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Contents

Biochemical Analysis of Soybean Cultivars from Burundi – a study of their total antioxidant capacity <i>Parfait Kezimana, Romanova E.V., Marakhova A.I., Gins V.K., Akossi J.P., Dranidis A.</i>	5
Transmission of Tomato chlorosis virus (ToCV) with biotype Q of Bemisia tabaci and evaluation of weed species as viral sources <i>Orfanidou C.G., Maliogka V.I. and Katis N.I.</i>	10
Aeroponic technologies for accelerated reproduction of breeding material, obtained by biotechnological methods <i>L.U. Martirosyan, A.A. Kosobrukhov, M.N. Poljakova, K.A. Koledenkova, U.Tz. Martirosyan</i>	12
Metabolomic and proteomic analysis revealed the influence of cytokinin-like compound CPPU (forchlorphenuron) on multiple steps of kiwifruit (<i>Actinidia deliciosa</i>) development and ripening <i>Aggeliki Anailidou, Aikaterini Karamanoli</i>	17
The role of 5'-Untranslated Region (5'-UTR) in mechanism of regulation heterologous gene expression in plants <i>Quimisse M.G., Kabardaeva K.V., Pakina E.N., Gra O.A., Mustafaev O., Sadovskaya N.S., Tyurin A.A.</i>	18
Towards understanding the superficial scald etiology in 'Granny Smith' apples: a physiological and molecular approach <i>Evangelos Karagiannis, Athanassios Molassiotis</i>	28
The study of papaya plant in the controlled environment <i>Sementsov I.E. , Pakina E.N.</i>	29
The role of zeolite for insect control: Evaluation of zeolite lethal effects on adults of <i>Acanthoscelides obtectus</i> Say <i>G. Floros, A. Kokkari, D. Lagogeridis, N.A. Kouloussis and D.S. Koveos</i>	35



Influence of organic cultivation technology on quality of a tea leaf <i>Kuvaeva A., Gresis V., Lyashko M.</i>	36
Effect of sewage sludge stabilized with steelmaking slag on yield and nutrients uptake of wheat and on soil properties <i>Eftihia Samara and Theodora Matsi</i>	39
Evaluation and selection of different varieties and lines of soy-bean for breeding for valuable traits in the Central European part of Russia <i>Shafigullin Damir, Romanova E.V., Gins M.S.</i>	40
Characteristics conformance evaluation of cheese within the Customs Union <i>Maryina N. A.</i>	43
Peculiar to the game mammals and wildfowl <i>Manchenko Varvara, Zhukova Daria</i>	47
Microencapsulation of probiotic strains for enhanced viability by complex coacervation and subsequent ionotropic gelation <i>Dimitrios Dourvanidis, Thomas Moschakis, Costas G. Biliaderis</i>	48
Investigation of the accuracy of satellite geodetic control for survey works <i>Batishcheva E. N.</i>	49
Fuel Type Mapping using Satellite Remote Sensing and Ancillary Geographic Data <i>Alexandra Stefanidou, John Getas</i>	52
Evaluation of genetically improved fast growing species and clones for biomass production and carbon sequestration <i>E. Malliarou, and F. A. Aravanopoulos</i>	53
International cooperation on certification and agricultural production quality management between Russia and Greece. <i>Antonova V.V.</i>	54



European Union Environmental Policies and Information and Communication Technologies <i>Christiana Koliouka, Zacharoula Andreopoulou</i>	59
“A business plan for the reorganization of the agrotourism enterprise "Ziogas Western City" <i>Kaplani Evanthia, Partheniadis Emmanouil and Iakovidou Olga</i>	60
Do consumers care for cooperative products via short food supply chains? <i>Aristotelis Batzios, Panagiota Sergaki</i>	61
Deformation Precursors of Strong Earthquakes Derived from GNSS Observation <i>V. Kaftan, A. Melnikov</i>	62



Biochemical analysis of soybean cultivars from Burundi – a study of their total antioxidant capacity.

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Abstract: The aim of this paper was to study the total antioxidant capacity of five soybean cultivars from Burundi. As known in plants like soybean there are some biochemical compounds such as phenolic acids, flavonoids and others, which contribute to its antioxidant properties. The antioxidant capacity of soybean from Burundi was studied using a flow-injection system with an amperometric detector. The higher antioxidant capacity was found in cultivar Yezumutima – $2,8 \pm 0,1$ mg. eq. gallic acid/g of soybean.

Key words: *antioxidant capacity, soybean*

INTRODUCTION

In Burundi, and indeed worldwide, soybean is regarded as an important and nutritionally rich food ingredient. Soybean is known as one of the main protein sources among legumes. Nevertheless, soybeans have been also gaining consideration among researchers due to its biochemical content that is why they have been many studies on clinical application of soybean [2, 6].

Antioxidant activity of chemical compounds such as polyphenolics and flavonoids, all of which are present in soybean can protect the human tissue from free radicals released from organs, thereby reducing oxidative stress [4,7]

Soybeans contain an impressive array of phytochemicals, biologically active components, the most interesting of them being isoflavones. Besides their antioxidants properties, isoflavones such as genistein and daidzein in the soybean seed have been studied in relation to the relief of certain menopausal symptoms, cancer prevention, slowing or reversing osteoporosis and reducing the risk of heart disease [3]



Since increased oxidative stress is identified as a major causative factor in the development and progression of several life threatening diseases, including neurodegenerative and cardiovascular disease, it became important to study the antioxidant potential of commonly produced plants, such as soybean. In soybeans, apart from flavonoids and phenolic, there are also several oxidase enzymes, such as lipoxygenase and peroxidase that are also implicated in the antioxidant metabolism.

The objective of this work was to study antioxidant capacities of extracts from five soybean cultivars, produced in Burundi using antioxidant testing device CvetYauza (ЦветЯуза) – a flow-injection system with an amperometric detector (fig 1.).



Fig 1. The device use to analyze antioxidant capacity.

MATERIALS AND METHODS

Plant material

The plant material used during the experiment, consisted of five soybean cultivars' seeds produced at ISABU (Institute of Agriculture sciences in Burundi). The names and characteristics of used cultivars are given in table 1.

Cultivars' characteristics.

Cultivar	Vegetation period, days	Plant height, cm	Seeds (color)	Yield, t/ha
Yezumutima	80-110	36	Brown	1,5-1,8
Soprosoy	80-105	36	White	2-2,5
Peka 6	90-115	37	Yellow	2,5-3,5
449/6/16	75-90	32	Yellow	2-2,7
Rial Nami	90-100	60	White	2-3,5



Sample preparation

Soybean seed (3 g) were powdered and extracted using hydrochloric acid. In order to determine the antioxidant capacity, beside the amount of various substances with antioxidant character present in soybean seeds, an important issue is their extraction from the sample, respectively the used solvent [1,9,11-12]. There are several solvents usually used to extract plant substances such as water, aqueous mixtures of ethanol, methanol, acetonitrile, acetone and hydrochloric acid. The nature and the concentration of the solvent used for extraction affects the antioxidant activity, that's why we choose to use HCl, given that the highest antioxidant activity was found by using as solvent the hydrochloric acid 2% [5].

Biochemical analysis – Antioxidant activity

To determine total antioxidant capacity of studied cultivars we used a flow-injection system with an amperometric detector (fig 1.), amperometric detectors are interesting because of their low limit of detection (10⁻⁹ - 10⁻¹²g) and selectivity [10, 13-15]. We evaluated the antioxidant capacity with Gallic acid as a standard. Gallic acid has a row advantage compared to other antioxidants of phenolic type: easily dissolves in water, is rather a pure substance (~ 98% from different producers), widely present in chemical content of many plants and is stable in water solutions. Its reductive properties, availability as a standard sample and the study of its chemical properties, allow to carry out recalculation of the sum of antioxidants on gallic acid.

According to a number of authors the use of gallic acid as a standard in an assessment of antioxidant activity provides correctness and uniformity of measurements [8].

RESULTS AND DISCUSSIONS

Antioxidant capacity

The results regarding the antioxidant capacity are shown in table 2.

Table 2. Antioxidant capacity (RA)

Table 2. Antioxidant capacity (RA)

Cultivar	RA, mg. eq. Gallic acid/g sample
Yezumutima	2,8±0,1
Soprosoy	2,2±0,1
Peka 6	2,5±0,1
449/6/16	1,9±0,1
Rial Nami	2,6±0,1



These data presented in table 2 shows that the antioxidant capacity of Yezumutima are higher than that of others cultivars, and it is in 449/6/16 that we found the lowest antioxidant capacity. The theory is that in Yezumutima there is a high antioxidant capacity due to the fact that there is some carotenoid in the seed coat. To prove the theory we are planning on doing another experiment when we will analyze the antioxidant capacity of the seed coat and the dehulled bean.

CONCLUSION

Our experiment helped us distinguish the differences in the antioxidant capacity within the soybean cultivars studied. The antioxidant capacity in soybean cultivars ranged from 1,9 to 2,8 mg. eq. gallic acid/g of soybean. The highest antioxidant capacity was found in cultivar "Yezumutima".

REFERENCES

1. Antolovich M., Prenzler P., Patsalides E., McDonald S., Robards K. Methods for testing antioxidant activity, *Analyst*, 2002. V. 127
2. Boudjou S, Oomah BD, Zaidi F, Hosseinian F. Phenolics content and antioxidant and anti-inflammatory activities of legume fractions. *Food Chem* 2013;138(2-3):1543-50.
3. De LML (2001). Effects of soy phytoestrogens genistein and daidzein on breast cancer growth. *Pharmacother.*, 35(9): 1118-1121.
4. Fritz KL, Seppanen CM, Kurzer MS, Csallany AS (2003). The in vivo antioxidant activity of soybean isoflavones in human subjects. *Nutr. Res.*, 23: 479-487.
5. Ionică M. E., Nour V., Trandafir I. Polyphenols content and antioxidant capacity of goji fruits (*lycium chinense*) as affected by the extraction solvents//*South Western Journal of Horticulture, Biology and Environment*. 2012. Vol.3. No.2.pp.121-129
6. Messina M, Mccaskill-Stevens W, Lampe JW (2006). Addressing the soy and breast cancer relationship: Review, Commentary, and Workshop Proceedings. *J. Ntl. Cancer Inst.*, 98(18): 1275-1284.
7. Prakash D, Upadhyay G, Singh BN, Singh HB (2007). Antioxidant and free radical-scavenging activities of seeds and agri-wastes of some varieties of soybean (*Glycine max*). *Food Chem.*, 104: 783-790.



In Russian:

8. V. M. Misin, I. V. Klimenko, T. S. Zhuravleva. O prigodnosti gallovoj kisloty v kachestve standartnogo obrazca sostava antioksidanta // Kompetentnost'. 2014. № 7. S. 46-51.
9. Lyubickij O.B., Gins M. S., Romanova E.V., Il'ina S.E., Potapov S.A., Abo Hegazi S.R.E., Gins V.K., Kononkov P.F. Issledovanie antioksidantnoj aktivnosti rastitel'nyh ehkstraktov// Trudy VI Mezhdunarodnogo simpoziuma «Novye i netradicionnye rasteniya i perspektivy ih ispol'zovaniya». - M.: Izd-vo RUDN, 2005. - T.III. - S. 360 - 362.
10. Misin V.M., Sazhina N.N., Zav'yalov A.YU., Yashin YA.I. Izmerenie sodержaniya fenolov v ehkstraktah lekarstvennyh trav i ih smesyah amperometricheskim metodom //Himiya rastitel'nogo syr'ya. 2009. № 4. S. 127-132.
11. Romanova E.V., Gins V.K., Magashi A.I. Antioksidanty ovoshchnyh rastenij // Vestnik RUDN., ser. Sel'skohozyajstvennyye nauki, Agronomiya. - 2002. - № 8. – S.48-51.
12. Summarnoe sodержanie antioksidantov fenol'nogo tipa v smesyah sokov yagod, fruktov i ovoshchej V. M. Misin, N. N. Sazhina, A. YU. Zav'yalov. // Pishch. promyshlennost'. Pivo i napitki. 2009. №4. S. 48
13. Chupahina N.YU., Tynutare T., Moor U. Sravnenie metodov analiza summarnoj antioksidantnoj aktivnosti // Vestnik Baltijskogo federal'nogo universiteta im. I. Kanta. 2012. Vyp. 1.
14. Yashin A.Ya. Inzhekcionno-protocchnaya sistema s amperometricheskim detektorom dlya selektivnogo opredeleniya an- tioksidantov v pishchevyh produktah i napitkah // Rossijskij himicheskij zhurnal. 2008. T. LII. №2. S. 130–135.
15. Yashin A.Ya., Yashin Ya.I., Chernousova N.I., Pahomov V.P. Ehkspressnyj ehlektrohimicheskij metod opredeleniya antioksidantnoj aktivnosti pishchevyh produktov // Pivo i vody. 2004. №6. S. 44–46.



Transmission of Tomato chlorosis virus (ToCV) with biotype Q of *Bemisia tabaci* and evaluation of weed species as viral sources

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Tomato chlorosis virus (ToCV) is a crinivirus (Family Closteroviridae) transmitted in the semi-persistent manner by the whitefly species *Trialeurodes vaporariorum*, *T. abutilonea* and *Bemisia tabaci* and is related with Tomato yellows disease (TYD). ToCV cannot be transmitted through seed; consequently, weed species play a significant role in its epidemiology. In Greece, the host range of ToCV includes 19 weed species (11 families) but their role as viral sources has not been evaluated yet. Initially, the transmission efficiency of ToCV was determined on its main host (tomato hybrid Belladonna) by adults of the biotype Q of *B. tabaci* by using different acquisition and inoculation access periods, as well as different numbers of whiteflies. Thereafter, 4 weed species (*Solanum nigrum*, *Sonchus oleraceus*, *Amaranthus retroflexus* and *Chenopodium album*) were evaluated as viral sources through transmission experiments by biotype Q. Both weeds and tomato plants (hybrid Belladonna) were inoculated with the virus using a high density of whiteflies and two weeks post inoculation, ToCV titer was calculated with quantitative (q) RT-PCR. Concurrently, infected plants were used as sources of ToCV in transmission experiments. Results revealed that most of the weeds showed a lower titer (Ct: 30,53-35,99) than tomato (Ct: 23,32) and the variation of the virus concentration was broader in weeds (3,65-5,47 Ct qRT-PCR), while it appeared narrower among tomato plants (1,42 Ct qRT-PCR). Moreover, tomato proved to be the best source for ToCV (transmission efficiency 70%) compared to weeds (ranged from 20-40%), while considerable differences were observed among the four weed species; *S. nigrum* was the best source of ToCV (transmission efficiency 40%), and *C. album* was the poorest (transmission efficiency 20%). These results underline the impact of alternative hosts of ToCV, such as weed species, in the epidemiology of TYD and should be considered when designing virus control strategies.



Aeroponic technologies for accelerated reproduction of breeding material, obtained by biotechnological methods

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Aeroponics is high-technological substrate-free way of plant cultivation with a special nutrient solution application. Aeroponics is agricultural instrument, which allows increasing plant productivity, improving production quality. And it is also environmentally friendly and completely safe for the health.

Aeroponic plant cultivation indoors eliminates the influence of seasonality, the usage of substrates, pests and fungal disease control agents. Aeroponics requires smaller amounts of nutrient solutions, water, electrical power and fertilizers as compared with other methods of cultivation.

Different types of multipurpose aeroponic and aeroponic plant cultivation systems was developed and constructed in All-Russian research institute of agricultural biotechnology (Martirosyan, Kharchenko, 2009; Martirosyan et al., 2008).

These systems can be used for adaptation of revitalized by apical meristem method plants, propagation, cultivation and rooting. Plant cultivation in aeroponic conditions allows smooth transition from in vitro to in vivo conditions; it cases the best survival rate. It can be used for growing of valuable, rare, tropical, medical, essential oil-bearing plants and also green-stuff crops, vegetables, flowers and berries.

Aeroponics requires smaller squares as compared with other methods of cultivation (on the field or in the greenhouse).

There is no any competition between plants for nutrition and light in aeroponics. That is why you can adapt and grow more plants in the same area (600 plants from the glass tubes per 1 square meter) compared with cultivation in greenhouses. Besides, there is no any substrate and you really don't need its sterilization, pests and disease control agents. Work with plants become easier with the help of aeroponics.



Application of new light sources – LED lamps with all needed parameters allows reducing electrical energy consumption because of its light efficiency, the absence of infrared component in the spectrum, long working life and the regulation of the spectrum emission (Erokhin, Berkovich, 2005).

Today aeroponics is economically effective for growing some vegetables. For example: tomatoes, cucumbers, green-stuff and root crops, flowers and medical plants.

Basal principles of aeroponics, differences from hydroponics

Plants are cultivated in aeroponic systems indoors. Plant growing place is equipped with climate control unit. Plant growing panel consists of parallel lines of trays that are situated on the certain distance from the floor. You can move the bottom of the tray and work with roots if you need it. And it also helps to check plant growth and development conditions in the root zone. It is easy to harvest tubers and roots of plants too.

Revitalized plants from glass tubes are fixed in special upper growing lids with intervals. There is u-like inclined tray under the lid. Nutrient solution goes directly to the root zone from the tank with the help of high-pressure pump and special nozzles. This solution becomes an aerosol. Then after moisture condensation this nutrient solution flows downward to the tank. Periods of working rotates with periods of root aeration. Nutrient solution is special for each plants growth period.

There are lamps behind the plant growing panel; there is a special hoisting mechanism that helps to maintain an optimal level of illumination.

System is equipped with the automatical control unit. It controls the supply of nutrient solution, root aeration, the length and cyclic recurrence of light period, temperature and humidity. Also carbon dioxide amount and ventilation are controlled.

Application of aeroponic technologies in scientific research

Application of aeroponic technologies solves different scientific and practical problems:

- study of the migration of macro - and microelements in the system "plant-environment", microelement accumulation in the required proportions in obtained agricultural goods;
- study of physiological and genetic patterns of growth, development and adaptability of plants, improving the breeding process efficiency;
- Creation of waste-free environmental adaptive systems and full-year vegetable and other crops production cultivation.



- Crop breeding time shrinking.

Aeroponics is important for transgenic plants multiplication and experimental plant investigation because you can use it as replacement of quarantine areas. You can completely avoid contact of plants with the environment. This technology is very actual for studying of plant stress tolerance and comparing GMO plants with normal plants.

We used different genotypes of potato, tomato, tobacco and compared its responses to the simulated environment conditions, including stress factors in our aeroponic systems. We selected transgenic tomato plants, grew and propagate it, then we made physiological research. It is shown that the introduction of the gene of superoxide dismutase was improved the stability of the photosynthetic apparatus of tomato plants to the action of high salt concentrations, UV radiation (Serenko et al., 2010). Transgenic Fe-SOD plants compared with the control ones were smaller decrease in the rate of photosynthesis, which allowed them to better adapt to oxidative stress. Plants with introduced Fe-SOD gene was less damaged by oxidative stress.

Application of aeroponic technologies in seed potatoes obtaining

The most important element of the modern industry of potato growing is well regulated system of seed breeding.

And if we talk about potato seed breeding we mean biotechnological methods, which are successfully and widely used, because it helps to solve the main problem of potato seed breeding – accumulation and sap-transmission of viruses in generations.

According to the scheme of successive steps of potato seed breeding, the chain of production begins with in vitro material, and these plants which are grown in test tubes have to put sure start for successful passing of other stages of seed breeding.

Future return depends on the seed potato quality. During last 400 years people had gained great experience of potato growing and breeding. It helped to create productive culture. Nowadays people obtain potato yield that is more than 50-70 t/ha.

Low potato yield is connected with the application of low-quality seed material that is infected. Nowadays more than 40 potato viruses are known. Some of them (L, Y, A, X, S, M) are the most dangerous.

Potato yield increasing is related with new technologies introduction, including production, testing and reproduction of revitalized plants (Ewing 1995; Rodrigas et al. 2006; Hofius, Bornke, 2007). Aeroponic technologies for accelerated reproduction maximize root and



air plant nutrition by aerosol using and optimal favorable light conditions. Plant nutrition was optimized for different plant growing periods.

The effectiveness of any plant cultivation technology is determined by the possibility of regulating each stage of plant growth and development.

Aeroponics allows better regulation plant growing conditions than traditional methods and technologies (even field or greenhouse). The possibility of rapid regulation of the root system environment is one of the most important benefits of plant growing aeroponic technology.

There are 5 periods of aeroponic potato plant growing. It starts from adapted plant transferring to the system. Growing period lasts for 3-4 months. You can obtain 50-120 minitubers of 5-30 g with the usage of proper technology. But result will be different with different potato varieties. In some experiments we obtained 250-300 tubers per 1 plant. Yield depends on potato variety, the length of growing period and cultivation conditions (Pictures 1,2,3).

So, aeroponics is innovational, high-technological and environmentally safe method of plant cultivation. Aeroponics has great potential of application in agriculture, seed production for accelerated reproduction of revitalized seed potato and other agricultural crops.



Picture 1. Potato roots in aeroponic system



Picture 2. Potato minitubers in aeroponic system



Picture 3. Potato plants in aeroponic system in the initiation of cultivation

Literature

1. Erokhin A.N., Berkovich U.A., 2005, Analysis of space salad greenhouse characteristics with the automatical control unit with light-emitting diodes. *Aerospace and ecological medicine*, vol. 39.
2. Martirosyan, Y. Tz., A. A. Kosobryukhov, Dilovarova T. A., Melik-Sarkisov O. S., Kharchenko P. N., 2008, The Influence of additional low-energy irradiation from different spectral composition LEDs on potato growth and development. *Collection of scientific works, Minsk: RUE Scientific-practical center of NAS of Belorussia of potato, fruit and vegetable cultivation*, vol. 15.
3. Martirosyan, Y. Tz., Kosobryukhov A. A., Kreslavsky, V. D., Dilovarova T. A., Melik-Sarkisov O. S., Letunova S. V., Kharchenko P. N., 2008, Photosynthesis and potato plant productivity in airponics with additional LED irradiation. *Agricultural biology*. No. 3.
4. Martirosyan, Y. Tz., Kosobryukhov A. A., Kreslavsky, V. D., Melik-Sarkisov, O. S., 2007, Photosynthesis and potato plant productivity under low-energy light 625 nm. *Sat.: Potato*. Minsk: RUE "Scientific and practical center of NAS of Belorussia". vol. 13
5. Martirosyan, Y. Tz., Kosobryukhov A. A., Melik-Sarkisov O. S., Kharchenko P. N., 2007, Development and creation of airponic system (with elements of light-emitting diodes) for plant cultivation. *Materials of the fourth Moscow international Congress "Biotechnology: conditions and perspectives"*.
6. Serenko E. K., Baranova E. N., Balakhnina T. I., Kurenina L. V., Gulevich A. A., Kosobryukhov A. A., Maisuryan A. N., Polyakov V. Yu., 2011, Structural organization of tomato plants chloroplasts (*Solanum lycopersicum*), that was transformed by gene of Fe-dependent superoxide dismutase. *Biological membranes*. T. 28. No. 3.
7. Ewing E.E., 1995, *The Role of Hormones in Potato (Solanum tuberosum L.) Tubercization*. *Plant Hormones, Physiology, Biochemistry and Molecular Biology* Ed. Davies P.G. Dordrecht: Kluwer.
8. Hofius D., Bornke F., 2007, *Photosynthesis, Carbohydrate Metabolism and Source-Sink Relations*. *Potato Biology and Biotechnology*. Ed. Vreugdenhil D. Amsterdam: Elsevier.
9. Rodrigues-Falcon M., Bou J., Prat S., 2006, Seasonal Control of Tubercization in Potato: Conserved Elements with the Flowering Response // *Annu. Rev. Plant Biol.* V. 57.



Metabolomic and proteomic analysis revealed the influence of cytokinin-like compound CPPU (forchlorphenuron) on multiple steps of kiwifruit (*Actinidia deliciosa*) development and ripening

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The use of synthetic cytokinin forchlorphenuron (CPPU) on kiwifruits (*Actinidia deliciosa* [A. Chev.] C.F. Liang et A.R. Ferguson var. *deliciosa* cv. 'Hayward') is a common cultural practice applied by kiwifruit growers in order to increase fruit growth and consequently their income. Although the effect of this bio-regulator on fruit enlargement is well documented, its role on fruit physiology and the possible mechanism underlying its impact on fruit growth and development remains mostly obscure.

Under this scope, current study is focused on the role of CPPU on fruit physiology and metabolism during fruit growth until harvest, and also in ripening stage. To investigate the mechanism underlying CPPU function, metabolomic and proteomic analysis, along with measurements was employed to profile early fruit development stage, maturity and ripening. Data revealed that during fruit development, the abundance of 19 polar metabolites, belonging mostly in three groups of primary metabolites (sugars, organic acids and amino acids) altered in the fruit flesh by CPPU. In the same time, the expression of 16 proteins that are mainly related to defence were also increased by CPPU. Sugar homeostasis, cell wall modifications, TCA cycle and myo-inositol pathway seem to be mostly affected by CPPU in kiwifruit during development. Upon postharvest ripening at 20 °C following 2 months cold storage (0 °C), CPPU suppressed ethylene production and retained columella firmness, indicating that CPPU delay ripening in a specific tissue-dependent manner. Nineteen columella proteins and up to 15 metabolites were regulated by CPPU in ripen flesh and columella tissues. These observations provide insights into CPPU-regulated control of kiwifruit growth and ripening leading to a greater understanding in the regulation of fruit development and ripening by exogenously supplied cytokinins.



The role of 5'-untranslated region (5'-utr) in mechanism of regulation heterologous gene expression in plants

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Abstract. The 5'-untranslated region is an important module-expressing sequence located in 5'- noncoding region of the majority mRNAs. The results of bioinformatics analysis allowed to reveal the following consistent pattern: the average length of the 5'-UTRs for most *A. thaliana*'s genes with high expression levels range from 70 to 120 bp, with an average GC content of 36,5%. Based on alignment results was defined motive in 5'-UTRs, as a new regulatory element, which could potentially provide highly efficient expression and synthesis of the target product in plants. This sequence has a length of 87 bp and GC content of 35,6%. It was demonstrated that consensus sequence of 5'-UTRs increased accumulation of the bi-reporter protein more than 25%, by that acting as a potential positive regulatory element on translational efficiency.

Key words: plants, 5'-untranslated region, translation and gene expression.

INTRODUCTION

Recombinant proteins (heterologous proteins) are proteins encoded by cloned genes (heterologous genes). These proteins are used in the manufacture of biopharmaceuticals, which have therapeutic, preventive and diagnostic properties for humans and other animals. Furthermore, they are also used in the production of biopesticides, detergents, non-medical diagnostic kits, broad-spectrum enzymes, in the food industry and bioremediation processes.

The demand of recombinant proteins is constantly increasing, this leads to need to sim-



plify and intensify the recombinant proteins production processes free from infection and other unwanted residues, which in turn confronts researchers with problem of development approaches to more accurately and efficiently control expression level of target polypeptides at all stages of genetic information either transcription, translation, stabilization of protein products or etc.

The cell totipotency is one of main advantages of use of plant-based expression systems as producers of valuable recombinant polypeptides and/ or proteins.

The 5'-untranslated region (5'-UTR) is an integral modular regulatory element present in genomes of various living beings, which determines the efficiency of gene expression at stages of translation and mRNA stabilization. This regulatory element is located at downstream position of some transcripts and also may include other determinants of gene expression, such as ribosome binding sites [Cap (m7G-cap), rbs and IRES], Kozak consensus sequence [environment of start codon (AUG) – from -3 to +4 bp] [6–8; 12], riboswitches, upstream open reading frames, attenuators and others.

The use of intelligent database system “FlowGene.az” and effective methods of experimental verification allows us to create and improve the optimization algorithm of regulation of heterologous gene expression in plant-based systems.

MATERIALS AND METHODS

Bacterial strains. *E. coli* strains XL1-Blue, JM110, BL21 and *A. tumefaciens* strain GV3101 were used.

Plant material. 6-week-old tobacco plants “*Nicotiana benthamiana* Domin” were used in this study, which were grown in a greenhouse at a temperature of 25°C and under a photoperiodic lighting (16 hours of light:8 hours of dark).

Molecular cloning. Standard molecular cloning techniques were employed, such as polymerase chain reaction (PCR) and restriction enzyme-ligase methods [2]: Restriction endonucleases, T4 DNA ligase, Taq and Pfu DNA polymerases, and phosphatases were used as recommended by the manufactures (Promega, United States and Fermentas, Lithuania).

Bacterial transformation. *E. coli* strains XL1-Blue, JM110 and BL21 were transformed by the heat shock method [2]. *E. coli* cells were grown at 37°C in the LB medium containing ampicillin. Transformation of *A. tumefaciens* strain was performed by electroporation method, and the resulting transformants were selected in a medium containing carbenicillin at 28°C.



Agroinfiltration. *A. tumefaciens* GV3101 cells were grown in the 2YT medium supplemented with 50 µg/mL rifampicin, 25 µg/mL gentamycin, and 50 µg/mL kanamycin (for the agrobacterial vector) at 28°C overnight. Cells were collected by centrifugation at 5000g for 5 min and resuspended in an agroinfiltration buffer (10 mM MgSO₄, 10 mM MES, pH 5.6). The cell concentration was inferred from OD₆₀₀, and OD₆₀₀ was adjusted to 0.2. The culture was used to infiltrate the bottom part of a leaf in 6-week-old *N. benthamiana* tobacco plants with the help of a syringe without a needle. The results were evaluated four day after agroinfiltration. Agroinfiltration with individual strains was carried out on at least three independent experiments and five biological replicates. As a control, we used the *N. benthamiana* tobacco plants that were not subject to agroinfiltration.

Extraction of total soluble protein. Plant tissue (fresh or frozen in liquid nitrogen) was ground with 50 mM Tris-HCl (pH 8.0), using 2–4 mL of the buffer per 1 g of tissue. The extract was centrifuged at 10000g for 10 min, and supernatant was collected.

Protein analysis of cell lysates. Protein concentration in preparations was measured by Bradford's method [3], using a Bio-Rad dye reagent (BioRad, United States); a calibration plot was constructed using bovine serum albumin (BSA) (Sigma, United States). Lichenase activity was assayed using lichenan (Megazyme, Ireland) as a substrate, with 10 min incubation. Reducing sugars released from the substrate were determined according to Wood and Bhat [13].

RESULTS AND DISCUSSION

The conclusion, that 5'-UTR of genes with similar expression level are likely to have similar motives, is among the most fundamental underlying hypothesis in the present work. The FlowGene output visualization of bioinformatics analysis is presented as graphs in figures 1 and 2.

Effect of 5'-UTR length on heterologous gene expression

We initially wanted to determine the relationship between genes distribution and length of the 5'-UTR in *A. thaliana* genome.

The FlowGene database and accompanying software were used in order to determine the relationship between length of the 5'-UTR and gene expression level, were formed five groups of *A. thaliana* genes with different relative expression levels to analyze this relationship. *A. thaliana* genes have relative expression levels from 1 to 100, from 101 to 1000, from 1001 to 10000, from 10001 to 20000 and from 20001 to above respectively, according to such division 42,1%, 46,8%, 10,8%, 0,3% и 0,05% (fig. 1).



The distribution of the number of genes with different expression levels depending on length of the 5'-UTR and gene expression level was calculated using the FlowGene database software. Figures 1 and 2 show the resulting data analysis. The table 1 illustrates the analysis results.

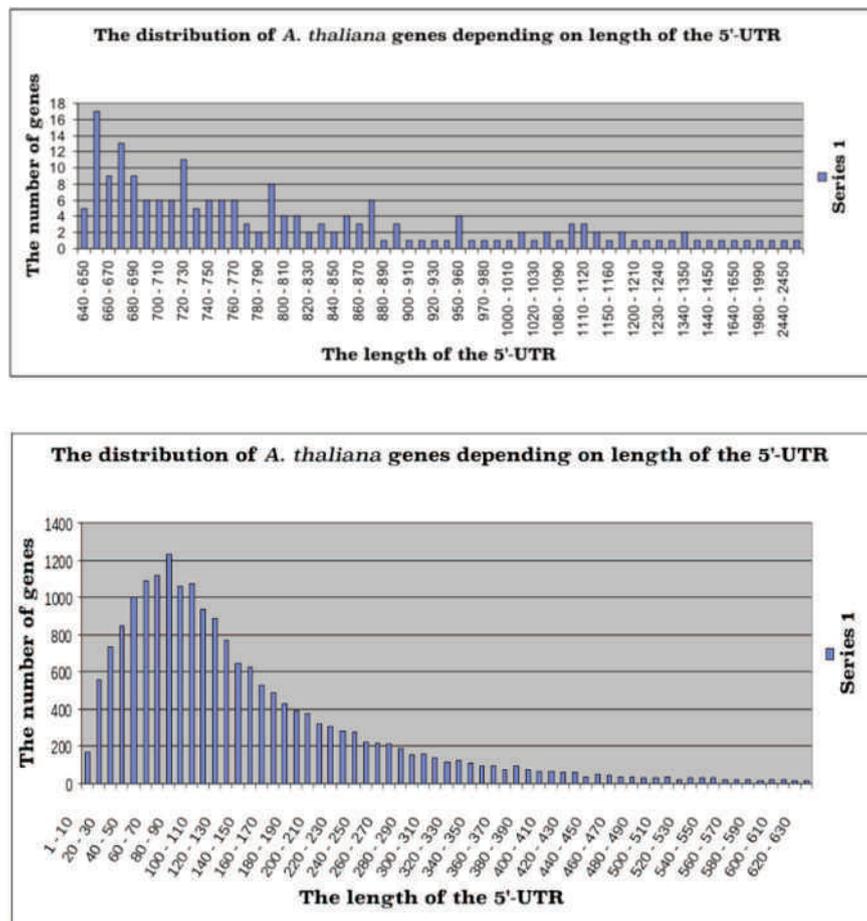


Figure 1. The distribution of *A. thaliana* genes depending on length of the 5'-untranslated region.

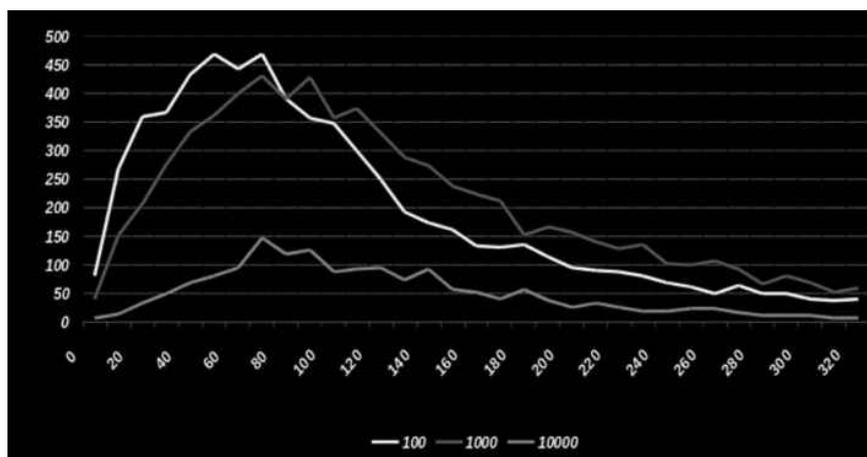


Figure 2. The distribution of *A. thaliana* genes depending on length of the 5'-untranslated region in the range from 1 to 310 bp and gene expression level from 1 to 100, from 101 to 1000 and from 1001 to 10000.

Table 1. Effect of 5'-UTR length on heterologous gene expression

Gene expression level		Length of the 5'-UTR (bp)		
	%	Limit of length	Characteristic length	Average length
1–100	42,1%	1–1600	20–180	128,7
101–1000	46,8%	1–1400	50–130	156,3
1001–10000	10,8%	1–1000	60–140	139,2
10001–20000	0,3%	30–210	80–160	127
20001–40000	0,05%	–	–	97

Effect of GC content of the 5'-UTR on heterologous gene expression

We assume, that the GC and AT content of the 5'-UTR as its length may play an important role in the regulation of gene expression. The FlowGene database and accompanying software were used in order to determine the relationship between GC content of the 5'-UTR and gene expression level, were previously formed three main groups of *A. thaliana* genes with different relative expression levels (from 1 to 100, from 101 to 1000, from 1001 to 10000) to analyze this relationship (fig. 3). The table 2 illustrates the analysis results.

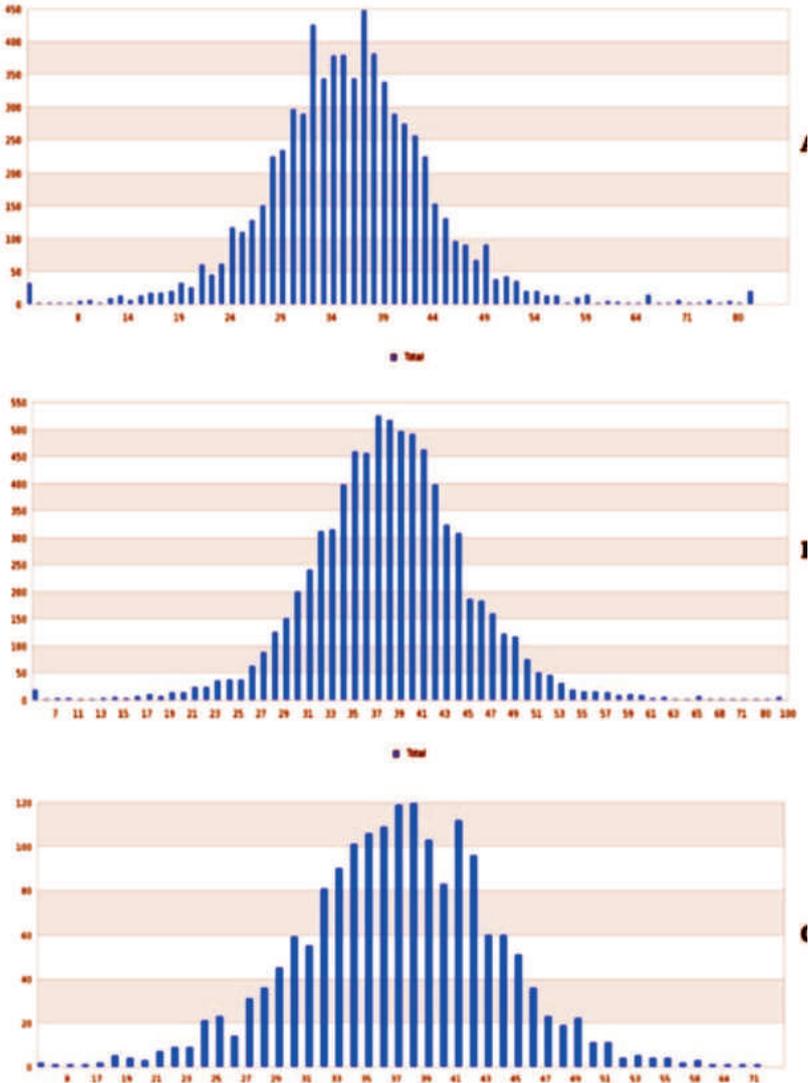


Figure 3. The distribution of *A. thaliana* genes depending on GC content of the 5'-untranslated region and gene expression level. A – gene expression level from 1 to 100; B – gene expression level from 101 to 1000; C – gene expression level from 1001 to 10000.



Table 2. Effect of GC content of the 5'-UTR on heterologous gene expression

Gene expression level	GC content of the 5'-UTR (%)	
	Maximum GC content	Characteristic GC content
1–100	33–37	34–35
101–1000	37	–
1001–10000	37–38	36

The 87-UTR-synthetic consensus sequence of the 5'-UTR

In order to find out whether there is an interrelation between gene expression level (at translation) and the presence or absence of a 5'-UTR, we conducted theoretical and experimental studies, the results of which are outlined below. For this purpose, we had to find the consensus sequence 5'-UTR specific to plant genes with a high level of transcription. The following algorithm was used to predict the theoretical consensus 5'-UTR:

1. The selected 1000 random sequences in groups with different gene transcription levels up to 100, 1000 and 10000 and having a length from 100 to 199 bp;
2. in each group of the consequences at the expense of multiple alignments were defined motifs exhibiting conservative and having an average GC content of 37%;
3. obtained motives are united and determined the length of the sequences (87 bp) for further analysis and identification of a consensus sequence;
4. the web-LOGO program was used to visualize the consensus sequence.

As a result of theoretical studies 5'-UTR was determined as a new regulatory element, which could potentially provide highly efficient translation, and as a consequence, high levels of the target protein product in plants (Fig. 4). This sequence has a length of 87 bp and GC content of 35.6%.

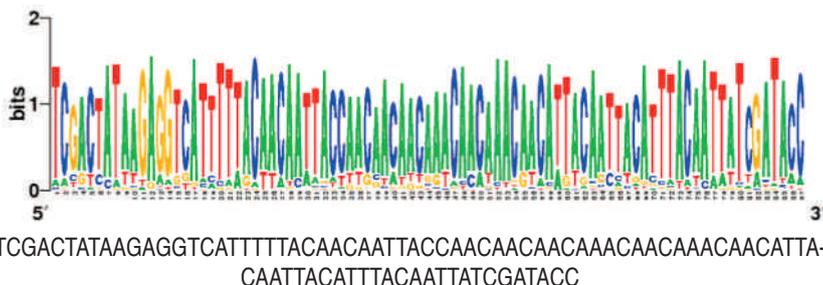


Figure 4. The consensus sequence 5'-untranslated region selected for further studies.

Then, using the procedures of molecular cloning, was obtained an expression vector for transient expression in plants pVIG-T-87-UTR-LG. The figure 5 shows the scheme of the vectors which contain this regulatory element .

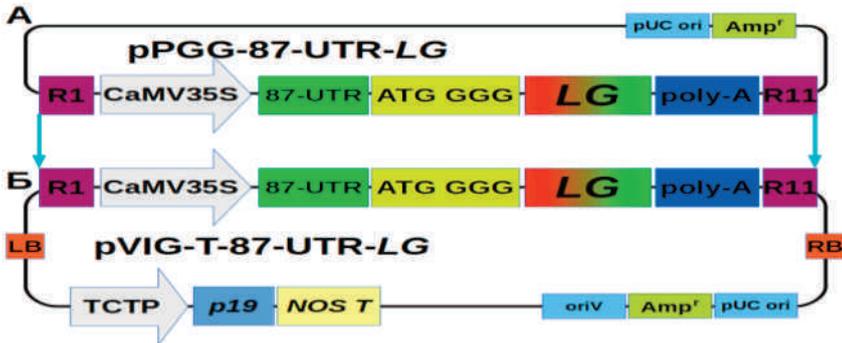


Figure 5. Scheme vectors. A – pPGG-87-UTR-LG; B – pVIG-T-87-UTR-LG. CaMV35S – 35 promoter of cauliflower mosaic virus. TCTP - gene promoter translationally controlled tumor protein (translationally controlled tumor protein). p19 - p19 gene of the virus Cymbidium ringspot (CymRSV). LB & RB - boards left and right, respectively. R1-R11 - restriction sites for cloning of the target gene in an expression cassette and its transfer to the final plant vector. PUC ori, oriV – origin of replication for *E. coli* and *A. tumefaciens*. Amp^r - the ampicillin resistance gene. polyA - polyadenylation signal. 87-UTR – synthetic consensus 5'-UTR.

The agrobacteria (*A. tumefaciens*) strain GV3101 was transformed by the obtained vector, which are then used for agroinfiltration of 6-week-old tobacco plants *N. benthamiana*. Initially, the efficiency of agroinfiltration was assessed by fluorescence of the green fluorescent protein that is expressed as part of the bireporter protein.

The figure 6 shows the summary results of testing the effectiveness of the 5'-UTR as regulatory of translation. The presence 87-UTR-consensus sequence in the 5'-UTR of the bireporter gene provides increased accumulation of the bi-reporter protein more than 25% compared with control, as seen in the results.

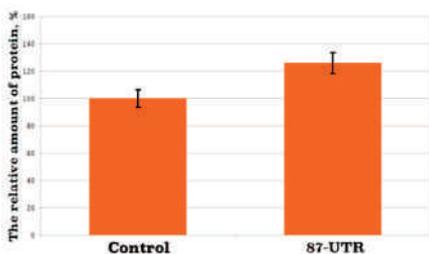


Figure 6. The levels of accumulation of reporter protein using synthetic consensus 5'-UTR. Versus control (vector with the same reporter system, but without 87-UTR-pVIG-T-LG). Control - pVIG-T-LG, 87-UTR – pVIG-T-87-UTR-LG.

ACKNOWLEDGEMENTS

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REFERENCES

- [1] Vyacheslavova A.O., Mustafaev O.N., Tyrin A.A., Shimshilashvili K.R., Berdichevets I.N., Shayakhmetova D.M., Goldenkov M.A., Fadeev V.S., Sheludko Yu.V., Goldenkova-Pavlova I.V. Set of Module vectors for stable or transient expression of heterologous genes in plants. *Russian Journal of Genetics*, 2012. vol. 48, №. 9, pp. 1046–1056.
- [2] Маниатис Т., Фрич Э., Сэмбрук Д. Молекулярное клонирование. М.: Мир, 1984. 480 с.
- [3] Bradford M.A. Rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Analytical Biochemistry*, 1976, vol. 72, pp. 248–254.
- [4] Calvo S.E., Pagliarini D.J., Mootha V.K. Upstream open reading frames cause wide spread reduction of protein expression and are polymorphic among humans. *Proceedings of the National Academy of Sciences of the United States of America*, 2009. vol. 106, pp. 7507–7512.
- [5] Iacono M., Mignone F., Pesole G. uAUG and uORFs in human and rodent 5' untranslated mRNAs. *Gene*, 2005, vol. 349, pp. 97–105.
- [6] Kozak M. Downstream secondary structure facilitates recognition of initiator codons by eukaryotic ribosomes. *Proceedings of the National Academy of Sciences of the United States of America*, 1990, vol. 87, pp. 8301–8305.



- [7] Kozak M. Point mutations close to the AUG initiator codon affect the efficiency of translation of rat preproinsulin in vivo. *Nature*, 1984, vol. 308, pp. 241–246.
- [8] Kozak M. Point mutations define a sequence flanking the AUG initiator codon that modulates translation by eukaryotic ribosomes. *Cell*, 1986, vol. 44, pp. 283–292.
- [9] Mann D.G.J., King Z.R., Liu W., Joyce B.L., Percifield R.J., Hawkins J.S., LaFayette P.R., Artelt B.J., Burris J.N., Mazarei M., Bennetzen J.L., Parrott W.A., Neal Stewart C.J. Switchgrass (*Panicum virgatum* L.) polyubiquitin gene (PvUbi1 and PvUbi2) promoters for use in plant transformation. *BMC Biotechnol*, 2011, vol.11, №. 11, pp. 74.
- [10] Masura S. S., Ahmad P. G. K., Ti L.L.E. Isolation and characterization of an oil palm constitutive promoter derived from a translationally control tumor protein (TCTP) gene. *Plant Physiology and Biochemistry*, 2011, vol. 49, pp. 701–708.
- [11] Park S.H., Yi N., Kim Y.S., Jeong M.H., Bang S.W, Choi Y.D., Kim J.K. Analysis of five novel putative constitutive gene promoters in transgenic rice plants. *Journal of Experimental Botany*, 2010, vol. 61, №. 9, pp. 2459–2467.
- [12] Pelletier J., Sonenberg N.J. Insertion mutagenesis to increase secondary structure within the 5' noncoding region of a eukaryotic mRNA reduces translational efficiency. *Cell*, 1985, vol. 40, pp. 515–526.
- [13] Wood T.M., Bhat K.M. Methods for measuring cellulase activities. *Methods in Enzymology*, 1988, vol. 160, pp. 87–112.



Towards understanding the superficial scald etiology in 'Granny Smith' apples: a physiological and molecular approach

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The superficial scald is an important physiological disorder affecting apple fruit quality during postharvest storage. Strong evidence suggests that the applications of 1-methylcyclopropene (1-MCP), an inhibitor of ethylene perception, reduce the development of superficial scald in apple. In addition, ozone (O_3) has been shown to extend fruit ripening, however the exact impact of O_3 in scald development is unknown. Herein, "Granny Smith" apples, immediately after commercial harvest, were treated or not with 1-MCP ($0,6 \mu\text{L L}^{-1}$) and then placed in cold storage (0°C , 95% RH) in the absence or presence of O_3 ($0,3 \mu\text{L L}^{-1}$) for 6 months and subsequently were allowed to ripe at 20°C for 5 days. It was evidenced that 1-MCP largely depress endogenous ethylene production and the accumulation of enzymes and metabolites involved in ethylene biosynthesis, resulting in the delay of flesh softening. Nevertheless, the physiological effect of O_3 on ethylene biosynthesis and apple ripening was minor compared with the effect of 1-MCP. Although O_3 strongly induced the development superficial scald symptoms compared to either individual 1-MCP application or to control, the combination of chemical treatments (1-MCP+ O_3) remarkably reduced scald appearance. Two-dimensional gel electrophoresis (2DE-PAGE) coupled to tandem mass spectrometry (nanoLC-MS/MS) revealed that the three treatments (1-MCP, O_3 , 1-MCP+ O_3) have significant influence on apples' proteome map. Particularly, the abundance of 83 proteins has altered in flesh tissue and of 217 proteins in outer pericarp (skin). The results presented in this work represent a step forward in understanding the physiological mechanisms of superficial scald in "Granny Smith", shedding light on the specific function of 1-MCP and O_3 cascade.



The study of papaya plant in the controlled environment

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Abstract

Papaya is a major fruit crop worldwide that is primarily consumed as fresh fruit. Papaya fruits consist mostly of water and carbohydrate, low in calories and rich in natural vitamins and minerals, particularly in vitamins A and C, ascorbic acid and potassium. Besides fruit production papaya is cultivated in tropics and subtropics for obtaining papain, which is widely used in medicine and in other industries. Papain is extracted only from unripe fruits, that is why we were interested in cultivating this plant in the controlled environment, where ripening is not necessary. In this research seeds from papaya fruits of different origin, and especially the amount of fixed oil in them, were compared.

Key words: papaya, papain, controlled environment, lipids of the seeds, lipid complexes

Papaya (pawpaw) *Carica papaya* L. belongs to family Caricaceae. Papaya is a very good source of fruit sugar, vitamin A, B and C. This fruit is rich in minerals and salts and makes very good food.

Enormous, simple, lobed leaves combine with a single trunk and delicious fruit to make this a desirable plant for many landscapes. Flowers are produced along the trunk from the leaf axil. Flowers on male plants are more conspicuous and showy; female flowers are borne close to the stem.

Papaya fruits are borne by both female and hermaphrodite trees, but their shapes differ. Fruits from female trees are round whereas fruits from hermaphrodite trees are elongated. The fruit is a berry that can range from 5 cm in diameter and 50 g in weight to 50 cm or longer, weighing 10 kg or more. Papaya fruits are covered with a smooth thin green



skin that turns to yellow or red when ripe. The flesh is succulent, varying in texture and colour, ranging from yellow to orange to red.

Papaya is a major fruit crop worldwide that is primarily consumed as fresh fruit. Papaya fruits consist mostly of water and carbohydrate, low in calories and rich in natural vitamins and minerals, particularly in vitamins A and C, ascorbic acid and potassium.

One hundred g of papaya contains: 55 calories, 0.61 g protein, 9.8 g carbohydrates, 1.8 g dietary fiber, 89% water, 283 IU vitamin A, 62 mg vitamin C, 38 mg folate and 257 mg potassium. Papaya is consumed as jams, pickles, and desserts. Unripe fruit is frequently used in cooking. Papaya plants are also produced for papain and chymopapain, two industrially important proteolytic enzymes found in the milky white latex exuded by fruits. In general, female fruits tend to exude more papain than hermaphrodite fruits. Green fruits are generally better sources, containing more papain than ripe fruits. The latex serves as an excellent meat tenderizer, for treatments of gangrenous wounds or burns [4], and is used in cosmetic products, the light industry and food processing.

Papaya milk latex shows anti-bacterial properties, inhibits fungal growth [3].

Papaya is used in tropical folk medicine. In Mauritius, the smoke from dried papaya leaves relieves asthma attacks. In Australia it is believed in some quarters that several cancer diseases can improve after drinking papaya leaf extract. Papaya latex is very much useful for curing dyspepsia and is externally applied to burns and scalds. [6] showed that the fruit and seeds have antihelminthic and anti-amoebic activities. Packages of dried, pulverized leaves are sold by "health food" stores for making tea. The dried leaf infusion is taken for stomach troubles in Ghana and it is used as a purgative. In India, unripe and semi-ripe papaya fruits are ingested or applied on the uterus to cause abortion.

A study with rats at different stages of gestation showed that the consumption of unripe and semi-ripe papaya fruits could be unsafe during pregnancy given the high levels of latex in the fruits at these stages of maturity. But consumption of ripe fruits during pregnancy causes no risk [5].

Although described as a tree, the papaya plant is a large herb or soft-wood tree (1.8 to 6 meters). Generally papaya wood has very little application. It has long been used in the manufacture of rope but it was recently shown that papaya bark can be used as a new biosorbent of heavy metals and has potential application to the treatment of waste water. Saeed et al [7] demonstrated that 97.8, 94.9 and 66.8% of 10 mg/L copper (II), cadmium (II) and zinc (II) solutions, respectively were removed with 5 g/L papaya wood



during a shake flask contact time of 60 minutes.

Besides fruit production papaya is cultivated in tropics and subtropics for obtaining papain, which is widely used in medicine and in other industries. Papain is extracted only from unripe fruits, that is why we were interested in cultivating this plant in the controlled environment, where ripening is not necessary. Unripe green but fully mature fruits are lanced with a knife. On a single fruit there can be four cuts at equal distance. Latex is collected in a suitable vessel of glass or porcelain. Extract papain from the green fruits after collecting latex as pawpaw fruit contains 10 % papain on dry weight basis.

In greenhouse papaya seeds were planted in each pot and watered daily. Seedlings were raised in black polythene bags (planter bags) of 20x12.5cm, which have a number of holes for proper aeration and water drainage. Nitrogen, Phosphorous and Potassium (NPK) were applied at the rate of 1g/plant fortnightly until the plants were ready for transplanting. After 8 to 10 weeks from sowing, seedlings were ready for planting (about 20cm in height).



Picture 1. Papaya seedlings in greenhouse

We cultivated papaya in greenhouse, mainly for obtaining papain, but we have an idea of complex utilization of papaya plants, as far as this very culture is known to be used in many other fields of production, besides medicine.

One part of our complex research was to compare seeds from papaya fruits of different origin, especially the amount of fixed oil. Nuts oils, seed oil and oils of fruit and vegetables are receiving growing interest due to their high concentration of bioactive lipid components, such as polyunsaturated fatty acids and phytosterols, which have shown various health benefits. Fats and oils, and their several lipid components are extensively used in the food



and also in cosmetics, pharmaceuticals, oleochemicals and other industries [8].

For microscopy of papaya seeds we prepared temporary agents: cross sections of papaya seeds of the crushed material and non-fat meal. The slides were examined using a microscope "LOMO MIKMED - 1" lenses 10, 20 and 10x eyepiece, 8x. Photomicrography were performed with a digital camera Canon (power shot A95 - Ai AF) zoom lens 3x-7,8-23,4mm, 5.0 mega pixels 167 on the microscope with different lenses.



Picture 2. Papaya seeds

Materials and methods

Papaya fruits were delivered from different countries from the open field plantations and from greenhouse in Russia. Prior to processing, the seeds of the fruits were manually separated from the pulp. The flour of seeds was dried in an oven at 60 °C for 24 h.

The lipids of the seeds of papaya fruits were extracted with the Soxhlet method according to [1]. A sample of each kind of seeds flour was extracted using diethyl ether as solvent.



The solvent was removed with a rotary evaporator. The fatty acid profile was determined as fatty acid methyl esters by gas chromatography. The methyl esters were prepared by according to method AOAC 996.06 [2]. The oil was transferred to a pyrex test tube with screw cap, and 2 mL of methanolic-HCl solution 3M were added. Sample was placed in a water bath at 80 °C for 60 min. The fatty acid methyl esters were extracted with n-hexane, after addition of distilled water. The solution was directly injected into the gas chromatograph (GC) for analysis.

Result and discussion

Output of lipid complex from the seeds of various origins (Table 1) ranged from 18.30 to 27.00%, based on air-dry raw materials. Such a high content of hydrophobic fraction suggests papaya seeds as fatty acid oilseed feedstock.

The level of lipid complexes in papaya seeds from different origin

Origin of papaya seeds	Output of lipid complex, %
1. Kenya	25,0
2. Dominican Republic	27,0
3. Angola (fruits with red pulp)	27,0
4. Angola (fruits with yellow pulp)	26,0
5. Ghana	18,3
6. Brazil	21,1
7. Russia, greenhouse	23,0

Fatty oil from papaya seeds – is mobile, oily liquid. Samples of fatty oil have refractive index in the range 1.4667 - 1.4678. Such values are characteristic of liquid vegetable oils, relating to non-drying.

REFERENCES

1. Васильев, И. Б. Жидкие лекарственные формы. Настои и отвары: учебное пособие / И. Б. Васильев.- ГБОУ ВПО ИГМУ Минздрава России. – Иркутск.- РПФ Весь Иркутск.- 2013. – 49 с.
2. AOAC International, 1997, revised 2001, Official Method 996.06, Official Methods of Analysis, 17th edition, Association of Official Analytical Chemists, Gaithersburg, MD, United States.



3. Giordani R, Siepai OM (2001) Antifungal action of *Carica papaya* latex isolation of fungal cell wall hydrolyzing enzymes. *Mycoses* 34, 469-477
4. Hewitt HH, Whittle S, Lopez SA, Bailey EY, Weaver SR (2000) Topical uses of papaya in chronic skin ulcer therapy in Jamaica. *West Indian Medical Journal* 49.1, 32-33
5. Lohiya NK, Manivannan B, Garg S (2006) Toxicological investigations on the methanol sub-fraction of the seeds of *Carica papaya* as a male contraceptive in albino rats. *Reproductive Toxicology* 22, 461-468
6. Okeniyi JA, Ogunlesi TA, Oyelami OA, Adeyemi LA (2007) Effectiveness of dried *Carica papaya* seeds against human intestinal parasitosis: A pilot study. *Journal of Medicinal Food* 10, 194-196
7. Saeed A, Waheed Akhter M, Iqbal M (2006) Removal and recovery of heavy metals from aqueous solution using papaya wood as a new biosorbent. *Separation and Purification Technology* 45, 25-31
8. Sahena F, Zaidul I.S.M., Jinap S., Karim A.A., Abbas K.A., Norulaini N.A.N., Omar A.K.M., 2009, Application of supercritical CO₂ in lipid extraction, A review, *Journal of Food Engineering*, 95, 240–253.



The role of zeolite for insect control: Evaluation of zeolite lethal effects on adults of *Acanthoscelides obtectus* Say

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We studied the lethal effects of different doses of natural zeolite applied on dry beans, on adults of *Acanthoscelides obtectus* Say (Coleoptera: Bruchidae) under laboratory conditions (25°C, LD 16:8). It was found that at certain zeolite doses, percentages of adult mortality were very high to 100% within the first 24 hours of exposure. The lethal zeolite dose for 50% adult mortality (LD50) was 0,229 gr after adults' exposure for 48 h. The results indicate that zeolite is a promising product for the control of *A. obtectus*. Further experiments are running in our laboratory to evaluate the toxic effects of zeolite under different temperature and relative humidity conditions.



Influence of organic cultivation technology on quality of a tea leaf.

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Researches took place on plantations in Matsesta district of Krasnodar region, where «Verkhne-Matsestinskiy» tea state farm was founded on 10 October 1947. This enterprise flourished until 1992, when reorganization period has begun, which turned state farm into JSC «Matsesta tea». Enterprise was completely transferred onto territory adjoining the tea plantations in 2009.

Nowadays a domestic variety called «Matsestinskiy urojainiy», which was bred by selectionists from Sochi, is cultivated here. Area of the plantations is 180 hectares. Tea is grown 400 meters above the sea level. Tea plantations are not exposed to chemical treatment.

Climatic conditions of Krasnodar region

Krasnodar region is notable for unstable weather conditions. It is located on the border of temperate and subtropical climate and on the meeting point of plains and mountains. Temperate climate prevails on the plains and subtropical on the Black sea shore. Average January temperature on the plains is -3 -5 degrees Celsius, average July temperature is 22-24 degrees Celsius. Annual precipitation reaches 2500 mm.

Subtropical zone is defined by clearly expressed warm and cold periods. Such conditions allow cultivating subtropical evergreens and defoliation plants on the open grounds. Sochi has got short rainy and warm winter, arid and hot summer, which covers first two months of autumn.

Krasnodar region terrain is divided into two parts, unequal in geological, soil and climatic regard. Those are mountains, foothills and valleys. Mountainous regions might reach up to 3000 meters above sea level, protecting the subtropical sea shore from cold winter northern and northeastern winds. At the same time they help protecting moisture and heat, accumulated by the sun and Black sea.



Tea is a heat-loving plant and demands median yearly temperature of 13-15 °C to sustain normal life support processes, such as growth and photosynthesis.

Tea plantations usually have brown forest soil, which has dark grey upper layer color and powerful cross-section. Such soil is distinguished by high humus concentration (2-4%), total nitrogen level (0,16-0,4%) and phosphoric acid level and is has good chemical characteristics.

Organic agriculture

Organic agriculture is a form of rural economy without utilization of synthetic fertilization, pesticides and growth regulators. Crop rotation, applying of organic fertilizers (manure, compost etc), different methods tillage are widely used to increase productivity, to provide mineral elements and to fight pests and weeds.

Organic agriculture is oriented to work with ecosystems, biogeochemical cycle of substances and elements, supports them and obtains optimization effect. Organic agriculture has to produce only healthy products and should prevent soil degradation.

So far, production from Matsesta plantations is pollution free and has an appropriate certificate. This is the only tea enterprise in Russia, which became a member of ecological control system under supervision of ICEA. Quality control is carried out on several points:

- Planting and growth of tea bushes without applying of non-organic fertilizers;
- Environmental friendly harvesting;
- Tea leaf treatment without aggressive coercion;
- Utilization of environmental friendly recyclable packaging materials.

Predatory insects, such as ladybirds (*Coccinella hieroglyphica*), are used to combat tea greenfly (*Toxoptera aurantii*) instead of insecticides. (Picture 3)

Organic fertilizers (peat, bird excrements etc.) are the best for tea plantations of all ages.

Research data

While traditional method productivity totaled some 5 tons of fresh tea leaves per hectare, organic agriculture productivity dropped to 2,6 – 3 tons per hectare for the price of improvement of production quality and ecology.

Samples were taken on the most elevated part of the plantation, on the slope and in the lowland. Relief plays an important role in the soil formation and development. Composition of soil and leaves is affected by the location of the plantation. We have studied the distinctions between the test samples, gathered at 10 meter difference. It's interesting that tannin contents increase with the height of the plantation. The most elevated part of plantation shows the maximum tannin level.



Research data shows that the lack of nitrogen and phosphorus has been found among the gathered samples, but nevertheless they still have increased tannin level, which is one of the most important tea quality indicator. Accordantly to the stated above, we can make a conclusion that organic agriculture has a positive effect on the tea leaves quality. Productivity decrease is compensated by the increase of tea value.

In our future work we are going to study the composition of extractive elements in vegetable samples.

According to the analysis, tannin percentage, which is an important tea leaf quality indicator, is corresponds or higher than standard.

Table 1.

Sector number	Leaf % N	Leaf % P2O5	% tannin
1.1	3.79	0.15	15
1.2	3.04	0.23	14.7
1.3	4.24	0.14	10
2.1	3.61	0.19	8.3
2.2	2.89	0.23	7.3
2.3	3.08	0.17	6.4
Optimal standard*	4.6	0.72	6-8**

*Optimal tea leaf nitrogen and phosphorus level at the end of vegetation period. (Nagorniy V,1985)

**Old tea leaf tannin standard

Table 2. Height of the first level.

Sector number	1.1	1.2	1.3
Location	Upper part	Slope	Lower part
Height	384	374	364

Table 3. Height of the second level.

Sector number	2.1	2.2	2.3
Location	Upper part	Slope	Lower part
Height	364	354	334

Citing literature:

Ralf Fyuks: Intelligent Wachsen. Die grüne Revolution

Selyaninov G: Prospects of subtropical agriculture in the USSR in accordance with climatic conditions, 1961



Effect of sewage sludge stabilized with steelmaking slag on yield and nutrients uptake of wheat and on soil properties

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The use of sewage sludge stabilized with steelmaking slag as N fertilizer for wheat (*Triticum aestivum* L.) was evaluated. In addition, the effect of such a use on soil chemical properties and available N, P, K was also investigated. A mixture consisted of 25 % steel-making slag and 75 % (wet weight basis) dewatered sewage sludge was added to three soils with different pH (acid, neutral and alkaline). The treatments were addition to the soils of: i) 3 % mixture (rate equal to the common inorganic N fertilization for wheat, based on mixture's water soluble NO₃-N content); ii) 1 % mixture (rate equal to the common inorganic N fertilization for wheat, based on mixture's total N content); iii) the common inorganic N fertilization for wheat (120 kg N ha⁻¹) as NH₄NO₃ (86 mg kg⁻¹); iv) no fertilization (control). After equilibration, the treated and untreated soils were used in a pot experiment with winter wheat. Upon mixture application at both rates, soil pH significantly increased to the alkaline range remaining below 8.5 in all cases. Similarly, KCl extractable NO₃-N, Olsen-P, organic C and total N significantly increased, whereas the total amounts of heavy metals remained unchanged. Soil electrical conductivity significantly increased in both rates of mixture addition, exceeding at the highest rate the critical limit of 2 dS m⁻¹, above which salinity hazard is probable. As far as wheat growth is concerned, dry aboveground biomass yield and N and K plant uptake significantly increased with mixture addition at both rates in comparison to control and ranged at levels higher than those of the inorganic fertilization. Consequently, sewage sludge stabilized with steelmaking slag could be used as fertilizer (with regard to N mainly, although other nutrients cannot be excluded). However, potential environmental impacts should also be taken into consideration.

Keywords: nitrogen fertilization, sewage sludge, soil fertility, soil salinity, steelmaking slag, wheat



Evaluation and selection of different varieties and lines of soybean for breeding for valuable traits in the Central European part of Russia

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Soybeans is the most important source of high quality protein using as food, and oil. Soybean protein is balanced amino acid composition, and this is its advantage in comparison with other legumes, oil crops and cereals. Soybean protein contains all the essential amino acids in a ratio close to the animal protein. Due to the acute shortage of the protein the interest of the soybean production and the breeding of new varieties are constantly growing worldwide.

It was revealed the most early maturity lines for the duration of the vegetation period and interphase periods of development. It was searched the soybean samples with a maximum seed weight per a plant, thousand-seed weight and the largest number of seeds in a bean. It was identified the genotypes with the optimal displays of these signs for the breeding in the different directions.

The purpose of research: Evaluation of different varieties and lines of soybean for valuable traits and selection of early ripening and productive forms in the Central European part of Russia.

Research tasks:

- To study the dynamics of growth and development of soybean plants;
- To identify the most early maturing samples;
- To determine the structure and the volume of the yield;
- To find the most productive plants.

Location of research: The studies were conducted on the experimental field of the laboratory of legumes breeding of "All-Russian Scientific Research Institute of vegetable breeding and seed production" (Moscow region) in 2015.



The object of research: The collection of soybean samples of domestic and foreign breeders obtained from Vavilov Research Institute of Plant Industry (St. Petersburg) in quantity 83 pieces.

The quantity of soybean samples were ranged over the length of the vegetation period, pieces.

It was conducted observations of plant growth and development (phenological phases). All researched samples were split into 4 groups of ripeness for the length of the vegetation period.

3 varieties (I group) were the ultra-short ones for the length of the vegetation period (89 days). The largest group (40 pieces, II group) were samples with a short period of the vegetation.

The second largest (30 pcs, III group) were samples with a medium period of the vegetation (121 days).

Semu 315, Envy and PEP 13 (IV group) were the latest-maturing samples - 131, 133 and 141 days respectively (the long vegetation period). 4 Samples: Krushulya 9/3, Rosinka, Safran and breeding sample B-1 did not give seeds.

All ultra-fast plants (I group, 3 varieties) were selected for further study, from II group it was selected 30 samples (75%), from III group - 10 samples (33%). In IV group all the samples were discarded as a very late and unproductive.

The quantity of soybean samples were ranged over the weight of seeds per a plant, pieces.

All samples were graded by weight of seeds per a plant into 5 groups. The most productive and the smallest group (6 plants), included varieties and lines with a weight of seeds > 33 g. - very large weight of seeds. The second group (8 pieces) represented samples with large seed weight - 26-33 g. The third group (39 pieces) included the medium weight of seeds - 18-24 g.

Fourth, the largest group (69 pieces) is the interval of 10 to 16 g - a low weight of seeds. Last, the fifth group (17 pieces) included very low weight ≤ 8 g.

The quantity of plants of soybean samples were ranged over the weight of 1000 seeds, pieces.

All samples by weight 1000 seeds were divided into 4 groups. The group with the highest weight (>250 d) included 3 plants. The second group (190-250 g) represented 28 plants - the big weight.



The third group (130-190 g) included the largest quantity of plants - 86 pieces - the medium weight. The left number of samples represented a group with a low seed weight (110-130 g) - 22 pieces.

The quantity of plants of soybean samples were ranged over the average number of seeds in a pod, pieces.

The samples are interesting for the hybridization by the number of seeds in a pod with an average number of seeds in a pod > 2 pieces (72 samples, 51.7% of the total selected). The most valuable varieties and lines contained in a pod on average more than 2.5 seeds (5 pieces).

The conclusions:

1. As donors of early ripening for the duration of the vegetative period may be the following samples: Altom (Russia), SibNIISKHOZ 6 (Russia), Kasatka (Russia), VO-3 (Russia), Okskaya (Russia).
2. As the parent lines for the high productivity may be the following samples: VO-5 (Russia), VO-14 (Canada), VO-6 (Russia), VO-8 (Belarus), VO-12 (Japan), VO-2 (Poland).
3. As a valuable source of big-size seeds of breeding material may be the following samples: VO-12 (Japan), VO-13 (Japan), VO-10 (Japan), VO-11 (Sweden), VO-5 (Russia), VO-1 (Sweden).
4. As donors for the number of seeds in a pod may be the following samples: Altom (Russia), M-37 (Russia), SibNIISKHOZ 6 (Russia), M-12 (Russia), VO-4 (Germany), VO-7 (Russia), Okskaya (Russia).



Characteristics conformance evaluation of cheese within the Customs Union

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The requirements binding for their application and fulfillment in the customs territory of the Customs Union regarding the safety of milk and milk products/ Certification cheese is a part of the technical regulations of the Customs Union.

Key words: Cheese, dairy products, quality, safety, technical regulations

During the activation of Russian foreign trade standardization is of a key importance whereas it is necessary to ensure competitiveness of Russian economy and integration within the Customs Union. Standardization can become one of the crucial components of policy in the international trade relations sector and the most important tool of quality and service improvement.

Technical Regulations of the Customs Union were adopted in order to enhance and speed up the integration processes occurring in the Customs Union in the framework of the Eurasian Economic Community and the development of the Common Economic Space, as well as to harmonize with the international requirements. Technical Regulation of the Customs Union 021/2011 "Food Safety"; Technical Regulation of the Customs Union 022-2011 "Food Products Marking"; Technical Regulation of the Customs Union 005/2011 "Package Safety" are among them.

The dairy industry is the largest and a constantly developing branch of the food industry. The phenomenon is due to the significance of milk and milk products in the population's nutrition as a source of complete animal proteins, fats, carbohydrates, minerals, vitamins, and other necessary ingredients in an individual's diet. Cheese is food, which almost everyone has in his diet, and it is difficult to find a person who would not like it.

According to the presence and length of ageing cheese is classified into: ripened cheese and cheese without maturation; according to the moisture content in fat-free substance cheese can be: soft, semi-hard, hard, extra-hard and dried; according to the fat content



in dry matter cheese can be: high fat, fat, semi-fat, low fat, fat free.

Soft cheese is a popular product in Russian market with high profitability. With a view to high levels of competition in the market cheese must be of high quality and visually appeal to meet exquisite tastes of modern consumers.

The name of cheese often speaks of its country of origin. Feta cheese is not an exception. Only cheese manufactured in Greece can be called like that. As a rule, other countries manufacturing similar cheese change its name, for example, Fetaki.

We will focus on the following Regulation which is significant for the dairy industry: Technical Regulation of the Customs Union 033/2013 "Safety of milk and milk products". It sets the requirements binding for their application and fulfillment in the customs territory of the Customs Union regarding the safety of milk and milk products being produced for circulation in the customs territory of the Customs Union, the production processes, storage, transportation, sale and utilization, and marking and packing of milk and milk products for their free transportation as well.

Milk products must be produced from raw milk and/or raw skim milk and/or raw cream meeting safety requirements set by this Technical Regulation. The products must be exposed to heating.

In accordance with Annex 1 to the Technical Regulations of the Customs Union "Food safety" To identify cheese and soft cheese products organoleptic parameters are used: appearance - low cylinder-like shape or other free shape: texture - from soft plastic, firm, slightly elastic to delicate, oily consistency. The texture can be slightly brittle and crumbly. A small amount of eyes and holes are allowed; taste and smell is fermented or cheesy typical for the particular type of cheese; color can vary from white to yellow.

Cheese and soft cheese products must comply with the physical and chemical parameters specified in Table 1.

Table 1. Physicochemical parameters of cheese and cheese products

Product	Weight content, %			
	Moisture	Moisture in fat-free substance	Fat in dry matter	Salts
Cheese, dry cheese products	2 – 10	Less 15	1 - 40	2 - 6
Cheese, extra-hard cheese products	30 – 35	Less 51	1 - 60 and more	2-3
Cheese, hard cheese products	40 – 42	49 - 56	1 - 60 and more	0,5 -2,5
Cheese, semi-hard cheese products	36 – 55	54-67	1 - 60 and more	0,2 - 4
Cheese, soft cheese products	over 55-80	67 and more	1 - 60 and more	0 - 5



Hygienic safety requirements to cheese and cheese products must not exceed standard figures specified in Table 2.

Table 2. Hygienic safety requirements of cheese and cheese products

Toxic elements	Maximum allowable level, mg/kg
Lead	0,5
Arsenic	0,3
Cadmium	0,2
Mercury	0,03

Assessment (confirmation) of conformity of milk and dairy products to the requirements Technical Regulations of the Customs Union 033/2013 «Safety of milk and milk products» A declaration of conformity is carried out through the adoption of a declaration on the basis of own proofs, and (or) proof got from third parties

Tests of samples of dairy products are carried out in the test laboratory of the applicant (the applicant's choice of testing samples of dairy products can be carried out by accredited testing laboratory included in the Unified Register of certification organization and testing laboratories (centers) of the Customs Union).

Declaration of conformity of milk products include the following general procedure: - Formation and analysis of technical documentation - Implementation of production control; - Testing of product samples; - Adoption and registration of the declaration of conformity; - The application of common sign of products on the trade states - members of the Customs Union.

In accordance with the Technical Regulation of the Customs Union 021/2011 while being produced, stored, transported and sold food products safety is carried out under the implementation and maintenance of the procedures based on the principles of Hazard Analysis and Critical Control Point: the selection of necessary technological production processes; the selection of sequence and route of technological operations in production; setting controllable stages of technological operations and tracing food products in the stages of their manufacturing; control raw ingredients, technological facilities, and packing; control the operation of technological equipment; recording information on controllable stages of technological operations and results of food products control.

The quality and safety of the products are most important conditions for the prevention of diseases in the population. From the way a person eats, depends on its health, productivity, quality of life. In this connection, control the manufacture of food products plays a very important role.



Quality of food include monitoring of food products for physico-chemical, organoleptic and safety indicators, in accordance with the requirements of normative law documents. Entered into force on 9 of October 2013 the requirements specified in TR CU 033/2013 «The safety of milk and dairy products" to minimize the production of fake products thus give manufactured products meet safety standard.

References:

1. Technical Regulation of the Customs Union 021/2011 Food Safety., 2009. 52p.
2. Technical Regulation of the Customs Union 033/2013 Safety of milk and milk products., 2013. 62p.
3. State Standard 52686-2006. Cheese. General specifications. Moscow, Standartinform Publ., 2008. 20 p. (In Russian)
4. State Standard 32263-2013. Soft cheese. General specifications. Moscow, Standartinform Publ., 2013. 15 p. (In Russian)
5. Osnovy tehnologii moloka i molochnyh produktov: uchebnoe posobie/ M.B. Rebezov, O.B.Bogatova, N.G. Dogareva i dr. – Cheljabinsk: IC JuUrGU, 2011. – 58 s.
6. Metody issledovaniya svojstv syr'ja i molochnyh produktov: uchebnoe posobie/ M.B. Rebezov, E.P. Miroshnikova, G.K.Al'hamova I dr. – Cheljabinsk: IC JuUrGU, 2011. – 58 s.



Peculiar to the game mammals and wildfowl

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Among the natural resources, of which Russia is famous, an important place in obtaining food and raw materials for medical, fur and leather industry wild animals take place.

Wild animals and birds are produced for obtaining meat, including diet meat, fat, hides and raw materials for medicines.

We should consider that many species of fowl are the reservoir of many pathogens of natural focal infectious diseases. Conducting veterinary-sanitary examination of products of slaughter of wild animals is difficult and different from studies of meat products derived from domestic animals. Veterinary-sanitary examination of products of slaughter of wild animals is difficult and different from examination of products derived from domestic animals. Among the natural resources, of which Russia is famous, an important place in obtaining food and raw materials for medical, fur and leather industry wild animals take place.

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Meat and other slaughter products of poultry may be a source of proliferation "of infectious and parasitic diseases hazardous to farm animals and humans. Under the current "Rules of veterinary inspection slaughtered animals and veterinary expertise of meat and meat products" meat, obtained from animals and poultry suffering from infectious, parasitic and noninfectious diseases or noxious substances, regardless of the source of infection or intoxication, may not be used for food purposes without prior thermal disinfection (boiling, canned meat, meat jellies, boiled sausages).



Microencapsulation of probiotic strains for enhanced viability by complex coacervation and subsequent ionotropic gelation

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Probiotics are associated with the delivery of several health benefits to the host, thus raising the interest of the food industry for the production of functional foods with probiotic cultures. One of the main challenges in exerting their health effects is to maintain high viability ($>10^6$ CFU/g) during food processing, storage and upon their transit through the gastrointestinal tract system. The objective of this study was to investigate the viability of two probiotic strains under exposure to low pH conditions and after heat treatment by using complex coacervation and a dual encapsulation process; i.e. the combination of biopolymer complex coacervation followed by external ionotropic gelation. For this purpose, complex coacervates were firstly formed using whey-protein-isolate (WPI) and either Low-Methoxyl-Amidated Pectin (LMAP) or Gum Arabic at an optimum weight ratio of 3:1 and 2:1, respectively, at pH 4.0. Droplets of the WPI:LMAP coacervate's final suspension were added slowly into a CaCl_2 0.05M solution by means of a syringe and gel microspheres were formed by ionic gelation of the pectin and by the calcium ions. The results showed that all encapsulation techniques significantly improved the viability of the cells compared to the free cells. Moreover, the dual encapsulation of probiotic cells in gel beads made by ionic gelation with embedded coacervates offered a slightly higher protection to the bacterial cells upon heating compared to the coacervates alone. Complex coacervation as the sole encapsulation technique, resulted in a better cell viability in a low pH environment (pH 2.0). Moreover, after spray drying, both complex coacervates systems retained a high population of viable bacterial cells showing the potential to be used for production of functional foods containing probiotics in a powdered form. Overall, the experimental findings indicated that dual encapsulation of cells in gel microspheres containing coacervates can offer improved protection for certain applications related to actual food matrices.

Keywords: Probiotics; Complex coacervation; Ionotropic gelation



Investigation of the accuracy of satellite geodetic control for survey works

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This graduation work presents the author's research on the analysis of the main components of the baseline - coordinate increments, distances and elevation - between points of constantly-operating network stations in the form of a geodesic quadrangle.

Geodetic network, the accuracy of satellite observations, satellite geodetic measurements, satellite receivers, cadastral works, satellite geodetic support, treatment of observations, equalization

The aim of my work is to analyze satellite geodetic measurements of the network of base stations to determine their accuracy and the possibility of their use in the cadastral works.

For the accuracy analysis I took the network in the form of a geodesic quadrangle with vertices located on the roofs of buildings in the suburban town of Voskresensk, Lukhovitsy, Silver Ponds, Kashira.

GNSS satellite systems TrimbleR8 are established at all points of analyzed geodetic network. They represent a dual-frequency receiver and antenna in a single housing.

Satellite measurements data obtained from these stations are available on the website GeoSkyNet.

Daily file for each of the first day of the month in the period from 10 January to 10 December was loaded.

Satellite observations reduction process was made in software product Trimble Business Centre. So, I got baseline parameters and evaluation of the accuracy of measurement results, which are presented in the tables. For example, I present the results of satellite



observations reduction process for the baseline Voskresensk – Lukhovitsy.

Deviations of each cycle from zero cycle were calculated for the main components of baseline – coordinate differences, distance, and height difference. Measurement results on January 10 were taken for zero cycle, for the n-th cycle - 10 December. The calculations were performed by the formulas:

$$DS_i = S_0 - S_i; DH_i = dH_0 - dH_i;$$

$$DX_i = dx_0 - dx_i; DY_i = dy_0 - dy_i; DZ_i = dz_0 - dz_i;$$

The calculation results are shown in Table. On this data I built graphics with trends to each parameter (3rd degree polynomial).

I present the analysis of the most characteristic of them.

The graphic of changes of coordinate differences of baseline Kashira - Lukhovitsy shows that on 10 February the rate of change of coordinate difference X and Z made a sharp rise and reached 64 mm and 59 mm respectively. Then value change of coordinate difference X began to decline and the rate of change of coordinate difference continued sharp rise and reached its maximum – 124mm – on 10 May. The rate of change of coordinate difference Y also peaked 47 mm on 10 May. Further, the value of both parameters was gradually decreased.

The graphic of changes of distance and height difference of the baseline Kashira – Lukhovitsy shows that on 10 February the distance rate of change goes to its minimal value -49mm. On 10 May, both parameters reached maximum 24 mm and 132 mm, respectively, and then decreased.

The graph of behavior of baseline Kashira - Luhovicy shows that from 10 January to 10 April, the measurements were accurate enough, then on 10 May an abnormal jump of the value change of mean-square error of all the parameters is observed (mean-square error of height difference reached 33 mm, the mean-square error of distance - 21 mm, mean-square error coordinate difference Z - 24 mm, mean-square error coordinate difference Y - 21 mm, mean-square error coordinate difference X - 24 mm). Then on 10 June indexes normalized but on 10 July made a big jump again, and further continued to grow.

For the analysis of satellite geodetic measurements a statistical test of the hypothesis of the equality of the variances of the measured values of the lengths and height differences baselines was carried out.



During the experiment were computed deviations of the measured values from the average value, then i determined their sum, after which the obtained values were squared. The calculation results are shown in Tables. For example, I introduced the calculation of the dispersion relations of the baseline Voskresensk – Lukhovitsy.

After calculating the actual dispersion relations it's necessary to make their comparison with the theoretical value at probability 0.95. The results of calculations of actual values and theoretical dispersion relations given in the table.

As we can see from this table theoretical values of the dispersion ratio exceeds practical for baselines Luhovicy-Silver Ponds, Silver ponds Kashira, Voskresensk-Silver Ponds, and for baseline Voskresensk – Lukhovicy theoretical value is almost equal to the practical, which may indicate that random errors may likely impact on the identified changes of baseline parameters.

For baseline Voskresensk – Kashira practical value variance ratio exceeds the theoretical value of almost 2.5 times, indicating that the change in the parameters of the baseline can not be explained by random errors and it's likely have physical and mechanical nature, in other words, due to the influence of movements and deformations of the earth's surface.

The research results suggest that it's necessary to have a prior analysis of the accuracy of satellite observation of base stations network before using them for the geodetic and cadastral surveying in RTK mode.



Fuel Type Mapping using Satellite Remote Sensing and Ancillary Geographic Data

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Abstract

Over the past decades, fire occurrence has grown rapidly in Europe resulting in serious ecological, economic and social problems. This is the reason why, rational fire management becomes crucial. Fuels is one of the most important factor that should be taken under consideration in fire management. Information regarding the spatial distribution of fuels and their properties are essential. Consequently, the need for the production of updated and accurate fuel maps remains constant and imperative.

Satellite remote sensing constitutes a key element for an effective fuel type mapping. A variety of methodologies has been developed for the production of accurate fuel type maps. The present study aims at the development of a methodology for the production of fuel type maps, through an object-based analysis of satellite images and their combination with an available vegetation density map.

In the present study, the potential of fuel type mapping through an object-based analysis of DMC and Landsat 8 satellite images was evaluated. Initially, an object-based classification model was developed using a DMC image, in order to map fuel types, and its' transferability to a second study area was evaluated. Then, an evaluation for the transferability of the model from a DMC to a Landsat 8 image was performed, to both the first and the second study area. Last but not least, an object-based classification model was also developed using a Landsat 8 image, in order to map fuel types, and its' transferability to a second study area was also evaluated. The estimated accuracy of the cartographic products indicates that the object-based analysis of medium-high spatial resolution satellite images, such as DMC and Landsat 8, can be implemented for fuel type mapping producing highly accurate maps.

KEYWORDS: FUEL TYPE MAPPING, DMC, LANDSAT 8, OBJECT-BASED CLASSIFICATION, REMOTE SENSING, GEOGRAPHIC INFORMATION SYSTEMS



Evaluation of genetically improved fast growing species and clones for biomass production and carbon sequestration

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Five hybrid clones of *Platanus* sp. and seven of *Populus*, sp. resulting from the Fast-Growing Species Genetic Improvement Program of the Forest Genetics and Tree Breeding Laboratory, Aristotle University of Thessaloniki (1975 – 2010), were investigated for their performance in a short rotation intensive culture context. The study was conducted in an experimental plantation located on the right embankment of the Axios river in northern Greece that has been established in 2000. Clonal evaluation was based on quantitative and qualitative data (crown form, branching diameter, branching angle, forking, stem straightness) as well as on DNA markers. Data were processed and analyzed with statistical and genetics software packages Excel 2007, SPSS 20 and GENEALX. Clonal DNA fingerprinting was carried out using with nine (*Platanus*) and seven (*Populus*) microsatellite DNA (SSR) primers. Evaluation at 14 years after establishment presents a very good level of precision with regards to clonal performance for fast growing species. The plantation clones presenting the best performance in most characteristics studied were X3, Sparta 1 (poplars) and P2 (plane trees). Clones lagging behind were P8 (plane tree), T1 and Axios 3 (poplars). SSR loci were polymorphic, presented a high discriminating capacity for both genera and were thus particularly effective for DNA fingerprinting. For *Platanus* clones, polymorphism was at 55.55%, mean number of alleles per locus was 2.6 and expected heterozygosity ranged from 0.46 to 0.62, whereas observed heterozygosity from 0.25 to 1.00. SSR markers for *Populus* were also polymorphic (at 60%), mean number of alleles per locus was 1.8 and mean expected and observed heterozygosity were 0.32 and 0.50 respectively. Nei genetic distances were in concordance to the origin and the open pollinated family relationships of *Platanus* clones. Clones of *Populus* of similar origin were grouped together and groups were separated according to clonal origin. Full clonal identification of all genotypes studied could be achieved by employing only two microsatellite primers.



International cooperation on certification and agricultural production quality management between Russia and Greece

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Introduction

Agriculture is one of the most important sectors of the economy of Russia and also in Greece. Agriculture employs about 12% of all people employed in the Greek economy, in Russia this figure is slightly lower around 10.5-11%.

Based on official information, as you can see 41.5% of Greek exports to Russia is for the products of the agricultural sector. The main products imported from Greece in Russia are strawberries (7.8%), nectarines (12.3%), apricots (1.3%), cucumbers (1.0%), olives and olive oil, or (1.0 %).

In late January 2015 the turnover of foreign trade of Russia with Greece increased by 0.7% compared to the same period in 2014. The main imports by Russia are the corn. After the meeting, Russian President Vladimir Putin and Greek Prime Minister AlexisT-sirapsa was determined cooperation plan for the year 2015-2016, one of the decisions of the meeting was cooperation in the agricultural sector through the creation of joint ventures. It should also be noted that in 2016 will be declared the Year of Greece in Russia and Russia in Greece.

For the international support in the agricultural sector between Russia and Greece become more viable is very important to find ways of cooperation on standardization and certification of agricultural products.

Standardization - rule-making activity and characteristics for voluntary multiple use purposes, aimed at achieving order in the spheres of production and circulation of produ(a)cts and impro(y)ve the compEtitiveness of products, works or sErVICES. Russian national standardization of leaders provides national standards body - the Federal Agency



for Technical Regulation and Metrology (Rostechregulirovanie), an analogue of the Greek Organization for Standardization Hellenic Organization for Standardization (ELOT).

Cooperation between Russia and Greece to determine seed quality for potatoes

Potatoes are an important crop for both the Russian Federation and for Greece. An important is that the potato seed is not entered in the product list under sanction.

To determine the technical conditions for production of quality seed potatoes in Russia we have to use the default (Russian) national GOST R 53136 to 2008.

This means that the seed potatoes are tubers or any other propagation material, but not like seed potatoes to plant species *Solanum tuberosum* L., which are based on regular assessment during growth and screening duly recognized as suitable for reproduction. The seed for potatoes as regards the quality and the quality of planting, depending on the play stage are divided into categories:

- Original seed category includes potatoes for seed, without sickness and without virus (micro-plants, micro-tubers, mini-tubers), and the classes of the first generation of mini-tubers field and super-super-elite;
- Elite category includes potatoes for seed super élite and elites;
- Category for seed potatoes for production comprises first and second after the reproduction of the elite for use in seed purposes and the production of marketable potatoes.

Potatoes for seed must be of quality and must meet the requirements established for the respective categories in Table 1.

Table 1. Requirements on quality of planting material

Name	Micro-plants and micro-tubers in vitro	mini-tubers	OS	ES	PC ₁	PC ₂
I. Tolerances for landings (percentage of plants)						
Other varieties	0	0,01	0,25	0,25	0,5	0,5



Dickeya / Pectobacterium spp.	0	0	0,5	1	1,5	2
Viral diseases (for acute forms)	0	0,1	0,4 (0,2)	0,8 (0,4)	2 (1)	10 (2)
2. The tolerances for the parties (the percentage of tubers)						
Soil and impurities	0	1	2	2	2	2
Erwinia caratovora (if they are not caused by <i>Synchytrium e.</i> , <i>Clavibacter m.</i> , <i>Ralstonia s.</i>)	0	0,2	1	1	1	1
External defects	0	3	3	3	3	3
Shriveled tubers	0	0,5	1	1	1	1
Common scab contained (<i>Streptomyces scabies</i>)	0	5	5	5	5	5
Rhizoctonia	0	1	5	5	5	5
Total tolerances(%)	0	5	6	6	6	6

Abbreviations:

OS - the original seed potatoes;

ES -elite seed potatoes;

RS1-2 - the first and second reproduction of seed potatoes after elite.

The potato crop seed plants should be representative of the morphological characteristics and botanical varieties, aligned for growth and development. Leaf blade should be a uniform color without spots signs of bending, twisting or twist, plain or with a characteristic curling variety.



Potato plants cultured in vitro must be green color with well developed root systems and foliage, with the number of interstices of at least four. There should be growing plants with more than normal (with curved stems) or to the mixture of other varieties, and other viral infections. Seed potatoes must be healthy, intact, for husked inexperienced shape and color typical for its botanical variety; dry, non-germinated (with the exception of the spring tubers embodiment with no more shoots than 5 mm). Size of tubers the transverse diameter should be of 28-60 mm, mini-tubers 9-60 mm. With exception of seed potato pests, diseases, weeds of quarantine significance seeds for the Russian Federation, according to the list approved by the established procedure.

The ES and OS category includes the presence of plants and tubers affected by viral and / or bacterial infection in a latent form, based on leaf samples of laboratory tests and tubers according to the requirements.

Packing

The boxes in which the plants are transported in vitro must contain a special inscription "Caution", the product content must be less than 15 kg. Sending to seed potatoes are made into boxes without any foreign smell.

Conclusion

This Russian national standard is based primarily on international standards due to the technical conditions of seed potatoes.

In order to deepen cooperation between our countries in the agricultural sector, there is a need for you guys to know our national standard, which complies with ISO International Standards Organization. The same should conclude additional agreements in the framework of the Black Sea Economic Cooperation and the WTO, for greater harmony between standards, and to better align the default category of direct application. The basis for development of the standard should be taken into account EEK UN C-1. Should take into account the list of products in quarantine (banned products) in deferent's country.

And it must create a table of the appropriate category of seed potatoes between Russia and the European Union. An example of this table is available in the GOST R 53136-2008 (Table 2) in my country.



Table 2 Correspondence table between categories of seed potatoes

<i>The European Union</i>	<i>Russia</i>
Pre-Basic seed	The original seed potatoes
Basic seed	Elite seed potatoes
Certified seed	Reproduction

Creation of such a standard is another step in the strengthening and development of economic relations between Russia and Greece, in the current circumstances. It should also take into account that the development of this standard will contribute to the development of the Black Sea Economic Co-operation and as a consequence of the development of the market of agricultural trade in the Black Sea region.

List of references

1. Krylova G. D. basics of standardization, certification, Metrology: Textbook for universities. - M.:UNITY - DANA, 2000. - 711 p
2. Law of the RF "On certification of products and services" in the version dated 10.01.03.
3. The RF law "On standardization" from 29.06.15.
4. Russian state standard GOST R 53136 to 2008.



European Union Environmental Policies and Information and Communication Technologies

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European Union (EU) provides a hierarchy of objectives and targets starting with the Treaty's objective of a high level of protection and improvement of the quality of the environment. Environmental policy of the EU helps green the economy, protect nature, and safeguard the health and quality of life of people living in the EU. As a global actor, EU plays a key role in international efforts to promote sustainable development globally. All environmental objectives and targets need Information and Communication Technologies (ICTs) as key catalysts, and ICTs will be absolutely crucial for achieving these goals. In recent years, the implementation of most new European Union legislation is supported by ICT systems. This paper presents the ICTs usage in European Union environmental policies.



A business plan for the reorganization of the agrotourism enterprise "Ziogas Western City"

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ABSTRACT

The «Ziogas Western City» is an agrotourism enterprise established in 1996 in a small village called Lefkohori, 30 km from Thessaloniki. It is involved in providing horse riding, horse riding lessons, food services and practical information about manufacturing of local food products. The initial investment cost was €200.000 and it was co-financed by European Union programs (LEADER+). There are four seasonal employees working in this family business, apart from the four family members.

With the help of the business plan and taking into account the swot analysis, as well as the existing market conditions and competition, we will attempt to diversify the agrotourism product offered by the enterprise. The construction of a five beds guesthouse and the creation of a small farm, where visitors could participate in various stages of production and taste the products are the new activities that will attract more tourists. The new agrotourism product of "Ziogas Western City" will include accommodation, restoration facilities, horse riding, horse riding lessons, archery, shooting, farm activities and training.

The cost for the new activities is calculated in €85,000. This investment will be co-financed by European Union programs. The break-even point will be achieved four years after the investment. From this point the enterprise will make profit. The expected increase of tourists will offer multiple benefits to all the region around the investment as it is going to attract more investors.



Do consumers care for cooperative products via short food supply chains?

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Short food supply chains (SFSCs) describe food chains with less intermediaries in relation to a conventional food supply chain with farmers, cooperatives, manufacturers, wholesalers, retailers and consumers. They are important because they manage to bring closer consumers to producers and guarantee fair prices for both of them. The main aim of this empirical research is to investigate the consumers' willingness to purchase cooperative products via short food supply chains. More specifically, a structured questionnaire was conducted in June 2015 and answered by 489 consumers in Thessaloniki. The empirical results reveal that the cooperative brand influences positively the 81,4% of the respondents to purchase the product. Therefore, a cooperative brand constitutes a very strong motive for its sale. Moreover, consumers feel more comfortable purchasing brand cooperative products from local producers or SFSCs not only in order to support them in the middle of the severe economic crisis, but also because they trust them. The results are very useful for policy-makers as well as for the directors of agricultural cooperatives because they reveal that consumers are willing to support greek producers and agricultural cooperatives even if the product prices are not very competitive.



Deformation Precursors of Strong Earthquakes Derived from GNSS Observation

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ABSTRACT

The results of GNSS observations in areas of strong earthquakes are analyzed. The characteristics of land surface deformation before, during and after earthquakes have been obtained. The results prove the presence of anomalous deformations near their epicenters.

Key words: earthquake precursors, Earth's surface deformation, GNSS observation.

Introduction

Researches of deformation earthquake precursors were on the front burner from the middle to the end of the previous century. The repeated conventional geodetic measurements such as precise leveling (see example [1]) and linear-angular networks have been used for the study. Many examples of studies referenced to strong seismic events using conventional geodetic techniques are presented in [3]. One of the first case studies of geodetic earthquake precursors was done by Мещеряков [2].

Rare repetitions, insufficient densities and locations of control geodetic networks made difficult predicting future places and times of earthquakes occurring.

Intensive development of Global Navigation Satellite Systems (GNSS) during the latest decades allows doing the research in a more effective level.



Investigation Area and Networks

Today permanent GNSS stations being installed widely all over the world. It is possible now to study the Earth's surface deformation on a scale never possible before. Some of permanent GNSS networks are covering the seismo-generating zones. One of the more investigated seismic areas is San Andreas Fault zone of California, USA [4]. Two of GNSS networks of this zone are well placed to study Earth's surface deformation just near the epicenters of the strong Parkfield (September 28, 2004, $M_w=6.0$) and El Mayor Cucapah (April 4, 2010, $M_w=7.2$) earthquakes. The epicenters of the earthquakes are conveniently located several kilometers far from the permanent GNSS networks.

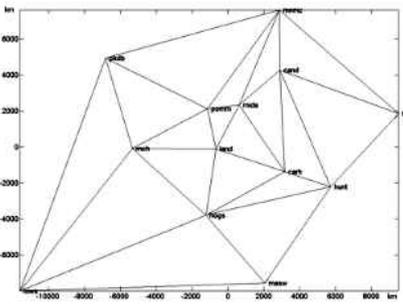


Fig.1. Parkfield permanent GPS network used in the study

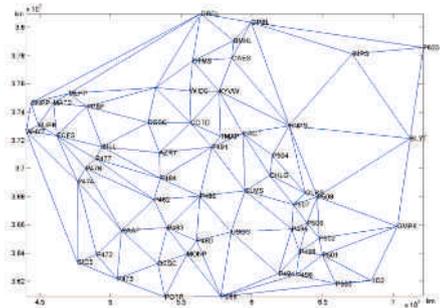


Fig.2. CRTN network used in the study

The Parkfield permanent GPS network of the Plate Boundary Observatory, USA, was used for the study of the Earth's surface deformation in relation to the Parkfield earthquake (Fig. 1). The usage of the network for the study of seismic displacements is described in [5].

The California Real Time Network (CRTN) of permanent GPS stations (Fig.2) is located not far from the epicenter of El Mayor Cucapah main shock and covers epicenters of some aftershocks of it. The Southern California Integrated GPS network is described particularly in [6].

The only shortest baseline vectors formed the Delaunay triangulation were used in the processing as it is recommended in [7] and shown at Fig.1-2.



Observation Data and Preprocessing

The block flow diagram of the analysis is shown at Fig. 3.

Observation data used for the deformation analysis was received from the archive of the Scripps Orbit and Permanent Array Center (SOPAC) [http://sopac.ucsd.edu/]. Data sampling is equal to 30 sec. Daily measurements were processed using MAGNET Tools software for the determination of baseline vectors and its co-variation matrices. Such processing was performed for the 6 measurement epochs for both GNSS networks. Then the obtained baseline vectors were adjusted using the special technique. The two dimensional approach of the deformation analysis has been used in the study. It is recommended as a proper and unified an example in [8].

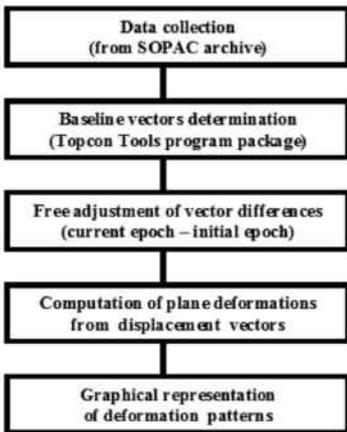


Fig. 3. Block flow diagram of the analysis

Measurement Adjustment and Graphical Representation

The procedure of the adjustment is described as follows.

Observation equations were presented as

$$v = Adx + l, \quad (1)$$

where v – vector of the derived corrections to the differences of repeatedly measured baseline components of the order $(3n-3) \times 1$ for n baselines;

A – matrix of the coefficients of the observation equation (1); dx – vector of point displacements of the order $3k \times 1$ in case of k determinate points; l – vector of the differences of the measured network elements of the order $(3n-3) \times 1$.

The Least Square solution of the observation equations (1) is

$$dx = -N^{-1}L = -Q_{dx}L, \quad (2)$$

where $N = A^T Q_l^{-1} A$ and $L = A^T Q_l^{-1} l$, the so-called matrix of the normal equations coefficients and vector of the free terms of the normal equations, where $Q_l^{-1} = P$ is the matrix of the weights of the measurements.



This solution satisfies not only the condition $v^T P v = \min$ but the $x^T Q x + x = \min$ too.

The adjustment procedure makes possible to calculate the plan deformation characteristics. Deformations of dilatation Δ have been used in this study.

$$\Delta = \frac{x_2(dy_3 - dy_1) - y_2(dx_3 - dx_1) - x_3(dy_2 - dy_1) + y_3(dx_2 - dx_1)}{x_2y_3 - x_3y_2} \quad (3)$$

where x_i, y_i are plan coordinates; dx_i, dy_i – plan displacements; i – indices of vertex of triangles.

Deformations of dilatation were calculated for the three epoch differences before and three epoch differences after the El Mayor Cucapah earthquake. Corresponding characteristics referenced to the Parkfield earthquake were received from the study [9]. The graphical contour maps of the dilatation patterns as a result of the "quick look" analysis are presented in Fig. 4-5 in comparison to each other. Fig. 4 shows the existence of substantial Earth's surface deformations prior to the both earthquakes rising in time approaching to the moments of the main shocks. The main extremes of deformations are placed near the earthquake epicenters. It is possible to consider that these features have to be considered as the earthquake precursors. The postseismic deformations are shown at Fig. 5. It accelerates in the same locations in relation to the preseismic patterns.

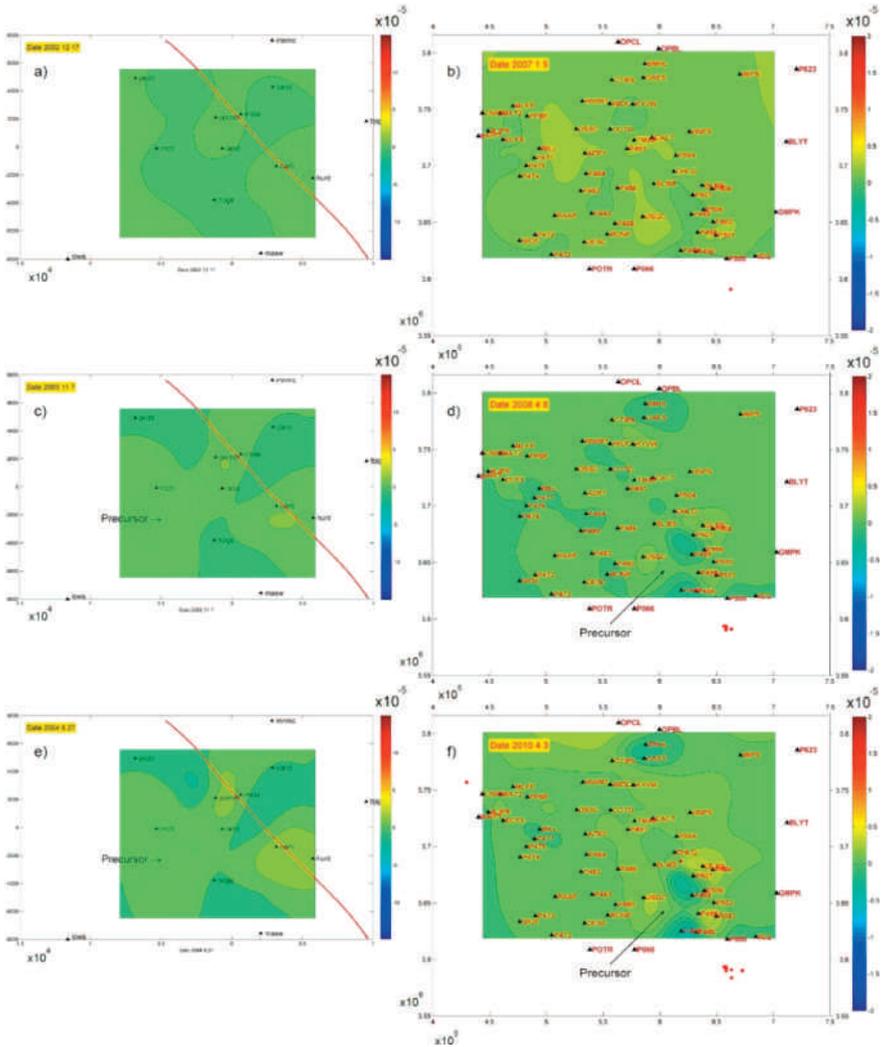


Fig.4. Preseismic dilatation patterns before the Parkfield (a, c, e) and the El Mayor Cuapah (b, d, f) earthquakes.

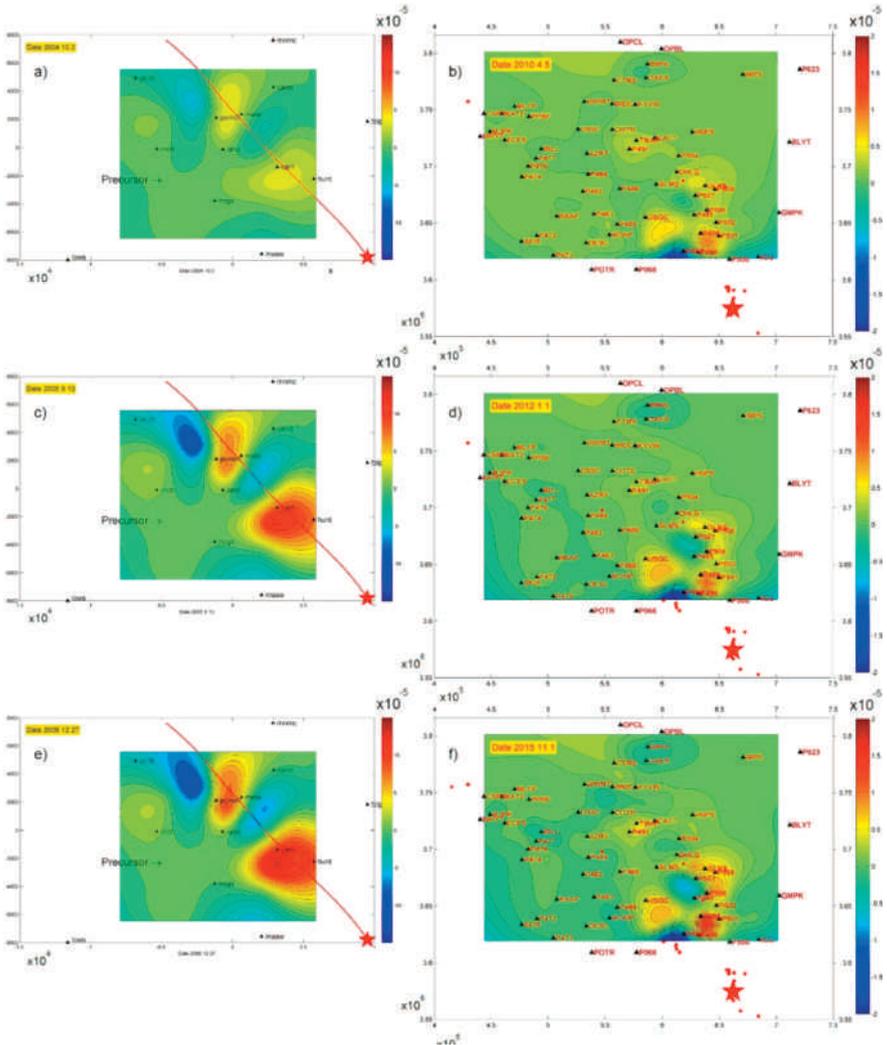


Fig.5. Postseismic dilatation patterns before the Parkfield (a, c, e) and the El Mayor Cucapah (b, d, f) earthquakes. Red stars are the main shock epicenters. Red dots are the aftershocks.



The quantitative estimates of the dilatation and root mean squares (RMS) of every observation interval for both study cases are represented in the table. Preseismic and post-seismic dilatation values are written in the top and bottom parts of the table respectively. The values of preseismic deformations vary from 0.2 to 1.8×10^{-5} . The world practice demonstrates that so high level of deformation corresponds to seismic processes. These values of deformations can be considered as alarms of approaching to seismic event occurrences near its localizations.

Dilatation Extreme and Accuracy Estimations

Parkfield, September 2004, M=6.0			El Mayor Cucapah, April 2010, M=7.2		
Time before the Earthquake (years)	Time Interval from the First Epoch (years)	Dilatation \pm RMS (10^{-5})	Time before the Earthquake (years)	Time Interval from the First Epoch (years)	Dilatation \pm RMS (10^{-5})
1.78	0.96	0.50+0.04	3.42	0.66	0.19+0.03
0.89	1.85	1.00+0.07	2	2.08	0.11+0.01
0.01	2.74	1.77+0.06	0.01	4.08	0.26+0.01
-	2.74	3.41+0.04	-	4.08	1.00+0.03
-	3.7	10.1+0.06	-	5.5	1.10+0.01
-	5	12.5+0.06	-	9.66	1.40+0.01

Conclusion

Two studied cases of horizontal deformation behavior before and after strong earthquakes show the contrast deformation changes from years by days before the events near their epicenters.

The estimated extremes can be considered as temporal precursors of the earthquake occurring.

It is possible that the places of the earthquake occurring can be predicted using the extremes too.



The permanent GNSS networks covering seismic generating fault zones can be effective tools for the earthquake prediction.

The further research will be continued to reveal the more detailed tendencies and regularities of Earth's surface deformation behavior in seismo-generating zones.

References

1. Kaftan V.I., Ostach O.M. Vertical land deformation in Caucasus region // Earthquake prediction Research .- 1996.- Vol.5.- P. 235-245
2. Мещеряков Ю.А. Изучение современных вертикальных движений земной коры и проблема прогноза землетрясений / Сб. Современные движения земной коры, М., 1968.- №3
3. Rikitake T. Earthquake Prediction, Elsevier Scientific Publishing Co. , 1976
4. Wallace R.E. (editor) The San Andreas fault system, California. U.S. Geological Survey professional paper 1515. — Washington, D.C.: U.S. Government printing office, 1990, — 405 pp.
5. Langbein J., Bock Y. High-rate real-time GPS network at Parkfield: Utility for detecting fault slip and seismic displacements // Geophysical Research Letters, 2004, Volume 31, L15S20.
6. Hudnut K.W., Bock Y., Galetzka J.E., Webb F.H., Young W.H. The Southern California Integrated GPS Network // The 10th FIG International Symposium on Deformation Measurements. 19—22 March 2001 Orange, California, USA. 2001. — pp. 129—148.
7. Докукин П. А., Кафтан В. И., Красноперов Р. И. Влияние формы треугольников в геодезической сети на результаты определения деформаций земной поверхности // Известия вузов. Геодезия и аэрофотосъемка. 2010. № 5. С. 6—11.
8. Dermanis A., Kotsakis Ch. Estimating Crustal Deformation Parameters from Geodetic Data: Review of Existing Methodologies. Open Problems and New Challenges // International Association of Geodesy Symposia. 2005. Vol. 131. — pp. 7—18.
9. Кафтан В. И., Красноперов Р. И., Юровский П. П. Графическое представление результатов определения движений и деформаций земной поверхности средствами глобальных навигационных спутниковых систем // Геодезия и картография. 2010. № 11. С. 2—7.