0.918. Enhancement of procedure (correction of parameters of automatic analysis) caused increase of correlation between results of enhanced automatic procedure and human observation (r=0.999).

Table 1. Number of infested kernels in dependency of time of infestation

Time of infestation, days	Number of infested kernels		
	Human observation	Automatic analysis	Enhanced automatic analysis
5	4	4	4
10	57	41	48
15	68	55	61
20	79	41	69

However, in both automatic analysis procedures many sound kernels were classified as infested (58 and 34 for automatic analysis and enhanced one, respectively). This suggests, that early stages of infestations (0-5 days of infestation) are difficult to detect and more experiments should be carried out to fit parameters of procedure for elimination of false positive infested kernels.

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DYNAMIC VISCOSITY OF PLUM JAM

Peter Hlavac

Slovak University of Agriculture in Nitra
Tr. A. Hlinku 2, Nitra, 94976, Slovakia
e-mail: Peter.Hlavac.MF@uniag.sk

The results from measuring of dynamic viscosity of plum jam are shown in this paper. Measuring was performed by viscosimeter Anton Paar (DV-3P). Measurements were done on different samples of plum jam, which were removed after different time of cooking. Measured values of samples cooked in different cauldrons (copper and enamelled) were compared. Dependencies of dynamic viscosity on time of cooking, time of storing and rotational frequency of probe are shown. The dynamic viscosity decreases with frequency of probe rotation and increases with storing time. The dynamic viscosity of plum jam increases with time of cooking. Values of dry matter content were determined according to standard. Time of cooking dependencies of dry matter content is described. Dry matter content had also influence on dynamic viscosity of used samples. Plum jam sample with longer time of cooking had higher values of dry matter content.

MICROSCALE MODELLING OF O_2 AND CO_2 DIFFUSION IN FRUIT TISSUE

Quang Tri Ho[1], Hibru K. Mebatsion[1], Bert E. Verlinden[1], Pieter Verboven[1], Stefan Vandewalle[2] and Bart M. Nicolaï[1]*

[1]BIOSYST-MeBioS, Katholieke Universiteit Leuven
Willem de Croylaan 42, B-3001 Leuven, Belgium
[2]Scientific Computing Research Group, Computer Science Dept., Katholieke Universiteit Leuven
Celestijnenlaan 200A, B-3001 Leuven, Belgium
*e-mail: quangtri.ho@biw.kuleuven.be

To extend their storage life, fruit are commonly stored under controlled atmosphere conditions in which the oxygen concentration is reduced and the carbon dioxide concentration increased. However, if the oxygen partial pressure is too low or the carbon dioxide partial pressure too high, the metabolism may change from aerobic to anaerobic and this may cause fermentation related physiological disorders like core breakdown and accumulation of fermentation volatiles. Optimal storage conditions are related to the respiratory activity and the gas exchange properties of the fruit. Gas filled intercellular spaces are considered the predominant pathways for gas transport through plant organs and, as such, are greatly related to the characteristics of gas exchange. In this contribution, a microscale model for the transport of gas in the intercellular spaces and the intracellular liquid phase was developed to better understand the transport mechanisms of gas transport in fruit tissue. The model was used to quantify the pathways of gas transport in relation to the microstructure of fruit tissue.

The 2D microstructure of pear tissue was modelled based on light microscopy images. The geometrcal model was generated using an ellipse tessellation method based on the geometrical properties of the tissue. Gas transport properties of the gas and liquid phases and the cell membrane were extracted from available literature data. A microscale model was constructed for O_2 and CO_2 transfer through the network system of intercellular spaces, cell wall and cytoplasm in the tissue. The gas transfer model in each phase was based on diffusion laws and irreversible thermodynamics. The model was numerically solved using the finite element method (Comsol 3.3, AB, Stockholm).

The results showed that the microscale model can be applied to study gas transport in fruit tissue. Macroscopic effective diffusion properties were predicted by means of micro scale simulations. The model quantified the pathways of gas transport in fruit tissue. The O_2 transport mainly occurred through the intercellular space and less through the intracellular liquid, while CO_2 transported in both phases.

Acknowledgements

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SELECTED PROPERTIES OF LEACHED FOREST-MEADOW CHERNOZEM POLLUTED WITH LEAD AND CADMIUM

Natalyja Hrebelna[1], Grzegorz Bowanko[2]*

[1]Agrarian University, Department of Ecology and Biology
V. Velykoho str., c. Dublyany, Zhovkva distr., Lviv reg., 80381, Ukraine
[2]Institute of Agrophysics, Polish Academy of Sciences
ul. Doswiadczalna 4, 20-290 Lublin, Poland
*e-mail: g.bowanko@ipan.lublin.pl

Contamination with heavy metals is of major concern because of their toxicity and threat to human life and environment. Much studies have been conducted on heavy metals contamination in soils from various anthropogenic sources such as industrial wastes, traffic emissions, mining activity and agricultural practice.

Soils are the receptors of large quantities of pollutants, such as heavy metals, being therefore key of environmental chemical cycles. The accumulation and mobility of heavy metals in soils are determined largely by the extent of their adsorption by soil particles. In particular, soil organic and mineral particles can bind toxic elements by formation of complexes. The retention of metals by soils, and consequently their availability to plants, are also influenced by pH and ionic composition of the soil solution. The relationship between the amount of metal adsorbed and composition of the soil is complicated due to solid phase heterogeneity and influence of soil solution chemistry. Metal coming from anthropogenic sources are environmentally unstable, thus more soluble and bioavailable than natural forms.

Lead and cadmium are important contaminants present in natural wastes which deleterious effect on various animals.

The aim of this work is to reveal properties of leached forest-meadow chernozem developed from loess responsible for accumulation of lead and cadmium and metal uptake by spring barley.

Experiment was set up on research field of Lviv State Agrarian University. The experimental area is $300m^2$ divided on 35 plots of $2m^2$. The phytotoxical effect of lead and cadmium on growth of spring barley was investigated at the contamination levels of 1, 5 and 10 of the Theshold Limit Value. Heavy metals were applied into top layer of soil as water salt solutions with different doses: 0, 32, 160, 320 mg/kg of soil for Pb ($Pb(CH_3COO)_2$) and 0, 3, 15, 30 mg/kg for Cd ($Cd\ Cl_2 \cdot 2{,}5\ H_2O$). The soil samples were taken from every 10 cm layers from the soil profile from 0-60 cm depth. The plants were taken at seedling, flowering and ripeness stages.

Basic chemical and physical properties of the studied soils were measured using routine laboratory analysis. Soil reaction was measured by potentiometer

with a combined glass/calomel electrode in 1 M/dcm^3 KCl and in H_2O at 1:2,5 (m:v) soil:solution ratio. Organic carbon was determined oxidometrically with potassium dichromate in hot sulphuric acid (modified Tiurin method) and the granulometric composition with the areometric Cassagrande method modified by Prószyński.

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LEAD AND CADMIUM CONTENT IN SOIL AND DANDELION PLANTS

Natalia Hrebelna[1], Alicja Szatanik-Kloc[2]*

[1]Agrarian University, Department of Ecology and Biology
V. Velykoho str., c. Dublyany, Zhovkva distr., Lviv reg., 80381, Ukraine
[2]Institute of Agrophysics, Polish Academy of Sciences
ul. Doswiadczalna 4, 20-290 Lublin, Poland
*e-mail: akloc@ipan.lublin.pl

Samples of soils and dandelion (*Taraxacum officinale L.*) plants were taken from 3 sites localized on degraded forest-meadow chernozem developed from loess (Przemyśl-Młyny, sites nr 1 and 2 and Przemyśl- Medyka, site 3). Sites 2 and 3 were arable lands (pH 6.43 and 6.60, respectively). Habitat nr 1 was grassland of pH=4.8 (in KCl).

Total cadmium and lead content was determined in the soils and different parts (roots, leafs and flowers) of dandelion plants using ASA method. The lead content was highest in upper parts of the plants from habitat nr 3. Cadmium content was highest in roots from habitat nr 1. No particular dependence of the content of the studied metals in plants and in the soil was found. The soil pH influenced only the cadmium content in plants – the lower the pH the higher the Cd content.

Detailed results are presented in the papers cited below.

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DRY MATTER EXTRACTION FROM VALERIAN ROOTS (VALERIANA OFFIANALIS) WITH HELP OF PULSED ACOUSTIC FIELD

Zbigniew Kobus

Agricultural University of Lublin
ul. Doświadczalna 44, 20-236 Lublin, Poland
e-mail: zbigniew.kobus@ar.lublin.pl

Valerian is one of the basic and widely cultivated herbal plants in Poland. Its medicinal properties have been already known in ancient Greece and Rome. Extracts from valerian are broad applied. The first main use of valerian is as a tranquillizer for people with a hyperexcitability. The second use of valerian is as a smooth-muscle relaxing agent. This action is applied to treatment of stomach and intestines cramp and so-called vegetative neurosis [2]. The valerian is also components of many herbal mixtures, which are widely used to treat sleeping disorders [1].

Method for obtaining bioactive compounds from valerian is maceration. Due to the instability of active compounds the process is conducted at temperatures between 20 and 30°C. The low temperature causes that extraction process is of a small yield and time-consuming. Hence, methods are being sought which will reduce treatment time and simultaneously increase yield of extraction. One of them may be using an ultrasound field [3, 4, 5, 6, 7]. However, continuous ultrasounds cause fast heating of treatment medium and require intensive cooling during extraction. Application of pulsed ultrasound slows down the increase of temperature in the treatment medium and, as a consequence, reduces costs of cooling.

The aim of this study was to investigate the influence of pulsed ultrasonic field on extraction dry matter from valerian roots and compare the results with classical method (maceration).

The research materials were roots of valerian. The raw material came from plantation located in the Lublin Upland, where it is widely cultivated. The valerian roots were grinded and next divided on fractions using laboratory sieving device. One fraction of particle size 0.25 mm – 0.5 mm was selected to the tests. Classical extraction was performed in thermostat by heating of solid-liquid mixture in Erlenmeyer's flask in temperature of 25 C. Solution was not stirred during heating. Ultrasonication was carried out using the ultrasonic processor (Sonic VCX 750) at frequency 20 kHz. It was applied pulsed mode of device working. The duration of pulsed impulse was 2s, and the interval between impulses was 1s. The total time of treatment was 15, 30, 45 and 180 minutes. The sonic power were as follow: 3,2 W/cm^2, 4,8 W/cm^2, 6,2 W/cm^2.

All experiments were performed on samples 10 g dispersed in 100 ml of water without additional stirring. The temperature of the medium during extraction was kept at 25±2 C. Separation was made by gravitation method using metal perforated plate with 0.15 mm of mesh diameter, funnel and Erlenmeyer's flask.

It was evaluated rehydratation coefficient, yield of extraction, dry matter content in residue, dry matter content in extract, energy consumption during ultrasonic extraction and unit consumption of energy for extraction 1g of dry matter from valerian roots.

The utilization of pulsed ultrasound has proven to be more efficient technique than maceration to extract bioactive components from dried valerian roots. The pulsed ultrasound had positive effect on the yield of extraction and dry matter content in obtained extract. The highest yield was observed after 180 minutes at 6,2 W/cm^2 sonic power. The effectiveness of ultrasonic field was also confirmed by decrease of dry matter content in residue. The lowest unit consumption energy was observed at the lowest of sonic power (3,2 W/cm^2).

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VISUAL TEXTURE ANALYSIS FOR QUANTIFICATION OF PLANT TISSUE CELLULAR STRUCTURE

Roman Konskyy[1], Artur Zdunek[2], Justyna Cybulska[2], Krystyna Konstankiewicz[2]*

[1]Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine
5, Naukova str., Lviv 79601, Ukraine
[2]Institute of Agrophysics Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin 27, Poland
*e-mail: frf@ipm.lviv.ua, romanko83@yandex.ru

The understanding the relationships between cell structure and mechanical properties is necessary for enhancing the quality of fruits and vegetables. The textural quality of these materials depends on cell size and cell shape spatial distribution. The fruits and vegetables tissue is very heterogeneous, therefore micro-structure parameterisation requires statistical information obtained from high number of cells. This approach is realised using different types of microscopes that give images which should be analysed in different way. At present the best results can be obtained using confocal laser scanning microscope which provides images relatively easy for segmentation. However, the segmentation is usually a critical step in quantification and very often is impossible due to high heterogeneity of objects within images, artefacts caused by sample preparation or optical features of a system used.

The aim of this research is applying visual texture analysis for quantification of plant tissue cellular structure images obtained by confocal laser scanning microscope (CSLM) and conventional transmission optical microscope (CTOM).

Visual texture analysis procedure bases on method developed by work of Devaux et al. (2005). Images are processed using *Closing* operator with increasing size of a square structural element. A total grey level *G(i)* is measured after each step and grey level variation *g(i)* is calculated using following equation:

$$g(i) = \frac{G(i) - G(i-1)}{G(0)}$$

An example of grey level variation for two images obtained from different potatoes is shown in Fig. 1. A size of the structural element at a maximum of the grey level variation relates to the size of the cells within images. Grey level variation will be correlated with actual 2D cell size within images obtained by automatic segmentation in the case of CSLM (Zdunek et al., 2004) and by semiautomatic segmentation in the case of CTOM (Konstankiewicz et al., 2001).

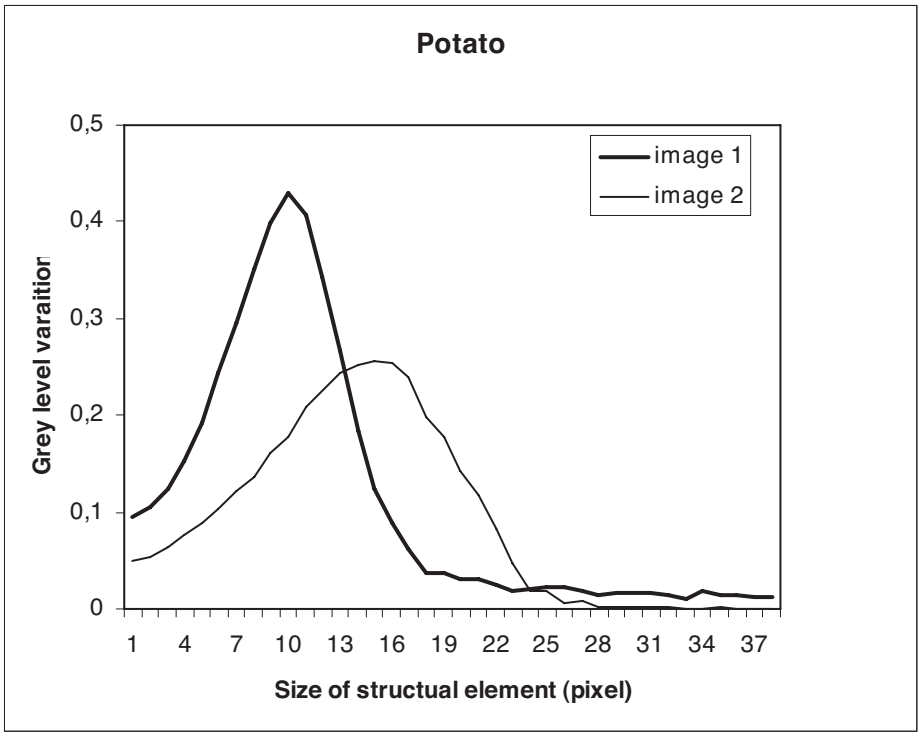

Fig. 1 An example of grey level variation for two images obtained from different potatoes.

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PEDOTRANSFER FUNCTION FOR ORGANIC SOILS OF POLESIE REGION

Mykola Korus[2], Cezary Sławiński[1], Barbara Witkowska-Walczak[1]*

[1]Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
[2]KarpenkoPhysico-Mechanical Institute of the National Academy of Sciences of Ukraine
Naukowa Str. 5a, 79053 Lviv, Ukraine
*e-mail: c.slawinski@ipan.lublin.pl

Among hydro-physical properties of soils there are two properties which play a fundamental role in forming the water balance of regions. They are the water capacity and the water permeability. It has been revealed that through the knowledge of these properties and their dependence upon various factors it possible to control the processes of water circulation in the biosphere. Therefore, they are responsible for the amount of water in the river systems, surface and underground water reservoirs and for the proper conditions of plant growth and development with consideration of the most efficient consumption of water.

Modelling is the means of prediction the water conditions forming within a region. The usefulness of models depends mainly on the accuracy of the data of hydrophysical soil characteristics, and for that reason the methods of their measurements were and still are extensively improved. The measurements of soil hydrophysical characteristics are time and labour consuming and they require special equipment. An alternative to the direct measurements is to estimate these characteristics with the use of pedotransfer functions. Whereas for the mineral soils there are many models, which enable to derive the water retention curve and the coefficient of water conductivity on the base of the knowledge of easily measurable physical parameters of the soil such as the bulk density, the aggregate size distribution, etc., then for organic soils these models can not be used due to differences in physical properties between these soils. Therefore, a necessity exists to investigate the impact of physical-chemical parameters on hydrophysical characteristics of organic soils to make it possible to elaborate their pedotransfer functions.

The aim of the investigation was to determine the dependence between the physical-chemical parameters of the organic soils from the Polesie region and their hydrophysical properties.

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THE EFFECT OF SOIL PROPERTIES ON TOXICITY OF LEAD AND CADMIUM ACCUMULATED IN SOIL

Olga Kosynets[1], Artur Nosalewicz[2], Grzegorz Bowanko[2], Alicja Szatanik-Kloc[2]*

[1]Agrarian University, Department of Ecology and Biology
V. Velykoho str., c. Dublyany, Zhovkva distr., Lviv reg., 80381, Ukraine
[2]Institute of Agrophysics, Polish Academy of Sciences
ul. Doswiadczalna 4, 20-290 Lublin, Poland
*e-mail: okosynets@ipan.lublin.pl

Cadmium and lead are the most widely spread heavy metals, and enter plants mainly through the root system. The uptake and integration of Pb and Cd into plants are affected by many environmental factors. Methods used to decrease toxicity of other heavy metals in soils usually are not sufficiently efficient to cadmium. Cd usually occurs as sulphide that is highly mobile in neutral soils, fixed by carbonates in acid soils. Sorption of Cd often occurs on clays and organic matter. Because of its high mobility, Cd can be highly accumulated in plant tissues therefore its transfer to the food chain imposes a serious threa. Pb is less mobile than Cd, for soils pH >6.5 it can be immobilized by carbonates and phosphates. Pb is also easily fixated by iron Fe and Mn.

The aim of the study is to compare soil properties affecting toxicity of lead and cadmium accumulated in polluted soil.

Two soils Haplic Phaeozem developed from loess and Leptic Podzol developed from hydroglacial sand were compared. The pH analysis was done by the potentiometric methods (in H_2O and KCl), organic carbon by Turin method, soil texture by Casagrande method with modification of Prószyński. Flow photospectrometer FIA- Star 5000 was used to determine phosphorus content. Results indicate higher content of clay and higher pH in Haplic Phaeozem than Leptic Podzol (Table 1) thus stronger effect of immobilization of heavy metals in the former.

Table 1. Selected soil properties.

	Haplic Phaeozem	*Leptic Podzol*
	0-20 cm	
Sand (%)	19	66
Silt (%)	57	22
Clay (%)	25	12
pH (KCl)	7.4	4.7
C_{org} (%)	0.9	-

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ASSESSMENT OF THE INFLUENCE OF MASS SHARES OF THE GRANULAR STRUCTURE ON THE RUN OF THE MIXING PROCESS

Jolanta Królczyk, Marek Tukiendorf*

Department of Agriculture and Forest Technology
Opole University of Technology
ul. S. Mikołaczyka 5, 45-271 Opole, Poland
*e-mail: jolantakrolczyk@wp.pl

The state of the knowledge concerning mechanisms ruling mixing multicomponent, non-homogenous process is still insufficient. Describing the mixing process, of which one of the factor is an influence of the participation of the randomization movement of particles is bringing additional problem with himself. In the article authors have made an attempt at describing the mixing process consisting of 10 different components differing in their characteristics, among others with sizes of seeds, densities or the shape. Cluster analysis has been used for the description of the process, which homogeneous subpopulations have been singled out from objects originating in the heterogeneous population. In the described case the heterogeneous population was a matrix of input data, in which each of the component of the mixture has been ordered to each results (percentage shares) obtained form the experiment during 30 mixing minutes. This research was carried out in industrial conditions in the vertical mixer with worm agitator of mass filling 2000 kg. Dendrogram analysis illustrating taxonomical distances between mixture component describe, which from the ingredients have the biggest influence on the run of this process in the examined device.

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THE PRE-CARPATHIAN SULPHUR-BEARING BASIN - RESEARCHES OF CURRENT IMPORTANCE OF TECHNOGENIC AREAS

Vitaliya Levik

Institute of Ecology of the Carpathians of the National Academy of Sciences of Ukraine
Kozelnitska 4, Lviv 79026, Ukraine
e-mail: vlevyk@ipan.lublin.pl

The Pre-Carpathian sulphur-bearing basin is one of the most abundant deposits in the world. It is located in the Pre-Carpathian Foredeep and occupied territory within Western Ukraine, South-Eastern Poland and partly Nothern Rumania. The exploitation of the Pre-Carpathian sulphur deposits was started in 50th of XX. The first sulphur mine was founded in 1950 in Rozdil (Ukraine). The following were founded about 30 mines, more famous of them are Jaworiw, Nemyriw, Podorozhne, Gymenets, Zhydachiw (Ukraine, Lviv and Iwano-Frankiwsk regions), Jeziorko, Machow, Bashnia, Grzybow, Piaseczno, Osiek (Poland, Staszow, Tarnobrzeg and Lubaczow regions). The sulphur was mining in the open pit and only from 1966 (sulphur mine in Grzybow) - by underground melting. These actions bring a negative influence in the environment. According to low profitability of sulphur ore extraction in the Pre-Carpathian sulphur-bearing basin the mining in Poland and Ukraine was closed in 90th XX. Then trend human actions are directed on restoration and reclamation of disturbed territories left after mining industry. Projects of mine reclamation in Jaworiw (Ukraine) and Machow (Poland) permit to form an artificial lake from the large hole by sulphur excavation and to create a zone for recreation.

Destroying of huge squares of natural landscapes, destruction of fertile soils, pollution of soils and underground water with sulphur compounds, changes of natural vegetation – these are the problems followed the mining in the Pre-Carpathian sulphur-bearing basin. Many Ukrainian and Polish researches are interested in such problems as formation of soil covering on the polluted and disturbed sulphur mine areas, aqua-physical and chemical properties of initial soils, biological processes being in soil matter and soil forming processes [2, 4, 6], water pollution with sulphur compounds [5], formation of vegetation covering [1], microorganism`s activity [7] and composition of mezofauna`s organisms [9]. Most of research works are considered problems of liquidation and restoration technogenic territories by agricultural and forestry recultivation [3, 8].

Following investigations of the soil biological processes, connected with a transformation substances and energy in the natural ecosystems and being the base of quality and fertility of soils, would give more information about relations between the stages of vegetation succession and physical and physico-chemical properties of soils formed on the territories of former sulphur mine. The results

of those investigations are important for prevision of time requisite for natural restoring of disturbed areas and for elaboration of practical recommendations for management of mine industry territories.

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INFLUENCE OF SOIL PHYSICAL PROPERTIES ON N_2O EMISSION FROM AGRICULTURAL SANDY LOAM SPODOSOLS

Sergey V. Pavlik, Eugeniy V. Balashov, Elena Y. Rizhiya, Natalya P. Buchkina*

Agrophysical Research Institute
14 Grazhdansky prospect, St. Petersburg, 195220, Russia
*e-mail: sergei-pavlik@mail.ru

All the countries, which have signed the Kioto protocol, agreed to monitor and reduce greenhouse gas emissions from different sources on their territories. Nitrous oxide is a greenhouse gas. It was estimated that almost half of the global N_2O emissions, 8.1 Tg N $year^{-1}$ out of 17.7 Tg N $year^{-1}$, were of anthropogenic origin, with agricultural soils contribution being as high as 4.2 Tg N_2O -N $year^{-1}$. However, these estimates are very uncertain as N_2O emission not only has high yearly variations but also depends on many soil properties including such soil physical properties as soil bulk density, soil water content and water filled pore space (WFPS).

The objective of our study was to estimate how different soil physical properties affect N_2O emission from cultivated sandy loam Spodosols containing different amount of soil organic matter.

Direct N_2O fluxes from the soil on the experimental site of the Agrophysical Research Institute (St. Petersburg region, Russia) were measured using the closed chamber technique. The studied plots were cropped with potato. The measurements were conducted from the end of April until early October in 2004 and 2005. There was one plot with soils containing 19 g C kg^{-1} soil in 2004 and two plots – with 16 and 21 g C kg^{-1} soil - in 2005. Ammonium nitrate, at a rate of 120 kg N ha^{-1}, was used as a source of mineral nitrogen for potato crop. Eight cylindrical PVC chambers were used on each plot: 4 on ridges and 4 in furrows. The closure period was normally 75 min. Gas samples were collected in glass vials two or three times a week. N_2O concentrations in the samples were measured in the laboratory with a gas chromatograph fitted with an electron capture detector.

Soil samples for bulk density and soil moisture content were collected every two weeks from the 0-10 cm layer in furrows and on ridges. Climatic factors most likely to affect the amount of N_2O produced in the soil were monitored during the experiment: daily rainfall and average, max. and min. air temperatures, and soil temperature at 10 cm depth on the days when the gas samples were collected. Soil samples for mineral nitrogen (NH_4^+ and NO_3^-) were collected once in two weeks.

The warmest months in both seasons were July and August with average air temperatures 15-20 ^oC. Annual rainfall was 1254 and 1013 mm in 2004 and 2005, respectively, with the rainfall from the beginning of May until the end of September being 750 mm in 2004 and 570 mm in 2005. Soil bulk density on

ridges was normally between 1.0 and 1.1 g cm^{-3} when in furrows it was reaching the values as high as 1.35 g cm^{-3}. At the same time water content was always higher in soils of furrows than in those of ridges. In 2004 maximum soil water content in the soil was 27 and 42% (of weight) for ridges and furrows, respectively. In 2005 this values were reaching 24 and 37 % (of weight) for the same locations. WFPS in the soils of the two locations was very different during the growing seasons of both years: in 2004 this parameter varied between 20 and 45 % for soil of ridges and between 20 and 86 % for soils of furrows. In 2005 these parameters were 13-28 and 16-37 % for ridges and furrows, respectively.

N_2O losses during the growing season of 2004 were higher, both for the soils of ridges and furrows, than during the growing season of 2005. It corresponded with higher rainfall in the growing season of 2004. Both years N_2O losses from the soils of furrows were higher than those of ridges. The N_2O losses had strong correlations to soil bulk density and soil WFPS. The higher these two values were the higher N_2O cumulative fluxes from the soil were registered.

In 2004 the cumulative N_2O fluxes for 5 months were 2.07 and 1.11 kg $N\text{-}N_2O$ ha^{-1} for furrows and ridges, respectively. In 2005 N_2O losses were higher from the soil containing higher amount of soil organic matter - 1.64 kg $N\text{-}N_2O$ ha^{-1} for furrows and 1.02 kg $N\text{-}N_2O$ ha^{-1} for ridges - than from the soils with lower organic matter content – 1.36 kg $N\text{-}N_2O$ ha^{-1} for furrows and 0.48 kg $N\text{-}N_2O$ ha^{-1} for ridges. Soils with higher amount of soil organic matter always had higher soil water content, both in soils of furrows and ridges, resulting in better conditions for N_2O production in the soil.

IMPACT OF DRYING TEMPERATURE ON THE CONTENT OF BENSO(A)PYRENS IN RAPESEEDS

Natalia Pits[1], Katarzyna Skiba[2], Jerzy Tys[2]*

[1]Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine
5 Naukova str., Lviv 79601, Ukraine
[2] Institute of Agrophysics, Polish Academy of Sciences
ul Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: frf@ipm.lviv.ua, nataliapits2007@yandex.ru

Key words: rapeseeds, drying, high temperature, benzo(a)pyrene.

Continued efforts towards increasing intensity of rapeseed growing is forcing the producers to apply such amounts of production improvers (fertilisers, etc) and to use such post-harvesting methods of processing and seed conditioning which are heavily affecting the nutritional value of seeds delivered for further processing. Rapeseed drying is one of the most important elements in the complex of activities referred to as the post-harvest processing. It is very often the case that the rapeseed drying facilities do not comply with the basic technical and exploitation standards.

Analytical material for the research was samples of rapeseed procured from producers in northern Poland, where the seeds are grown in their highest concentration. Determination of the benso(a)pyrene was conducted using the method based on highly efficient liquid column chromatography (the HPLC), using the liquid chromatograph.

The conducted research has demonstrated that the general contamination of rapeseed with benzopyrene - the main representative of the WWA family – exists at the level permitted by the world normative standards. However, there have been individual cases, especially of dried samples, where the B/a/P content was reaching 8,30 $\mu g \cdot kg^{-1}$ of seeds, which shows that the problem of the seed pollution by poly-nuclear aroma hydrocarbons is still unsolved while the raw material for further processing requires careful and continuous monitoring.

Monitoring the WWA risks seems indeed purposeful on account of the presence of the B/a/P in samples without post-harvesting processing.
It should also be noted that the B/a/P is only a fraction within the entire substance of the WWA family, and noteworthy is the fact that high temperature deteriorates this substance, which can successfully "blur" the real nutritional value of the seeds processed.

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TESTING PARAMETERS OF THE GRAIN OF THE RYE IN GRANARIES IN „OPOLE-WRÓBLIN”

Joanna Rut, Katarzyna Szwedziak, Marek Tukiendorf*

Department of Agriculture and Forest Technology
Opole University of Technology
ul. S. Mikołaczyka 5, 45-271 Opole, Poland
*e-mail: akcent70@op.pl

The rye is a plant typically fodder donated to animals. The grain of the rye is also being used in the cereal-miller's industry as the raw material for the production of flour (bright or dark), which is created from of different kind bread. The quality of the grain and the technological usefulness resulting from it and the permanence in keeping is different. He is depending on the variety of the cereal crop, the area and conditions of the cultivation, the prevailing weather during the harvest and the way of carrying sets. At taking the grain to granaries, as well as at serving the grain, a row of examinations testing parameters of the grain is moving. Grains of the rye belong to the most important qualitative characteristics: humidity, density, number of falling, useful and unusable pollutants. Having given parameters it is possible to carry a statistical analysis testing the quality of the taken and spent in granaries grain. Behind the help of methods of statistical forecasting having data concerning the taken grain it is possible to define the quality both of stored as well as served from magazines grain.

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EFFECT OF ULTRASONIC TIME ACTION ON SOIL SAMPLE DISPERSION

Magdalena Ryżak

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
e-mail: mryzak@ipan.lublin.pl

Particle size distribution affects many physical soil proprieties and processes taking place in soil. On the basis of solid phase parameters of soil, such as particle and aggregate size distribution, one can estimate the basic hydrophysical characteristics of soil - water retention and water conductivity coefficients in the saturated and unsaturated zone. Particle size distribution is also the basis of soil texture classification.

Soil samples should be prepared before particle size measurements. The procedure of sample preparation has to assure the stability of results in time, i.e. soil aggregates should not break up under peptisation during the measurement. The procedure of sample preparation for measurements involves soil dispersion, which is most frequently achieved in two ways: chemical and mechanical. Chemical dispersion consists in the addition of suitable surfactants to the sample, to prevent flocculation during the sedimentation of the soil particles. Mechanical dispersion consists in mixing the sample with the use of different kinds of stirrers (this way of dispersion is usually applied in combination with chemical dispersion) or in subjecting the sample to the effect of ultrasounds. The ultrasonic dispersion of a sample consists in the transmission through soil solution of a sound wave with suitable frequency which is needed to break up aggregates naturally occurring in soil sample. The ultrasonic action not only dissagregates the particles but also break individual particles and the excessive sonification may cause the grain fracturing or floculation/aggregation.

The aim of this work was to evaluate the influence of sonification on soil samples and to determine the minimum time action of ultrasonic which assure the stability of results in time.

The measurements were conducted on soil samples coming from profiles of: Mollic Graysols, Orthic Rendzina, Haplic Phaeozem and Haplic Luvisols. The measurements of particle size distribution by means of laser diffraction method were performed with the Mastersizer 2000 (Malvern Instruments) which measures particles in a wide range of 0.02 μm – 2.0 mm. The measurements were conducted in liquid dispersion, in distilled water with refractive index for light equal to 1.33. In the calculation of particle size, the Mie theory which describes the interaction between laser light and matter (by dint of exact solution of Maxwells equations) was used.

Analysing the results of measurements one should conclude that minimum time action of ultrasonic, which assure the stability of results in time, averaged from 5 to 15 minutes and was dependent on the type of soil and the way in which soil samples were prepared before measurement.

NON-CONTACT LASER-BASED ULTRASONIC COMPUTERIZED TOMOGRAPHY (PROBLEMS OF REALIZATION)

Roman Sharamaga, Volodymyr Koshovyy, Oleg Mokryy*

KarpenkoPhysico-Mechanical Institute of the National Academy of Sciences of Ukraine
5 Naukova str., Lviv 79601, Ukraine
*e-mail: sharamaga@ipm.lviv.ua, koshovyy@ipm.lviv.ua

The problem of material characterization, i.e. non-destructive evaluation of volume distribution of material physico-mechanical properties of material is actual one for the decision of tasks of evaluation of quality both industrial products and products of farm production. In this sense one of the most informative technologies are diagnostic technologies which are based on principles of ultrasonic computerized tomography (USCT). The row of such technologies and facility is developed at Karpenko Physico-Mechanical Institute (PMI) of the National Academy of Sciences of Ukraine (Lviv).

Practical application of the USCT technologies for the control of quality of industrial wares and products presently is complicated, including because of the limitations conditioned by the problem of contact generating/receiving of ultrasound. Progress in this direction it is possible to attain by application of non-contact methods of generating/receiving of ultrasound. The development of such methods which are based on application of laser technique and are adapted for the decision of tasks of industrial application of the USCT technologies, begun at Karpenko PMI. The given report is devoted to presentation of basic technical problems which it is here necessary to decide, and to presentation of some results which it is succeeded already to get.

Basic technical problems are related to the decision of problem of influencing of vibrations and roughness of surface on the laser components of generating/receiving of ultrasound. In the given work for the receiving of ultrasound the modified laser Michelson interferometer have been developed, analysis of its work was conducted on the basis of the developed numerical model. As a result of the analysis the concrete methods of diminishment of influencing of vibrations and roughness of surface were offered. A method for the removal of dependence of sensitiveness of the Michelson interferometer from the difference of optical ray's path has been developed. The numerical modeling of this method was conducted. It was shown possibility of practical realization of registration of ultrasonic vibrations on a rough surface. Applying the developed principles and methods a high sensitiveness is attained during registration of ultrasonic vibrations that allows using them in the tomographic systems.

THE INFLUENCE OF DRAINAGE SYSTEMS OF A NATURE PROTECTION ZONE OF NATIONAL FLEET « BELOVEZHSKAYA PUSHCHA » ON WOOD PHYTOCENOSIS'S MOISTURE

Nikolay Sheshko

Brest State Technical University
Moskovskaya street, 267, Brest, Belarus
e-mail: optimum@tut.by

As a result of large-scale drying melioration in the 70th years of the last century for agricultural use very wet grounds adjoining to National park «Belovezhskaya Pushcha» were drained. Meliorative systems arrange on former marsh masses. Drainage of marsh masses has led to partial change of typical structure of a forest stand in adjoining territories. In the beginning of a current century in conducting of National park these grounds are transferred, and their status is changed. Proceeding from it, the estimation of influence of existing meliorative systems on a water mode of soils of these grounds and on phytocenosis National park is necessary. In present days physical and the obsolescence of meliorative systems has already stepped. Besides their operation is unsatisfactory because more than 40 % of spending channels are in silty condition. During the spring periods at the passing of a drain of thawed snow in silty channels backing is formed. For this reason flooding root system of adjoining large forests by soil subsoil waters is observed. Thus, generated phytocenosis is oppressed and their class of growth is decreases.

The numerical experiment lead by us has allowed to appreciate influence of existing drying systems on a water-air mode soil of these territories and to develop actions on optimization of parameters of existing meliorative systems. It is defined that as a result of change of a mode of levels on adjoining meliorative systems on 0,5 m a zone of their influence comes to 2500 … 3500 m depending on mechanical structure of silty grounds.

HYDROCHEMICAL COMPOUND OF AN UNDERGROUND DRAIN

Marina Shpak

Brest State Technical University
Moskovskaya street, 267, Brest, Belarus
e-mail: shpakm@tut.by

As a result of scale carrying out of land improvement in 60th years of the XX century the hydrochemical compound of an underground drain has changed. For an estimation of quality of underground waters it is subjected to the physical and chemical analysis. Judging about the comparison of results of the chemical analysis of water can speak about what changes have occurred and what condition of suitability there is water. Four objects have been taken for studying materials of researches: 1. meliorative system "Bylkovo" Zhabinkovsky area, 2. meliorative system "Diatlovichi" Drogichinsky area, 3. meliorative system "Morochno" Stolinsky area and 4. meliorative system "POMZ" Luninetsky area.

Engineering researches have been lead on investigated objects at primary meliorative land development and then at reconstruction of meliorative systems (1. Zhabinkovsky area - 19.02.1976 - 29.09.2005; 2. Drogichinsky area - 29.04.1997 – 10.15.2005; 3. Stolinsky area - 29.04.1969 - 25.05.2006; 4. Luninetsky area - 1.06.1974 - 18.07.2006). Analyzing the results of the chemical parameters have received following: *pH* - on three systems (1, 3, 4) the reaction of environment has remained neutral, the fourth (2) - from rigid has been changer into neutral; *the general rigidity* - has not changed on 1, 3, 4 and has been increased twice on 2 system; *aggressive carbonic acid* hasn't changed 2 and in 3 meliorative systems, has decreased in 1,8 times and in 4,1 times on 4 and 1 systems, accordingly; CO_2 - on 1, 3, and to 4 systems has not changed and has increased on 2 meliorative system in 2,2 times. Quantity of ions *Ca, Mg, Cl,* SO_4, HCO_3, *Na+K* has not changed essentially.

HUMIDITY MODELLING OF THE RIVERS BASINS OF THE WESTERN POLESIE FOR VARIOUS VARIANTS OF THE CLIMATE CHANGE IN THE FUTURE

Natalia Shpendzik

SSE The Polesie Agrarian Ecological Institute of the National Academy of Sciences of Belarus
Moskovskaya str. 204, 224020 Brest, Belarus
e-mail: shpendik@tut.by

Humidity of basins and amount of heat are the major factors of ecosystems formation. Predicted change of climate, undoubtedly, will disturb developed balance on the rivers basins that will cause also changes in formation of river ecosystems.

Using the hydro-climatic method based on the joint solution of water and thermal balances of river basins, we execute numerical experiment for estimation of humidity change of basin for various variants of the future climate changes. In particular variants of increase of annual air temperature up to 2^0C and reduction of atmospheric precipitation up to 10 %, and also their various combinations were considered.

At most adverse of considered variants (the increase of air temperature up to 2^0C and reduction of atmospheric precipitation by 10 %) depending on kinds of a spreading surface humidity will decrease on the average from 5 up to 20 % from the modern level.

Predicted warming of the climate will cause the next negative reaction both whole water ecosystems and their separate parts. Especially it will affect on bottomland of the rivers - the most sensitive landscapes, here changes are the most essential.

VERTICAL DISTRIBUTION OF SOYBEAN ROOTS IN RELATION TO SOIL COMPACTION AND MULCHING

Anna Siczek, Jerzy Lipiec*

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: a.siczek@ipan.lublin.pl

Soil compaction directly affects various physical properties. The most important for plant growth are: pore size distribution, aeration, water content, strength and temperature. Common root response on excessive mechanical impedance is change in root distribution in soil profile (shallow rooting depth and horizontally rather than vertically growth). This results in smaller water and nutrient uptake from deeper layers and consequently in reduction of yield. Moreover the plant roots grown in severely compacted soil have a greater diameter, a higher degree of flattening and an irregular surface with distorted epidermal cells.

Some of the soil physical conditions important for plant growth can be improved by surface mulching. It dampens the influence of environmental factors on soil by temperature amelioration, water conservation and improvement stability in the topsoil.

The aim of ours study was to determine the effect of soil compaction and mulching on vertical distribution of soybean roots in soil profile.

Studies were conducted at the experimental field of the Lublin Agricultural University in Felin (51˚15'N, 22˚ 35'E), Poland. Long-term annual mean temperature is 7.4˚C and mean precipitation averages 572 mm. The soil was an Orthic Luvisol developed from loess.

The experimental area was 256 m^2 divided into 3 sections consisted of 6 micro-plots (7 m^2). In each section soil compaction was obtained through passes of tractor (2300 kg): 0, 3 or 5 passes 2 weeks before sowing. This resulted in a wide range of soil bulk density (1.2 to 1.65 Mg m^{-3}). After soil compaction and prior to sowing the entire plot area was tilled with a cultivator-harrow to a depth of 5 cm. "Aldana" soybeans were sown on 9.V.2006 with interrow spacing 30 cm. Immediately after sowing half of each micro-plot was mulched with straw chopped into approximately 2 cm long pieces, at an amount of 0.5 kg $m^{2.}$

Soil samples for root measurements were taken from the rows from each soil treatment at the beginning pod stage of soybean. A probe with a sampling tube 10 cm long and 7 cm in diameter was used for sampling. The plants and any loose residue on the soil surface were removed at the sampling site. The sampling tube was centered over the plant and the samples were taken to a 40 cm depth. Roots were washed and then fresh and dry matter (after drying at 60 ^{O}C for 48 h) was

measured. Roots were scanned and root length and diameter were determined by using image analysis system.

Totally soybean roots length in samples was the highest under plots without passes and with mulching. As regards plots with 3 and 5 passes higher length was observed in plots without mulch than with mulch. Regardless of soil treatments the greatest contribution of roots with diameter 0.15-0.3 mm was recorded. This root diameter is considered as favourable to plant growth because fine roots are more efficient in water and nutrient uptake. Root length layer was changed with soil depth (up to 40 cm) and it was considerably higher in layer 0-10 cm than in deeper layers in all treatments.

SIGNIFICANCE OF PARTICLE ELONGATION IN A PARTICULATE ASSEMBLY UNDER UNIAXIAL COMPRESSION - DISCRETE ELEMENT MODELING

Joanna Sykut[1], Marek Molenda[1], Jin Ooi[2], John Favier[3]*

[1] Institute of Agrophysics Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
[2] Departament of Civil and Environmental Engineering, University of Edinburgh, UK
[3] DEM Solutions Ltd., Edinburgh, UK
*e-mail: jsykut@ipan.lublin.pl

The increasing interests on particulate materials in numerous branches of industry (cosmetic, pharmaceutical, mining, food, agriculture etc.) result in intensive examinations of the properties of these particulate materials. In agriculture, the typical granular plant materials are grains and seeds. Improving the understanding of the behavior of these materials provide opportunities to optimise the industrial handling processes including harvesting, seeding, conveying, storing and transporting.

One of the most important factors that can influence the processes is the packing structure of the particulate assembly. The packing structure may be affected by the method of deposition, the mechanical properties of the individual grains (modulus of elasticity, friction coefficient, etc.) and the geometrical parameters of the grains (size, shape). The majority of agricultural seeds (e.g. rye, oat) have ellipsoidal shapes with various elongation. Rapeseeds and soybeans have shapes close to spherical. This study will explore the influence of particle elongation using the discrete element method.

The structure of assembly can affect strength, stress-strain relationship, loading response, flow pattern and other processes [1, 3, 4, 5]. The density of assembly and its packing structure is related to the coordination number (number of contacts for each particle) and porosity.

Both, experimental [5, 7] and numerical [2, 6] methods are commonly applied to investigate the fabric of grain assembly. The objective of this study is to analyse the effect of particle shape on uniaxial compression test through application of Discrete Element Method (DEM). DEM is a computational technique for investigating granular matter based on computing individual interparticle interactions. The commercial software EDEM was used for this research.

The simulations for spherical and elongated particles were conducted. The elongated particles were composed of 2 or 3 overlapping spheres providing aspect ratios of 1.6 and 2.1. Uniaxial compression test in a rectangular box filled with monosized particles was modeled with the top lid compressing with a constant speed up to the vertical lid pressure of 100 kPa. A series of numerical tests for assemblies

with thickness equal to 3 times the particle length was conducted and compared. The mechanical parameters of rapeseed of 15% moisture content were adopted in all the simulations.

Increase in the aspect ratio of grains from 1.0 to 1.6 showed a 25% decrease in the lateral pressure ratio. Further elongation of particles did not affect stress transmission in system.

The change in porosity with loading appears to be independent of particle elongation while coordination number increased significantly with aspect ratio of particles from 1.0 to 1.6. Further elongation of particles had no influence on coordination number of grains. Further interpretation of experimentally observed effects with further numerical investigations is continuing to provide further insight into the particulate assembly.

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MICROBIOLOGICAL ACTIVITY OF POST-BOG SOIL FILTERS DURING WASTEWATER TREATMENT

Paweł Szarlip, Teresa Włodarczyk, Urszula Kotowska, Małgorzata Brzezińska*

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: pszarlip@ipan.lublin.pl

Soil dehydrogenase and catalase activities were measured in post-bog soils planted with willow and grasses and periodically irrigated with municipal wastewater. Simultaneously, soil redox potential (Eh) as well as nitrate and ammonium concentrations in drainage waters were determined. The changes of soil microbial activity and Eh significantly depended on soil type, soil depth, plant cover, and wastewater dose. Stimulation of activity of oxidoreductases was observed in soil underneath willow, especially in deeper soil layers (30-70 cm, $P<0,001$). The efficiency of soil filters to elimination of biogenes was up to 91% for ammonium and up to 86% for nitrate (under willow and under grasses, respectively). Based on composition of drainage waters inflowing the Bystrzyca river, post-bog soils retained >60% and >85% of N- and P-forms, respectively, that were introduced into the soils with wastewater.

USING THERMAL ANALYSIS FOR DISCRIMINATION OF β-GLUCANS FROM DIFFERENT SOURCES

Anežka Veselá[1,2], Jana Ederová[2], Andriy Synytsya[1], Jana Čopíková[1]*

[1] Institute of Chemical Technology, Department of Carbohydrate Chemistry and Technology
Technická 1905, 166 28 Prague 6, Czech Republic
[2] Institute of Chemical Technology, Central Laboratories – Laboratory of Thermal Analysis
Technická 1905, 166 28 Prague 6, Czech Republic
*e-mail: anezka.vesela@vscht.cz

Different polysaccharides and their derivatives can be distinguished by thermal analysis according to the mechanism of their decomposition [1]. Thermogravimetry (TG) and differential scanning calorimetry (DSC) have been widely used for this purpose. TG is a technique whereby a sample is continuously weighted as it is heated at a constant, preferably linear, rate. DSC is a thermal technique in which the heat effects associated with physical or chemical changes are recorded as a function of temperature or time as the substance is heated at uniform rate.

β-Glucans are common cell wall polysaccharides of cereals, yeast and mushrooms. These are linear or branched polymers of glucose units connected by β(1→3), β (1→4) and β(1→6) glycosidic linkages. These polysaccharides can be used as soluble fibres in human diet. DSC and TG measurements of β-glucans were made in inert atmosphere. Both endothermic and exothermic events can be observed in DSC thermograms. The low temperature endotherm is usually caused by evaporation of water, while other processes at higher temperatures can be ascribed to thermal decomposition of β-glucans. Endothermic peaks may correspond to depolymerisation of polysaccharide chains with formation of char and volatile low molecular products; exothermic peaks may result from cross-linking reactions occurring during the thermal degradation and following thermal degradation of a new cross-linked material [2]. Structure of □-glucans varies depending on their sources, so thermal analysis could be useful tool for their discrimination due to different decomposition mechanism.

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INFLUENCE OF PHOSPHATES ON POTENTIOMETRIC TITRATION CURVES OF SOIL ORGANIC MATTER – METHODICAL ASPECT

Patrycja Warchulska, Zofia Sokołowska, Grzegorz Józefaciuk*

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: p.warchulska@ipan.lublin.pl

Among many methods of getting information on properities of acidic groups, potentiometric titration is frequently used. A back titration method has been applied for the determination of the dependence of variable surface charge Q versus pH.

The back titration measures the titration curve of organic matter suspension and titration curve of its equilibrium solution, starting from low pH. The titration curve of humic acid (HA) has been determined by substarction of the pH curves of equilibrium solution from the pH's curve of suspension. The total proton consumption Q, which accompanies the rise of pH from its starting value is a measure of variable surface charge.

The main objective of these investigations was found optimum conditions, technical parameters for titration processes and also tried to define change of surface charge under the influence different concentrations of phosphates.

In this purposes, model solutions of humic acid (Fluka HA) based on sodium chloride and equilibrium solutions of sodium chloride without HA were made. All samples contained increasing HPO_4^{2-} concentrations.

All investigations were carried out using Titrino 702 (Metrohm). Samples were titrated using 0,1 M sodium hydroxide solution based on sodium chloride (0,5 M and 1M) in wide range of pH (3 – 11).

Process was difficult to execute from technical side:

- Phosphates in aqueous solution created buffer systems, which could extend total time of titration and could disturb analytical signal.
- Presence of phosphates in solution may be also reason that equilibrium state, at some of pH range, was not reached and different interferences may be occur.

With the purpose of minimize noises and get the best measuring signal, effect of series factors were investigated e.g. volume step [ml], potential drift [mV/min], sodium chloride and phosphates concentration, equilibrium time.

On the basis of obtained curves surface charge of humic acid was preliminary determined.

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QUANTITATIVE AND QUALITATIVE DETERMINATION OF SOIL SALINITY

Andrzej Wilczek, Jolanta Cieśla, Wojciech Skierucha*

Institute of Agrophysics, Polish Academy of Sciences
ul. Doświadczalna 4, 20-290 Lublin, Poland
*e-mail: a.wilczek@ipan.lublin.pl

The presence of mineral primary nutrients (nitrogen, phosphorus and potassium) and secondary nutrients (calcium, magnesium, sulfur or sodium) in the soil is essential for plant production but their excessive presence can deplete production or cause environmental pollution. Water is taken up by the fine roots of plants through the process of osmosis, which involves the movement of water from regions of low salt concentration (such as the soil) to regions of high salt concentration (such as the inside of root cells). When salt concentrations in the soil are high, the movement of water from the soil to the root is slowed down. When the salt concentrations in the soil are higher than inside the root cells, the soil will draw water from the root, and the plant will wilt and die. This is the basic way in which salinization affects plant production. The damaging effects of salt on plants are caused not only by osmotic forces, but also by toxic levels of sodium and chloride.

Electrical conductivity (EC) of soil solution (σ_w) or the 1 : 5 volumetric mixture of soil and distilled water are reliable indicators of its solute (cation or anion) concentration in the soil [4]. Measurements of effective (bulk) electrical properties of soils started at the end of 19th century and the practice of measuring effective (apparent) electrical conductivity (ECa or σ_a) a step in assessing soil salinity, has been spreading continuously. In the last two decades, another significant incentive for the determination of soil solution EC from ECa measurements has arisen from the possibility of simultaneous measurements of ECa and soil volumetric water content (θ) by the time domain reflectometry (TDR) method [2,3,5]. The the variales θ and σ_w are indeed the major factors affecting σ_a, which provides the justification for using the $\sigma_w(\sigma_a,\theta)$ assessment.

The soil electrical conductivity measurements of soil salinity let us determine the total concentration of ions. Consequently, determination of content of particular ions in soil solution needs to use other methods.

The presented research is focused on the development of soil temperature, moisture and salinity monitoring system by its combination with electrochemical sensors – ion selective electrodes. The method is based on the measurement of electromotive force in a cell composed of electrode, which is sensitive on presence of analyzed ion (e.g. H^+, K^+, Na^+, NH_4^+, NO_3^-) and reference electrode. Ion concentration is calculated from potentiometric signal by use of Eisenman-

Nicolsky equation [7]. Laboratory tests of this method are concentrated on its correct cooperation with an existing system monitoring of soil physical and chemical parameters. Methodology of measurement is also important, especially taking into account an effect of soil environment factors, which could be a source of interferences (e.g. presence of other ions, charged soil colloids). An initial results [1,6] suggest that an application of potentiometric sensors for monitoring of chosen components of soil is possible.

The study presents laboratory experiments with the use of potassium selective electrodes installed in soil samples of different water content. Other parameters measured simultaneously were: water content (by TDR method), electrical conductivity and temperature of the soil sample. The results of this experiment also confirm the usefulness of ion selective electrodes in the measurement of ion concentration in the soil.

The study discusses dielectric measurement of soil electrical conductivity. Apart from TDR method, which calculates this value from the attenuation of the reflected pulse from the probe, there is also possibility to determine ECa of soil from the analysis of the imaginary component Im(ε) of the complex dielectric permittivity ε^* in different frequencies. Changing the frequency of the signal applied to the dielectric probe in the soil allows to separate other physical phenomena that influence the measured Im(ε^*), i.e. dielectric loss selectively measured in microwave frequencies, ionic and surface conductivity in lower frequencies.

Integration of electric as well as dielectric methods to calculate soil or soil solution electrical conductivity with ion selective measurements give not only quantitative but also qualitative information about the state of the soil solution.

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AIR VELOCITY IN MOUTH DURING COUGH

Josef Zeman

Czech University of Agriculture
Kamycka 129, Prague, 16521, Czech Republic
email: zemanj@tf.czu.cz

This paper describe the velocity measurment of coufing human expired gases in his mouth. Mentioned measure human is perform for breathing out only (expirations). Being done by breath of Pitot tube. In the following time analysis of the signal you can find importante physiology detail of the process. Comparable with the works of other autors and partly you will find dominant natural oscillation frequency of anatomic element. You haven't found yet in the subject publication.

AUTHORS

Olga V. Alokhina	Karpenko Physico-Mechanical Institute of National Academy of Sciences of Ukraine, 5, Naukova str., Lviv 79601, Ukraine	o.alokhina@ipan.lublin.pl
Alexandra Antoniuk	The Polesie Agrarian Ecological Institute of the National Academy of Sciences of Belarus, 204, Moskovskaya str., 224020 Brest, Belarus	ant_sash@rambler.ru
Eugeniy V. Balashov	Agrophysical Research Institute, 14 Grazhdansky prospect, St. Petersburg, 195220, Russia	
Piotr Bańka	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	pbanka@ipan.lublin.pl
Jiří Blahovec	Department of Physics, Technical Faculty Czech University of Agriculture, 165 21 Prague 6 – Suchdol, Czech Republic	blahovec@tf.czu.cz
Grzegorz Bowanko	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	g.bowanko@ipan.lublin.pl
Monika Božiková	University of Agriculture in Nitra, Faculty of Agricultural Engineering, Department of Physics Tr. A. Hlinku 2, 949 76, Nitra, Slovakia	Monika.Bozikova@uniag.sk
Małgorzata Brzezińska	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	m.brzezinska@ipan.lublin.pl
Natalya P. Buchkina	Agrophysical Research Institute, 14 Grazhdansky prospect, St. Petersburg, 195220, Russia	
Jolanta Cieśla	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	jciesla@ipan.lublin.pl
Jana Čopíková	Institute of Chemical Technology, Department of Carbohydrate Chemistry and Technology, Technická 1905, 166 28 Prague 6, Czech Republic	Jana.Copikova@vscht.cz
Justyna Cybulska	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	j.cybulska@ipan.lublin.pl

Jana Ederová	Institute of Chemical Technology, Central Laboratories – Laboratory of Thermal Analysis, Technická 1905, 166 28 Prague 6, Czech Republic	Jana.Ederova@vscht.cz
John Favier	DEM Solutions Ltd., Edinburgh, UK	
Lyudmyla Frankevych	Karpenko Physico-Mechanical Institute of National Academy of Sciences of Ukraine, 5, Naukova str., Lviv 79601, Ukraine	dep24@ipm.lviv.ua, luda@pavlo.org.ua
Marek Gancarz	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	marko@ipan.lublin.pl
Andrzej Gawlik	Department of Physics, University of Agriculture, s. Papieża Pawla VI 3, 71-459 Szczecin , Poland	gawlakggg@wp.pl
Dorota Gołębiowska	Department of Physics, University of Agriculture, s. Papieża Pawla VI 3, 71-459 Szczecin , Poland	Dorota.Golebiowska@agro.ar. szczecin.pl
Jarosław Grodek	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	jgrodek@ipan.lublin.pl
Stanisław Grundas	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	s.grundas@ipan.lublin.pl
Peter Hlavac	Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, Nitra, 94976, Slovakia	Peter.Hlavac.MF@uniag.sk
Quang Tri Ho	BIOSYST-MeBioS, Catholic University of Leuven, Willem de Croylaan 42, B-3001 Leuven, Belgium	quangtri.ho@biw.kuleuven.be
Józef Horabik	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	j.horabik@ipan.lublin.pl
Natalia Hrebelna	Agrarian University, Department of Ecology and Biology, V. Velykoho str., c. Dublyany, Zhovkva distr., Lviv reg., 80381, Ukraine	n.hrebelna@ipan.lublin.pl
Grzegorz Józefaciuk	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	g.jozefaciuk@ipan.lublin.pl

Zbigniew Kobus	Agricultural University of Lublin, Doświadczalna 44, 20-236 Lublin, Poland	zbigniew.kobus@ar.lublin.pl
Roman Konskyy	Karpenko Physico-Mechanical Institute of National Academy of Sciences of Ukraine, 5, Naukova str., Lviv 79601, Ukraine	frf@ipm.lviv.ua, romanko83@yandex.ru
Krystyna Konstankiewicz	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	k.konstankiewicz@ipan.lublin.pl
Mykola Korus	Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine, 5 Naukova str., Lviv 79601, Ukraine	m.korus@ipan.lublin.pl
Volodymyr Koshovyy	Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine, 5 Naukova str., Lviv 79601, Ukraine	koshovyy@ipm.lviv.ua
Olga Kosynets	Agrarian University, Department of Ecology and Biology, V. Velykoho str., c. Dublyany, Zhovkva distr., Lviv reg., 80381, Ukraine	okosynets@ipan.lublin.pl
Urszula Kotowska	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	u.kotowska@ipan.lublin.pl
Jolanta Królczyk	Department of Agriculture and Forest Technology, Opole University of Technology, ul. Sy. Mikołaczyka 5, 45-271 Opole, Poland	jolantakrolczyk@wp.pl
Izabela Krzemińska	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	i.krzeminska@ipan.lublin.pl
Vitaliya Levik	Institute of Ecology of the Carpathians of the National Academy of Sciences of Ukraine, Kozelnitska 4, Lviv 79026, Ukraine	vlevyk@ipan.lublin.pl
Jerzy Lipiec	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	j.lipiec@ipan.lublin.pl
Hibru Kelemu Mebatsion	BIOSYST-MeBioS, Catholic University of Leuven, Willem de Croylaan 42, B-3001 Leuven, Belgium	hibrukelemu.mebatsion@student.kuleuven.ac.be
Oleg Mokryy	Karpenko Physico-Mechanical Institute of the National Academy of Sciences of Ukraine, 5 Naukova str., Lviv 79601, Ukraine	

Marek Molenda	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	m.molenda@ipan.lublin.pl
Bart Nicolaï	BIOSYST-MeBioS, Catholic University of Leuven, Willem de Croylaan 42, B-3001 Leuven, Belgium	bart.nicolai@biw.kuleuven.be
Artur Nosalewicz	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	a.nosalewicz@ipan.lublin.pl
Jin Ooi	Departament of Civil and Environmental Engineering, University of Edinburgh, UK	J.Ooi@ed.ac.uk
Sergei V. Pavlik	Agrophysical Research Institute, 14 Grazhdansky prospect, St. Petersburg, 195220, Russia	sergei-pavlik@mail.ru
Natalia Pits	KarpenkoPhysico-Mechanical Institute of the National Academy of Sciences of Ukraine, 5 Naukova str., Lviv 79601, Ukraine	frf@ipm.lviv.ua, nataliapits2007@yandex.ru
Zbigniew Ranachowski	Institute of Fundamental Technological Research Polish Academy of Sciences, ul. Świętokrzyska 21; 00-049, Warsaw, Poland	zranach@ippt.gov.pl
Elena Y. Rizhiya	Agrophysical Research Institute, 14 Grazhdansky prospect, St. Petersburg, 195220, Russia	
Joanna Rut	Department of Agriculture and Forest Technology, Opole University of Technology, ul. St. Mikołajczyka 5, 45-271 Opole, Poland	akcent70@op.pl
Magdalena Ryżak	Institute of Agrophysics Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	mryzak@ipan.lublin.pl
Roman Sharamaga	KarpenkoPhysico-Mechanical Institute of the National Academy of Sciences of Ukraine, 5 Naukova str., Lviv 79601, Ukraine	sharamaga@ipm.lviv.ua
Nikolay Sheshko	Brest State Technical University, Moskovskaya street, 267, Brest, Belarus	optimum@tut.by
Marina Shpak	Brest State Technical University Moskovskaya street, 267, Brest, Belarus	shpakm@tut.by
Natalia Shpendzik	SSE The Polesie Agrarian Ecological Institute of the National Academy of Sciences of Belarus, Moskovskaya str. 204, 224020 Brest, Belarus	shpendik@tut.by

Anna Siczek	Institute of Agrophysics Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	asiczek@ipan.lublin.pl
Katarzyna Skiba	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	kskiba@ipan.lublin.pl
Wojciech Skierucha	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	w.skierucha@ipan.lublin.pl
Cezary Sławiński	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	c.slawinski@ipan.lublin.pl
Zofia Sokołowska	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	z.sokolowska@ipan.lublin.pl
Joanna Sykut	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	jsykut@ipan.lublin.pl
Andriy Synytsya	Institute of Chemical Technology, Department of Carbohydrate Chemistry and Technology, Technická 1905, 166 28 Prague 6, Czech Republic	Andrej.Sinica@vscht.cz
Paweł Szarlip	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	pszarlip@ipan.lublin.pl
Alicja Szatanik-Kloc	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	a.szatanik@ipan.lublin.pl
Katarzyna Szwedziak	Department of Agriculture and Forest Technology, Opole University of Technology, ul. Sy. Mikołaczyka 5, 45-271 Opole, Poland	kaszwed@po.opole.pl
Marek Tukiendorf	Department of Agriculture and Forest Technology, Opole University of Technology, ul. Sy. Mikołaczyka 5, 45-271 Opole, Poland	mtuk@po.opole.pl
Jerzy Tys	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	j.tys@ipan.lublin.pl
Stefan Vandewalle	Scientific Computing Research Group, Computer Science Dept., Katholieke Universiteit Leuven, Celestijnenlaan 200A, B-3001 Leuven, Belgium	Stefan.Vandewalle@cs.kuleuven.be

Pieter Verboven	BIOSYST-MeBioS, Catholic University of Leuven, Willem de Croylaan 42, B-3001 Leuven, Belgium	Pieter.Verboven@biw.kuleuven.be
Bert Verlinden	BIOSYST-MeBioS, Catholic University of Leuven, Willem de Croylaan 42, B-3001 Leuven, Belgium	bert.verlinden@biw.kuleuven.be
Anežka Veselá	Institute of Chemical Technology, Department of Carbohydrate Chemistry and Technology, Technická 1905, 166 28 Prague 6, Czech Republic	anezka.vesela@vscht.cz
Vlasta Vozárová	Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, Nitra, 94976, Slovakia	vlasta.vozarova@uniag.sk
Patrycja Warchulska	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	p.warchulska@ipan.lublin.pl
Jerzy Weres	Department of Applied Informatics, Institute of Agricultural Engineering, Agricultural University of Poznań, Ul. Wojska Polskiego 28, 60-637 Poznań, Poland	weres@au.poznan.pl
Andrzej Wilczek	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	awilczek@ipan.lublin.pl
Barbara Witkowska-Walczak	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	bwitwal@ipan.lublin.pl
Teresa Włodarczyk	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	t.wlodarczyk@ipan.lublin.pl
Artur Zdunek	Institute of Agrophysics, Polish Academy of Sciences, ul. Doświadczalna 4, 20-290 Lublin, Poland	a.zdunek@ipan.lublin.pl
Josef Zeman	Czech University of Agriculture, Kamycka 129, Prague, 16521, Czech Republic	zemanj@tf.czu.cz