AGRORES

XI INTERNATIONAL SYMPOSIUM OF AGRICULTURAL SCIENCES

BOOK OF ABSTRACTS

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26-28, May, 2022
Trebinje
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AGRORES 2022

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ORGANIZERS

Faculty of Agriculture
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Chamber of Commerce of
Agricultural Engineers of the
Republic of Srpska

BTF Biotehnički fakultet

Biotechnical Faculty
University of Montenegro

Institute of Field and Vegetable
Crops Novi Sad

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Institute of Genetic Resources
University of Banja Luka

Agricultural Institute
of the Republic of Srpska

South Eastern Europe
SWG RRD
Regional Rural Development Standing Working Group

Regional Rural Development
Standing Working Group (SWG)

RebResNet
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Ministry for Scientific and Technological Development, Higher Education and Information Society of the Republic of Srpska;
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SCIENTIFIC PROGRAM

Thursday, May 26

	The City of Sun'Trebinje Hall 2
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	The City of Sun'Trebinje Hall 2
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Friday, May 27

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SESSION 1: CROP SCIENCE 2

Oral Presentations The City of Sun'Trebinje Hall 1

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	Chair: to be unounced	

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PLENARY LECTURES

Keynote speaker

Carlo Leifert - Southern Cross University, Lismore, Australia

Prior to taking up his position at Southern Cross University on the 1st of March 2018, Carlo was Research Development Professor of Ecological Agriculture at Newcastle University for 17 years, and also served part-time as Dean for Business Development (2014-2016) in the Faculty of Science, Agriculture and Engineering.

His work over the last 20 years has focused on:

- applied agronomic R&D and technology transfer to improve quality and safety and reduce costs in sustainable and organic food production systems,
- strategic R&D into interactions between food production methods and food quality (especially nutritional and sensory quality) and safety characteristics and
- selection/breeding of crop and livestock varieties suitable for "low input" and organic production systems.

Prof Leifert is a visiting professor at the Chinese Academy of Agricultural Science (www.caas.cn/en/), and the Department of Nutrition at the Oslo University Medical School (www.med.uio.no/imb/english/about/organization/departments/nutrition/) and a member of the academic advisory board of the Thünen Institute (the German Federal Research Institute for Agriculture, Forestry and Fisheries (www.thuenen.de/en/). Between 1999 and 2009 he was a member of TESCO's Food quality and Safety expert panel and advisory board of Nature's choice, which is TESCO's quality assurance auditing system for its global produce supplier base.

He has also been research manager in a plant biotechnology/breeding company (Neo Plants Ltd. 1986-1990), technical director of a vegetable production and processing firm (Howegarden Ltd.; 1996-1999), research fellow/lecturer at Manchester (1990-1993) and Lecturer/Senior lecturer at Aberdeen University (1993-2000).

As an apprentice/student he worked on farms in Germany, Greece and Israel and he has a small farm in Crete, Greece producing organic olive oil and herbs.

He has published 2 textbooks and more than 150 peer reviewed papers.

PL_01

Integrated soil, crop and livestock management in organic agriculture; a logical framework to ensure food security and human health?

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Abstract

The environmental and biodiversity benefits of organic farming are widely recognized. There is also mounting evidence from (1) field experiments and farm/retail surveys that organic food production methods improve the nutritional quality of foods and (2) epidemiological/cohort studies that organic food consumption has significant health benefits[1].

However, there is concern about whether organic farming methods can provide enough food for a growing world population, since recent meta-analyses showed that yields in organic farming systems are on average 25-30% lower than those currently achieved by intensive conventional production systems. Also, the higher cost of organic food is currently the main barrier for a more rapid expansion of demand for organic food[1].

This review will present emerging evidence that the (1) greater reliance of conventional farming systems on non-renewable resources (e.g. fossil fuel required to manufacture mineral N-fertilizers and pesticides; mined mineral used as fertilizer such as P and K) and (2) cost of fertilizer and pesticide inputs are increasing more rapidly than agricultural commodity prices and that this is (3) already narrowing the yield gap between organic and conventional crop production systems and price gap between organic and conventional foods.

Give that both the "law of diminishing returns" and the "law of the minimum" apply to agricultural production systems it can be predicted that mineral NPK fertilizer and synthetic chemical pesticide inputs will become unaffordable and eventually unavailable to an increasing proportion of farmers globally and that this will results in a substantial reduction in global crop yields.

In contrast, the nutrient recycling focused fertilization regimes and preventative crop health management practices used in mixed organic farming systems are less affected by the availability and cost of non-renewable resources; synthetic chemical N-fertilizer and pesticides are prohibited and the

use and reliance on mineral P and K fertilizer is significantly lower. According to FAO predictions the productivity and efficiency of organic farming systems is likely to increase due to economies of scale associated with the expansion of the sector.
If recent observational studies which reported that high levels of organic food consumption is associated with significant public health benefits (e.g. lower incidence of diseases obesity/overweight, cancer and metabolic syndrome) are confirmed, it is likely that there will be a further increase in consumer demand and government support for the organic sector (e.g. R&D, training, post-conversion support payments) in Europe. This is likely to further improve the efficiency of organic production and close both the yield and cost gap between organic and conventional production.
The opportunities and challenges associated with a rapid expansion of organic farming in Europe are discussed.

Key words: organic farming**;** conventional farming**;** food composition**;** human health**;** food security**;**

[1], Rempelos, L. et al. Integrated Soil and Crop Management in Organic Agriculture: A Logical Framework to Ensure Food Quality and Human Health? *Agronomy* **2021**, *11*, 2494. https://doi.org/10.3390/agronomy11122494

Keynote speaker

Mary Ann Lila is Director of the ***Plants for Human Health Institute***, North Carolina State University, North Carolina Research Campus. She holds the David H. Murdock Distinguished Professorship, and is a Professor in the Department of Food, Bioprocessing, and Nutrition Sciences. Through ground-breaking, transdisciplinary discovery and outreach, her team of faculty at the Plants for Human Health Institute (PHHI) pioneers a dramatic shift in the way the American public views and uses food crops – not merely as a source of nutrients and flavorful calories, but as a powerful resource for components that protect and enhance human health. Integrated research in metabolomics, biochemistry, pharmacogenomics, molecular breeding, regenerative medicine, translational food science and nutrition and postharvest are aimed at development and promotion of mainstream fruit and vegetable produce with enhanced health benefits, *and* introduction of new or underappreciated crops and products from around the globe, allowing consumers to make proactive, responsible dietary choices that benefit their own, and their families' health. Dr. Lila's is a recent recipient of the Babcock-Hart Award for food technology/public health (through the IFT), and the Copernico Bronze Medal for Food Science & Nutrition.

Recent projects include a Foundation for Food and Agriculture Research (FFAR) grant on 'Closing the gap in delivery of fruit and vegetable benefits'; a USDA-funded initiative on polyphenol-protein aggregates for attenuation of food allergies; a USDA SCRI CAP grant on leveraging genomic and genetic resources to enable improved blueberry and cranberry fruit quality attributes; a USDA/ARS Pulse Crop Health Initiative; and a Phase II USDA SBIR on 'Clean, cost-effective technology to recover and stabilize phytoactive fruit compounds from waste streams'.

Lila was formerly Director (2006-2008) of ACES Global Connect (the international arm of the College of ACES, University of Illinois) and Associate Director of the nationally acclaimed Functional Foods for Health Program (1997-2000) at the University of Illinois. Dr. Lila has been honored with the Paul A. Funk Scholarship Recognition Award (the premier research award in the College of ACES, University of Illinois), the Spitze Professorial Career Excellence Award, the Faculty Award for Excellence in Research, the University Scholar Award, the Amoco Award for Excellence in Undergraduate Instruction, and the Lilly Endowment Teaching Fellowship. Dr. Lila has ongoing research projects in Australia, New Zealand, and various countries in Europe and Africa, and is Vice President of the Global Institute for BioExploration (GIBEX). In 1999, Dr. Lila won a Fulbright Senior

Scholarship to conduct research and outreach in New Zealand, and (at least before COVID) returns to Australasia at least once/year.

PL_02

If Food Is Medicine, Then How Can We Increase Its Influence on Immune Health?

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Abstract

There's no question that plant foods (fruits, vegetables, and herbals) are able to synthesize complex chemical bioactive compounds (phytoactives) that are more sophisticated than any human synthetic chemist can create – and in many cases, more efficacious at preventing or treating chronic human diseases and metabolic disorders. Despite the fact that a wider diversity of produce than ever before is available to modern consumers, and ample evidence for effective disease prevention using certain diets is readily available in the popular press, the human race seems to be sliding down a slippery path to largely preventable ill-health. Why? One reason is the basic change that has occurred in both the plant and animal foods on offer in the supermarket – often quite a drastic change from a century ago. Wildcrafted plant foods that provided a plethora of phytoactives and nutrients have been transformed into blander, uniform produce with sometimes limited nutritive value. We've lost some of the critical nutrients and extranutritional components that were present in the wild. A second issue is related not to the foods, but to basic lifestyle choices in dietary habits and mobility. If plant science and food science research is expected to come up with answers to these conundrums, we can't just 'discover', we have to deliver. Recent research has concentrated immunoprotective fruit and vegetable phytochemicals for delivery in convenient, and highly bioavailable functional food formats, for example, protein-phytochemical aggregate particles that can serve as novel ingredients to reverse the nutritional deficits. Sensory panels confirmed the favorable organoleptic properties of the ingredient, and recommended wider applications to counteract the negative trends of Western diets. Most recently, the phytoactive-protein chimeric ingredients were incorporated into snack food products with direct utility for meals in transit, and even for humanitarian aid efforts in undernourished populations. Simultaneously, the complexing of phytoactive-protein particles addresses structural and formulation challenges (e.g. bar hardening, thermal degradation, or ingredient separations) that are current challenges in the industries. By combining horticultural breeding strategies with innovative food technologies, the health potency of our foods can be greatly enriched.

Key words: phytoactive chemicals, wild crops, genomics and metabolomics, immunoprotection

Keynote speaker

Manuel Mota completed a PhD in Plant Pathology at Virginia Tech in 1992 and has since worked with *Globodera* and *Bursaphelenchus* plant parasitic nematodes. In 1998, he established the Nematology Lab (NemaLab) at the University of Évora (Portugal). A major scientific achievement in 1999 was his detection, first in the EU, of the pinewood nematode, *B. xylophilus*. He has subsequently pursued a steady line of research on the physiology and the processes involved in plant disease induced by this nematode. He has contributed to the pest risk analysis for the territories of the European Union on *B. xylophilus* and its vectors. His recent interests include entomopathogenic nematodes, root lesion nematodes (*Pratylenchus* spp.) and longidorid virus-vector nematodes.

PL_03

Plant parasitic nematodes, from soil to top of plant : a challenge for our time

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Abstract

Plant parasitic nematodes (PPN) are a group of plant pathogens and pests which cause serious damage worldwide, with an estimated value of over $USD 1 billion. The belong to the zoological Phyllum Nematoda, the most abundant animal group in the biosphere. Among the most important soil PPN we highlight the species *Meloidogyne* spp. (root knot nematodes), *Heterodera* and *Globodera* spp.(cyst nematodes) and *Pratylenchus* spp.(lesion nematodes). Included in the most damaging PPN is also the pinewood nematode, *Bursaphelenchus xylophilus*. The increasing world population as well as the threats of climate change have increased the need to study plant pathogens, including PPNs. New control methods are in progress, to compensate for the drastic reduction of available nematicides. Biocontrol as well as the use of phytochemicals have gained added importance in recent times, as well as the study of the nematode-plant interaction, at the cellular and molecular levels. An overview of these methods and importance of soil PPNs is provided.

Key words: plant parasitic nematodes, crop losses, control, population.

Keynote speaker

Professor Felix Arion, PhD,AgroTransilvania Cluster Manager

He is economist specialised in agricultural and rural management and rural development strategies, General Director of AgroTransilvania Cluster (Gold labelled cluster) and, the Head of Department of Economic Sciences. Obtained a joined PhD at UASVM Cluj-Napoca in consulting the agricultural and rural companies. It has been involved into 21 international research (EU funds, World Bank funds, other) and development projects (Leonardo da Vinci, ERASMUS, IP, other) projects, 2 of them as project manager and for 12 as institutional coordinator with a wide range of partners from Europe, USA and not only. It has been involved in projects with partners from Europe and Asia, and not only, for developing the supply chain for domestic producers and for international agri-food companies.

PL_04

Doing agribusiness in a competitive environment

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Abstract

The agribusiness activity sector is probably one of the most sensitive areas in the national economies, both due to the interest it presents at national and European level, as well as due to the complex issues generated by its operation. Attracting producers from the agro-industrial sector into supply chains takes into account the context of the development of a modern agriculture, being the main element around which an overview must be built. In the alternative, it is necessary to ensure a decent standard of living for farming families by ensuring the protection of the environment. Given that the rural economy in general and agriculture in particular represent a huge market for the upstream and downstream branches, it directly contributes to the development of non-agricultural branches as well as agriculture-related sectors. Various national studies have concluded that the national agri-food sector does not offer the opportunity to make efficient use of existing resources and the opportunities available to it, as a direct result of a lack of understanding of technical, economic and economic legitimacy. Consequently, it is desirable to develop integrative structures, in various fields, in the form of a cluster, which would give its members the opportunity to understand not only the socio-economic phenomena themselves but also to describe the impact that the development of entrepreneurship has on society. general. The cluster is able to generate benefits for the target group involved. For the target groups within the cluster, the involvement will lead to an increase in the quality and efficiency of their activity in terms of modern and non-traditional methods of production, processing, processing and marketing, but also through a more correct understanding of the economic environment. products intended for the market, thus being able to contribute to increasing comparative advantages.

Key words: cluster, value chain, integration, competitivity

Keynote speaker

Prof. Zoran T. Popovski PhD acquired bachelor and master degrees in biology and biochemistry at the Faculty of Natural and Mathematical Sciences in Skopje. He received his PhD from the Faculty of Agriculture and Food Sciences in Skopje where he is employed as a full professor and Head of the Department for biochemistry and genetic engineering.

The main fields of his scientific interest are application of molecular markers in selection and production of recombinant proteins, but also the laboratory that he is leading is the first authorized laboratory for GMO testing in Macedonia.

He spent few years as researcher and professor at Osaka Prefecture University in Japan, Univesitta dellaTuscia in Italy, University of Sarajevo in Bosnia and Herzegovina, INRA – Nantes in France, Lund University in Sweden, Ohio State University and Case Western Reserve University in USA. Currently, Dr. Popovski is a visiting professor at the Faculty of Biology and Technology in the frame of the Novosibirsk State Agrarian University in Novosibirsk, Russia.

He is an author of more than 70 scientific papers published mostly in international journals and more than 50 abstracts participating in a lot of international scientific events usually as invited speaker and Scientific Committee member. Dr. Popovski published 12 teaching tools as Textbooks, Manuals, Guidelines, Dictionaries, Teaching movies and Documentary movies.

In the past he was State Secretary for Education and Science in the Republic of Macedonia while currently, he is member of the Executive Board of COST (Cooperation in Science and Technology in Europe) which is the biggest scientific network in the world.

Since 2020, Prof. Popovski is member of Academy of Europe (Academia Europea) as a first scientist from the Republic of Macedonia.

PL_05

Further challenges of genetic modification in agriculture

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Abstract

The human population is constantly growing in parallel with the need for more food. But, agricultural land per capita is constantly declining, which imposes the need for new approaches in agricultural production. Agricultural biotechnology is scientific application of living things to define their role in agriculture and it brought great impact on agricultural productivities, qualities and sustainability. Agro-biotechnological applications vary from low-tech approaches, like artificial insemination, fermentation techniques and bio-fertilizers, to advanced DNA-based techniques, such as genetic modifications. Since 90's, the influence of GM crops showed an increase in productivity. New genetically modified crops were developed in order to reduce the use of agricultural inputs such as pesticides and artificial fertilizers. This improved profitability, but also in most of the cases reduced adverse effects on the environment and human health. There are already many applications of genetic engineering to develop genetically modified crops that are resistant to pests, diseases and different biological enemies on the field. Also, agro-biotechnology applications have made several efforts to prolong the shelf life of fruits by delaying repining, to engineer a wide variety of aesthetic traits in the floriculture industry and speed time to flowering, to upgrade the content of some nutrients etc. The further challenges in GM of crops are identified in crop production for abiotic resistance; improvement of human nutrition, production of edible vaccines and biopharmaceuticals, bioremediation, growth control etc. Abiotic stresses like increased salinity, drought and frost are a limiting factor to the growth of crops and in that sense the genetic modification still didn't contribute at expected level. Most crops are susceptible to elevated salt conditions. Another major problem in crop production is climate change and

drought. Drought resistant transgenic crops can also be produced. Finally, GM crops can be tolerated at extremely low temperatures by intervening in their genome. Transgenic crops production is expected to improve the quality of food by increasing the nutritional content, promoting stable digestion by lowering glycemic index, improving flavor and taste, increasing of vital components (vitamins, unsaturated fatty acids) or reducing those substances in food which traditionally produce allergies, such as gluten. GM can be used in common plant foods to carry antigens and to produce edible vaccines. Molecular pharming is becoming interesting method for the production of recombinant pharmaceutical proteins in plants whose are preferable bioreactors because of their lower cost of production and easy management practices. The possible benefits in application of GM crops can be also foreseen in bioremediation using different plants for extracting of heavy metals from soil. Are tobacco without nicotine, coffee without caffeine, slow-growth grass, non-allergic peanuts, wheat in deserts, strawberries that are no freezing, golden rice, oily crops with dominantly omega fatty acids visible reality?

Key words: genetic modification, crops, challenges, benefits, risks

Keynote speaker

Milan Mirosavljević is the coordinator of small grains genetics and breeding at the Institute of Field and Vegetable Crops, Novi Sad (Serbia). He earned his B.S. and M.S. from the Faculty of Science (University of Novi Sad) in biology (plant physiology) and his Ph.D. degree from the Faculty of Agriculture (University of Novi Sad) in crop physiology and breeding. Dr. Mirosavljević's research has focused on plant genetics and breeding and development of crop cultivars including triticale, durum and bread wheat. His recent activities are devoted to the crop physiological mechanisms related to cereal breeding. Dr. Milan Mirosavljević is an author and co-author of more than 25 cultivars of small grains and a leader and member of several national and international projects dealing with small grains breeding and genetic resources. He published 28 papers in JCR-indexed journals

PL_06

Changes in physiological and quality traits related to the breeding progress

Milan Mirosavljević[1], Vojislava Momčilović[1], Tanja Dražić[1], Vladimir Aćin[1]

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Abstract

Constant grain yield improvement is the main objective of breeding programs worldwide. During the past century, grain yield potential of main European cereal crops, maize, barley and wheat has been continuously improved as the result of changes in production technology and development of modern high-yielding cultivars. Information about changes in physiological and quality traits and their contribution to the grain yield improvement are important for further adaptation of cereal breeding strategies.0 Growing conditions in the Pannonian Plain are negatively influenced by climate changes, limiting high and stable grain yield production of different main cereal crops. Therefore, constant development of new cultivars and hybrids with stable and higher grain yield is one of the most important strategies to mitigate the negative influence of changing climate, securing the higher grain yield production. During the past century, the grain yield of different cereal crops significantly increased at the rate of approximately 50 kg ha-1 in maize, winter wheat and winter barley under conditions of the Pannonian Plain. Increase in grain yield potential are followed by changes in main agronomic and physiological traits. Grain yield improvement was highly related to the increase of the grain number per unit area, where changes in the grain weight were less pronounced. As result of the breeding activities fruiting efficiency increased with year of cultivars release, mostly due to increase in grain number per spike. Modern cereal cultivars are generally characterized by higher nitrogen use efficiency, which is more related to nitrogen uptake efficiency than to nitrogen utilization efficiency. As result of significant changes in phenology, mostly decreased duration of pre-anthesis period, new cultivars are characterized by prolonged duration of stay green period, as well as higher crop greenness during different senescence stages.

Although maintenance of high grain quality with constant grain yield improvement is essential for human nutrition, as well as wheat milling and processing industry, improvement of grain quality traits is a secondary

breeding goal. In wheat and barley, protein content significantly decreased with year of cultivar release, mostly due to dilatation effect and inadequate nitrogen translocation from pre-anthesis reserves, restricted post-anthesis nitrogen uptake and low nitrogen harvest index. On the other hand, sedimentation values and gluten index were highly increased in modern wheat cultivars indicating higher protein quality.
Additionally, implementation of modern available phenotyping instruments, such unmanned aerial vehicles that provides NDVI, canopy temperature and similar physiological measurements could further contribute to more efficient breeding activates improving cereal grain yield genetic gain.

Key words: cereal, crop physiology, grain yield, quality traits

Session 1: CROP SCIENCE

Poster Presentations

P1_01

Influence of different quantities of nitrogen fertilizers on yield and quality of Banja Luka wheat varieties Julija and Nova Bosanka in the dry 2021

Đorđe Todić[1,2], Dragan Mandić[2]

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Abstract

Nitrogen belongs to the group of elements necessary for the growth and development of plants and is found in the soil in several forms. Easily soluble mineral forms of nitrogen are available to plants - ammonia, nitrate and nitrite. Nitrogen fertilization should be aimed at achieving high yields, but not to impair grain quality. In the case of nitrogen deficiency, the plants have a weaker growth, both aboveground mass and roots. In contrast, excess nitrogen causes damage in the form of intensive growth of aboveground plant organs, which in favorable conditions, with excess precipitation, leads to lodging and decay of wheat, and more intense attack of plant diseases. This paper tries to show wheat varieties of the Agricultural Institute of the Republic of Srpska react to different amounts of applied nitrogen. The experiment was set up in a random block system with plots of 5 m^2. The amounts of applied nitrogen ranged from 80 kg/ha to 160 kg/ha. It was expected that high doses of nitrogen would cause the plants to rot, but due to the severe drought in the period of plant growth, we had a different effect, and the plants with the highest nitrogen level were the most productive and of the highest quality. The highest grain yield of 9.2 t/ha^{-1} was achieved by the cultivar Nova Bosanka, with the application of 160 kg/ha of nitrogen, while with the same amount of fertilizer the cultivar Julija achieved a yield of 8.4 t/ha^{-1}.

Key words: wheat, variety, yield, nitrogen

P1_02

Influence of zinc application on grain yield and leaf area of different maize genotypes

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Abstract

Maize is grown in different regions, in the era of climate change, research aimed at achieving stable grain yields is very important. The aim of this study was to determine the influence of zinc application on yield and leaf mass area of three maize genotypes. The experimental experiment was set up in the region of Mačva (ΨN 44 ° 36 ′ 31.8 ″, λE 19 ° 47′4.2 ″). For plant nutrition, the following is provided: 160 kg ha^{-1} nitrogen (30 kg ha^{-1} in basic cultivation, 90 kg ha^{-1} in pre-sowing and 40 kg ha^{-1} in top-dressing). The research was conducted in the period 2017-2018. years (factor A). Sowing was done in the first decade of April with three hybrids ZP 724, ZP 548, ZP 687 (factor B). In addition to control, zinc treatments were applied: Zn_1 $ZnSO_4$ 25 kg ha^{-1} was introduced into the soil before sowing; Zn_2 seed treatment + foliar treatment. Before sowing, 63 grains were immersed for 24 h in aqueous $ZnSO_4$ solution (0.129 g and supplemented with 200 ml of water). Foliar treatments in the phenophase of 5-7 leaves with 2 l ha^{-1} liquid fertilizer (7% Zn). The grain yield of hybrids was highly influenced by the year. Treatments and their interactions significantly increased grain yield $p<0.05$. Compared to the control, Zn_1 increased grain yield by 14.56% and Zn_2 by 14.17%. The ZP 687 hybrid had the highest average yield. The ZP 427 hybrid at Zn_1 10.33 t ha^{-1} in 2018 individually. Leaf surface area was highly influenced by all examined variables and their interactions. In 2018, the leaf mass area was on average 3.24% higher than in 2017. The largest leaf mass area was in the ZP 687 hybrid, which was 8.30% larger than the ZP 548 hybrid and 25.10% larger than the ZP 427 hybrid.

Key words: corn, zinc, grain yield, leaf mass area

P1_03

Differences in Determination of Soil Erodibility Between USLE Nomograph and Erodibility Equation

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Abstract

Universal Soil Loss Equation (USLE) is the most applied model for soil erosion assessment. It takes into consideration five soil erosion factors: rainfall erosivity, topographic factor, vegetation cover, applied conservation practices, and soil erodibility. Soil erodibilty factor (K-factor) is a measure of inheritant reistance of soils to erosion. In the formulation of USLE model, K-factor was determined experimentally. Experimental determinations are costly and time-consuming, so the authors have encouraged scientists to utilise USLE nomograph or derived equations. This paper aims to compare USLE nomograph and soil erodibility equation which was derived from nomograph by the same authors. A total number of 108 soil samples have been collected on agricultural land of Western Serbia. For the determination of K-values, particle size distribution and soil organic matter content were determined in the laboratory, whereas soil permeability and soil structure were assessed according to the nomograph. The results have been compared using basic statistics. The average K-values obtained by nomograph and derived equation are 0.034±0.010 and 0.029±0.012, which is 14.7% difference. Coefficient of determination (R2) amounts to 0.5802, which indicates deviation of 23.9%, although there is statistically significant correlation between two methods. Root Mean Square Error (RMSE) is 0.008, which is 23–27% difference. The RMSE is not low, whereas index of agreement amounts to 0.93, which represent good agreement, and also there is significant correlation. These results are ambiguous. We think that 15% of absolute error is a threshold value for good correlation, which occur on only 56% of samples. K-factor is an important part of various soil erosion models and it is of high importance to determine it in the best manner. Therefore, the obtained results indicate the gaps in the determination of K-factor and could contribute to further improvment of soil erodibilty determination and consequently, soil erosion assessment.

Key words: soil erodibility, USLE, soil erosion, nomograph

P1_ 04

Importance of sowing date optimization for morphological properties and grain yield

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Abstract

The aim of this study was to determine the significant influence of sowing date on morphological properties and grain yield. The experiment was conducted in a two-year trial (2018-2019), at one location. Three inbred lines, produced at the Maize research Institute, were used as material to prove the set hypothesis. Sowing was set in two terms, earlier 01.04 (SD1) and later 20.04 (SD2). Morphological properties of the cob were measured in laboratory conditions: ear weight, cob weight, cob length, cob thickness, 1000 kernel weight and grain yield. The sowing date did significantly affect the morphological properties of the cob ($p \leq 0,05$). The interaction of factors also had a significant impact on the variability of traits. By individually determining the level of parameters, the differences indicated that in the SD1, genotype ZP1 and ZP2 have higher yield values (6,28 t ha^{-1}, 7,05 t ha^{-1}). 1000-kernel weight in all three genotypes was higher in the SD1, ZP1 (324.35 g), ZP2 (329.78 g), ZP3 (326.55 g). The earlier sowing date was also favourable for the weight of the cob, which was lower compared to the later period. The climatic condition can be more or less stressful. One of the ways act upon it is to adapt the production technology, primarily by applying the optimal sowing date and the genotype that gives positive responses to variable environmental conditions.

Key words: sowing date, maize, grain yield

P1_05

The influence of fertilization on soil compaction and maize yield

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Abstract

Compacted soil causes weaker growth of the root system, weaker microbial activity, slowing down the absorption of water and nutrients, thus slowing down the growth of plants. Breeding plants on such soils result in reduced yields and increased production costs. This study was aimed to determine the impact of manure and mineral fertilizers on soil compaction and maize yield. The experiment was performed on the territory of the municipality of Leskovac on Smonitza soil type. The experiment included four variants of fertilization with organic and mineral fertilizers. Compaction was measured after sowing and after maize harvest, by penetrologger Eijkelkamp hardware, version 6.0, software version 6.03. The application of manure in combination with mineral fertilizers significantly reduced soil compaction. The highest compaction was recorded at a depth of 40-50 cm, after which it stagnated and slightly decreased to a depth of 80 cm. The average compaction measured after harvest was 24.10% higher than that measured after sowing. The soil moisture content was higher on plots with manure and mineral fertilizers than on non-fertilized plots. Maize yield was significantly higher in variants where manure was used together with mineral fertilizers compared to variants with the only use of mineral fertilizers and variants without fertilizers. Variants with the lowest soil compaction achieved the highest yields. The recommendation to maize producers is to apply more organic matter on heavy and compacted soils, primarily manure, but also mineral fertilizers, to have high and stable yields.

Key words: soil compaction, manure, mineral fertilizers, moisture, yield

P1_06

Influence of different fertilization treatments on agronomic properties of broad beans (*Vicia faba* ssp. *eufaba* var. *major* Harz.)

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Abstract

The broad bean is an annual legume that can be used to produce fodder and grain. It is suitable for growing in mixtures with corn and sorghum for the production of silage. Beans contain a lot of crude protein, so it can be used as a concentrated fodder, and is also suitable for human consumption. It has the ability of nitrogen fixation, and it is also suitable for bee grazing.Tests of agronomic properties of broad beans were performed in 2020-2021 on the experimental field of the Agricultural Institute of the Republic of Srpska at the location named Delibašino selo. The seeds of the broad bean population from the fava bean collection of the Institute were used for these tests. Sowing of beans in both years was done at the end of March. The experiment was set up in four replicates according to a randomized block system. The size of the basic plot was 10 m^2. Sowing was done at a row spacing of 50 cm. The sowing rate was 220 kg/ha of seeds. During the experiment, four fertilization treatments were applied, namely: control, 300 kg/ha NPK 15:15:15, biostimulator Slavol S (250 ml/ha) and 300 kg/ha NPK 15:15:15 + biostimulator Slavol S 250 ml/ha). During these tests, the following properties were monitored: plant height, number of pods/plants, length of pods, number of grains/pods, number of grains/plants, weight of grains/pods, weight of grains/plants, weight of 1,000 grains and weight of harvest residues. The tested properties number of pods/plant, number of grains/plant, weight of grains/plant and weight of 1,000 grains, in both years, had the highest values on plots where the treatment of 300 kg/ha NPK 15:15:15 + biostimulator Slavol S was applied. On the plots where the treatment of 300 kg/ha NPK 15:15:15 was applied, during both years of testing, the highest values of the number of grains/pods and the weight of grains/bean were achieved and the highest average biennial plant height (61.9

cm) and the largest pod length (8.14 cm) were achieved. The highest average two-year yield of harvest residues (12.9 g/plant) was achieved on plots where Slavol S biostimulator was used.

Key words: broad bean, yield components, NPK fertilization, application of biostimulators

P1_07

Vegetation indices for differential soil zones and variable sowing

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Abstract

Pedogenesis generate very fertile soil in Vojvodina. The dominant type of soil is chernosem, which is an ideal soil for agricultural production. For economical and profitable field production, appropriate edaphic properties of soil, physical and chemical characteristics, micro and macro elements, moisture, mechanical composition, are required and represent soil potential for certain agroecological conditions. The production potential of soil can be determined in several ways. As soil sampling methods require significant financial resources, times and manpower, accessed alternative analyzes. The soil of its positive and negative characteristics exhibits over crops and yields. The observation in this case involves taking over the satellite multispectral images of electromagnetic radiation reflection from the surface of the overhead crop, which is the task of paper. The reflected visible part of the electromagnetic radiation spectrum was detected by a multispectral camera. The recordings feature 12 wavelengths visible but also infrared and near infrared spectrum. The combination and mutual intersection of the mentioned spectrum, are obtained by vegetation indices in order to perform crop differentiation on a field, which is the goal of work. The multi-annual 5-year observation of the field provides more precise determination of differential zones on the plot. Downloaded satellite images are 3 x 3 m resolution with 0.25 x 0.25 m correction. For different purposes, indices of improved green crop vegetation indices, index of soil reflection, index of chlorophyll, biomass, leaf area index, stress surface index and stress vegetation index due to water deficiency can be used. Using general, surface indices and volume of vegetation, photosynthesis index and stress index, a production field differentiation on zones can be performed. The zones can be used for variable fertilization, sowing and pesticides application, which should lead to more efficient, more economical and profitable agricultural production, which means sustainability.

Key words: vegetation indices, crops, multispectral footage, variability, sowing, fertilizing, pesticide application

P1_08

Advantage and possibilities of application of precise systems in agricultural production

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Abstract

A special area with application in agriculture is the correct driving of tractors with the aim of minimizing overlap of passages, i.e. avoiding empty spaces. The use of standard markers is not possible when working with large working machines, and in many cases due to poor additional processing, the marker cannot leave a good enough "record" on the ground. The aim of this research is to describe the development, working principle, application and advantages of GPS in modern agricultural production, and to assess the cost-effectiveness of the global positioning system. GPS-based guidance technology can be used in many agronomic operations. The application of GPS relates to the finding spatial and temporal data, where, for certain classes of applications, centimeter accuracy is required in determining the position. Different types of data need to be collected for effective management in this area. The use of the system result with less overlap and it increase the coefficient of utilization of the working procedure. This technique can provide complete autonomous navigation.

Key words: guidance, precision agriculture, productivity, practical application

P1_09

Plants response to the elevated nickel (Ni) content in the soil

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Abstract

Nickel (Ni), a potentially toxic metal, is relatively abundant and present in all soils, where it derives from either the parent material (lithosphere), anthropogenic activities (mining, smelting, application of some organic amendments, burning of diesel, chemical industries, etc.) or both. The ecotoxicological risk of Ni in soils is controlled by its availability to reach living organisms (plants and animals) and water resources. The aim of this research was to determine Ni content in shoots of five plant species: *Ambrosia artemisiifolia*, *Erigeron canadensis*, *Plantago major*, *Taraxacum officinale* and *Trifolium repens* grown naturally nearby a mine and thermal power plant Stanari. To determine metal content, the samples of selected plants and associated soil were air-dried, acid digested, and the total Ni content was measured using the atomic absorption spectrophotometry (AAS). The results showed that the soil in the study area was slightly acidic and significantly exceeded (596,98 mg/kg) the allowed maximum (50 mg Ni/kg) for unpolluted soils. It was also found that this soil was very poor provided with organic matter and essential plant nutrients, potassium (K) and phosphorus (P). Tested plants responded differently depending on the species and the highest concentration was found in *Taraxacum officinale* (140,25 mg/kg) > *Ambrosia artemisiifolia* (116,65 mg/kg) > *Plantago major* (60,17 mg/kg) > *Trifolium repens* (54,63 mg/kg) and conspicuously lower in Erigeron canadensis (19,1mg/kg). According to the total Ni content, all plants samples exceeded toxicity threshold (10 mg Ni/kg), several of them 5-14 times. Due to the deleterious effects of Ni on human health as well as its dangerous consequences on ecosystem, further investigation is needed in order to establish exact pollution degree. Furthermore, special attention should be focused on strategies to remove Ni from the environment, such as phytoremediation and phytomining.

Key words: nickel, *Taraxacum officinale*, ecotoxicological risk, phytoremediation.

P1_10

Radionuclide contamination and nutritional evaluation of mostly used wheat in Republic of North Macedonia

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Abstract

Wheat is one of the world's most commonly consumed cereal grains. It comes from a type of grass (*Triticum*) that is grown in countless varieties worldwide. Bread wheat or common wheat, is the primary species. Several other closely related species include durum, spelt, emmer, einkorn, and Khorasan wheat. In addition to being a major source of starch and energy, wheat also provides substantial amounts of a number of components which are essential or beneficial for health, notably protein, vitamins (notably B vitamins), dietary fiber, and phytochemicals. Wheat is the basic food product of the Macedonian population. This study is mainly focused on measuring the concentration of radioactivity due to natural radioactive nuclides (226Ra, 232Th, 40K) in wheat grain samples, as well as on determining the quality of wheat used in the daily diet. In addition, in this study, we calculated the radiation hazard indices (radium equivalent activity and internal hazard index) in the wheat sample. In the wheat sample, average activity concentrations of 226Ra, 232Th, and 40K were 0.57±0.14; 0.39±0.11; 96.55±0.86 (Bq/kg^{-1}), respectively. The radiation hazard indices were calculated for all samples in this study where the mean values did not exceed the safety limits, pointing out the negligible radiation hazard arising from terrestrial radionuclides that are naturally present in wheat. In terms of quality, we confirmed that all tested samples meet the requirements regarding their quality in accordance with the quality laws in our country.

Key words: radioactivity in wheat; radionuclides; gamma spectrometer; quality control

P1_11

Accumulation of heavy metals in root and shoot of red fescue grown at the flotation tailings dump

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Abstract

To examine the possibility of growing perennial grass species, red fescue (*Festuca rubra* L.) at the extremely unfavorable conditions, the experiment with fertilization was set up on flotation tailings dump in the Central Serbia. Flotation tailings are often completely without plant cover. Therefore, phytoremediation is one of the most economically and ecologically justified ways to recover such substrates. In the examined tailing, content of nitrogen, phosphorus and potassium was very low, while the content of all tested heavy metals (Cu, Cd, Ni, Pb, Zn) except Mn, was above the allowed amounts. As a consequence of high content of these elements in substrate, the concentrations accumulated in the roots of red fescue were at the levels that are toxic for most plant species. The contents of heavy metals were 50-80% higher in roots than in shoots of red fescue and 25-50% higher in the control plants comparing to fertilized one. The most accumulated element in plant material was Mn with concentration of 2725 mg/kg in root and 628 mg/kg in shoot of control plants respectively 2183 mg/kg in root and 911 mg/kg in shoot of fertilized plants. The translocation coefficient of all metals was less than 1, which means that the red fescue accumulates most of the adopted elements in the root.

Key words: red fescue, flotation tailing, heavy metals, phytoremediation

P1_12

Effects of different production methods on content of some microelements in spelt seed (*Triticum spelta*)

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Abstract

Numerous worldwide studies have shown that there is a difference in the mineral composition between organically and conventionally produced plants and their products. Spelt (*Triticum spelta*), alternative grain from the family Poaceae, occupies a very important place in the production of healthy food. Also, spelt represents commonly grown organic crops due to the ideally balanced ratio of nutrients. In addition to the macroelements, for the survival and normal plant function some microelements are also needed. The aim of this study was to determine the existence of differences in the content of microelements and (B, Ba, Cu, Li, Mn and Se) in organically and conventionally produced spelt seeds, in period of 2015-2017. The determination of these elements was conducted by using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) with previous digestion of samples and results were expressed as mg/kg of dry weight. In samples collected during 2015 and 2016, B and Ba were not detected. In conventional spelt seed, higher quantity of Ba (2.366 mg/kg), Cu (6.356 mg/kg) and Mn (55.878 mg/kg) was determined, while organic spelt seed contained higher content of B (0.875 mg/kg), Li (14.77 mg/kg) and Se (0.275 mg/kg) compared to conventionally grown sample. The obtained results for the examined elements revealed that the lowest content in analyzed seeds was for Li (conventional seed from 2017, 0,008 mg/kg), while Mn was quantified in the highest amount (conventional seed from 2017, 55.878 mg/kg).

Key words: organic production, conventional production, *Triticum spelta*, trace elements.

P1_13

Phenotypic diversity of the most important agronomical traits in a long-term breeding period of barley breeding in Serbia

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Abstract

Barley breeding program in the Institute of Field and Vegetable Crops Novi Sad has a very long tradition. The great effort focused on selecting and creating varieties with high yielding potential and good malting quality. This study aimed to analyse phenotypic variation during the historical period. The studied material consisted of 90 representative barley genotypes, which varied in a row number and growing types (6-rowed winter, 2-rowed winter and spring types) encompassing three different breeding periods. Field experiments were conducted in three growing seasons using a randomised complete block design with three replications. Eight important agronomic traits were evaluated during this period. The ANOVA showed that most of the analysed traits varied significantly between seasons, row types, and breeding periods. Comparison of three groups with different row types revealed earlier heading and flowering time of two-rowed than six-rowed types of winter barley. The earliest heading and flowering time were observed in the third historical period. Also, the plant height significantly decreased in the last two breeding periods compared to the first period for these barley types, whereas spike length showed a significant increase in two-rowed barley types. As one of the most important agronomic traits, grain yield improved significantly over time. Obtained phenotypic variation of the analysed barley varieties showed their great potential for further barley breeding progress and improvement.

Key words: Hordeum vulgare L., yield-related traits, agronomical variation, three breeding periods

P1_14

Root trait variability in cereal grain crops: potential use in breeding programs to enhance adaptation to water stress

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Abstract

Crop root systems directly interact with soil in capturing water and nutrients. Root system architecture and growth has important functional implications for the timing and extent of soil water and nutrient extraction, yet selection for root traits in breeding programs has been limited due to the labour-intensive and costly phenotyping methods for characterizing roots in field crops. The objectives of this research were to identify root traits in key cereals grain crops (maize, sorghum and wheat) that can be potentially employed as candidate traits conferring water stress tolerance. Genotypes within these crops has large variation in different root traits. Root traits such as total root length, root length at various depths, rooting depth, numbers and area of fine roots and nodal root angle. These traits have the potential to serve as functional parameters for plant breeding programs aimed at developing genotypes with improved resource use efficiency and adaptation to adverse environments (e.g., drought stress), enhancing overall crop productivity. Modification of root system architecture could contribute to improvements of desirable biomass, yield, drought tolerance, and resiliency under isolated or combined nutrient deficiencies. Some of the key root traits can form a basis for aiming to producing specific materials for improved adaptation to target production environments (TPEs).

Key words: root traits, cereal grain crops, adaptation, stressful environments

P1_15

Interdependence of seed yield components of pumpkin (*Cucurbita pepo* L.) genotypes

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Abstract

The aim of this study was to analyze the interdependence of seed yield components of the pumpkin (*Cucurbita pepo* L.) genotypes, which are grown in Western and Central Serbia. The experiment was performed in the period 2021-2022. In the initial phase, the fruits of genotypes of pumpkin grown in the villages from Priboj in the south to Šabac in the north, Smederevska Palanka and Krusevac in the east were collected. A total of 81 pumpkin fruits of 27 different genotypes were gathered. The following yield components were analyzed on selected fruits: fruit weight, number of seeds per fruit, dry seed weight per fruit, thousand seed weight, kernel weight per fruit and kernel percentage. Fruit weight was significantly positively correlated with number of seeds per fruit, dry seed weight per fruit, kernel weight per fruit and thousand seed weight, and significantly negatively correlated with kernel percentage (r = -0.44). Fruit weight was not significantly correlated with number of seeds per fruit, while number of seeds per fruit was significantly positively correlated with seeds weight per fruit and kernel weight per fruit. Seeds weight per fruit was in a significant positive correlation with kernel weight per fruit and thousand seed weight. Kernel percentage was significantly positively correlated with the number of seeds per fruit, seeds weight per fruit, kernel weight per fruit and the thousand seed weight. The analyzed genotypes represent an important source of diversity that could be used in plant breeding studies in the future.

Key words: correlation, pumpkin genotypes, seed

P1_16

Interdependence of yield and soybean yield components

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Abstract

This paper presents the results of a two - year study of six selected soybean genotypes with the aim of examining which of the genotypes in the given production conditions gives the best results in the amount and quality of seed yield. All genotypes belong to the zero-maturity group. All varieties were sown in four replicates according to a random block system, in standard agrotechnics for soybean seed production. Correlative relationships between the studied properties were calculated as Pearson′s correlation coefficients. The correlation between grain yield per plant and other studied traits was tested through linear (simple) correlations.Testing showed that the following had a positive highly significant impact on seed yield: number of seeds per plant (0.917**), seed germination energy (0.897**), seed moisture content (0.803 **), plant height (0.802**), seed germination (0.789**), number of seeds in pods (0.696**), number of harvested plants per m^{-2} (0.590**), number of plants (phenophase 1-3 in the three-leaf stage) per m^2 (0.550 **) , kernel weight (0.471 **), number of secondary branches (0.412**).

Key words: soybean, genotype, correlations, yield

P1_17

Quality characteristics of tortilla chips based on dark red corn

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Abstract

Tortilla chips belong to the snack product group, which are popular foods in the diet of the widest population. However, they are characterized by an increased content of fat and salt, while the dietary fibers content is decreased. Snack products with such a nutritional composition can cause metabolic disorders cardiovascular and oncological diseases. The main goal of this research was to formulate nutritionally improved tortilla chips, with reduced fat and salt content and increased fiber content. This can be achieved by applying a basic raw material with functional properties such as dark red corn, as well as by modification in the final stage of processing tortilla chips. Dark red corn is a highly nutritional raw material with health effect derived from anthocyanins and other phenolic compounds. Flour from dark red corn was utilized for the production of tortilla chips. The proportions at the final mix were 80:20 mass percents (corn: wheat). Tortilla chips were moulded and baked in a preheated oven at 200°C for 10 min. Chemical composition, sensorial and textural properties were evaluated. A commercial tortilla chips was used as a control. The tortilla chips based on dark red corn contained 33.3% more of dietary fiber, 20% less fat and 47.5% less salt than commercial tortilla chips. Hardness of dark corn tortilla chips was increased from 737.0 g to 1673.74 g while fracturability was decreased from 0,991 mm to 0,741 mm. Reduced fracturability is a great feature due to market manipulation. The mean acceptability score for the dark corn tortilla chips was 14.2 (unstructured line scale 0-15 cm), while 95% of the panelists rated the snacks as acceptable.

Key words: dark read corn, tortilla chips, sensory and texture properties

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P1_18

Induced mutations in cereals breeding

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Abstract

Induced mutations are used for the production of mutant varieties with altered plant characteristics, which result in a significant increase in production and / or improvement in quality. The resulting mutants have contributed to overcoming numerous obstacles in plant breeding and creating new and valuable forms, such as e.g. semi-dwarf wheat varieties, early maturing, disease resistance, etc. The application of induced mutations was widely spread between the 1950s and 1980s, and great successes have been made in creating mutated varieties. The early years of the 21st century have witnessed a return of induced mutation technologies due to a better understanding of mutagenesis and related disciplines, leading to a number of different applications. The economic value of this technology has been proven by the fact that more than 3,300 mutant varieties of different plant species have been created in the world so far, including 291 varieties of bread wheat and 316 varieties of barley. Using this technology, only one variety of paprika (*Capsicum annuum* L.) was registered in Serbia - Horgoška slatka -X-3 in 1974. Since that time, there have been no examples of successful mutation use in crop varieties creation in Serbia. Participation in the project: "Enhancing Productivity and Resilience to Climate Change of Major Food Crops in Europe and Central Asia" (RER5024) will give researchers from the IFVCNS the opportunity to make some improvements in this field. So far, some preliminary studies were performed in order to identify the effect of Gamma irradiation on seed germination and growth in wheat and barley varieties. The doses of Gamma irradiation that caused 50% growth reduction were identified for each variety and used for production of mutation populations. The obtained populations will be used in wheat and barley breeding programs for improved tolerance to climate change.

Key words: mutational breeding, barley, wheat, improved characteristics, climate change

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P1_19

ZP4242- a new maize hybrid

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Abstract

During the past seven decades, the Maize Research Institute, Zemun Polje has been succeeding in keeping up with global trends within the fields of developing and producing hybrids of various FAO maturity groups (100-700). Considering the length of the growing season, breeding of such a wide range of hybrids, has provided marketing of hybrid maize seed all over the world. Mercantile corn production in Serbia increasingly involves the participation of medium early hybrids FAO 300-400. These hybrids should be characterized as high and stable yields with a quick release of moisture from the kernels. The intensification of agricultural production, higher inputs, harvesting corn directly by shelling in grain, high temperatures accompanied by dry winds and lack of rainfall during the growing period are among the most important causes for the growing medium early hybrids. Medium early hybrids have a smaller plant which enables them growing in higher densities that is, larger number of plants per unit area. Also, due to the shorter growing season, these hybrids go through a period of grain filling in terms of better soil moisture supply. In the Maize Research Institute, Zemun Polje in recent times, the development of medium early maturity hybrids has been performed, and the hybrid ZP 4242 (FAO 400) is a result of such development. This hybrid was tested in trails of the Commission for the Variety Releasing in 2020 and 2021. During the investigation period, yields of the hybrid ZP 4242 were significantly higher than yields of check hybrids NK PAKO and ZEROS. ZP 4242 had a moisture level content on the level of check hybrids. Because of its adaptability, yield stability and good level of drought tolerance new ZP hybrid has good potential for production in different agro-ecological environments.

Key words: maize, new hibryds, yield

P1_20

Effects of high temperature stress on microsporogenesis and pollen production in sunflower

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Abstract

Heat stress can affect pollen production as it may interrupt the process of microsporogenesis and prevent normal pollen development. The aim of this research was to investigate whether occurence of male sterile plants in a male fertile sunflower accession may be due to the heat stress during microsporogenesis. Male sterile and male fertile plants of an inbred line were analyzed by evaluating development of anthers, presence of pollen, pollen vitality and analysis of meiosis – microsporogenesis. Anthers of male sterile plants were poorly developed and without pollen while fertile plants had pollen vitality of 98%. Analysis of meiosis showed normal diakinesis with 17 bivalents in both sterile and fertile plants. However, the following phases were all with abnormalities in sterile plants (metaphase I 6-18%, anaphase I 6-10%, telophase II 32-46%), while in fertile plants abnormalities were also present but less expressed with 5, 1 and 20% respectively. After telophase II, microspores were found sporadiccaly but smaller than normal, deformed and without an exine. Variable degree of observed irregularities was most probably caused by non uniform flowering and therefore variable exposure to heat stress in the pre-anthesis period. According to literature, heat stress can cause male sterility in plants as temperatures higher than 32/26ºC day/night disrupt microsporogenesis, development of pollen epidermis and endothecium. Daily maximum temperature in the 15 days prior to full flowering of the analysed accession was on average 36ºC. Therefore, continuous exposure to high temperatures may have caused male sterility in the most affected plants manifested by complete interruption of microsporogenesis and less developed anthers.

Key words: Heat stress, microsporogenesis, sunflower, male sterility

P1_ 21

Effect of manganese on antioxidant activity in maize

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Abstract

Manganese (Mn) is an essential element for plant growth. For metabolic function, Mn^{2+} is required at low concentrations, but Mn^{2+} excess can change the activity of various enzymes and interfere with the absorption and translocation of some minerals such as Ca, Mg, Fe, and P. Mn availability to the plants depends on pH of the growth medium and on root exudates for Mn chelation or reduction. The main aim of this research was to investigate the effect of Mn^{2+} on the main parameters of secondary metabolism: total phenolic content (TPC) and total antioxidative activity (TAA) in maize (*Zea mays* L.) shoots and roots. Maize was chosen as agricultural species important for human and animal nutrition, and a simply cultivated plant. Maize seeds (inbred line Va35) were germinated in distilled water and then transferred into the hydroponic (KNOP/2) growth solution. Mn^{2+} was applied in two different concentrations (5 and 100 μM) by adding $MnSO_4$ into the hydroponic solution. After 7 days (December 2021) of growing under 8/16h photoperiod, the leaves and roots were collected. The TPC was measured according to Folin-Ciocalteu's spectrophotometric procedure, while TAA was determined by ABTS/HRP assay. The results showed that TAA was significantly decreased only in maize roots after the treatment with 5 μM Mn^{2+}, while higher Mn^{2+} concentration (100 μM) did not change TAA in maize roots. TAA in shoots and TPC in both parts of maize was unchanged. Finding that 5 μM of Mn^{2+} have decreasing effect on maize antioxidative activity without harming plants indicates that lower concentration can be more toxic due to: 1. plants excreting an excess of Mn^{2+} into the environment after the treatment with high Mn^{2+} concentration and 2. Mn can affect the metabolism of small molecules (enzymes or phytochelatins) binding for them and decreasing the total ROS scavenging activity.

Key words: maize, manganese, total antioxidant activity, total phenolic content

P1_ 22

Genetic variability of maize grain antioxidant compounds

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Abstract

Due to its natural diversity maize is one of the most heterogeneous cereals in terms of biochemical composition. Maize grain contains antioxidant compounds, associated with nutraceutical properties and health promotion benefits. Therefore, such grain is considered to be a functional food and features high antioxidant activities and preventive functions against cancer, diabetes, obesity and neurodegenerative disorders. The purpose of this research was to screen a set of six maize lines from MRI gene bank and a set of 10 ZP commercial lines for phenolic acids, tocopherols and carotenoids content by HPLC. Ranges of phenolic acids were as follows: gallic 2.86-26.99 μg/g, protocatechuic 2.21-75.92 μg/g, vanillic 1.10-10.34 μg/g, caffeic 0.65-8.77 μg/g, syringic 0.57-12.74 μg/g, sinapic 0.11-4.50 μg/g, p-coumaric 0.23-1.58 μg/g, ferulic 0.71-4.61 μg/g, and cinnamic acid 0.87-45.61 μg/g. Significant variations for all analyzed components between genotypes were observed. The highest coefficient of variation is estimated for β carotene and sinapic acid. Maize lines from gene bank collection had highest average content of gallic acid, δ-tocopherol, γ+β-tocopherol, α-tocopherol, and β carotene. ZP commercial lines had higher average value for protocatechuic, vanillic, caffeic, syringic, sinapic, p-coumaric, ferulic, cinnamic acid and lutein + zeaxanthin. Line ZPL6 had the highest content of phenolic acids and β carotene among the lines from the gene bank; line ZPL14 and ZPL16 had the highest value of vanillic, p-coumaric, ferulic acid, γ + β-tocopherol and lutein + zeaxanthin. PCA for all analyzed antioxidant compounds clearly separated inbred lines from MRI gene bank from ZP commercial lines. This study provides baseline information on the nutritional value of analyzed maize lines which can be used for future breeding works and enhance germplasm utilization focused on the improved nutritional and functional properties of maize.

Key words: phenolic acids, tocopherols, carotenoids, maize, HPLC

P1_23

Analysis of local Serbian wheat varieties and landraces as a new source of variability for breeding

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Abstract

Intensive agriculture led to reduction of crops diversity, resulting in a loss of their genetic and nutritional values. Old wheat varieties and landraces, which are considered to be a significant source of genetic variability and potentially important for addressing challenges related to climate change, have almost vanished from farmers' fields. To estimate performances of wheat genetic resources, 20 local varieties and 20 landraces from Serbia collected within a project funded by the Benefit-Sharing Fund of the International Treaty on Plant Genetic Resources for Food and Agriculture were analysed in a field trial. Early vigour, winter hardiness, heading time, disease resistance, lodging resistance, chlorophyll content, normalized difference vegetation index (NDVI), plant height, protein content and grain yield of the two groups were investigated and compared at Rimski šančevi, Serbia in 2020/21. Significant phenotypic variations of all traits were found. Wheat landraces had significantly higher protein content and were more resistant to powdery mildew than the old cultivars, but had less early vigour, less winter hardiness, higher stems prone to lodging and lower yield. There were no significant differences between varieties and landraces in chlorophyll content, NDVI, resistance to Septoria leaf blotch, leaf and yellow rusts. Principal component analysis differentiated cultivars from landraces and indicated positive correlations between yield and early vigour, chlorophyll content and powdery mildew, and negative correlations between yield and lodging, plant height, heading time and protein content. Several genotypes with high protein content (>15%), high yield (8 t/ha) and resistant to diseases could be a valuable breeding material for climate-resilient cultivars. This research was funded by the Benefit-Sharing Fund of the International Treaty on Plant Genetic Resources for Food and Agriculture within the project PR-166-Serbia, “Redesigning the exploitation of small grains genetic resources towards increased sustainability of grain-value chain and improved farmers’ livelihoods in Serbia and Bulgaria-GRAINEFIT”.

Key words: diversity, landraces, phenotyping, *Triticum aestivum* L., varieties, wheat

P1_24

Organic vs. conventional foods: differences in nutrients

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Abstract

Organic agricultural production enables the production of high-quality food, without residues of pesticides, certified, safe, and at the same time it provides high economic and ecological profit and preserves a healthy environment. Numerous studies around the world comparing the nutrient content of organic and non-organic foods have had mixed results. Most of the conducted studies compared the effects of organic and conventional fertilisers on the nutritive composition of products, but not the effects of the production system as a whole. The aim of the present review is to compare chemical compositions of organically vs conventionally grown plants and their products. Organic products compared to conventional contain more dry matter, significantly less nitrates, a higher level of macro-and micro-elements (especially Ca, Mg, Fe, P, Zn), vitamin C, fewer proteins and a higher proportion of essential amino acids, total sugars, more polyphenols and they had higher total antioxidant capacity. There is an insufficient number of studies on vitamin levels, in particular β-carotene and vitamin B group. The differences in the nutritional composition between organically and conventionally grown plants and their products vary depending on the production season, plant species, morphological parts of plants being analysed, as well as on tested nutrients. Due to these facts it is very difficult to draw a final conclusion on the effect of the cultivation system on the nutritional composition of plants. There is no clear consensus whether organic grown plants and their products have an improved chemical composition compared to conventional products has not been reached yet. The conclusions are ambivalent and therefore further research is needed.

Key words: organic production, conventional production, chemical composition, vitamins, minerals, nitrites

P1_25

The most important crop measures in organic production of winter wheat

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Abstract

Organic products of winter wheat are believed to be more nutritious and safer foods compared to the conventional alternatives by consumers, despite the higher price of these products. The experiment with organic technology of winter wheat was conducted at the research and study field "Radmilovac", Faculty of Agriculture Belgrade in 2016/17 and 2017/18 year on the luvic chernozem soil type. Organic cropping system included tillage with a disc harrow at 20 cm with the complete maize crop residues incorporation and the pre-sowing tillage with a harrow. The basic fertilization was conducted in autumn with 3.000 kg ha-1 biohumus (commercial name „Biohumus Royal offert“, producer „Altamed“ Serbia) and top dressing in spring with 5.0 l ha-1 biofertilizer („Slavol“, producer „Agrounik“ Serbia). The common (cv. 'NS 40S') and durum (cv. 'Dolap') winter wheat cultivars were used, both developed and adapted for organic growing system. It was important to underline that organic cropping system, after 17 years of experiment (from the beginning of the establishment of the organic four-field crop rotation until 2017/18) increased soil organic matter, due to the application of organic fertilizer in combination with other practices as a part of this system (application of bio-fertilizers, incorporation of crop residues, etc.). Statistical analysis confirmed that year and genotype have greater impact on wheat productivity than their interactions. More favorable meteorological conditions in the first year led to obtaining significantly higher grain yields (4.84 and 4.45 kg ha-1) and a greater 1000-grain weight (41.6 and 40.2 g). There were also significant differences in the productivity of the studied wheat cultivars. The grain yield of common soft wheat (4.34 kg ha-1) was significantly higher than that of durum wheat (3.050 kg ha-1). The inclusion of high yielding genotypes, with enhanced utilization efficiency into low-input technology based on careful choice of cultural practices, could be the important step in organic farming systems.

Key words: organic growing technology, fertilizer, cultivars, grain yiel

P1_26

Economically important oilseed flax -NS Primus

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Abstract

There are three "golden" oilseeds in the world: soybeans, sunflowers and oil flax. Flax (*Linum usitatissimum* L.) is an economically important oilseed because seed of flax has an excellent nutritional composition, has a high oil contentoil content (40-50%), protein (19-25%), sugar (22-35%) and mineral salts (2-3%). It is also rich in omega 3 fatty acids, vitamins (A, D, E, K, B1,2,3,6,9), minerals (Ca, K, Mg, Mn, Zn, Fe, F, Se) and lignans, which is of great importance in medicine, has antioxidant and anti-inflammatory effects. The aim of this study was to examine the productivity of the variety NS Primus, grown in Novi Sad, on chernozem soil, in the production year 2020. Previous crop was winter wheat. Sowing was done in early March with a sowing rate of 60 kg ha^{-1}. Optimal crop care measures were applied during the vegetation period. The harvest was done in the technological maturity of the crop, on September 15, 2020. The variety "NS Primus" has created excellent performance, the grain yield was 2210 kg ha^{-1}, while the oil yield was 750 kg ha^{-1}. Based on the above, we conclude that the sowing of oil flax "NS Primus" achieves economically justified production.

Key words: flax, yield, economical production

P1_27

ZP Belija- wheat variety for confectionery industry

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Abstract

The present study displays the most important agronomic and technological traits of the only Serbian winter wheat variety for confectionery industry, ZP Belija, developed at the Maize Research Institute, Zemun Polje. ZP Belija was created by crossing two wheat varieties for special purposes, has large grains of flour structure and characteristic white color. Grain yield of the ZP Belija in the two-year trails of the Serbian Committee for the Release of Varieties amounted to 7980 kg ha^{-1}. In both seasons standard wasn't sown because none wheat variety for confectionery industry is currently recognized in Serbia. ZP Belija is a late wheat variety with excellent resistance to lodging, volume weight up to 81.2 kg hl^{-1} and 1000 kernel weight 37.3g. Technological analysis showed that its protein content amounted 13% and wet gluten 31.5%. The variety is extremely suitable for cooking, grain absorbs water well, swells and increases its mass. Taking into account the lack of wheat varieties suitable for cooking and confectionary industry on Serbian market, breeding program of wheat for special purposes will be continued.

Key words: wheat, confectionery industry, variety, breeding

P1_28

Evaluation of *Lathyrus sativus* L. seed for protein content and trypsin inhibitor activity

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Abstract

Grass pea (*Lathyrus sativus* L.) is a legume with high protein content and good quantities of essential amino acids. It has high tolerance to drought, high adaptability to extreme conditions, disease resistance and low input requirement for cultivation, which makes it very useful for cultivation by resource-poor farmers. Potential usage of grass pea is limited due to the presence of anti-nutritional factors including protease inhibitors, especially trypsin inhibitors. They have a major impact on nutritional value, by inhibiting pancreatic serine proteases (thus impairing protein digestion), but are also likely to protect legume seed against attack by predators. Although once extensively grown throughout Balkan Peninsula, grass pea was nearly forgotten. In recent years there was an effort to reintroduce and increase the interest of researchers and farmers in this crop. The aim of this study was to establish whether genotype and environment have significant influences on trypsin inhibitor activity (TIA) in grass pea and to determine whether TIA is correlated with seed protein content. In twenty five accessions of from seven countries the seed protein content varied from 22.6 to 28.1%. The TIA was also variable, with values ranging from 26.67 to 90.33 TUI/mg, but there was no correlation between those two parameters. In order to establish if environmental condition can affect TIA, eight accessions, originating from Serbia, were grown in both, Slovenia and Serbia. The TIA values of accessions grown in Slovenia varied from 34 to 81 TUI/mg, while the accessions grown in Serbia had TIA values ranging from 40.33 to 57.00 TUI/mg. The correlation of TIA values between accessions grown in Slovenia and those grown in Serbia was 0.462. Since the presented data were results of just one-year field trials, it would be useful to continue the evaluation and establish which environmental factors have highest effect on the TIA.

Key words: grass pea, TIA, accessions, proteins, correlation

P1_29

Pathogenic potential of *Waitea circinata* var. *zeae*

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Abstract

Waitea circinata Warcup & P.H.B. Talbot (multinuclear *Rhizoctonia* spp.) is a widespread, soil-borne plant pathogen causing root rot mainly of monocotyledonous plants. Among five described varieties, the most common and widespread is *W. circinata* var. *zeae* Toda, Mushika, T. Hayak., Tanaka, Tani & Hyakum. Besides monocotyledonous hosts, a natural infection of a limited number of dicotyledonous plants, including soybeans, beans, peas, sugar beets and carrots were recorded recently. During 2017, cabbage and oilseed rape plants showing symptoms of root and root neck rot, sampled at the localities of Futog and Rimski Šančevi (Serbia), were proved to be infected with *W. circinata* var. *zeae*. This was the first record of natural infection of plants from Brassicaceae family worldwide. Two selected isolates from cabbage (299-17) and oilseed rape (300-17) formed fast-growing orange colonies with red sclerotia and multinucleate hyphae with a characteristic branching pattern. The identification was further confirmed by BLAST analysis of sequences of ITS rDNA, RPB2, LSU and β-tubulin genomic regions. Koch's postulates were fulfilled after inoculation of cabbage and oilseed rape seedlings, while an experimental host range was determined by inoculations of 14 different plant species from 8 families. *W. circinata* var. *zeae* caused mild to medium root necrosis on the majority of inoculated seedlings 7 days post inoculation. Seedlings of sunflower, carrot and tomato developed severe root necrosis followed by whole-seedling decay. Our results proved that host range of *W. circinata* var. *zeae* could be much wider than so far known which, coupled with its soil-borne nature, reveals a significant pathogenic potential of *W. circinata* var. *zeae* towards many important crops.

Key words: cabbage, oilseed rape, detection, host range, soil-borne

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P1_30

Occurence, importance and control of *Ramularia collo-cygni* – an emerging pathogen in barley

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Abstract

Ramularia leaf spot caused by the fungus *Ramularia collo-cygni* B. Sutton & J.M. Waller was first described by Carvara in Italy as far back as 1893, as the *Ophiocladioum hordei* Cavara. Since then, this disease has been rarely noticed, until the 80s of the XX century, when numerous epidemics and significant economic damages began to occur, which caused great interest of the scientific community for this pathogen. It is considered that the inconspicuous period of this disease is a consequence of its confusion with other leaf diseases, physiological leaf spots and rapid crop senescence. The disease usually appears later in the vegetation, from heading to ripening of barley, in the form of numerous reddish-brown necrotic spots surrounded by a chlorotic halo and visible on both sides of the leaves, leading to rapid leaf senescence and loss of green mass causing a significant reduction in yield, which in sensitive varieties of barley can be reduced by 5 and even up to 70%. In addition, this fungus has been found to produce host-specific anthraquinone toxins better known as rubella, which induce lipid peroxidation to cause chlorosis and necrosis, leading to accelerated decay of barley leaves. The pathogen has not been identified in our country yet, but it is present in our neighbouring countries Serbia and Croatia, also in many countries in Europe, South and North America and New Zealand. Measures to control this disease should be based primarily on preventive cultural practices, but also the use of healthy, certified seeds and the use of fungicides from the group of strobilurin and newer generations of SHDI's fungicides, which have shown high efficiency in controlling the pathogen. This review paper provides currently available knowledge on the occurrence and economic significance of this pathogen, its prevalence, hosts, epidemiology, and disease control methods.

Key words: Ramularia collo-cygni, ramularia leaf spot, occurence, importance, control

P1_31

Crop rotation influence on vertical weed seed bank

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Abstract

Soil weed seed bank represents a latent plant community, so, the knowledge of vertical distribution and number of seeds in soil profile is one of the reliable ways to prepare the adequate weed control strategy. It is believed that the crop rotation is one of the most important agrotechnical measures which, in interaction with weed control, impact both size and composition of the weed seed bank. In a long-term stationary experiment "Plodoredi" at the Institute of Field and Vegetable Crops, Novi Sad, Serbia (N 45° 19', E 19° 50') a weed seed bank in wheat monoculture, two year crop rotation (winter wheat – maize) and three year crop rotation (winter wheat – soybean – maize) has been estimated. Based on a three-year successive soil sampling in depth of 0–15, 15–30 and 30–40 cm and by applying the method of physical extraction of seed it has been established that in all three crop systems the seeds are distributed in the way that the layer of 0-15 cm had most seeds. The abundance decreased gradually with the increase in depth. The greatest abundance was stated in the layer of 0–15 cm in the monoculture of wheat (12.962 m^{-2}), then in the two year crop rotation of 10.950 seeds per m^{-2} and the least abundant was in the plot with three interchanging crops (7.135 $m-^{2}$). Depo, i.e. weed seed bank, were regularly greater in spring sampling compared to autumn ones for the autumn-spring period, whereas, more intensive seed rain has not been detected in two-field crop rotation during the last two years. Even though the hypothesis that crop rotation affects the decrease of seed bank size has been confirmed, on the other hand, greater diversity has been determined – 41 species in two-year crop rotation, i.e. 39 in three-year crop rotation in regards to wheat monoculture (17 species).

Key words: weed seed bank, vertical seed distribution, monoculture, crop rotation

P1_32

Threatened communities *Nymphaeion albae* Oberdofer 1957 alliance development in Ramsar area of Bardača

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Abstract

Endangered communities of *Nymphaeion albae* Oberdofer 1957 are the dominant floating vegetation of the Ramsar area of Bardača, which develops on the surface of full-scale ponds, canal networks and rivers of the catchment area of northeastern Bosnia and Herzegovina. The alliance *Nymphaeion* is represented with three communities: *Nymphaeetum albo-luteae* Nowinski 1928, *Hydrochari-Nymphoidetum peltatae* Slavnić 1956 and *Trapetum natantis* Müller et Görs 1960, whose all cenobionts except *Potamogeton fluitans* Roth. are found on the IUCN Red List of Threatened Species. Edificators of communities: *Nymphaea alba* L., *Nuphar lutea* (L.) Sm., *Hydrocharis morsus-ranae* L., *Nymphoides peltata* (Gmel.) Ktze. and *Trapa natans* L. are relict representatives of the tertiary flora. The floristic composition of the communities contains 23 species, 6 are characteristic of the *Nymphaeion* alliance and 8 of the order *Potametalia* and the class *Potametea*. Strong anthropogenic impact (drying of pools, destruction of emergent and ruderal vegetation, establishment of agrophytocenoses) has caused that, these communities being reduced to only two (Rakitovac and Sinjak) of 11 pools, on the estuary of the Stublaja River and a scarce canal network. Anthropogenic activities have led to a biodiversity reduction, suppression of relict tertiary species, increased numbers of invasive species and severely disrupted the protected area management action plan. The endangerment of certain species and their communities were observed by comparative analysis of physicochemical parameters of water quality and it was concluded that, differentiation of *Nymphaeion* alliance is due to the alkalinity and hardness of the water (Ca content). *Hydrochari-Nymphoidetum peltatae* community develops in waters with the highest alkalinity, higher content of Ca and lower O_2 content. The waters with slightly lower alkalinity, warmer canal water with lower CO_2 represent habitats for the *Nymphaeetum albo-luteae* community, while community *Trapetum natantis* develops in water with lowest alkalinity and highest pH.

Key words: Nymphaeion, IUCN, water properties, Bardača

P1_33

Response of *Xanthium orientale* L. to glyphosate

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Abstract

Xanthium orientale L. with three subspecies is annual weed species wide distribution, in many countries characterized as invasive species. This species is also wide spread as a weed on agricultural land, coast areas as on the ruderal area on the territory of Bosnia and Herzegovina. Mechanical, agrotechnical and chemical measures can be applied to control these species. The objective of this study was to conduct a biological study of the phytotoxic symptoms and effectivness of glyphosate on control *X. orientale*. The efficacy of glyphosate was expressed through biometric parameters (fresh shoot mass, dry shoot mass, fresh root mass, dry root mass) of plants treated in different growth phase. The regression relationship between the biometric parameters, as a dependent quantity, and the glyphosate rate, as an independent quantity, is represented by a sigmoid curve according to the logistic model based on the "dose-response" relationship. Although visible effects were observed on all treated plants the highest percentage of inhibition was achieved on the largest treated plants. *X. orientale* showed high sensitivity to the glyphosate. On all treated plants, regardless of the growth stage, the percentage of mass inhibition ranged 60-85%.

Key words: *X. orientale*, control, glyphosate, biometric parameters, growth phase

P1_34

Effect of glyphosate on wheat seedlings depending on the characteristics of the water

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Abstract

The aim of the research is to examine the dependence of the impact of glyphosate on wheat seedling depending on the characteristics of water it is dissolved in. The impact of water on effective concentration of glyphosate has been researched by bioassay methods. Wheat seeds were germinated on the filter paper in the Petri dishes on the temperature of 22˚C for six days whereupon the measurements of the mass of the shoot and root were taken. Wheat variety BELIJA was used in the experiment. Glyphosate was used in the following mass concentrations: 720, 1080, 1620, 2430 and 3645 µg a.s./L, as well as three types of water: spring water, tap water and distilled water. EC_{50} of glyphosate for the shoot weight in the natural water varied from 2571.9 to 3114.83 µg/L, as in the distilled water it was from 2251.99 µg/L. EC_{50} of glyphosate for the root weight in the natural water varied from 1571.49 to 2793.56 µg/L, as in the distilled water it was 1240.24 µg/L. By simple linear correlation it is determined that value $EC_{50Shoot}$ for the shoot weight statistically significantly depends on carbonate hardness and total water hardness while the linear correlation coefficients are r= 0.922* (p=0.026) and r=0.897* (p=0.039), respectively. It is determined that effective concentrations of glyphosate for the shoot weight $EC_{10Shoot}$ and root weight EC_{10Root}, statistically significantly depends on the concentration of magnesium in water and the linear correlation coefficients are 0.923* and 0.892*, respectively.

Key words: glyphosate, effective concentration (EC), water characteristic, wheat, bioassay

P1_35

Climate change: the impact on aflatoxin contamination in cereals

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Abstract

It is considered that one of the greatest food safety concerns worldwide is aflatoxins (AFs) contamination of cereals, due to its carcinogenic effects, high number of associated notifications in cereal based food and feed products, as well as in milk and dairy products. AFs produced mainly by *Aspergillus flavus* and *Aspergillus parasiticus*, are the most toxic and frequent contaminants of cereals, especially in areas with hot and humid climates. Changes in temperature and water availability related to global climate changes (increased temperature, heavy rainfalls, and droughts) are modulating factors of filamentous fungi growth and production of mycotoxins. Amongst all favouring factors, environmental factors (temperature, water activity (aw) and relative humidity (RH)) and climate change have been identified as the primary factors. The main secondary factors influencing AFs production in cereals are pH of the substrate, CO_2 levels in the gaseous environment, agronomic and socioeconomic determinants. Global climate change predictions indicate that AFs contamination of cereals could become a future food safety issue, in Europe as well, especially in the Mediterranean region. This review aims to give an overview based on the available information regarding AFs presence in cereals to reinforce AFs management, reduce economic losses, and prevent health issues related to the AFs exposure in the light of global climate change.

Key words: climate change, aflatoxins, cereals

Acknowledgement: The research was funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia, Contracts number 451-03-68/2022-14/200222 and 451-03-68/2022-14/200032.

P1_36

Occurrence of toxigenic fungi on spelt grain with special reference to *Aspergillus* species

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Abstract

In recent years, public attention has increasingly focused on the production and consumption of high quality safe food. Changes in the dietary trend have influenced the formation of specific market requirements that have led to the fact that in the diet are increasingly used alternative cereals of high nutritional value, in addition to conventional. The ancient wheat species spelt [*Triticum aestivum* subsp. *spelta* (L.) Thell.] has a growing interest due to its various health benefits. Due to its biological and agronomic characteristics, spelt takes an important place among alternative cereals. The aim of this study was to investigate the natural occurrence of pathogenic and toxigenic fungi on seven breeding lines of spelt grains in 2021 grown in Zemun Polje, Serbia. Based on morphological properties (colony and spore appearance) it was determined that breeding line 6337 was the least infected (2,2%) and that the peeled grains had a lower degree of infection compared to grains with glumes. Glumes have been shown to be a physical protection against pathogens. Mycological analyses confirmed the presence *Aspergillus* spp., *Alternaria* spp., *Fusarium* spp. which were the most prevalent. Considering the average values, the most frequent were *Aspergillus* section Nigri (1,64%). Significance of *Aspergillus* section Nigri is reflected not only in the deterioration of spelt grain yield, quality and large economic losses but also in the fact that many species of this genus produce toxic metabolites (mycotoxins), which are harmful to human and animal health. Climate change and high adaptability and resistance of toxigenic *Aspergillus* species are cited as the reason for this phenomenon.

Key words: fungi, *Aspergillus*, spelt

P1_37

Occurrence of mycotoxins in wheat grain during the period 2020–2021 in Serbia

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Abstract

Wheat and wheat products can be contaminated with various fungal species. Secondary metabolites of these fungi, such as deoxynivalenol, zearalenone, fumonisin B1 and aflatoxins are important mycotoxins that cause various harmful effects on human and animal health. Therefore, the aim of this study was to examine the concentration of mycotoxins in wheat grain. Wheat samples were tested for the presence of four mycotoxins (fumonisins, aflatoxins, deoxynivalenol and zearalenone). Samples were collected during two years (2020-2021), from different plots in Zemun Polje, Serbia. Grain samples were selected randomly. Total of 10 samples were tested each year. In order to perform the analysis for the presence of mycotoxins, grains were dried and ground. The analysis was performed by ELISA (Enzyme-linked immunosorbent assay) using Tecna´s ELISA test kit for mycotoxins. During the 2020 no fumonisins were recorded in any of the wheat samples. The values of synthesized aflatoxins ranged from 0.618-1.818 ppb, the values of deoxynivalenol ranged from 0.006-1.058 ppm while concentrations of zearalenone were highest and ranged from 0.230-9.379 ppb. In 2021 no fumonisins and zearalenone were recorded in any of the wheat samples. Aflatoxins ranged from 2.209-3.812 ppb, and deoxynivalenol ranged from 1.244-3.307 ppm. Contamination of wheat grain with toxic metabolites of fungi is one of the particularly important problems in global agriculture because it causes significant economic losses. Therefore, it is important to monitor the presence of these metabolites in order to develop effective methods to reduce grain contamination.

Key words: wheat, aflatoxins, fumonisins, deoxynivalenol, zearalenone

P1_38

Monitoring of the Brown marmorated stink bug (*Halyomorpha halys* Stål) in Banja Luka, in 2020 and 2021

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Abstract

Brown marmorated stink bug (*Halyomorpha halys* (Stål)), is an invasive and polyphagous stink bug native to South Asia, that has been recently introduced to Europe and Bosnia and Herzegovina. *Halyomorpha halys* is highly polyphagous pest of many economically important commodities including tree fruit, nut crops, field crops, vegetables and ornamentals. Moreover, it is a serious nuisance because large numbers of adults seek out man-made structures for overwintering. Monitoring of population dynamics of *H. halys* during two years 2020 and 2021 was performed in Banja Luka, Republic of Srpska. The pest was present through monitoring period April-October with the highest abundance in the third decade of July when all life stages were present. More individuals was caught on pyramid trap (845) compared to sticky trap (156) favoring pyramid trap for future monitoring. Total number of caught individuals was 6.5 folds higher in the second year of monitoring indicating population increase and potential threat to agricultural production.

Key words: invasive pest, population dynamics, pyramid and sticky traps

P1_39

Effect of soil and fertilization management on maize susceptibility to European corn borer (*Ostrinia nubilalis* Hübner)

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Abstract

European corn borer (ECB) is one of the most important maize pests. The aim of this study was to determine the effect of different soil and fertilization management on maize susceptibility to European corn borer attack. The experiment was set up in 2021 in Virovitica-Podravina County on maize hybrid OS378. Three treatments were included in the experiment. Treatment A – soil tillage: standard tillage (ST) and conservation system shallow (CTS), treatment B – liming: with liming (CY) and without liming (CN) and treatment C – fertilization: fertilization according recommendation (FR), FR+GeO2 (soil microbial biomass activator) (GFR), biochar (B) and biochar + FR (BFR). At the end of the vegetation ear weight (g), stem tunnel length (cm), ear shank damage (cm), number of larvae in maize stem and number of larvae in ear shank were recorded. Damage from ECB larvae for all tested parameters was greater on the CN compared to CY treatment and the ear weight was lower. CTS resulted in greater damage of maize stem and the number of larvae in the stem however, there was less damage to the ear shank and the number of larvae in the ear shank while the ear weight was also higher than the ST. BFR resulted in the highest ear weight on fertilization treatments and the lowest ear shank damage as well as the number of larvae in ear shank. Biochar treatment had the lowest ear weight, stem tunnel length and number of larvae in the maize stem, but also the greatest ear shank damage. According this results for all tested parameters from the ECB larvae, ear shank damage was the most important parameter in ear weight reduction.

Key words: European corn borer, tillage, fertilization, maize, liming

P1_40

Occurence of *Phthorimaea operculella* (Zeller, 1873) in polog region of North Macedonia

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Abstract

The potato tuber moth *Phthorimaea operculella* (Lepidoptera: Gelechiidae) had got economic importance as a pest for potato crops in North Macedonia in last four years. The moths develops 2-3 generation per year, depend on the region and feed on with tomato and tobacco as well as. But, the moths is the most destructive for the potato, attacking tubers and foliage, especially when the crop has grown in monoculture, which often happens in Polog Region. The attacks are more intensive on lower attitude, on sun exposed and drier places, on the tuber closer to the soil surface. The second generation is the more numerous, attacking dominantly potato tubers. The damages on potato in 2019 has been estimated on 60% attacked tubers. Trying to develop proper control measure, the pest had been monitored in 2020 in four localities in Polog Region (500 m altitude), in the second part of the season, since July to September, by the yellow sticky traps. The monitoring was repeated in 2021 since May to September on the same localities. The monitoring had shown more intense population of *Ph. operculella* at the end of the summer. In order to decrease the damages and to improve production of potato the set of cultural measures (crop digging during the season, sprinkler irrigation) and chemical applications had recommended during the August. The chemical protection emphasized mixed insecticides (chlorantraniliprole, deltametrin, abamectin, cypermetrin). The efficiency of the plant protection program, had been estimating by the number of caught adults and percent of worm eaten potato tubers. At the end of the season the percentage of the damaged tubers was within 0-2%. For the next season are recomendaded crop and field rotation, deeper sowing of the tubers, irrigation and keep monitoring of the pest.

Key words: Potato tuber moth *Ph. operculella*, potato, crop protection, North Macedonia

P1_41

Identification of microRNA targets responsive to *Verticillium nonalfalfae* infection of hop (*Humulus lupulus* L.)

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Abstract

Micro RNAs (miRNAs) are 21 to 24 nucleotide long non-coding RNA molecules that regulate gene expression at the post-transcriptional level by cleaving and preventing the translation of transcripts into proteins. miRNAs are a major class of regulators of gene expression, thereby modulating a variety of biological processes, including plant response and resistance to fungal pathogens. Verticillium wilt disease, caused by the phytopathogenic fungus *Verticillium nonalfalfae* (Inderb. *et al.*, 2011) is a major contributor to yield losses in many economically important crops, including hops (*Humulus lupulus*), as there is currently no effective plant protection product available to successfully limit the spread of the fungus. In this study, we aim to elucidate the impact of fungal infection of hops at the level of miRNAs and their targets, and thereby identify potential biological processes and molecular functions that are specific to resistant hop cultivars and potentially contribute to resistance to infection. The results of our studies show that susceptible and resistant hop cultivars respond differently to *V. nonalfalfae* infection at the miRNA level and that miRNAs may contribute to the successful defense of the resistant cultivar. In the resistant cultivar, we observed increased expression of hlu-miR160a, which is involved in modulation of signaling pathways and auxin-mediated hormone signaling, and hlu-miR319c, which is involved in root growth and development. The latter may suggest a potential involvement of these two miRNAs in the successful defence of the resistant cultivar against *V. nonalfalfae* infection. Using the RLM-RACE method, we confirmed the interaction between these miRNAs and their targets during the pathogenesis of verticillium wilt of hops. In the future, we will further characterize the function of the miRNA targets by MR VIGS. The method allows us to observe the effect of silenced targets during *V. nonalfalfae* infection by overexpression of

mentioned miRNAs and subsequent silencing of the targets in a susceptible hop cultivar.

Key words: Verticillium nonalfalfae; biotic stress; microRNA targets; RLM-RACE; VIGS

Session 1: CROP SCIENCE

Oral Presentations

O1_01

Smart specialization strategy: concept, methodology, agri-food as area of priority, regional value chain

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Abstract

The Smart specialization strategy combines industrial, research and innovation policies to suggest that countries or regions identify and select a limited number of priority areas for knowledge-based investments, focusing on their strengths and comparative advantages. It is bottom-up process, very inclusive one, evidence-based, dynamic/entrepreneurial discovery process involving key stakeholders with global perspective on potential competitive advantage and potential for cooperation, focusing investments on regional comparative advantages. This paper is describing the process conducted in Serbia in close cooperation with Joint Research Center (JRC) of European Commission based on the methodology developed by JRC. The process included the mapping of economic, research, and innovation potential of Republic of Serbia than qualitative analysis and selection the preliminary list of priority areas, and finally the entrepreneurial discovery process by which the priorities are finally defined. One of the four vertical priorities in the case of Serbia is Food for future, including high-tech agriculture, value added food products and sustainable food production chain. Action plan of the strategy is covering 2021/2022 with the budget of over 150 million euros. The measures and the actions of the AP are described, as well as how the Serbia Accelerating Innovation and Growth Entrepreneurship (SAIGE) Project is supporting the implementation of the strategy. The establishment of the regional value chain based on the common priorities, in particular based on agri-food one, and possible ways of investing in it is presented too.

Key words: Smart specialization strategy, Serbia, agri-food

O1_02

Smart agricultural water management of maize crop cultivation on two different pedoclimatic locations in Bosnia and Herzegovina

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Abstract

Prioritizing the adaption of smart agricultural water management techniques with the use of new tools and applications could help farmers in BiH to optimize the yield and efficiently use of water resources which is the main objective of HORIZON 2020 "SMARTWATER" project, funded by European Commission. A joint experiment on two locations in Bosnia and Herzegovina has been studied in 2021 in order to understand the crop water requirements in local hybrid BL-43 under different water regimes. The experimental locations Aleksandrovac is characterized by fine clay loam soil and moderate continental climate, whereas Butmir site is characterized by clay loam soil and temperate warm and humid climate. Maize was sown on April 22 and May 9, emerged on May 4 and May 19 and harvest took place on September, 15 and October 4, at Aleksandrovac and Butmir sites, respectively. Three water regimes (full, deficit and rainfed) were applied and irrigation scheduling were managed following the standard FAO Penman-Monteith approach on a daily basis. Soil water status (soil moisture in volume percentage) was monitored using gravimetric method during the period of irrigation on a weekly basis for two soil profile depth (0-30; 30-60 cm). The total accumulated evapotranspiration at the end of the vegetation period was recorded with total of 624.49 mm, 506.84 mm and 300.38 mm at Aleksandrovac and 576.27 mm, 446.78 mm and 288.56 mm at Butmir for FI, DI and R plants, respectively. A very high

evaporation rate has been noticed around tasseling time which imposed water stress on non irrigated maize at both locations. The overall results showed important evidence of the water stress impact on maize and suggest the increased need for water management in maize production for Bosnia and Herzegovina.

Key words: HORIZON; Smart Agricultural Water Management; maize; BIH

O1_03

Analysis of climate changes in peri - Pannonian Basin and Dinaric region: basis for future agricultural strategies

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Abstract

The aim of this study was to describe the process of climate changes on the selected meteorological stations in the Pannonian Basin and Dinaric region. The material has been collected from different sources for complete periods of measurement. The main method was based on comparing data among more stations for different periods. Extreme weather events are described too. The trends of temperature regime (temperature increase) in the period of measurements show similarity on all stations. Past decennium was the warmest one with sudden deviation from previous ones. Global warming has been followed with frequent occurrences of extreme weather conditions. This analysis can be used as a basis for more detailed studies of climate changes as well as for the development of agricultural strategies of adaptation to global warming in future.

Key words: climate changes, extreme events, the warmest decennium

O1_04

Classification of irrigated areas: application to the central Ebro river basin (Spain)

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Abstract

The large diversity of irrigated agricultural areas hinders the development of social consensus and complicates decision-making about the allocation of investments for irrigation modernization. A classification of irrigated areas permits the identification and mapping of different categories and reveals the strengths and weaknesses of each category regarding specific criteria. This paper proposes a binomial (genus and species) classification methodology of irrigated areas, which was designed based on a participatory approach. Four internal properties determine the genus: type of water source, type of water energy, on-farm irrigation method and water availability. Four external properties classify the variability within each genus into species: land tenure, crop type, existence of an environmental protection figure and socio-economic level. The method was applied to the irrigated area of the Ebro river basin in the Aragón region of Spain (ERB-Aragón). A total of 435,851 hectares were classified. A large part of the irrigated land uses surface water (94%), does not have water availability problems (80%), is not affected by environmental protection figures (97%), is devoted to field crops (86%), and manifests a low (45%) or moderate (41%) socio-economic level. A total of 24 genera and 126 species were identified. The proposed methodology can be adapted to other areas of the world by adjusting criteria and categories to local conditions.

Key words: irrigation classification binomial Ebro Aragón

O1_05

Irrigation, hydrology and crop yield simulation in a solid-set sprinkler irrigated farm

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Abstract

Solid-set sprinkler irrigation is commonly used in irrigation modernization projects in the Ebro valley of north-eastern Spain. In this method, an underground network of pipelines distributes water to sprinklers distributed throughout a farm. Since capacity of the water supply network does not permit to irrigate all sprinklers simultaneously, the farm is divided in sectors, with a typical area of about 1 ha. Sectors are sequentially irrigated using an automation system composed by an electronic programmer and a mini-hydraulic circuit. Electric signals are transmitted to the mini-hidraulic circuit, which operates the opening / closing of the sector valves. Decades of research have produced reliable simulation models in a number of domains related to agricultural production in solid-sets. Among them: 1) ballistic models of sprinkler irrigation water application; 2) hydraulic models of water flow in networks of pipelines distributing water from the water supply to the individual sprinklers (such as EPANET); and 3) crop water and yield simulation models, such as FAO's CropWat or Aquacrop. In this research, a coupled model was built connecting a ballistic model with EPANET and a replica of CropWat. The model was applied to the simulation of a corn crop in a 24.5 ha farm divided into 26 sectors and counting on 899 sprinklers. two soil types were considered in the farm, differing in water retention capacity. The soil was represented by 18.995 cells, with an area of 3.6 x 3.6 m each. A crop simulation was performed in each cell. Irrigation water in each cell was determined from the water application from neighboring sprinklers. The model permitted to estimate farm irrigation uniformity and efficiency, as well as crop yield reduction due to water stress. These indicators could also be obtained for each soil type and farm sector.

Key words: Sprinkler irrigation Cropwat EPANET ballistic uniformity efficiency yield

O1_06

Variable corn sowing based on soil potential

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Abstract

Compared to the expected production in 2020 in Serbia, corn yield was 9.6 percent higher, and 29.4 higher compared to the ten-year average (2010-2019). Corn is the most important export raw material of the Republic of Serbia and the export will exceed one billion euros. Uniform seed distribution and uniform sowing depth are prerequisites for even seed germination, growth and development, which represents the potential for high yields. Edaphic properties of the soil significantly affect the growth and development of crops. The cause-and-effect approach, which, in addition to the potential of the soil, also includes climatic factors, agro-ecological conditions, physical and chemical properties of the soil, enables that the field can be differentiated into potential zones. Different sowing norms can be applied in the differential zones of soil potential, which is a variable sowing of corn. The task of the work is to sow corn crops on the basis of pre-made zones of the field. The aim of this work is to avoid stress in corn crops and achieve higher yields in relation to the fixed sowing norm. The production field is differentiated on the basis of multispectral images of crops from the previous 5 years. The downloaded satellite images have a resolution of 3 x 3 m with a correction of 0.25 x 0.25 m. A model consisting of an enhanced green vegetation index, a triangle vegetation index, and a stress vegetation index was used. Hybrids with genetic potential for variable sowing were used in the macro experiment of 20 ha. The sowing rate ranged from 65,000 to 78,000 seeds/ha. Achieved yields in the production year 2021. indicate that variable sowing of corn can achieve a higher yield of 9.5 to 21.3% compared to conventional sowing. Vegetation indices can be used for the purpose of creating variable sowing maps.

Key words: corn, variable sowing, vegetation indices, hybrids, soil potential, stress

O1_07

Grain yield performance and adaptation to different environmental conditions of ZP commercial maize hybrids

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Abstract

Maize is the most important crop and among the most important exports of Serbia. Maize hybrids developed and released by the Maize Research Institute, Zemun Polje (MRIZP) occupy an important position in maize seed market in Serbia and region. Crop production in Serbia is characterized by very different agro-ecological conditions and farmers with very different crop management practices. It is well known that genotype x environment interaction plays an important role in grain yield performance of maize. Therefore, assaying of maize cultivars' performance pattern in different environments to maximize maize production through recommendations of appropriate cultivars to producers is essential. Stability analysis of grain yield based on multi-environmental trials is useful tool to gain insight in genotype reaction to different environments and growing conditions. Every year the Marketing Department of the MRIZP conducts testing of the bestselling and new promising commercial maize hybrids (so-called ZP hybrids) in a wide range of environments. The aim of this research was to evaluate grain yield and grain yield stability of ZP commercial maize hybrids and based on these results to determine which hybrid could accomplish the best its genetic potential in which growing conditions. Eleven maize hybrids of different maturity groups were tested at 45 locations in Serbia in 2021. Based on grain yield data, the stability analysis was performed using linear regression model proposed by Eberhart and Russel (1966). The mean grain yield ranged from 5 645 kg/ha to 6 863 kg/ha in the hybrids ZP 427 and ZP 5601, respectively. The values of regression coefficient (bi) ranged from 0.9008 in the hybrid ZP 427 to 1.0828 in hybrid ZP 5090. Based on the results, the adaptation of evaluated hybrids to different environments and growing conditions were discussed and recommendations were given to maize producers.

Key words: maize hybrids, grain yield, GxE interaction, grain yield stability

01_08

Productivity of natural grassland and pastures of Serbia and Srpska

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Abstract

Characteristic types of wetland grasslands in Serbia and Srpska are: *Phalaridetum arundinaceae, Beckmanietum erucaeformis, Caricetum vulpinae-rippariae, Agrostidetum-Juncetum effusi, Molinietum coeruleae, Deschampsietum caespitosae* and others. Hay yields range, without the application of fertilizers, from 3.5 t / ha to 4.5 t / ha. The following types of natural grassland are most common in the valley-lowland area: *Cynosuretum cristati, Alopecuretum pratensis, Arrhenatheretum elatioris, Agrostidetum albae, Festucetum pratensis, Agrostidetum vulgarae, Festucetum pseudovinae*. Hay yields range on average, without the application of fertilizers, on the pastures 2.0 t / ha and on the natural grassland 3.2 t / ha. Types of natural grassland and pastures represented in the hilly area are: *Agrostidetum vulgarae, Agrostideto-Chrysopogonetum grylli, Chrysopogonetum grylli, Danthonietum calycinae, Festucetum vallesiacae* and *Brometum erecti*. Hay yields, without the application of fertilizers, range on the pastures 0.9 t / ha and on the meadows 1.6 t / ha. Types of meadow and pasture mostly present in mountainous area are: *Danthonietum calycinae, Agrostidetum vulgarae, Festucetum sulcate-Potentilla rectae, Festucetum rubra-fallax, Brometum erecti, Festucetum vallesiacae, Poetum violaceae, Festucetuma spam strictae, Nardetum strictae* and *Festuco-Armerietum canescentis.* Average hay yields range on the pastures 0.7 and on the natural grassland 1.2 t / ha.

Key words: natural grassland and pastures, hay yield

O1_09

Effect of cutting management on seed yield, seed yield components and seed quality of red clover (*Trifolium pretense* L)

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Abstract

Red clover (*Trifolium pratense* L.) is the second most important perennia foragel legumes in the Republic of Serbia, cultivated on 90-120.000 ha. Nowadays red clover is considered as a very important catch crop and green manure as well as row material for production of pharmaceutical supplements based on phytoestrogens. Currently, domestic seed production is not sufficient to meet the demand, so the import of seeds from other countries is necessary. One of the most important factors that guarantee high yields of red clover seeds is cutting management, heavily influenced by environmental conditions. The objective of this study was to determine the effects of cutting management on seed yields, some seed yield components and seed quality of NS red clover variety Una. The trial was established on the experimental field of the Institute of Field and Vegetable Crops in Bački Petrovac according to a randomized block design with three replicates. Red clover variety Una was sown on April 10, 2018, at a row-to-row spacing of 25 cm with a seeding rate of 15 kg ha^{-1}. The size of the elementary plot unit was 15 m2 (3x5 m). Five cutting schedules with variable dates of initial cutting were tested in the period 2019-2020. First growth was used for seed production in the c1 schedule and second growth in the c2-c5 schedules (c2-budding, c3-start of flowering, c4-mid of flowering c5-full flowering). The statistical processing of the data was done using the analysis of variance (ANOVA). In all cutting systems, significantly higher seed yields were achieved in 2019 (the second year of red clover life). The highest seed yield (539 kg/ha) was achieved in the c2 cutting schedule. The cutting management had no significant effects on seed quality.

Key words: red clover (*Trifolium pratense* L.), seed production, cutting management

O1_10

The effects of fertilization treatments on phytoremediation properties of tall fescue (*Festuca arundinacea* Schreb.)

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Abstract

The goal of this research was to examine the influence of different types of fertilization treatments on phytoremediation qualities of tall fescue (*Festuca arundinacea* Schreb.). The experiment was set up in pots in the green house of the Faculty of Agriculture - University of Belgrade. The flotation tailings from the mine of lead, copper and zinc, which has very unfavourable chemical characteristics, was used as substrate. The pots were treated with 3 fertilization treatments (mineral fertilizer, organic fertilizer and mixture of this two fertilizers) and 2 rates of irrigation (50% FWC and 75% FWC). After each mowing the mowed biomass was measured and chemically analysed in order to determine the absorbed amounts of most important nutrients. The best result regarding the plant height of 56 cm was recorded in plants treated with organic fertilizer, while the ones treated with the mineral fertilizer showed the lowest growth (16.3 cm). Organic fertilizer treatment also showed the best biomass yield (6.1 g) while the plants treated with the mixture of organic and mineral fertilizer had the poorest biomass yield of 0.49 g. Nutrient accumulation showed significant variation with the different types of fertilization treatments. Highest amounts of nitrogen were recorded in plants treated with mineral fertilizer while the amounts of potassium and phosphorus were highest in plants treated with the organic fertilizer. Irrigation had no significant effects on the biomass yield nor the nutrient amounts in plant material.

Key words: tall fescue, phytoremediation, fertilizer, irrigation, yield

O1_11

CTM hybrids – a unique solution in maize production

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Abstract

Cycloxydim Tolerant Maize (CTM) was developed at the University of Minnesota, USA. CTM plants contain a nuclear, partially dominant single gene mutation (known as Acc1) that confer tolerance to cycloxydim. Cycloxydim is a systemic, post emergence herbicide for grass weeds control in dicot crops. Conventional maize is susceptible to cycloxydim, so the gene of tolerance must be introduced in both inbred parents to provide complete tolerance of CTM hybrids. Although this increase the number of required conversions, many seed companies have commercialized CTM hybrids. Institute of Field and Vegetable Crops from Novi Sad was the first to commercialize CTM hybrid in Serbia. Application of cycloxydim based product in CTM hybrids can provide efficient and reliable control of annual and perennial grass weeds without risk of phytotoxicity to the crop. Also, the technology is suitable for use in intercropping (an example: CTM + beans). Moreover, represent unique, flexible and reliable solution for control of Johnsongrass resistant to sulfonylurea herbicides. In addition to herbicide tolerance, high agronomic performances of CTM hybrids are crucial to secure profitability to maize producers. The research was supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, grant number: 451–03–68/2022–14/200032.

Key words: maize, cycloxydim, tolerance

01_12

Analysis of soybean varietal trials in 2015 and 2016 / Danube Soya project

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Abstract

The varietal trials with soybean were performed at the experimental site of the Agricultural Institute of the Republic of Srpska (abrr. the Institute) at Banja Luka in 2015 and 2016. The Danube Soya Association coordinated these activities through the research network in six European countries. The main objective of the research was to assess the suitability of the selected varieties for the production in the Banja Luka region. The material consisted of 12 varieties from three breeding institutions (Banja Luka, Novi Sad, SELSEM). The trial was designed in four replications. In addition to the standard measurements and observations, climate data were analysed on a daily basis. Due to the extremely unfavorable weather conditions in 2015, grain yield and quality failed on all varieties. The complex of fungi Diaporthe/Phomopsis was strongly activated in the rainy October causing significant soybean seed decay. Unlike 2015, optimal weather conditions in 2016 resulted in record grain yields, while the protein content was relatively low. More varieties in sowing structure is a measure for mitigating and preventing the risks of drought and heat stress. It can be concluded that all tested varieties can be recommended for commercial production in the region Banja Luka.

Key words: soybean, variety, extreme weather conditions, grain yield, protein

O1_13

Variation of protein content in wheat seed

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Abstract

Wheat grain quality characteristics depend greatly on genotype, environment and interaction genotype/environment. The aim of the study was to determine grain protein content, amino acid content and dry gluten content in eight bread wheat genotypes grown under different environmental condition. In this paper gluten content, grain protein content and amino acid content of eight wheat genotypes were analyzed during two year (2015/16 and 2016/17) with different climatic conditions (temperature and precipitation). In the first year, the genotype Dukat had the lowest content of protein (11.80%) and dry gluten content (24,21%), while genotype KG 3633-1/00, had the highest protein content (13.20%) and gluten content (27.15 %). In second year the lowest content of protein (12.80%) had KG-3606-2/00 and the lowest dry gluten content was in wheat Dukat (27.84%) while in genotype KG 3633-1/00, found the highest protein content (14.40%) and gluten content (31.10%). The contents of essential and non-essential amino acids in wheat grains and EAA value were higher in novel genotypes. The differences of amino acid composition in analyzed genotypes were determined. The content and composition of proteins and amino acids, especially essential amino acids, are

important for proper nutrition and human health, which has a significant contribution to the economy of wheat production.

Key words: wheat, quality, genotypes, environment

O1_14

Advanced phenotyping techniques in sunflower breeding

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Abstract

Breeding and phenotyping of sunflower are mainly based on traditional methodologies that are generally time-consuming, labor-intensive, prone to errors in the sampling, and with, in some cases, biased nature of the evaluation results. However, over the past decade, plant phenomics has made impressive progress in developing sensors and imaging techniques for a wide range of crop traits, organs and incidences. They enabled direct or indirect monitoring of growth and development, recording of architecture and helped evaluate resilience and tolerance to biotic and abiotic stresses. In IFVCNS, there were several successful attempts to use advanced phenotyping techniques in the identification and determination of desirable traits in sunflower. Using Flower Color Image Analysis (FloCIA) software, enhanced ray florets color determination and paved the way to more objective and accurate sunflower phenotyping, while thermal imaging was used for screening of sunflower for tolerance to Sclerotinia head and stem rot. Besides monitoring the development of the above-ground parts of plants, the automated image platform has been used for sunflower root development and morphology screening. Within the framework of SmartSun and CROPINNO projects and activities of Climate Crops Centre, a prototype of an automated root phenotyping platform for analysis of root system architecture of plants grown in rhizotrons was set. The aim is to monitor root development and morphology (architecture) of sunflower genotypes from the IFVCNS collection, under water stress conditions. This will facilitate the creation of a sunflower "ideotype" for the 21st century, more resilient to extreme environmental conditions caused by climate change.

Key words: sunflower, phenotype, digital image, rhizotron

O1_15

Study of the amino acid content of triticale to compare with other cearial crops genotype

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Abstract

During the season 2013-2014, the investigation was carried out in the south of Libya, to evaluate the chemical content under the irrigation condition at arid regions, to study the amino acid content of Triticale var. (Begal *Tritcosecale Wittmack) bread wheat var. (Bohot 208), durum wheat var. (Bohot 107) and barley var. (Acsad 176). They were all cultivated under the same conditions. The results of amino acid content indicated that tryptophan and histidine had the smallest concentration in triticale grains, while glutamic acid, followed by proline, leucine, and aspartic acid were the highest in concentration. The total content of essential amino acids and non-essential amino acids in triticale was 32.57% and 59.24% of the total protein, respectively. In comparison with other cereals of this investigation, the results showed that triticale had higher concentration of lysine, arginine, threonine, valine, methionine, and isoleucine than both types of wheat and higher concentration of arginine and methionine than barley. The total content of essential amino acids in triticale was higher than that in wheat (both types), but less than that in barley. The chemical score test indicated that lysine is the first limiting amino acid in triticale as well as in soft wheat, hard wheat, and barley.

Key words: triticale, bread wheat, durum wheat, barley, amino acid content

O1_16

Are drought and precipitation patterns affecting sunflower susceptibility wireworms?

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Abstract

Climate change, manifested in increasingly warmer weather conditions, prolonged drought periods and changed precipitation amount and patterns, has been identified as a changing force in agriculture production. Extreme weather events have a major impact on crops, but also on agricultural pests. Specifically, drought conditions enable pests to thrive and make higher damages due to altered bionomy but also increased susceptibility of host plants. Wireworms are most devastating soil-dwelling pests of a number of crop species, and according to the predictions, they are likely to become a bigger problem under the conditions of climate change. This work aimed to monitor the occurrence and activity of wireworms in sunflower, depending on the environmental conditions, precipitation patterns in particular, and plant growth stage. Wireworm presence was monitored in a three-year period, 2018, 2019 and 2021, on an untreated sunflower field. Wireworm presence and activity was deduced based on damaged plants (%), field emergence (%) and plant density (number of plants per 10 m out of 40 sown seeds), observed at two phenophases (one and three to four pair of leaves). These traits were correlated with precipitation amounts in period April-June and average daily temperatures. High precipitation in May 2019 (147.6 L) evidently affected feeding activity of wireworms, since the percentage of damaged plants was the lowest (0-0.7%) in this year. The opposite was recorded in years with average precipitation levels in May 2018 and 2021 (63-64.2 L) when the damages ranged from 2.69 to 16.5%. However, field emergence and plant density of sunflower did not differ significantly depending on the amount of precipitation in this period. Weather patterns in June did not affect wireworm feeding since sunflower exited sensitive phenophase. Given results confirm sunflower plasticity to a variety of water conditions, and also wireworm sensitivity to high water content in the soil during feeding period.

Key words: climate, soil-dwelling pests, sunflower, damages

O1_17

CBCVd viroid threat to European hop production

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Abstract

In 2007, hop farmers in the Savinja Valley in Slovenia reported the appearance of stunted yellowish hop plants. In the following years, this phenomenon spread rapidly in hop gardens suggesting mechanical means and planting material between farms. Classical diagnostic methods and molecular testing techniques were unable to detect a new pathogen. Therefore, NGS of total RNA and small RNAs from healthy plants and those with symptoms was used to identify the new pathogen. Bioinformatic analysis resulting in the identification of a new sequence of Citrus bark cracking viroid (CBCVd) in the stunted hop plants, which has never been reported before in hops. In addition, a controlled transmission experiment confirmed CBCVd as the causal agent of severe hop stunt disease. The new viroid challenged European hop producers and authorities to prevent its spread and eradicate infected plants, as well as to develop a rapid and reliable method for its detection. A reliable one-step multiplex method RT-PCR (mRT-PCR) was developed to simultaneously detect the four known viroids infecting hops. On the other hand, the discovery of new viroid with severe symptoms represents an interesting model to study the pathogenesis and hop-viroid interactions. To investigate the possible gene silencing in viroid-infected plants by viroid-derived small RNAs, in silico prediction of target transcripts for viroid-derived small RNAs was performed. The prediction models revealed that many hop transcripts have nucleotide homologies viroid-derived small RNAs and therefore could be silenced by RNA interference. Analysis of the response of hop microRNA genes to CBCVd infection was initiated. More than a hundred miRNA genes were identified from the hop genome. Some of them were differentially expressed

in response to CBCVd infection, demonstrating the importance of miRNAs in the innate immune response of hop plants. The presented efforts to identify and better understand the molecular mechanisms of viroid disease could initiate new strategies for prevention and help in the search for possible genetic resistance.

Key words: Citrus bark cracking viroid, Stunted hop plants, Small RNAs, Target transcripts

O1_18

Cytosine methylation in genomic DNA and identification of DNA methylases and demethylases in viroid-infected hop plants (*Humulus lupulus* var. 'Celeia')

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Abstract

Abiotic and biotic stresses can lead to changes in host DNA methylation, which in plants is mediated by an RNA-directed DNA methylation (RdDM) mechanism. Infections with viroids, the smallest known RNA pathogens without coding potential, have been shown to affect DNA methylation dynamics in different plant hosts. The objective of our research was to determine the cytosine methylation level (5-mC) in the genomic DNA of hop plant (*Humulus lupulus* L. var. 'Celeia') infected with different viroids and their combinations. The adapted HPLC method used proved to be suitable for this purpose, and thus we were able to estimate for the first time that the level of cytosine methylation in viroid-free hop plants was 26.7%. Interestingly, the observed level of cytosine methylation was lowest in hop plants infected with *Citrus bark cracking viroid* (CBCVd), *Hop latent viroid* (HLVd), and *Hop stunt viroid* (HSVd) (24.3%), whereas the highest level was observed in plants infected with HLVd only (31.4%). Infection of hop plants with HLVd only resulted in significantly higher cytosine methylation levels, indicating that only this viroid affects the cytosine methylation level of the hop genome. In contrast, no significant change in hop genome methylation level was observed in plants infected with CBCVd and another viroid combination. In addition, we used RNA-seq experiment to identify and analyze the expression of putative genes for hop DNA methylases and demethylases. This part of the research is ongoing, although preliminary results show that some of the identified genes involved in de-/me-thylation patterns are differentially expressed in viroid-infected plants ($p < 0.05$), further strengthening the

evidence for interaction of viroids with host factors involved in RdDM. Overall, part of our results supports the notion that viroids interact with RdDM to induce changes in host cytosine methylation levels.

Key words: DNA methylation; viroid; hop plant; HPLC; transcriptome

Session 2: HORTICULTURE

Poster Presentations

P2_01

Variability of chloroplasts and targeted nuclear DNA of grapevine (*Vitis* sp.)

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Abstract

NGS has dramatically expanded the capabilities for identification of allelic variation that could be in downstream application used for genotyping by multiplexing and streamlining DNA sequencing workflows. Based on gene-specific target enrichment protocol in the present project we designed probes to capture information of important sites in the grapevine nuclear genome: 2271 SNP loci; 943 sites of sex locus on Chr. 2, 96 GAl1 loci linked to berry traits and phenology, 51 loci linked to resistance, 59 random loci, 312 MYB

loci linked to colour and 47 TFL1 loci linked to flowering and phenology. For each polymorphic site, a 120-mer probe was designed with the expected variant in the central position. The panel was developed to genotype most of the diversity in grapevines from Balkan region (370 *Vitis vinifera* genotypes; 124 from Slovenia, 28 from Serbia, 76 from Croatia, 16 from Montenegro, 55 from BIH, 6 from Macedonia, 26 from Greece, 39 from Albania) and 23 *V. vinifera* references from France and 27 *Vitis* sp. species. The data obtained will enable to determine precise calling of variants for evaluation of Balkan grapevines: their true-to-typness, important traits and kinships in the grapevine genepool. For the same set of samples, we also employed whole-genome shotgun sequencing to target DNA variation in the chloroplasts and performed their sequence alignment and phylogenetic analyses. Analyses were performed on inter- and intra-specific levels with aims to improve earlier phylogeny works that were limited in taxonomic scope or marker choice (Peros et al 2011, Wan et al 2013, Trondle et al 2010, Lozsa et al 2015) and to improve the parentship analysis particularly of Balkans grape cultivars (Stajner et al 2015) using maternally inherited chloroplast variation. Using low coverage DNA-seq we were able to sequence a grapevine genome at average 0.17 coverage while chloroplast genome reached up to 60x coverage, which was high enough to call reliable SNPs positions.

Key words: variability, chloroplast, targeted nuclear DNA, grapevines

P2_02

Specifics of wine-growing locality and their impact on the grape and wine quality of black grapevine varieties

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Abstract

The production of quality grapes and wine depends on relationship of various factors such as: locality, variety and applied agro and ampelotechnical measures. The aim of this study was to examine some of the most important parameters of grape and wine quality in black wine varieties Blatina, Merlot and Cabernet Sauvignon in agroecological conditions of Trebinje wine-growinh locality. The specifics of Trebinje locality are defined through the calculation of some for this study area important bioclimatic indices, as well as the analysis of meteorological conditions in the study year (2020) in relation to two twenty-year periods from the past (1971-1990 and 2000-2019). Based on analysis of obtained data, differences between multi-year periods and examined year were observed. The Winkler index (WI) showed a change from WIN III region (zone) to WIN V region (zone), while Huglin (HI) index from HI+1 moved to HI+2 region (class). Locality of Trebinje is characterized by moderate nights (CI-1), in relation to cold nights (CI+1) which were characteristic for first multi-year period. The number of days with high temperatures (NTX35) in first multiannual period (2) was significantly lower compared to study year (7) and the second multiannual period (13.7). The difference between examined varieties was observed in all characteristics of berry. The lowest content of sugar, total acids and pH in the must (20.9%; 4.95 g/l; 3.08) was found in the grapes of Blatina variety, while the highest values of the examined grape quality parameters (25.5%; 5.20 g/l; 3.90) were determined in the grapes of Cabernet Sauvignon variety. Produced wines had appropriate characteristics with variety specifics. The alcohol content in wines ranged from 12.1 vol% (Blatina), 13.9 vol% (Merlot) to 14.6 vol% (Cabernet Sauvignon). Quality of grapes and wines of examined varieties was result of biological features of each variety as well as of the specific characteristics of Trebinje grape growing locality.

Key words: grapevine, variety, locality, bioclimatic indices, grape and wine quality

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P2_03

Technological characteristics of Cabernet Sauvignon cv clones grown in conditions of Krnjevo vine area

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Abstract

Research was performed during 2020 and 2021 in vineyard of "Radovanović" winery, Serbia, GPS coordinates N 44º 25' 47" and E 21º 02' 14". The aim of the research is to determine technological characteristics of superior clones of Cabernet Sauvignon 169, 191 and 412 in grass inter-row covered vineyard. In the inter-row space grass cover was established from a mixture of two grasses (red fescue 60% and perennial ryegrass 30%) and a legume (white clover 10%). The most important grapes and berries structural indicators, sugar and total acids content, pH and glycoacidometric index in must were determined. During the two-year examination by mechanical composition of grapes and berries, clone 191 was favorable, followed by clone 169 and finally clone 412. Sugar content in must varied from 21.8–27.%, acid content from 6.3-7.9 g/ and pH 2.55-3.13.

Key words: Cabernet Sauvignon, clone, grass cover, structural indicators, grape quality

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P2_04

Influence of temperature on grape quality parameters of Cabernet Sauvignon grapevine variety

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Abstract

Meteorological characteristics of locality have a significant impact on ripening dynamics and quality of grapes. The content and concentration of phenolic substances, sugars and total acids in the berry, apart from the variety and the applied viticultural practice, also depend on the temperature conditions during the ripening period. The aim of this study was to examine meteorological factors and their influence on the grape quality of Cabernet Sauvignon variety within consecutive two production years (2020-2021) at agroecological conditions of Grocka wine-growing sub-region. In addition to data from meteorological station for analysis of meteorological and observation of microclimatic conditions in the years of testing, data loggers were placed within the bunch zone and also used in the experimental vineyard. Grape quality parameters that were analyzed for the examined variety are the following: characteristics of berry, content of sugar, total acids and pH of the must, content of total phenols and anthocyanins in the skin. Air temperatures had different effects on grape quality measured during the period of 32 days before full grape ripeness. High temperatures (>30^{o}C) inhibit the accumulation of phenolic substances, and increase the sugar content in the must. A negative correlation was found between the content of total phenols in the berry skin and the sum of maximum air temperatures higher than 30^{o}C (SUMTx>30^{o}C) which was R=-0.51, while a strong positive correlation (R=0.77) was found for the sugar content in the must. Sums of minimum daily air temperatures (SUMTn) showed a negative correlation with the content of total anthocyanins and phenols in the skin of the berry (R=-0.88; R=-0.79), while a high positive correlation was found for the content of total acids in the must (R=0.80). It can be concluded that vineyard microclimatic conditions are significant factor in the process of production of grapes intended for making red wines, in this case in particular to the Cabernet Sauvignon grape variety.

Key words: meteorological factors, microclimate, grape, quality

Acknowledgements: The paper is the result of PROMIS project: "Integrated Agro-Meteorological Prediction System" (IAPS), grant no 6062629, funded by Science Fund of the Republic of Serbia.

P2_05

Characteristics of table grape varieties Matilde and Victoria in agroecological conditions of Mostar

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Abstract

Market demands for the highest quality grapes have imposed the need to create new varieties. The production of table grapes in Bosnia and Herzegovina has no major economic significance and is mainly realized in the territory of Herzegovina. The paper analyzes the basic characteristics of the introduced table varieties Matilda and Victoria during the two-year period (2019-2020). Field research was performed in the production plantation of the company "Jaffa Komerc" located in Mostar. Regular agro- and ampelotechnical measures are maintained in the orchard. During the experiment, the basic elements of fertility were monitored to obtain an answer about the indicators of the examined varieties. In the vineyard were determined: % developed shoots / grape vine, % fertile shoots / grape vine, number of clusters per shoot and number of clusters per fertile shoot. The analysis of clusters was performed in the Laboratory for Ampelography and Winemaking of the Faculty of Agriculture. Bunch weight (g), number of berries in the bunch, berry weight (g), berry length (mm), berry width (mm), sugar content (ºBrix) and titratable acidity (g/l tartaric acid) were determined. During the research period, the Matilde had a significantly higher mass of grapes (585.06 g - 2019; 464.77 g - 2020) compared to the Victoria (266.44 g - 2019; 252.95 g - 2020). The sugar content during the research period was higher in 2019, for both tested cultivars and ranged from 14.69 (ºBrix) in the Victoria, to 16.60 ((Brix) in the Matilde. During a two-year study, slightly better results in the observed characteristics were observed in the Matilde variety.

Key words: fertility elements, table varieties, grape quality

P2_06

Infestation rate of *Phyllocnistis vitegenella* Clemens in commercial vineyard in Neštin

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Abstract

Phyllocnistis vitegenella Clemens (Lepidoptera: Gracillariidae) is a leafminer of grapevine which was recorded during 2019 in Serbia for the first time. While feeding, larvae form serpentine-like mines on leaves. This leads to the reduction of assimilation surface, especially when the infestation level is high. Since this is a newly introduced pest, the aim of this study was to determine its infestation rate in a commercial vineyard throughout the vegetation season. The research was conducted during 2020 in a commercial vineyard, Italian Riesling variety, in Neštin area (northwest Serbia). Sampling was done once a month starting from May to October (16.05., 14.06., 11.07., 13.08., 14.09., 02.10.) by collecting 5 leaves from 20 randomly chosen vines (100 leaves per sample) from a 1 ha area. Collected leaves were transported to the laboratory for examination and rearing of larvae for the determination of species. The infestation rate was calculated according to Shareef et al. (2016). In this vineyard, as regular measure for the control of other grapevine pests, a total of seven insecticide applications were performed with 14 days interval, starting from the second decade of May to the second decade of July. Four applications were carried out with a product based on deltamethrin (10g a.i. ha-1) and three with chlorantraniliprole (36g a.i. ha-1). During this research, there were no mines detected in May, June, and July. First mines were recorded in August and infestation rate was 47%. Similar infestation rate (45%) was registered during September. The highest infestation rate (87%) was registered in October. The occurrence of mines on the leaves only after cessation of the application of insecticides in the vineyard as well as the increase of infestation rate towards the end of vegetation indicates that the applied insecticides have a negative impact on the population of *P. vitegenella*.

Key words: leafminer, infestation rate, grapevine

Acknowledgments: This research was funded by grants 451-03-68/2022-14/200116 of Ministry of education, Science and Technological Development, Republic of Serbia.

P2_07

Extraction kinetics of phenolic acids during prolonged maceration time and vinification of Cabernet Sauvignon grape variety

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Abstract

Effects of maceration time on the phenolic acids content in red wine grape variety Cabernet Sauvignon (*Vitis vinifera L.*) was investigated in this study. In focus of this study were four derivates of hydroxybenzoic and hydroxycinnamic acids: gallic, syringic, caffeic and *p*-coumaric acids extracted into wine during five different maceration periods and using two different yeasts (FX10 and Qa23). The control wine was made according to technology of white wine, exactly separated must and solids immediately after crushing and destemming. Concentrations of these compounds were measured using UPLC-MS system (Agilent LCTQ 6495C Triple Quadrupole). The most abundant phenolic acid in wines fermented with yeast FX10, was *p*- coumaric acid and its maximal value was on 12th day of maceration. The highest extracted values during fermentation with Qa23 were obtained for syringic acid with maximal value at 12th day of maceration. Gallic and caffeic acids values also showed exponential increase during maceration but its extracted values were lower. A statistically significant difference was found comparing content of tested phenolic compounds in control wine and wines obtained after maceration for 3, 5, 7, 14 and 21 days using FX10 yeast strain ($p < 0,05$). Maceration which lasted 5, 7 and 21 days using Qa23 yeast strain also showed a statistically significant difference than control wine in term of phenolic acids concentrations ($p < 0,05$).

Key words: extraction, maceration time, phenolic acids, yeast strain

P2_08

Agro-morphological characterization of pepper (*Capsicum annuum* L.) accessions from Gene Bank of Republic of Srpska

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Abstract

Through the Program for conservation of plant genetic resources in the Republic of Srpska, peppers germplasm was inventoried, collected and deposited in the Gene Bank of Republic of Srpska. The aim of this research was to determine differences in agro-morphological characteristics between 16 pepper accessions from the Gene Bank of Republic of Srpska. Characterization was carried out according to IPGRI (The International Plant Genetic Resources Institute) descriptors for Capsicum on 10 plants per accession. A total of 38 characteristics were monitored: 15 quantitative and 23 qualitative characteristics. The results show polymorphism was present in 94.74% of characteristics. All quantitative characteristics and 21 qualitative characteristics were polymorphic, while only two qualitative characteristics were monomorphic (no differences between accessions). A highly significant difference ($p<0.01$) was found in all quantitative characteristics. All pepper accessions had days to flowering in the range 33 to 58 and days to fruiting in the range 75 to 129. Fruit weight ranged from 1.9 to 95.97 g. Plant height was 25 – 45 cm in seven accessions, 46 – 65 cm in six accessions, 66 – 85 cm in one accession and over 85 cm in two accessions. The results showed that observed pepper accessions possess high agro-morphological diversity. The next part of the research should be characterization on the molecular level.

Key words: pepper, germplasm, IPGRI descriptors, diversity

P2_09

Assessment of molecular diversity of *Brassica oleracea* var. *acephala*

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Abstract

Family Brassicaceae is abundant in species used in food production, but also contains many industrial species, vegetables and ornamentals. Green collard (*Brassica oleracea* var. *acephala* L.) was traditionally grown in Balkan Peninsula and its wide green leaves, rich in vitamins A and C, are used for cooking. There is great diversity in *B. oleracea acephala* germplasm that reflects on agronomic, morphological and molecular characteristics. In this study, was assessed genetic variation of 38 accessions of green collard out of which 3 accessions were standard/commercial varieties and 35 were locally grown populations, collected in Western Balkan: 18 from Bosnia and Herzegovina, 8 from Serbia (Vojvodina), 7 from Croatia and two from Montenegro. Genetic diversity was assessed using twelve species-specific SSR markers (Simple Sequence Repeats) originating from *B. oleracea* (8), *B. rapa* (2) and *B. napus* (2). Each accession was represented with four individual samples. The results revealed high level of overall genetic diversity between/within accessions and commercial varieties (He>0.81) due to highly polymorphic SSR markers (PIC>0.86) applied for allele genotyping. Apart from molecular characterization of collection, future activities will be directed to biochemical analysis of leaves. Planned field trials will focus on producing seed that can be used for further breeding.

Key words: green collard, genetic diversity, SSR, genotyping

Acknowledgements: Bilateral projects “Characterisation of leafy kale genetic resources (Brassica oleracea var. acephala L.) for their preservation and sustainable use” (BiH: BI-BA/21-23-011; 19.032/966-14/20) and “Evaluation for the reintroduction of forgotten and neglected crops of Brassica sp. in Lathyrus sp.” (Serbia: BI-RS/20-21-015; 337-00-21/2020-09/14) including Research Program Agrobiodiversity P4 0072 financially supported by Slovenian Research Agency. • ECPGR project EUBRASWILD (First Call – Phase X (2019-2023))

P2_10

Nutraceutical and multi-element profile of elephant garlic (*Allium ampeloprasum* L.) and common garlic (*Allium sativus* L.) from Slovenia

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Abstract

Bulbous *Allium* spp. such as "big-headed" elephant garlic (*Allium ampeloprasum* L.) and common garlic (*Allium sativus* L.) contain a wide range of bioactive compounds with health-promoting properties and are most commonly used as food seasonings. The objective of the present study was to verify if there is a difference in selected nutraceuticals (dry matter, TPC, allicin) and elemental profiles (macro-, micro-elements) of the two *Allium* species produced in two growing seasons in Jablje, Slovenia (sub-Alpine region). The total phenolic content (TPC) was determined spectrophotometrically, the organosulfur compound allicin was determined by HPLC analysis and the multi-element profiles by inductively coupled plasma-mass spectrometry (ICP-MS). The results showed that elephant garlic bulbs had slightly lower TPC and about six times less allicin, the major organosulfur compound. The content of macro- (Mg, P, S, K, Ca) and micro-elements (Cr, Mn, Fe, Co, Cu, Zn, Mo) varied considerably among the *Allium* samples studied. The greatest differences between bulbs of elephant garlic and common garlic were observed for P, Ca, S, and Fe. Our results confirm the different nutritional characteristics of the bulbs and cloves of the two *Allium* species.

Key words: allicin; *Allium* spp.; ICP-MS; macro-elements; total phenolic content

P2_11

Heredity mode of duration of vegetative stage in onion (*Allium cepa* L.)

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Abstract

The duration of the vegetation period is a very important biological property of onion. In order to determine the ways of inheriting the duration of the vegetation period, the method of full diallel without reciprocals was applied, in order to obtain offspring of F1 and F2 generation. The field experiment with parents and hybrids of F1 and F2 generation was set up according to a random block system with five repetitions at the Institute for Vegetable Crops, Smederevska Palanka.

The mode of inheritance of early maturity in this experiment was superdominance, observing all crossing combinations. The best general combiner in both generations was the AC 101 line. The highest significant value for SCA in both the F_1 and F_2 generations had the hybrid created by crossing Piroška x AC 101.

Key words: onion, inheritance, vegetation period

P2_12

Morpho-physiological characteristics of ramson (*Allium ursinum* L.)

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Abstract

Ramson (*Allium ursinum* L.) is a wild growing plant that grows in forests and next to the streams. It has a specific aroma and taste resembling garlic. The aim of this study was to find the most representative ramsons populations at their natural habitat in parts of the territory of the Republic of Srpska and to estimate and compare their morphological and some of most important physiological characteristics of the leaves which are total antioxidant capacity, phenols and flavonoids. Plants were collected from five different locations in the Republic of Srpska with different altitudes: Laktaši, Kozara, Prnjavor, Kneževo and Drinić. Morphological measurments showed that the most representative samples of ramson. Physiological measuments showed that the Laktaši population of ramson showed antioxidative capacity of 0.153 µmol $Fe^{2+}g^{-1}$ DW, average phenols per plant 20.147 mg g^{-1} and measurement of 7.557 mg g^{-1} of flavonoids per plant.

Key words: ramson, morphology, total antioxidant capacity, phenols, flavonoids

P2_13

The content of metals and metalloids in bulbs of different genotypes of *Allium* species

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Abstract

In this research, we examined the effect of 15 genotypes of selected *Allium* species: *A. sativum* L. (10 genotypes), *A. ampeloprasum* L. var. *ampeloprasum* (3) and *A. cepa* L. (2), on the content of metals and metalloids in bulbs. Determination of the content of elements was performed using the method of atomic absorption spectroscopy and ICP-OES method (mg/kg of dry matter). This research found that all tested genotypes differed statistically significantly in the content of Na, K, Ca and Mg both from each other and within the species. The highest content of Na, K, Ca and Mg was established in *A. sativum*, while the lowest content were observed in onion (*A. cepa*). Genotypes of *A. ampeloprasum* var. *ampeloprasum* contained moderate amounts of Na, K, Ca and Mg. The content of certain metals was the same in all genotypes of the tested *Allium* species and was < 0.01 mg/kg (Hg) and < 0.5 mg/kg (Hg, Co, Ni and Mo). The species *A. ampeloprasum* var. *ampeloprasum* showed the highest affinity for Cd accumulation in bulbs, followed by *A. sativum* and *A. cepa*. According to the content of Fe and Zn, *Ljubičasti sredbrenjak* as onion variety, it stood out in relation to all genotypes of tested *Allium* species. The highest content of Cd, Mn and Se was noticed in genotypes of *A. ampeloprasum* var. *ampeloprasum*. The presence of potentially toxic elements (Pb, Hg, As) was also determined in the bulbs of tested species, but in the safe levels. Considering the fact that species of the genus *Allium* show the ability to accumulate elements that are important for human health, especially Fe, Zn and Se, future research should be directed to enriching popular species from this genus with these elements by applying simple and cost effective agrotechnical measures, such as biofortification.

Key words: Allium species, genotypes, metals, metalloids

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P2_14

Influence of lettuce cultivar on morphological properties and yield

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Abstract

Lettuce, or *Lactuca sativa* L.*,* is a leafy vegetable from Asteraceae family, that has great nutritional value and it is beneficial for human health. Leaves of this annual plant are great source of fiber in addition to bioactive compounds and are mostly consumed fresh, whereas in some cultures stems are also being prepared as meals. Cultivars of this cool-seasoned vegetable differ by the leaf number, color, size, shape and edges, stem and rosette development, etc. In this study, five lettuce cultivars were analyzed in order to inspect their impact on morphological properties and yield: *Aleppo* (type Lollo Bionda), *Carmesi* (Lollo Rosso), *Murai* (Red Oak leaf), *Kiribati* (Green Oak leaf) and *Tourbillon* (Crystal). The experiment was conducted in plastic greenhouse, using the method of randomized block design, where each of four repetitions consisted of eight plants. The analyzed traits were: number of leaves, fresh leaves weight, stem weight, diameter and height of plants, rosette diameter and height, whole plant weight. Statistical analyses pointed out significant differences for each examined morphological aspect. The largest diameter of the rosette was measured in cultivar *Crystal* (26.6 cm), as well as the diameter (25.9 mm), weight (7.3 g) and the height of the stem (44.6 mm). Further, cultivar *Green Oak leaf* was formed the largest number of leaves (39.7) in addition to greatest fresh leaves weight (343.5 g) and whole plant weight (347.0 g). Cultivar *Lollo Rosso* was achieved the highest rosette (18.5 cm) among others, whereas the lowest values in all parameters were obtained from *Red Oak leaf* cultivar.

Key words: cultivars, *Lactuca sativa,* lettuce, morphology, yield

P2_15

Effects of continuous fertilization on the tomato seedling quality

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Abstract

Intensive vegetable production in greenhouses begins with the production of seedlings. It is a very demanding and responsible job that requires appropriate equipment, materials and knowledge. The aim of this study was to examine the possibility of improving the quality of tomato seedlings by applying continuous fertilization with organo-mineral nutrients with low content of nutrients (Fitofert humistart). Tomatoes were sown in containers from where the plants in the phase of the first true leaf were transplanted into pots with a volume of 0.4 liters. After dipping, the plants were watered until the end of the seedling period, if necessary, with a nutrient solution of the mentioned nutrient in concentrations from 0.1 to 1%. The experiment was conducted in controlled conditions (greenhouse), and the plants were grown in commercial peat mix. The experiment lasted 57 days. At the end of the seedling period, the following plant parameters were determined, based on which the quality of the obtained seedlings was defined: plant height (cm), number of leaves, tree diameter (mm), leaf mass (g) and whole plant mass (g). On average, for all treatments, tomato seedlings had a height of 25 cm and a whole plant weight of 9.8 g. These plants had an average of 7.3 leaves and a tree thickness of 2.8 mm.
Continuous feeding had a positive impact on the quality of tomato seedlings. The best results were shown by the combination in which the seedlings were fed with a nutrient concentration of 0.3%, where the tomato seedling plants had a height of 28.5 cm, a weight of 12.6 g and were with 7.9 leaves. Differences from other treatments and controls (pure water) were statistically significant. Continuous fertilization of tomato seedlings with nutrient concentrations of 0.3% gives the best results.

Key words: tomato, seedling, continuous fertilization, seedling quality

P2_16

Influence of shading net on chlorophyll content, relative water content and weight of lettuce

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Abstract

The aim of this research was to determine the influence of light intensity on the growth and development of lettuce (*Lactuca sativa* L.), through changes in morphological and physiological parameters using a shading net with 50% density in autumn production. Cultivar Zeralda F1 is a type of butter lettuce that was used for late autumn production. Since the autumns have been warm for the last few years due to global warming, the use of shading net with 50% density in production of lettuce in greenhouse was tested. Chlorophyll content, relative water content (RWC) and weight of lettuce head were examined. The SPAD value of chlorophyll content and weight of lettuce head were shown to perform better in the shade net variant compared to non-shaded lettuce plants.

Key words: lettuce, shading net, chlorophyll content, RWC, weight

P2_17

Detection of soft rot bacteria causing potato blackleg and tuber soft rot

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Abstract

Detection of soft rot bacteria causing potato blackleg and tuber soft rot During August and September 2021 wilt of the growing potato plant Liseta varieties and soft rot of tubers were observed in potato field in Mokro polje, Trebinje, Bosnia and Herzegovina. Symptomatic tubers with soft rot symptoms were collected. The disease caused severe economic losses ranging from 20% to 60% on tubers in the field. Affected tubers had symptoms that ranged from light vascular discoloration to complete seed piece decay. Infected tuber tissue was often cream colored and soft to the touch. In the field, plants showed severe wilting, often with the appearance of slimy, brown necrosis of the lower stems. Isolations from diseased tubers yielded pectolytic bacteria on crystal violet pectate (CVP) medium and colonies were characterized after purification on King's B medium. Obtained isolates were gram-negative, able to degrade pectate, and rot potato slices. A bacterium with identical characteristics to those described above was reisolated from the rotted tissue of inoculated tubers. To our knowledge, this implies infection caused by *Dickeya solani*. The diseased potato plants originated from Netherland where the presence of the bacteria have been reported. Intense raining during May and top watering during the growing season have led to favorable conditions for the development of disease. B&H imports seed from various countries because of the current seed shortage and exports table potatoes to other states. In this regard, this finding has implications for the mentioned import of potato materials in B&H. Further work should be done on biochemical and molecular study of the soft rot bacteria.

Key words: soft rot, blackleg, potato, import

P2_18

Adaptability of indigenous vegetation on parking lots. Case study: tree alleys in Novi Sad, Serbia

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Abstract

Urban stress due to urbanization and climate change affects biological processes, dimension and vitality of street trees, especially those located on paved surfaces such as parking lots. In this study five indigenous species located on parking lots in Novi Sad, Serbia were examined (*Acer platanoides* 'Globosum', *Celtis australis* L., *Tilia tomentosa* Moench., *Carpinus betulus* 'Fastigiata' and *Corylus colurna* L.). By valuing their dimensions and vitality, the aim of this study is to represent their adaptability to harsh environmental conditions such as impermeable surface, compaction and low soil fertility, air and soil pollution, proximity of traffic and buildings, insufficient sunlight etc. Results showed that the most adapted alley species are *Celtis australis* L. and *Carpinus betulus* 'Fastigiata'. Besides having low vitality values, other species did not form uniform alleys because they had asymmetrical canopy, uneven height and mechanical damages that were caused by the insufficient root and canopy space and insufficient distance from buildings and traffic. In order to fulfill their ecological and aesthetical role, street trees must be carefully selected. Choosing well adapted indigenous tree species to reduce climate change impacts can be very challenging. Adaptability assessment of indigenous trees on parking lots in Novi Sad can be used as guidance to future urban planning in Novi Sad and other cities which have a high share of paved surface to reduce the climate change effect.

Key words: adapted species, climate change, paved surfaces, urban dendroflora, urban stress

P2_19

Court garden in Sremski Karlovci – natural and cultural heritage of Serbia

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Abstract

The purpose of the research of „Court garden in Sremski Karlovci“ was to find out when exactly it was designed, what was the original project and architecture of Garden, to find out historical names, historical plants of Garden, and to make an inventory of dendroflora in 2022. In this paper landscape-architectural, horticultural, dendrological, natural, cultural, historical and other values of the garden protected as natural monument, were represented. Archival material from archives, museums, documentation of the Institute for Nature Conservation of Vojvodina province, of Cultural Heritage Preservation Institute, the current urban planning, cadastral maps, plans, old photographs, postcards, e sources, etc. has been investigated. The Court garden was designed in the first half of the 19th century. A 117 species and lower taxa (21 coniferous and 96 deciduous) were recorded. Based on the analysis of the current state of the garden, values, historical genesis and current needs, it is possible to propose a measures of the protection, renewal and development.

Key words: court garden, natural monument, dendroflora, historical and field analysis

P2_20

Conceptual landscape design of central pedestrian zone in Laktaši (BiH)

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Abstract

Green infrastructure has a crucial role in improving natural and created environmental conditions in urban areas. Inadequate maintenance, on top of exposure to adverse effects of urban climate, leads to accelerated degradation of urban plants. This paper presents the conceptual solution of landscape design of central pedestrian zone in Municipality of Laktaši in order to select plant elements that meet the necessary functions, reconstruct and modify existing green spaces, as well as to give an adequate proposal of other landscape elements that will enrich the content in the pedestrian zone. The objectives of the paper are met through the analysis of natural and antropogenically generated conditions of the area, the current situation in the field, planned architectural and construction interventions, as well as good practice examples from around the world. In the process of urbanization in the past twenty years, this area has been reconstructed several times and various plant and architectural elements have been added, while business and touristic function have prevailed and suppressed the ecological, aesthetic and social function of this area. The existing green spaces are elevated in relation to the surrounding area, they are unconnected and contain fragmented groups of coniferous and deciduous trees and shrubs that are in satisfactory condition, but currently do not fulfil their aesthetic function. At the location of former lawns, new green spaces were formed by retaining the existing trees and shrubs and adding new plants. The composition is complemented by carefully selected woody and herbaceous species and other spatial elements that create harmonious and aesthetically-pleasing space. This work offers a new and original conceptual solution that envisages the transformation and modernization of the central pedestrian zone in Laktaši in the spirit of sustainable development and environmental principles.

Key words: urban plants, ecological function, sustainable development

P2_21

Seed germination of *Calendula officinalis* L. under influence of different light conditions

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Abstract

The aim of this study was to examine germination rate and morphological characteristics of English marigold seedlings under influence of different light conditions. Seeds of *Calendula officinalis* L. were collected from the natural population of the Botanical garden of the University of Banja Luka. Experiment was set up in four replicates for each light treatment. Petri dishes with seeds were placed in growth chamber under artificial white (FLUO) and blue, red, and combination of blue/red (LED) light with 16h/8h photoperiod. Germination energy was tested after 7 days and germination of the seeds was tested after 14 days. Results showed significant difference in germination energy, germination rate, hypocotyl height, root length, and fresh weight. The highest average values of the germination energy and germination rate of the *Calendula officinalis* L. were recorded under red LED light (32%; 47%) while the lowest values were recorded under blue LED light (1%; 23%). The highest average values of hypocotyl height, root length and fresh weight were recorded also under red LED light (3,70 cm; 6,33 cm; 0,97 g) while the lowest values were recorded under combination of blue/red LED light (1,95 cm; 2,52 cm; 0,28 g). It can be concluded that the use of red LED light is recommended in the seed germination phase, not only for better germination but also for better morphological development.

Key words: germination, *Calendula officinalis* L., morphological parameters, LED light

P2_22

The influence of organic biostimulators on the growth and development of medicinal and aromatic plant species *Ocimum basilicum* L. and *Levisticum officinale* L.

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Abstract

Ocimum basilicum L. and *Levisticum officinale* L. are well known medicinal, aromatic and spicy herbs with remarkable application in cooking and medicine. In an attempt to improve their potted production and increase the yield of aboveground biomass, a vegetation experiment was conducted in the experimental field of the Institute for Medicinal Plants Research "Dr Josif Pančić" Belgrade, Serbia. Therefore, the aim of this study was to determine the effect of organic biostimulators on germination, growth and productivity of *O. basilicum* and *L. officinale* in potted production, conducted under semi-controlled conditions. Following treatments of seeds were applied: organic biostimulators Ecobooster 1 (in concentrations 10%, 30% and 50%) and Slavol S (in concentration 10%, according to manufacturer's recommendations), and control treatment (without biostimulators). A significantly higher number of seedlings was achieved in the treatments with biostimulators compared to control. The best effect on germination of *O. basilicum* and *L. officinale* seeds was achieved with Slavol S (91.3% and 72.5%, respectively) and Ecobooster 1 – conc. 50% (83.4% and 61.3%, respectively). The best effect on height of O. basilicum and L. officinale plants were achieved with Slavol S (26.2 cm; 14.4 cm, respectively) and Ecobooster 1 – conc. 30% (20.0 cm and 17.1 cm, respectively) and Ecobooster 1 – conc. 50% (21.7 cm; 19.4 cm, respectively), while the best effect on number of brunches showed Slavol S (2.3 and 5.1, respectively) Ecobooster 1 – conc. 10% (4.2 and 4.7, respectively) and Ecobooster 1 – conc. 30% (4.1 and 5.2, respectively). The best effect on the aboveground plant mass showed Ecobooster 1 – conc. 10% (5.03 and 1.74, g of absolute dry mass). The obtained results confirmed that both organic biostimulators positively influence the observed morphological parameters in both plant species, particularly in the earlies phases of their development.

Key words: basil; lovage; Ecobooster 1; Slavol S

P2_23

Chemical characterization and ACE-inhibitory activity of acetone extract of *Geranium robertianum* L. flower

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Abstract

Geranium robertianum L. (Geraniaceae) has been traditionally used to treat a range of ailments, including high blood pressure Recent in vitro studies have shown that some traditional usages, such as antimicrobials, were scientifically confirmed. Although the phytoconstituents of this plant species have been extensively studied, some plant parts used in traditional medicine, such as flowers, have not yet been chemically characterized. Given that the inhibition of the angiotensin converting enzyme (ACE) is one of the most significant mechanisms for decreasing blood pressure, we undertook this investigation to find scientific support for G. robertianum anti-hypertensive traditional use. Acetone was used to extract plant material since prior research revealed that it had the highest total phenol and total flavonoid levels, which are considered to be the primary sources of bioactive chemicals. The chemical composition of *G. robertianum* collected in R. Srpska was determined using the LC MS method, and the ACE inhibitory activity of acetone extract was measured through the enzymatically cleaved 3-hydroxybutyric acid from 3-hydryoxybutyryl-gly-gly-gly. Geraniin, a hydrolysable tannin with a Mr of 952.6, was the most abundant single chemical found in the extract. Derivatives of galic and ellagic acids, as well as flavonoids like kaempferol and quercetine, a were also present in significant amounts. *G. robertianum* acetonic floral extract has been shown to be an effective natural ACE inhibitor with an IC50 of 22.14 μg/mL. To the best of our knowledge, this is the first report on the chemical composition of *G. robertianum* floral acetonic extract and its ACE inhibitory activity.

Key words: Geranium robertianum L., flower acetone extract, LC-MS, ACE inhibitory activity

P2_24

Health and safety risk analysis of *Platanus* x *acerifolia* (Aiton) Willd. by the method of acoustic tomography

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Abstract

The paper presents the results of tomographic measurements of 80 London Plane trees (*Platanus* x *acerifolia* (Aiton) Willd.) in the protected area „University City". The park architecture monument „University City", is a category VI protected area located in Banja Luka, and it is a university campus. The subject of the analysis of health condition and safety risk are valuable trees, formed as a two-row alley, over 100 years old – protected as Monuments of nature. The aim of the research is to assess the health condition and safety risk of London Plane trees in the protected area "University City" by determining their internal condition based on acoustic tomography. The examination of trees was performed by the ARBOTOM 5 series tree tomography instrument (ARBOTOM® Version 5, Rinntech, Germany). Tomography has been confirmed as a method for detecting internal decay of wood, the location where changes occur, and identifying their shape, size and characteristics that affect the mechanical properties of wood (Nicolotti et al., 2003). Tomographic measurements were performed at height of 30-40 cm, at the base of the tree. Based on the collected data, a graphical presentation of the measurement results (tomogram) was obtained, which shows differently colored cross-sectional zones depending on the degree of wood decay. Acustic tomographic images confirmed the presence of internal defects at 79 individuals, i.e. 67 trees had 0.65-30%, 11 trees had 31-60% and 1 tree had 69.12% damaged wood across measured cross-section. The obtained results serve as a basis for selecting the best sanation measures for the investigated trees in order to reduce the safety risks. The proposed measures include pruning of trees, control of diseases and pests, and tree removal.

Key words: risk assesment, tomogram, sanation measures

P2_25

Geometric morphometrics application in horticulture: a case study of *Rhododendron* leaves

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Abstract

Geometric morphometrics is often used method to distinguish species, varieties and populations of plants on the basis of shape information. However, it is mostly used in fundamental biological research, especially in taxonomic studies, while in other areas it has not been fully exploited. Here, we investigated the potential use of geometric morphometrics methods in horticulture using Rhododendron cultivars as an example. This study aimed to investigate whether the leaf shape differs among different cultivars of *Rhododendron*. We sampled 100 leaves from five *Rhododendron* cultivars ('Geisha Purple', 'Geisha Orange', 'Geisha Red', 'Kermesina Roze', 'Konigstein') cultivated under the same conditions (commercial greenhouse Topalović, Lipolist, Serbia), and on each leaf recorded 8 landmarks. Generalized Procrustes analysis (GPA), Procrustes ANOVA and principal component analysis (PCA) were performed in order to reveal the differences in leaf shape. Additionally, elliptical Fourier analysis (EFA) was performed to generate the mean leaf outline for each cultivar. Although a certain extent of overlap was observed, the results showed a tendency of separation between the analyzed groups, with different patterns of leaf shape variation, suggesting geometric morphometrics can be a useful tool for discrimination of *Rhododendron* cultivars. More research is needed on greater sample size and greater number of cultivars to fully recognize to which extent leaf shape represents the discriminant trait in *Rhododendron* and whether it can be used in cultivar identification.

Key words: geometric morphometrics, *Rhododendron*, leaf shape, leaf morphometrics, horticulture

P2_26

Flowering of autochthonous apples in the conditions of Banja Luka

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Abstract

Autochthonous fruit germplasm contributes significantly to the global agrobiodiversity. Fruit genetic resources collected from in situ conditions are maintained in ex situ collections for conservation and further use, both for direct use and for fruit selection and breeding programs. One of the selection's directions is the selection of genotypes of later flowering, which is especially important today due to evident climate changes. This paper presents data on the flowering of 167 apple accessions in 2021 in the Botanical Garden field collection in Banja Luka. The phenophase of the beginning of the opening of generative buds ('silver tips') started on February 20 ('Zveka') and lasted for most accessions until March 10, and for some accessions until the end of March. The beginning of flowering in most accessions is noticed from April 1, and in most accessions it ends between April 11 and 19. The phenophase of the beginning of flowering lasted on average about 10 days, and the longest duration was in the accessions 'Senabija', 'Ljepocvjetka', 'Batulenka', 'Zećuša', 'Cvjetača' and 'Slatka zelenika', on average 15-20 days. Full flowering in most accessions begins between April 5 and 12, and in two accessions begins earlier, on April 2 ('Zveka' and 'Šarenika'). This phenophase lasted about a month. In 2021, there was no fruit set in all accessions due to the appearance of frost in the phenophase of full flowering. Fruit set in most accessions was noticed on May 4, but the first one was observed on April 27 in the 'Šarunija' and 'Glavača'. Fruit set was recorded in 77 accessions in total. The obtained data showed very pronounced differences between autochthonous apples in the time of analyzed phenophases. For further work, the accessions of later flowering time with fruit set are shown to be interesting.

Key words: field collection, phenophases, flowering, fruit set

P2_27

In situ characterisation of Serbian autochthonous pear (*Pyrus communis* L.) genotypes

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Abstract

Pear is an important pome fruit species in the Republic of Serbia, with average production of 57,793 tonnes (2016–2020). Regardless of a wide range of new cultivars, world pear production relies on a small number of mostly old released cultivars. So far, the work at the Fruit Research Institute, Čačak (FRI) has been mainly focused on developing new pear cultivars and evaluation of *ex situ* genotypes. In recent years, the FRI work on assessing genetic variability in autochthonous pear material has been intensified. To avoid the loss and aiming to document, preserve and encourage the use of autochthonous material, seventeen genotypes corresponding to old cultivars or landraces were sampled in individual growers' orchards in central/southwestern Serbia. This study presents the results of *in situ* characterisation of main biological properties – flowering phenophase, harvest maturity, pomological properties (morphometric, chemical, organoleptic) and field resistance to causal agents of diseases (pear scab and fire blight) in the assessed genotypes. The earliest onset of flowering was recorded in 'Vodenjaja' (April 02nd) and the latest in 'Kantaruša' (April 21st). Regarding harvest maturity, the genotypes were divided into the groups from early ['Beli Mednjak' (July 23rd)] to very late ['Kantaruša' and 'Takiša' (October 05th)]. The highest fruit weight was determined in 'Kantaruša' (364.86 g), while the lowest was in 'Takiša' (20.49 g). The best fruit quality was found in 'Takiša' [soluble solids (14.85%); total sugar (10.33%)], whilst 'Kantaruša' was characterised by the highest total phenols (174.50 mg GAE/100 g FW) and free radical scavenging activity (70.97%). The highest total anthocyanins were found in 'Lubeničarka' (2.71 mg/100 g FW). All of the studied genotypes showed field resistance to fire blight and most of them to pear scab. Therefore, Serbian pear genotypes appear to carry useful traits that provide substantial potential for their use in future breeding programmes and production with reduced chemical inputs.

Key words: European pear, indigenous cultivar, landrace, fruit quality, resistance

P2_28

Floral biology and S-incompatibility research in cherries at Fruit Research Institute, Čačak – an overview

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Abstract

In addition to conventional breeding which has been resulted in release of two sweet cherry (*P. avium*) and five sour cherry (*P. cerasus*) cultivars, different aspects of reproductive biology in cherries are among the main research activities at Fruit Research Institute, Čačak (FRI). The most important results were obtained in the field of pollination and fertilization of cherries – flowering phenology, pollen quality, monitoring the pollen tube growth in vitro and in vivo (pollen tube number and growth rate through certain pistil parts, pollen-pistil interaction in the style, unusual pollen tube growth in the ovary), cytoembryology (stage of ovule development, viability of ovule and embryo sac, early embryogenesis). Investigations were also focused to specifities of cherry genotypes in their reproductive behaviour as polleniser/pollinated cultivar, and to the adequate choice of domestic and foreign cultivars' combinations that exhibit the best performance in terms of fruit set and yields. In the last decade, research work on self- and cross-(in)compatibility in sweet cherry has been considerably advanced by S-genotype identification of cultivars, landraces and hybrids using the consensus and specific primers to amplify the S-RNase alleles. Nowdays, pollen-pistil interactions have been considered in the context of temperature conditions, bearing in mind incidence of seasons with higher temperatures during the flowering in the main cherry-growing regions. Within the national CherrySeRB project whose FRI is the leading institution, characterisation of the indigenous genotype potential for desirable reproductive properties and defining 'good reproductive behaviour cherry model' that can face warmer temperature conditions during the flowering are in focus. The main idea of CherrySeRB is connection of production challenges arising from climate change and the richness of Serbian and Balkan cherry germplasm that is still unused enough, which represents a novelty in breeding approach, applicable to other fruit species.

Key words: sweet cherry, sour cherry, cultivars, S-genotyping, flowering, reproductive biology

P2_29

Morphological characterization of fruits and leaves in three blackthorn populations

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Abstract

Wild fruit species are an important component of biodiversity, as carriers of the resistance gene for diseases, pests, and abiotic factors, and as such, represent a source of desirable features when it comes to breeding of commercial varieties. Taking into account the blackthorn resistance to cold, drought, as well as to a high limestone proportion in soils, it is used to improve rootstocks or plum variety through interspecies hybridization. The aim of this study was to research the morphological characteristics of fruits and leaves in three blackthorn populations (P1-Stupna, P2-Janj, P3-Lubovo) in the municipality of Šipovo. In the period between 2020 and 2021, the following characteristics were measured: fruit weight, fruit length and width, petiole length and width, pit weight, leaf length and width, petiole length and width, leaf shape, leaf blade and leaf color. The qualitative characteristics of the fruit and leaf are described by using UPOV descriptors for blackthorn. According to the analysis, the highest fruit weight was achieved in the population P1-Stupna (1.45 g), and the lowest in the population P2-Janj (1.01 g). The same population P1-Stupna had the largest fruit length and width (12.93 mm and 12.48 mm), as well as pit width and length (10.07 mm and 7.75 mm). In the population P3-Lubovo, the longest petiole was recorded (6.00 mm) as well as the highest pit weight (0.30 g). As far as leaf morphology is concerned, the population P1-Stupna had the longest and widest leaf (36.29 mm long and 15.37 mm wide), then there were the population P2-Janj (32.95 mm) and population P3-Lubovo (23.52 mm). Based on morphological analyses, a highly significant difference between the examined populations for all analyzed features was observed.

Key words: blackthorn, fruit, resistance, UPOV descriptor

P2_30

Phenotypic variability of fruit properties in clones of sour cherry Šumadinka variety

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Abstract

In addition to dominantly represented Oblačinska sour cherry, Šumadinka is variety that is increasly grown in production orchards in Serbia. The main disadvantages of this variety are slightly lower soluble solids content, as well as uneven fruit ripening, which, together with fallen position of branches, is the reason why the harvest cannot be done mechanized. At the Faculty of Agriculture, University of Belgrade, work on clonal selection of this variety has begun. In addition to good yield, genotypes with larger fruits, high soluble solids content, and good resistance to biotic and abiotic stress factors are main goal of selection. In this paper, results of the two-year period (2020-2021) investigation of the most important physicochemical fruit properties of four clones of the Šumadinka variety (ŠK1, ŠK2, ŠK3 and ŠK4) selected from production orchards at the Grocka locality were presented. Significant differences between the tested clones were found for all physical and chemical fruit properties. Clone ŠK4 had the highest fruit weight (8.10 g), and clone ŠK1 had the lowest (6.80 g). Clone ŠK4 also had the largest fruit length (20.29 mm), fruit width (23.61 mm) and fruit thickness (21.19 mm), as well as stone weight (0.62 g), stone length (11.77 mm), stone width (10.29 mm) and stone thickness (8.34 mm). The smallest fruit dimensions were determined in clone ŠK1, and the smallest stone dimensions in clone ŠK2. All tested clones had a high soluble solids content, which varied from 14.21% (clone ŠK2) to 15.25% (clone ŠK4). The content of total acids ranged from 0.94% (clone ŠK2) to 1.12% (clone ŠK4). In terms of the examined traits, clone ŠK4 stood out, which has a good basis for introduction into production and further breeding work.

Key words: Prunus cerasus L., selection, clone, fruit size, quality

P2_31

Biological characteristics of new European plum genotypes developed in Serbia

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Abstract

The paper presents results of three-year investigations of the most relevant biological characteristics (flowering and ripening time, morphometric, chemical and organoleptic properties of fruit) and field resistance to causal agents of economically most important viral (plum pox virus) and fungal (red leaf spot, rust and fruit rot) diseases of new plum genotypes 'Lana' and 'G'. 'Lana' was bred at Fruit Research Institute, Čačak and released in 2020. Elite genotype 'G' was singled out at Faculty of Agriculture in Novi Sad and currently is under recognition. The experiment was conducted at Čačak's agro-ecological conditions, whilst 'Čačanska Rana' and 'Čačanska Lepotica' used as standard cultivars for 'Lana' and 'G', respectively. In comparison with appropriate standard, average flowering onset of 'Lana' and 'G' was one and two days later. The ripening time of 'Lana' was July 20th, nine days later than in 'Čačanska Rana', while for 'G', it was July 29th, ten days after 'Čačanska Lepotica'. Compared to 'Čačanska Rana', cultivar 'Lana' had significantly higher fruit weight (85.04 g) and dimensions, similar content of soluble solids (14.54%), higher total acids (1.20%) and lower ratio of the soluble solids and total acids (12.55). The fruit weight (41.87 g) and dimensions of genotype 'G' were similar to those of 'Čačanska Lepotica', but significantly higher soluble solids (17.65%), total sugars (10.23%), sucrose (3.95%) and ratio of the soluble solids and total acids (17.49) were found. The fruit organoleptic properties of new plum genotypes were in line with standards. In addition, both genotypes demonstrated the same level of field resistance to Plum pox virus as standards and better results regarding the field resistance to causal agents of fungal diseases.

Key words: plum, flowering and ripening time, fruit quality, field resistance

P2_32

Initial yield potential of three cherry cultivars on two combinations of rootstocks/interstock

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Abstract

Cherry is characterized by vigor initial tree growth. One of the basic goals of modern cherry growing is precocity, which is the best factors in suppressing vigor growth. Use the dwarf rootstock is for sure the best way to achieve this goal. In certain growing conditions, use of vigor roostock with dwarf interstock can be successful alternative. The paper presents the influence of the two combination of rootstock/interstock on the yield potential of three cherry cultivars ('Burlat', 'Regina', and 'Kordia') in the first years of cultivation. The cultivars were grafted on two rootstocks (seedlings of *Prunus avium* and *Prunus mahaleb*) with an interstock ('GiSelA 5'). The length of the interstock in all combinations was 40 cm. Experimental orchard is located in Ortiješ (Mostar), in the central part of Herzegovina. It is planted in the autumn of 2011 at a planting distance of 1.4 × 3.5 m, and trained in the form of a spindle-shaped pyramid. On five randomly selected trees of each combination of cultivar / interstock / rootstock (in total 30 trees) during two years (2014 and 2015) the analysis of buds number and type was performed. Based on measurements, the generative potential of each combination was calculated and expressed by the number of generative buds per unit of average trunk cross-sectional area. The comparison was performed using general linear models, and the level of significance of the differences was set at the level of significance $p<0.05$. The results showed a significant influence of the combination of rootstock/interstock on the examined parameters. Cultivar 'Regina' had the highest yield potential on combination mahaleb seedlings/'GiSelA 5', while cv. 'Burlat' had the lowest yield potential on combination wild cherry seedlings/'GiSelA 5'.

Key words: Burlat, Regina, Kordia, wild cherry, GiSelA 5

P2_33

The effect of gibberellic acid treatment on the soluble solid content in fruits of two cherrie varietes, Kordia and Regina

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Abstract

The growing demand for fresh cherry fruits is one of the main reasons for intensifying the cherry production process. Cherry fruits are non-climacteric, which means that they ripen quickly and do not have ability to for a long time storage. The market places demands on cherry producers regarding the quality of the fruit. The aim of research is to study the effect of gibberellic acid treatment on the soluble solid content in fruits of two cherrie varieties, Kordia and Regina, grafted on Colt rootstok. The experiment was set up in orchard in Popovo polje. Treatment with Giberellin, whose main ingredient is gibberellinic acid, was performed on three cherry trees of each variety. The results indicate that gibberellic acid significantly affects the percentage of soluble solid content. Kordia had significantly higher values o soluble solid content compared to Regina in general. Treatment samples of Kordia variety showed lower average of Brix content (15.99% Brix) compared to control samples (17.17% Brix), also, Regina variety showed significantly lower percentage of Brix in treatment samples (14.35% Brix), while in control samples Brix is significantly higher (16.48% Brix). The results indicate that gibberellic acid significantly reduces the soluble silid content , slows down metabolic processes and its use slows down the ripening process. The process of cherry production depends on the application of the results of new research, but also on the production practices that are represented in developed fruit regions. The application of gibberalic acid can be a successful solution for improving the quality and longer marketing period of cherry fruits.

Key words: Prunus avium L., ripening, giberelic acid, BRIX

Acknowledgements: This paper is part of a research project: \"Suppression of cherry fruit cracking and conditioning for long-term standing in storage with hormonal and mineral preparations\", implemented by Institute of Genetic Resources of the University of Banja Luka and supported by the Ministry of Civil Affairs of Bosnia and Herzegovina.

P2_34

The effects of planting distance on the initial productivity and fruit quality of plum cultivars grafted on 'Ishtara' rootstock

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Abstract

The aim of this study was to determiine the effects of the different planting distances on yield and fruit quality of plum cultivars 'Čačanska Lepotica' and 'Čačanska Rodna' grafted on 'Ishtara' rootstock. The experimental orchard was established in the spring of 2017 with the planting distances of: 4 × 1.5 m (1.666 tree ha^{-1}), 4 × 2 m (1.250 tree ha^{-1}), 4 × 2.5 m (1.000 tree ha^{-1}) for the cv. 'Čačanska Lepotica' and 4 × 2 m (1.250 tree ha^{-1}), 4 × 2.5 m (1.000 tree ha^{-1}) for the cv. 'Čačanska Rodna'. The research was conducted during years 2019 and 2020 and the following measurements were performed: yield (kg $tree^{-1}$), fruit mass (g) and diameter (mm), flesh ratio (%), fruit firmness (N), soluble solid content (SSC, °Brix) and titratable acidity (TA, %). The average yield per tree increased with the planting distance increment in both cultivars. During research the highest average yield was 4.4 kg $tree^{-1}$ in 'Čačanska Lepotica' and 3.5 kg $tree^{-1}$ in 'Čačanska Rodna' for the same spacing of 4 x 2.5 m. However, the yield per hectare decreased with planting distance increment and the highest yield per hectare of 6664 kg was achieved at the distance of 4 × 1.5 m in 'Čačanska Lepotica' and 3875 kg at the distance of 4 × 1.5 m in 'Čačanska Rodna'. In both cultivars, fruit firmness increased with increment of planting distance while SSC was higher in fruit from trees planted with smaller distance. The average value of SSC was 14.1 °Brix (4 × 1.5 m) in fruit of 'Čačanska Lepotica' and 19.1 °Brix (4 × 2 m) in fruit of 'Čačanska Rodna'. The effect of planting space was not significant for the average fruit weight and dimensions, flesh ratio and TA for both cultivars tested.

Key words: Čačanska Lepotica, Čačanska Rodna, yield, fruit firmness, SSC

P2_35

Influence of calcium oxide and hydroxycoric acids on storage of plum varieties

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Abstract

The aim of the study was to examine the effect of foliar application of calcium fertilizer (CaO 11%, B 0.3%) and plant growth regulator (hydroxycoric acids a.m.), as well as their combinations on the quality and stored characteristics of plum varieties. The tests were performed in the Grocka region during 2021. The experiment included two varieties originating from *Prunus domestica* L., Čačanska najbolja and Grosa di Felicio. The plant growth regulator was applied at a dose of 150 ml/ha, calcium fertilizer at a dose of 5 kg/ha, and a combination of preparations was applied in the same doses as in individual treatments. Foliar treatments were applied 20 and 10 days before the planned harvest for each variety individually. From the physical properties of fruits, fruit weight (g) and firmness (kg/cm^2) were examined, and from chemical properties, soluble dry matter (%), total acid (%) and vitamin C (mg/100 g). Immediately after harvest, the fruits were stored for 10, 20 and 30 days at temperatures of 3°C. The obtained results show that applied treatments have a significant impact on the length of storage and fruit quality, as well as the variety itself. In both tested varieties, a decrease in the value of fruit weight and firmness during storage was observed. The application of plant growth regulator had a significant impact on the quality of physical properties of fruits of the cultivar Grosa di Felicio, while the treatment with calcium fertilizer had the same effect on the characteristics of fruits of the cultivar Čačanska najbolja. The applied treatments did not have a significant effect on the chemical properties of the fruit of the examined varieties.

Key words: plum, fruit storage, calcium, plant regulators.

P2_36

Berry quality of northern highbush blueberry (*Vaccinium corymbosum* L.) during the harvest season

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Abstract

The blueberry ripens successively, and the commercial harvest usually lasts a few weeks during which the fruit changes. The aim of this research is to evaluate the characteristics of the fruit during the harvest period. The research was conducted during 2021 in a blueberry plantation located in Stari Martinac (Srbac municipality). So far, it has been established in 2013 on the banks in the north-south direction. Two-year seedlings with a well-developed root system were used to raise the orchards. Orchard is covered with an anti-hail net. The test was performed with Duke, Bluecrop and Chandler varieties. An analysis of the number of fruiting twigs and the number of fruits per bush was performed. The conditional yield per bush and unit were determined. The weight, height, width, and index of the fruit of each variety in different harvest period were calculated on a sample of 50 randomly picked fruits. Most of the examined parameters changed during the research period. The highest average fruit weight was achieved with the Bluecrop variety in the 1st harvest period (1.81 g) and the lowest with the Chandler variety in the 4th harvest period (1.09 g). With minor deviations, the morphometric characteristics of the fruit had lower values during later harvest. The highest average content of soluble dry matter was achieved in the Bluecrop variety in the 3rd harvest period (15.04 Brix) and the lowest in the Chandler variety in the 4th harvest period (10.55 Brix). The highest average content of total acids was achieved with the Chandler variety in the 2nd harvest period (1.45%) and the lowest with the Bluecrop variety in the 2nd harvest period (0.44%). Blueberry fruits harvested at a later stage of harvest were less visually attractive and with increased values of characteristics that affect fruit quality.

Key words: yield, fruit characteristics, seasonal variation

P2_37

An estimate of LiDAR supported spraying optimization for selected cases of plum tree cultivars

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Abstract

The main objective of this study was to determine the degree of possible spraying optimization for different types of plum cultivars. Different plum cultivars have different characteristic, and these must be considered when spraying the plants to save on plant protection products. This approach could be supported whit the help of LiDAR based system that uses two SICK TIM510 LiDARS and placed perpendicular to each other to produce readings used in custom developed SLAM and electro-magnetic valve triggering algorithm. This setup makes it possible to actively respond to the plant canopies' properties by positioning the system, using the readings from the horizontally placed LIDAR and vertically placed LIDAR to inspect plant canopies. The estimated savings that this system could offer was evaluated by inspecting different plum training systems, including spindle, UFO, Bi-axis, etc. The initial evaluation estimates show that potentially could save up to 10 to 20% of PPPs, based on different training systems and variety growing specificity.

Key words: spraying, plant protection products, plum cultivars

P2_38

Survey on the presence of *Plum pox virus*, the causal agent of sharka in Republic of Srpska during 2016-2021

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Abstract

Plum pox virus (PPV) the causal agent of sharka, originated in eastern Europe, presents one of the most devastating diseases of stone fruits regarding agronomic impact and economic importance. Since its first reports, around 1917 and in 1933, the virus has progressively spread to a large part of the European continent. Including Bosnia and Herzegovina (B&H), first report of PPV in Yugoslavia was recorded in 1937. Considering that PPV is widespread in B&H, surveys were carried out in Republic of Srpska (RS) during 2016-2021. The programs were approved and financed by Ministry of Agriculture, Forestry and Water Management of RS. Visual inspections and sampling of host plants was carried out in a number of registered nurseries and mother plant production places, as well as imported samples. Laboratory analysis was carried out in accordance with the EPPO Diagnostic protocol for regulated pests PM 7/32 (1) for PPV. According to this protocol samples were processed by DASI-ELISA for the serological detection followed by a RT-PCR for the molecular detection of PPV, two screening laboratory tests based on different principles. Based on the conducted laboratory analysis during six years, 63 positive samples were confirmed for the presence of PPV, 16 in 2016, 7 in 2017, 9 in 2018, 6 in 2019, 12 in 2020 and 13 samples in 2021. In accordance with programs of Ministry of Agriculture, Forestry and Water Management of RS, for positive samples measures of eradication were carried out by Republic Administration for Inspection Activities, Republic of Srpska Inspectorate – phytosanitary inspection. Thus, considering that PPV has been present in RS for the past six years, surveillance program will be continued in 2022. Also, implementation of this survey is very important in order to protect domestic production and timely detect infected consignments and/or registered production places.

Key words: Plum pox virus, DASI-ELISA, RT-PCR, survey, Republic of Srpska

P2_39

Evaluation of Streif's index and sensory properties of four club apple varieties in eastern Serbia

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Abstract

Premature or too late harvesting of apples influences the flavor, color, size and storability. Texture, along with its appearance, taste and nutritional properties, is one of the main quality indices of fresh apple fruits and one of the major indicators for assessing the quality. The most significant commercial club apple orchard in Serbia is within Delta Agrar Company in the region of Zaječar. The modern apple orchard was established in 2016 with a high slender spindle training system. Three-year study (2019-2021) of evaluation of apple fruits sensory quality were conducted with four club varieties: Evelina®, Pink Lady®, Modi® and Lafayette®. The Streif index (SI) was calculated as: fruit firmness (determined by standard penetrometer; expressed in kg/cm^2) / [soluble solids content (by refractometer; °Brix) × starch index (on a scale from 1 to 10)]; based of 30 fruits from each variety. At the time of harvest, Modi and Pink Lady had the highest fruit firmness (7.85 and 7.76 kg/cm^2, respectively). The soluble solids content was highest in the Pink Lady (14.75 °Brix), and the starch index in Lafayette and Evelina (9.82 and 9.85, respectively). The SI was significantly higher in the Modi variety (0.061) compared to others and the smallest in Evelina (0.051), while Lafayette and Pink Lady had the same values (0.059). Fruit evaluation of nine sensory attributes was performed by ten experienced panellists at technological maturity, immediately after harvest, by random sampling of ten fruits. Sensory analysis was based on grading method on a scale from 1 (worst grade) to 5 (best grade). The highest positive correlation with the average grade of cultivars had fruit shape, ground color and aroma, while the presence of skin russeting and the expression of lenticels significantly reduced the average score of varieties. During the three-year period, cultivar Evelina had the highest average grade.

Key words: club apple cultivars, fruit quality, sensory analysis

P2_40

Stability of vitamin C in apple fruits during shelf life

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Abstract

After harvesting, it is crucial to maintain the quality of apple fruits until the period of use. During the shelf life, there can be changes of biochemical characteristics of the fruit, which impairs their overall nutritional value. Vitamin C is an important vitamin in apple fruits, and the content of this compound is conditioned by production factors, but above all it depends on the variety specificity. The main goal of the research was to monitor the content of vitamin C in different varieties of apples from harvest to consumption. The fruits of 5 apple varieties (Pinova, Gala Schniga, Granny Smith, Golden Delicious and Cripps Pink) were sampled in the orchard of Potkozarje during 2020. The fruit harvest time was determined using methods for assessing the degree of fruit maturity (fruit size, penetrometric and refractometric methods). In total 30 fruits were taken for each variety. The half of the fruits was analyzed after harvest and the rest was exposed for 7 days of marketing conditions at room temperature after which the analyzes were repeated. Vitamin C content was determined by a standard AOAC (1990) method using 2,6-dichlorophenolindophenol reagent. The results indicated different behavior of the observed apple varieties during the shelf life period. Namely, the variety Gala Schniga recorded the highest content of vitamin C in both observed periods (0.55 mg/100 g FW at harvest and 0.37 mg/100 g FW after 7d shelf life), which indicates the good potential of this variety for prolonged placement on shelves. The greatest loss of this antioxidant during shelf life was registered in Golden Delicious variety, while Pinova and Cripps Pink varieties recorded an increase of vitamin C content in the postharvest period. The higher content of this compound after the shelf life indicates slower biochemical processes in the fruits of these varieties after harvest.

Key words: postharvest handling, fruit quality, biochemical characteristics

P2_41

The number and the character of leaf mass in different categories of fruiting twigs in pear trees

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Abstract

Leaf is a temporary organ of fruit trees, whose primary function is photosynthetic activity. Assimilates that are produced in leaves are transported to other organs where they participate in their construction. The target organ in fruit trees is the fruit whose quality is directly dependent on the activity of the leaves in certain growth categories. The number and character of individual increments depends on the age of the trees and the variety itself. The productivity and quality of pear fruit depend on the number of leaves formed, their square area and physiological activity. In our research, we studied the number of leaves on different categories of fruiting trees in three varieties of pear cultivars: Williams, Santa Maria and Packham's Triumph. Based on the results of researches conducted in 2011 and 2012, Williams cultivar had a consistent number of leaves in both years ($p=0.793$), while both Packham's Triumph and Williams cultivars showed a highly significant increase in 2012 ($p<0.0001$). It can also be stated that the year has a significant impact on the number of leaves formed on long shoots, and that the variety has a significant impact on the number leaves on long shoots and stems. While, in both years examined, the presence of leaves was not recorded on spurs.

Key words: fruiting twig, varieties, leaf, photosynthesis

P2_42

Fire blight survey in Republic of Srpska during 2016-2021

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Abstract

Erwinia amylovora (Burrill) Winslow et al., the causal agent of fire blight (FB) on pome fruit and ornamental plants, as one of the most intensively studied phytopathogenic bacteria, rapidly spread across eastern Mediterranean countries in the early 1980s. In Bosnia and Herzegovina (B&H) FB was recorded in 1991, in Northern part (Bosanska Gradiška) on 288 ha of pear and individual apple trees, causing a significant economic damage. Considering that occurrence of FB was registered a few more times, surveys on the presence of quarantine bacteria *E. amylovora* were carried out in Republic of Srpska (RS) during 2016-2021. The programs were approved and financed by Ministry of Agriculture, Forestry and Water Management of RS. Visual inspections and sampling of host plants were carried out in a number of registered nurseries and seedling production places, farms and gardens, as well as imported samples. Laboratory analysis was carried out in accordance with the EPPO Diagnostic protocol for regulated pests PM 7/20 (2): Erwinia amylovora. According to this protocol samples were processed by isolation, followed by DASI-ELISA for the serological detection and a conventional PCR for the molecular detection of *E. amylovora*, two screening laboratory tests based on different principles. The PCR products were separated on a 1.5% agarose gel in 1 x TAE buffer. Based on the conducted laboratory analysis during 2016-2021, 9 positive samples were confirmed for the presence of E. amylovora, 6 samples in 2017 and 3 in 2020. In accordance with programs of Ministry of Agriculture, Forestry and Water Management of RS, for positive samples measures of eradication were carried out by Republic Administration for Inspection Activities, Republic of Srpska Inspectorate – phytosanitary inspection. Considering consequences if bacteria occurs, as well that *E. amylovora* is on II/A2 list in B&H, survey will be continued in 2022.

Key words: Erwinia amylovora, fire blight, survey, Republic of Srpska

P2_43

Economic benefits of raspberry growing in a protected area

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Abstract

This research examined an economic analysis of raspberry production cv. Heritage in the greenhouse. As domestic experiences with the cultivation of floricane raspberry cultivars are very modest, the aim of the paper is to show the possibilities and point out the advantages of growing the raspberry cv. Heritage in a protected area on an agricultural farm in Milićevo village (Požega municipality). The calculation of production was done for two years, 2018 and 2019. Total production costs, total revenues and cost-effectiveness of production are shown. The yield in the orchard of 0.2 ha was 4,650 kg in 2018 and 5,145 kg in 2019. In 2018, the purchase price was 5 €/kg for raspberries of class I and 1 €/kg for raspberries class II, and in 2019 4 €/kg for raspberries of class I and 1.4 €/kg for raspberries of class II. In 2018, was generated a profit of € 10,200, and in 2019 a profit of € 8,183.The advantage of growing raspberries in a protected area, shows the great interest of producers in this type of production, both because of the quality of the products and because of the change in the climatic characteristics in Serbia.

Key words: raspberry, yield, revenue, costs

P2_44

Managing grey mould (*Botrytis cinerea* Pers.) on strawberry grown under ecosafe protective system

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Abstract

Grey mould (*Botrytis cinerea* Pers.) is one of the most important strawberry diseases, which in conventional farming is successfully controlled by chemical fungicides during flowering. Yet, in organic farming, due to the unavailability of appropriate non-fungicidal methods, its control is one of the biggest problems that can often cause a significant reduction in production and profitability. Thus, the study is aimed to investigate the possibility of using some biological alternatives (soil microorganisms) for controlling grey mould disease in strawberry plantings. For that purpose, in Fruit Research Institute Čačak (Republic of Serbia) a new formula of biopreparation (VCMo) consisting of microbes from *Trichoderma*, *Bacillus*, *Pseudomonas* and *Azotobacter* genera has been developed. The VCMo was applied at the beginning, full and the end of flowering stage. In three harvest times (beginning, middle and the end), its efficiency has been investigated by controlling B. cinerea of the fruits of organically cultivated 'Alba' strawberries (*Fragaria* x *ananassa* Duch). Besides, yield, physical fruit properties and soluble solids have been monitored also. Strawberry fruits obtained from plants exposed to VCMo application showed a lower incidence of grey mould (38.29%). In addition, degree of infection has been decreased from the beginning till the end of harvest (55.08, 49.97 and 39.13%, respectively). Higher yield of usable fruits was observed under VCMo application, especially in the middle harvest time (148.31 g/plant). The fruit weight and dimensions, as expected, varied under the influence of the harvest date. The application of VCMo showed a positive effect on the fruit weight in the middle and at the end of the harvest (28.61, 20.81 g), which can also be said for soluble solids (5.88 and 6.58 oBrix). Contrary, the fruit firmness was the highest at the beginning of the harvest (1.47 kg cm^2).

Key words: Botrytis cinerea; *Trichoderma*; *Bacillus*; strawberry; ecosafe strategy

P2_45

Results of monitoring of spotted wing drosophila (*Drosophila suzukii*, Matzumura) in the Republic of Srpska

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Abstract

Spotted wing drosophila (*Drosophila suzukii*, Matzumura) is an important pest of soft and pome fruits. It originate from Asia, now spread throughout Europe, North and South America. High reproductive potential, many generations per year and their overlapping made this pest hard to control. In Bosnia and Herzegovina SWD is present at least eight years and for that time little data is collected on its dispersal and behavior in agro-ecological conditions of Republic of Srpska. Monitoring was conducted in the period 2017-2021 in orchards of different plant hosts. For the purpose of monitoring traps made of PET bottles with apple cider vinegar as attractant were used in the period of fruit ripening. SWD was found in all agriculture regions of the Republic of Srpska with difference in population abundance. Adults of SWD are most active from the end of August and most harmful are for grape, blackberry and late varieties of raspberry. Among climate conditions the biggest influence on population movement had precipitation and air temperature.

Key words: spotted wing drosophila, pome fruit, berries, monitoring, Republic of Srpska

P2_46

Population decline of *Globodera rostochiensis* population in Serbia in the absence of the host

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Abstract

Potato cyst nematode *Globodera rostochiensis* was recorded in Serbia on Ponikve more than a two decades ago and its populations were in monitoring on the spot since 2005. Population decline of the population of *Globodera rostochiensis* is studied in the absence of the host over the period of 16 years in a field on Ponikve in Western Serbia. Soils samples were taken in 2006, 2010, 2011, 2012, 2014, 2016 and 2021. It was sampled with a 2.5 cm diam. auger by taking 100 cores in a zigzag pattern across the field, from 5-15 cm soil depth making a single 1.5 kg sample from the whole field. The 200g soil subsamples were dried and cyst extracted with the Fenwick can. Cyst viability was determined for 50 randomly selected cysts. Individual cysts were disrupted on a glass slide in a drop of water and viable content counted under a dissecting microscope. Population density is than calculated and expressed as number of cists, second stage juveliles (J2) per cyst and J2 per g of soil. In 2014 and 2021 cyst viability was determined also by J2-hatching-test in artificial hatching medium, 0.6 mM Sodium meta vanadate. *Globodera rostochiensis* population density decrease in the absence of the host plants was about 20, 98 and 99 % expressed as number of cyst/g, J2/cyst and J2/g of soil respectively. Although, after the 16 years since the last potato crop there was still some viable-looking J2 in a few cists in 2021 hatching tests did not show their viability.

Key words: potatao cyst nematodes, IPM, potato

P2_47

Evaluation of potential of four entomopathogenic nematodes to control box tree moth (*Cydalima perspectalis* Walker)

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Abstract

Box tree moth - *Cydalima perspectalis* Walker, 1859 (Lepidoptera: Crambidae) is native to South East Asia and has been recently introduced to Europe and Bosnia and Herzegovina, where it damages box trees. Insceticide application in urban areas where box trees are common part of ornamentals, might be not solution. Biological control agents, entomopathogenic nematodes, present an environmentally sound solution for control of wide range of pests. In this study we tested in laboratory and field conditions susceptibility of larvae of *C. perspectalis* to local strains of four species of entomopathogenic nematodes *Steinernema feltiae, S. carpocasae, S. kraussei* and *Heterorhabditis bacteriophora*. In laboratory condition aplied range of concentrations of 50-500 infective juveniles per larva caused mortality of 80-100%. However, in the filed conditions observed mortality was 13-30% revealing that foliar application of EPN might require interaction with ecological factors to achieve similar results like in favorable laboratory conditions.

Key words: biological control, *Steinernema*, *Heterorhabditis*, ornamental plants

Session 2: HORTICULTURE

Oral Presentations

O2_01

The response of grapevine cultivars to climate change

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Abstract

In the last few decades, many European wine-producing regions have experienced warming trends and an advance in grapevine phenology. As a result grape ripening occurs in a hotter part of the season which negatively affects both, yield and grape quality parameters. Moreover, the effects of climate change are not likely to be uniform across all cultivars and regions. High variations in temperature and precipitations could have negative effects on grape and wine production. The continuous production of high-quality grapes and wines is a challenge because a further increase in temperature may negatively affect the grape quality of the cultivars that we usually grow such as Chardonnay, Pinot noir, Merlot. To produce high-quality grapes of these cultivars appropriate agro-techniques should be applied in the field (leaf removal, cluster thinning), which are labor- intensive and time-consuming. However, it is more effective to grow cultivars tolerant to main fungal diseases that reach optimal maturity at the end of the growing season in a given area. Thus, the grapevine breeding program in Sremski Karlovci (Serbia) aims to create new cultivars less sensitive to variations in climate conditions with high tolerance to main fungal diseases and high grape quality. Wine cultivars, such as Morava and Dionis, released in 2003 and 2017 respectively, are recognized for their adaptability to Fruška Gora climate conditions, tolerance to main fungal diseases, and high grape quality.

Key words: grape quality, climate change, agro-technique, breeding program, fungus-resistant grape varieties

O2_02

Prokupac vine variety – in expectation of climate changes

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Abstract

This paper focuses on the spatial analysis of changes of main climate parameters, that is, viticultural bioclimatic indices that were determined for the purposes of viticulture zoning of Oplenac wine-growing district for the period 1961-2010, and those same parameters as determined for the current, that is, referential climate period (1988-2017). With the aim of making projections of climate changes, those same climate parameters, that is, bioclimatic indices were determined for wine-growing micro-areas in which vineyards are currently located in this wine-growing district. Projections of future climate conditions were carried out for the mid-century (2021-2050) and end-of-the-century (2071-2100) period by using results of the NMMB model. Simulation of climate changes was carried out within the ORIENTGATE project, as regionalization of projections of the global climate model CMCC-CM in the RCP8.5 scenario (Representative Concentration Pathways) for emission of greenhouse gases (GHG). Results of the research, that is, projections of climate changes indicate that by the end of the century the majority of examined climate parameters in the Oplenac wine-growing district will improve for the Prokupac vine variety. Two of the analyzed parameters will deteriorate, and it is predicted that two of the parameters will deteriorate by the mid-century, only to return to favorable values for production of high-quality grapes and wine by the end of the century. These projections of climate conditions indicate that changes of analyzed climate parameters, that is, bioclimatic indices will largely favor cultivation of varieties with later grape ripening times and those more

sensitive to low temperatures, such as the Prokupac variety, therefore, it is recommended to producers to planting the vineyards with this variety in the territory of the Oplenac wine-growing district more actively.

Key words: climate changes, Prokupac vine variety

O2_03

Rapid breeding of new cabbage (*Brassica oleracea* var. *capitata* L.) hybrid varieties

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Abstract

Hybrid seed production is prevalent in modern agriculture. Hybrids are selected to improve the characteristics of the resulting plants, such as better yield, greater uniformity, and they are a form of intellectual property. Breeding methods are complex and time consuming. Hybrid varieties are usually based on crossing of two inbred lines that should be genetically complementary. The most common method of hybrid breeding is based on the development of a large number of inbred lines either by self-pollination or by induction of double haploids from heterozygous parents. The inbred lines are then tested for hybrid vigor in two steps, first testing "general combining ability" and then "specific combining ability" to identify a pair that exhibits optimal traits. This standard procedure allows only a very limited number of line-to-line crosses because it is tedious and lengthy. We propose here a new method that allows a much higher number of line-to-line crosses than previously known. Our invention refers to an innovative method for testing the combining ability of inbred lines based on genotyping each genetically distinct inbred line, followed by the possibility of crossing the plants of the donor lines with each other to obtain F1 hybrid progeny. In the next season, the progeny will be phenotyped on an individual basis. In the case of superior individuals, the parental lines are determined by a paternity test, which allows the identification of both parental lines due to the homozygosity of the lines and the previous genotyping. With this method, a much larger number of line tests can be performed, overcoming the major bottleneck in breeding hybrid varieties. We have clearly demonstrated that the method is feasible, and we propose to apply it to various vegetable and crop species.

Key words: hybrids, inbred lines, combining ability, paternity test, molecular markers

O2_04

Dissipation and residues of emamectin benzoate in paprika

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Abstract

In this study, the dissipation and residues of insecticide emamectin benzoate in paprika fruits grown in a greenhouse were evaluated. Plant protection product based on emamectin benzoate was applied at the recommended rate. For the analysis of insecticide residues, the QuEChERS based method, followed with HPLC analysis was validated in accordance with SANTE/12682/2019. The results indicated that emamectin benzoate degrades rapidly in paprika fruits in greenhouse conditions and exhibited first-order kinetics dissipation, with a half-life of 0.6 days. The lowest residue level indicates that the pre-harvest interval for emamectin benzoate, after its application in the recommended rate in the paprika, is appropriately prescribed. Based on these results, it has been proven that, if pesticides based on emamectin benzoate are used in accordance with good agricultural practice, produced paprika fruits could be classified as "zero pesticide residues" products.

Key words: emamectin benzoate, paprika, dissipation dynamic, residues

02_05

Influence of natural and enriched pyrophyllite on onion yield (*Allium cepa* L.)

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Abstract

The effect of onion *(Allium cepa* L.) watering with a suspension of water and pyrophyllite and a suspension of water and enriched pyrophyllite with nitrogen (N) from urea was investigated. Pyrophyllite originated from the site Parsovići, Konjic, AD Harbi, B&H. The suspension used in treatment 1 was composed of water and pyrophyllite (4 g/L water) and in treatment 2 of water and enriched pyrophyllite containing 12.5% N (4 g/L water). The treatments 1 and 2, compared to the control treatment with only water, contributed to the increase in mass of onion heads by 18.31% and 24.09% ($p<0.01$), respectively. Achieved results indicate that the amount of N in the soil was a limiting factor as well as on the justification of the use of enriched pyrophyllite which, at the same time, has the function of a soil conditioner

Key words: pyrophyllite, urea, watering, onion, yield

O2_06

Invasive species in the Old park in Temerin (Serbia)

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Abstract

The paper analysis the invasive species in the Old park in Temerin, Serbia. The park is situated in the center of the town of Temerin, occupying approximately 3.8 ha. The park has been proclaimed a natural monument in 2003, due to the high values of its dendroflora elements – primarily related to their age and dimensions. According to the field survey, conducted in 2021, there are 31 species of trees and shrubs registered in the park, with a total number of 1,075 specimens. Even though the dendrofloristic composition of the park includes many valuable species such as *Aesculus hippocastanum* L., *Planatus* x *acerifolia* Willd., *Quercus robur* L., there are several invasive species registered in the park. A detailed categorization of plant species invasiveness on the territory of Serbia has been done by Lazarević et al. in 2012, and it is used in this paper as a reference. There are three species classified as highly invasive in this park and these are *Acer negundo* L., *Celtis occidentalis* L., *Robinia pseudoacacia* L. One species classified as invasive has been registered in the park and that is *Prunus serotina* Ehrh. In addition, the park is a habitat for one potentially invasive species – Broussonetia papyrifera Vent. Among the listed invasive species Celtis occidentalis is the most dominant one, with a share of 33% in the overall plant species composition, while all other invasive species are present with a share of less than 1%. Future park management strategies should propose a plan for a successive replacement of *Celtis occidentalis* specimens and include monitoring of other invasive species present in the park in order to prevent their possible spread.

Key words: flora, urban parks, biodiversity, invasive species

O2_07

Olive oil sensory quality

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Abstract

Olive oil is a product of great importance in Mediterranean countries, being one of the pillars of the Mediterranean diet, especially extra virgin olive oil (EVOO) contributes to the healthy and nutritional properties of the Mediterranean diet inscribed in 2013 on the representative List of the Intangible Cultural Heritage of Humanity by UNESCO. VOOs are defined by the European Community as those "…oils obtained from the fruit of the olive tree, solely by mechanical or other physical means under conditions that do not lead to alteration in the oil…" (EEC Reg. 2568/91). EVOO is the fatty fraction of olive juice extracted only by mechanical and physical processes, without any refinement (International Olive Council, 2021). Olive oil is recognized not only for the healthy properties ascribed to its high content in oleic acid and some minor components, but also for its unique sensory characteristics and measurable combination of aroma and taste, absent in other vegetable oils. EVOO is clearly distinguishable from other vegetable oils due to its content in aromatic substances among other compounds which influences the final profile. International Olive Oil Council (IOOC) had provided a sensory codified methodology for VOOs, known as the "COI Panel test", which approach is based on the judgments of a panel of assessors, conducted by a panel leader. The panel generally consists of a group of 8 to 12 persons, selected and trained to identify and measure the intensity of the different positive and negative sensations perceived. The EVOO sensory profile is the result of a combination of taste, odor and chemical responses produced by different compounds. Among these sensorial properties, three main positive attributes (fruity, bitter and pungent) are used for classification of EVOO. Moreover, the category of EVOO should not show any defects (e.g. fusty, musty, winey, metallic, rancid).

Key words: olive-oil, sensory analysis, panel, EVOO

O2_08

Non-EU fruit flies serious threat for European fruit production

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Abstract

The true fruit flies (Tephritidae, Diptera) includes more than 5000 species with around 350 being of economic importance. They are recognized as one of the world's most devastating pests for fresh fruits and vegetables. Among tephritids present in Europe of particular importance are Mediterranean fruit fly Ceratitis capitata and olive fruit fly Bactrocera oleae, both of African origin. According EU Council Directive 2000/29 EC there are 23 non European tephritid species whose introduction in EU is prohibited. The most important for Europe are oriental fruit fly Bactrocera dorsalis and peach fruit fly Bactrocera zonata. Both are of Asian origin, polyphagous, although B. dorsalis is considered as the most dangerous fruit fly for Europe. It is marked as a priority quarantine pest regulated on European territory (Regulation EU 2016/2031). From area of origin, both species spread westwards and now present in Africa. Within nearly 450 hosts the most common for B. dorsalis are apricot, avocado, citrus, coffee, fig, mango, papaya, peach, pear, persimmon, tomato. Its interceptions in Europe are registered in urban area of Vienna, Italy, France (Paris region), Southern France. Bactrocera zonata is widespread in Egypt, present in Libya, intercepted in Israel. Out of more than 50 hosts, peach, mango and guava are considered as the major. In Europe, few individuals have been trapped in urban areas in Austria. Having in mind climate in southern part of Montenegro, presence of some host plants and intense fruit trading, Phytosanitary Directorate of Montenegro included in Phytosanitary measures programme (Specific surveys) preventative monitoring for B. dorsalis and B. zonata since 2014. Monitored sites are sea port, marines, border crossing points, distribution centers for fresh fruits and vegetables. For both species, male attractant methyl eugenol is used in Jackson and McPhail traps. No captured flies were recorded from 2014 to 2021.

Key words: fruit flies, quarantine, Europe

O2_09

Blueberry latent virus in highbush blueberry (*Vaccinium corymbosum* L.) in Bosnia and Herzegovina

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Abstract

A small-scale survey for blueberry viruses in Bosnia and Herzegovina was performed in 2018. A total of 20 samples from three locations were collected and analyzed for the presence of 11 viruses. ELISA assays were performed for *Blueberry scorch virus* (BlScV), *Blueberry shock virus* (BlShV), *Blueberry shoestring virus* (BlSSV), *Blueberry leaf mottle virus* (BLMoV), *Tobacco ringspot virus* (TRSV) and *Tomato ring spot virus* (ToRSV). Samples were tested for *Blueberry red ringspot virus* (BRRV) by PCR and for *Blueberry fruit drop-associated virus* (BFDaV), *Blueberry latent virus* (BlLV), *Blueberry mosaic associated virus* (BlMaV), *Blueberry necrotic ring blotch virus* (BNRBV), *Blueberry virus A* (BVA), *Blueberry leaf mottle virus* (BLMoV) by RT-PCR. The analyses confirmed the presence of BlLV in eight samples with no other virus detected in any of the samples.

Key words: Vaccinium corymbosum L., BlLV, RT-PCR, sequencing, diversity

Acknowledgent: This work was supported through a Fulbright Visiting Scholar Grant at the University of Arkansas, Division of Agriculture, Department of Plant Pathology and by the Ministry of Civil Affairs of Bosnia and Herzegovina (contract number 10/33-14-632-1/17).

O2_10

Control of *Cydia pomonella* L. in apple orchards using spinetoram, pyriproxyfen and chlorantraniliprole

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Abstract

Codling moth occurs regularly in Republic of Serbia every year. It is one of the most important pests, particularly in apple orchards. It often causes permanent and high damages, that result in premature fruit drop, larvae-eaten fruit, and difficult preservation during storage, primarily due to untimely and inadequate protection. In 2021, the trials were carried out according to the standard EPPO methods with the aim to establish the level of apple protection against the codling moth, using three plant protection products based on insecticides pyriproxyfen (100 g a.i./L, EC), spinetoram (250 g a.i./kg, SG) and chlorantraniliprole (200 g a.i./L, SC). In apple orchard (variety Granny Smith) at Budisava locality (Vojvodina, Serbia), the products were foliar applied by backpack sprayer at a concentration of 0.04%, 0.10% and 0.02%, respectively. The experiment was set up in four replications in randomized block design. The efficacy of the insecticides was performed according to Abbott, and significance of differences (ANOVA) for the confidence interval of 95%. Eleven days after application the efficacy ranged from 90.5-94.4% for all applied products, while the chlorantraniliprole achieved the highest efficacy. After 24 days, the products showed good efficacy ranged from 85.4-97.1% and the highest efficacy was achieved by spinetoram. In both estimates, the number of damaged apples in the variants where insecticides were applied was significantly lower than in the control. Finaly, the applied insecticides showed high efficacy for the protection of apple fruits from *C. pomonella* in agricultural production in Vojvodina province.

Key words: apple, *C. pomonella*, insecticide, efficacy

Acknowledgement: This study was part of the project 451-03-68/2022-14/200117, funded by the Ministry of Education, Science andTechnological Development of the Republic of Serbia.

O2_11

Reviewing the progress and measures for control of *Phytophthora fragariae* var. *rubi*

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Abstract

Root rot of raspberry (*Rubus idaeus* L.) caused by the fungus-like pathogen *Phytophthora rubi* (W.F. Wilcox & J.M. Duncan) Man in 't Veld (syn. *Phytophthora fragariae* var. *rubi* W.F. Wilcox & J.M. Duncan), continues to be one of the most serious and an economically important diseases of raspberry in the Republic of Srpska. *Phytophthora rubi* is a soil-borne pathogen listed by EPPO as an A2 quarantine pest for which specific and sensitive detection methods are required to test the health of planting material. According to previous knowledge, *P. rubi* is found in orchards where most of the fresh and processed raspberries are produced but also in the nurseries. Better understanding of the biology and diversity within the genus *Phytophthora* is needed considering the impact on natural ecosystems and the regulatory issues associated with their management. This aspect increases due to attention to presence and extensive surveys to control the spread of quarantine species. In the Republic of Srpska, in the last 3 years, 168 samples from nursery production and 172 samples from orchard production were analyzed, and significant number of plants from production in 6 locations were examined. DNA was extracted directly from the sampled roots. Diluted DNA extracts were amplified by nested PCR (ITS4 and DC6 for first round, DC1 and DC5 for second round). Nested PCR is sensitive and less time-consuming, and therefore recommended as a routine control method. This report indicates that human activity might be the most important factor in moving the pathogen from nursery to fields and spread of disease. In the last few years, eradication of seedlings in raspberry nurseries has been carried out, thus significantly reducing the incidence of disease and the occurrence of spreading it from nurseries to orchards.

Key words: raspberry, *Phytophthora rubi*, nested PCR

O2_12

Elimination of grapevine viruses and viroids through in vivo thermotherapy and in vitro meristem tip micrografting

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Abstract

Grapevine (*Vitis vinifera* L.) is considered to be among the most widely grown and major fruit crops worldwide with high economic importance. Viruses and virus-like organisms cause considerable economic losses in vitiviniculture, and considering that they cannot be controlled by conventional plant protection methods, the use of healthy vegetative propagation material is crucial. In our study, a biotechnological approach in vivo thermotherapy combined with in vitro meristem tip (0.1-0.2 mm) micrografting onto in vitro growing seedling rootstocks of Vialla (*Vitis labrusca* x *Vitis riparia*) was used to study the elimination efficiency of: four viruses whose testing is mandatory in certification programs (GRSPaV, GFLV, GLRaV-3 and GFkV for rootstocks), two viruses detected for the first time in Slovenia (GRVFV and GSyV-1), an emerging virus associated with grapevine leaf mottling and deformation disease (GPGV), a virus whose elimination has never been reported previously in grapevine (RBDV), and two widespread viroids (HSVd and GYSVd-1) from preclonal candidates in six grapevine varieties. The medium used for the growth and root development of micrografts and micropropagated plants (1/2 MS with vitamins, 30 g/L sucrose, and 8 g/L agar) proved to be efficient, as physiological problems such as hyperhydration or necrosis of shoot tips were never observed. The regeneration rate was very low (8.5%), but it is sufficient to obtain one virus-free regenerated plant per candidate that can be further micropropagated. The in vitro plants were tested with RT-PCR. Elimination success was 100% for all eight viruses, while for the viroids HSVd and GYSVd-1 the elimination rate was significantly lower, 39.2% and 42.6%,

respectively. Virus-free in vitro plants were acclimatized in rockwool plugs in a mini-greenhouses and then transferred to soil.

Key words: grapevine, viruses, thermotherapy, micrografting, virus-free

Session 3: AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT

Poster Presentations

P3_01

Application of new technologies in transfer of knowledge and information in agriculture

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Abstract

The aim of this paper is to analyze how the application of information communication technologies facilitates the distribution of knowledge and information to farmers in Serbia. The obstacles in this process are the level of computer and media literacy of farmers and agricultural extension officers. Extension officers are in one of the most important "channel" for transfer of information, but other actors can participate in this process such as various agricultural development organizations, professional organizations or individuals. Desk research method is used in the paper. The research results indicate that information important for the improvement of agricultural production are efficiently distributed to agricultural producers using mobile telephony, personalized e-mail and Internet.

Key words: knowledge and information transfer, agriculture, ICT, agricultural extension service

P3_02

The analysis of business behaviour in terms of the crisis of three agricultural companies from Croatia, Serbia and Slovenia

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Abstract

The aim of this paper was to analyse how, in crisis conditions, to direct the cash flow of income to the business process that brings the greatest benefit. Therefore, the production of wheat and sunflower for three agricultural companies from different countries (Croatia, Serbia, and Slovenia) during one year, considering other factors: inflation, interest rates, cash flow and net present value, was analysed. The obtained results indicate that the current interest rate is within normal limits and that no significant price increase is expected due to it. Furthermore, the occurrence of inflationary pressures as a consequence of market shocks in cooperation with interest rates causes an additional increase in market prices. In such conditions, it is necessary to consider the value of money, i.e. the income that agricultural companies have at their disposal, and decide on future production. The results showed that the net present value is positive for all crops and that there are no major mutual oscillations, except for the agricultural producer from Slovenia, for whom sunflower production is much more profitable.

Key words: crisis, budget, interest rate, inflation, net present value

P3_03

Agricultural policy and productivity growth in Serbia undergoing the EU integration process

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Abstract

Agricultural policy reforms in Serbia are being carried out following the ongoing European Union (EU) accession process, as the agricultural support system should be compatible with the Common Agricultural Policy (CAP) system of the EU at the moment of accession. The main objective of this research is to estimate the production performance of Serbian agriculture and analyze the impact of the agricultural policy support measures on the growth of partial productivities of agriculture. In line with the objectives, a methodology for estimating the partial productivity of agriculture was used. The results of the research indicate that Serbia lags far behind the EU countries, and the most significant gap is observed in labor productivity. This difference is largely due to the production structure since it is dominated by extensive plant production. Also, there is an unfavorable resource structure because small farms dominate, while the gap in land productivity is less pronounced. The research results also indicate extremely frequent changes in support measures in agriculture in Serbia, which is a consequence of frequent changes in management structures and the lack of a clear vision for agriculture, limiting the impact of agricultural policy on agricultural development. Therefore, Serbia's agricultural policy will have to change in the direction of adjusting to measures and mechanisms within the CAP, which is not an easy task. Because of this, agricultural support restructuring programs need to be directed towards investing in programs that should lead to increased competitiveness through increased productivity and product quality. This task implies a large number of measures and coordinated activities, from knowledge transfer to changes in the structure of farms, intending to improve production performances through the growth of partial productivity of agriculture.

Key words: agricultural policy; Serbia; productivity growth

P3_04

Application of low/zero waste models in Serbia through utilization of fruit pomaces

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Abstract

Effective food waste management and moving towards circular economy should be achieved through a comprehensive approach. The change of practice of all participants in the food chain (primary agricultural producers, food processors, consumers) is possible only through strong educational and awareness campaigns. The fruit pomaces are currently one of the major environmental problem in this sector, since significant amount of these byproducts (currently being treated as waste) is deposited during the fruit processing. This is an easily perishable material that rapidly begins to ferment and consequently becomes a source of contaminations, unpleasant odours, etc. Currently, in Serbia, no large processor has a suitable solution for this issue. Generally, the pomaces are being stored in piles, and just a part is being taken by cattle breeders. Thus, main goal was to examine posibility of fruit pomaces valorization in Serbia. Friut pomaces are very valuable byproducts, primarily rich in fibers and has great potential as a raw material for anti-grain flours and fruit fibers production. In some Serbian agricultural cooperatives (e.g. "Naši voćari", "Kosjerka") a pilot production of such products was made from dried pomaces of raspberry, blackberry, black currant, cherry, and apple. Additional way of processing is the pureeing of pomaces left after squeezing and its utilization for the production of spreads. This approach, as well as production of oil from rosehip and roseberry seeds, is succsesfully applied with several small food producers in Serbia. This practice, as a responsible approach for environment point of view, is applied by only several companies that deal with fruit and vegetable processing in Serbia. Furthermore, the final eco-innovative products may have a nutritional statement "rich in fibers" or "a source of fibers". Additionally, pomaces bring to final products minerals, natural colourants, antioxidants, phenolic compounds, etc.

Key words: fruit pomace, low/zero waste, agricultural cooperative, circular economy, Serbia

P3_05

Quantitative measurement of agricultural support in Ghana using PSE (Producer Support Estimate) indicator

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Abstract

Averagely, agriculture accounted for 19.3% of the total GDP accrued to Ghana's economy, and provided employment for 32.49% of the total population within the period 2015 – 2019. Agricultural land in general occupies the greater percentage of entire land area in Ghana (65.14%). Almost half of the total population (44.61%) in Ghana lives in the rural areas and majority of which are engaged in agriculture. The aim of this paper is to measure the level of government support to farmers' income in Ghana, using the Producer Support Estimate (PSE) approach. Specifically, Single Commodity Transfers (SCT) and expression of % SCT for individual commodities, which account for about 70% of the total value of agricultural production in Ghana was used. Inasmuch as important data on market price and budgetary support to Ghana's agriculture in the period 2015 - 2019 were still not inserted in the OECD database, data on market price were sourced from World Bank and FAOSTAT for the analysis. On the other hand, data on budgetary support to Ghana's agriculture for 2015 - 2019 were not in existence. Inadequate literature on policy support to Ghana's agriculture and lack of data on budgetary support to Ghana's agriculture was a limitation and therefore limits the scope of this research. The study revealed that producers of agricultural commodities such as cocoa, maize and coffee received positive market price support, only with the exception of rice which received negative market price support in the period 2015 - 2019. The %SCT for cocoa, maize, rice and coffee were 57.83%, 37.73, -72.28 and 29.79 respectively. It is recommended that the government of Ghana would intensify the production to secure enough food for own population and jobs initiative as a policy support to provide sustainable incentives for producers of agricultural commodities in the country. This refers especially for rice, since it was the most deprived with significant market price support during the period of the research.

Key words: agricultural policy, PSE approach, Single Commodity Transfers, agricultural commodities, Ghana

P3_06

Forecasting long-term meteorological droughts and its possible impact on agriculture in Vojvodina Province, Serbia

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Abstract

Safeguarding the long-term future of society is closely connected with awareness of climate change and its impacts on many sectors of human activities. The stochastic nature of extreme and hazardous climate events is the focus of many scientific disciplines, primarily of meteorology, but also of water resources, security, business, agricultural production, energy, insurance, etc. Frequent and long periods without rainfall are primarily analyzed by scientists in meteorology. On the other side, lack of rainfall has a significant impact on the agriculture sector, especially during the growing season in Europe from April through September. In countries with agriculture as an important sector of the national economy, insufficiency and uneven distribution of rainfall in the time-space domain is commonly designated as agricultural drought. As such it is a subject of societal interest for related protection, management, and other structural and nonstructural measures. Agricultural scientists try to discover climate change-related patterns and recognize their negative impacts on agricultural production, soil and water quality, and others. The core issue is that climate variability challenges the ability of agricultural, societal, and environmental systems to mitigate or adapt to change. The Province of Vojvodina is the most productive agricultural area in Serbia. In this article, we explain how rainless periods, as undesired natural events, can be modeled as elements of the more complex meteorological stochastic process which includes multiple parameters of climate such as temperature, humidity, wind, air density, atmospheric radiation, evapotranspiration, etc. An example prediction of long-term extreme droughts is given for a selected central location in the Province based on a scientifically proven Zelenhasic-Todorovic (ZT) stochastic model of extremes. Historical daily rainfall data from the period 1961-2010 are used to model the process. The results indicate a 100-year return period of rainless periods with a duration of 65 days during the growing season.

Key words: agriculture, climate change, rainless periods, forecasting, ZT stochastic model.

P3_07

Impact of climate conditions of Vojvodina on soybean yields

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Abstract

Due to the constant increase in air temperature, prolongation of the vegetation period and large fluctuations in precipitation, especially in the last two decades, crop production is facing extreme oscillations, both in terms of yield and production results. Therefore, the subject of research in this paper is the influence of climate conditions on the formation of soybean yield in the territory of Vojvodina in the period from 1971 to 2020. The research was conducted on the basis of SORS (Statistical Office of the Republic of Serbia) data on realized yields and data of the Republic Hydrometeorological Service of Serbia on basic climate parameters (atmospheric precipitation and air temperature). According to obtained data, the aim of this paper is to examine the impact of atmospheric precipitation and air temperature on the soybean yields in the territory of Vojvodina, by using correlative and regression analysis. The research established that there is a great statistical significance of atmospheric precipitation in vegetation on the formation of soybean yields, while the air temperature in vegetation has no statistical significance.

Key words: soybean yield, impact, precipitation, temperature

P3_08

The influence of legislation on the operation of family entrepreneurships in agrobusiness

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Abstract

The purpose of this work is to indicate the specifics of family entrepreneurship in agrobusiness, and to define the importance of planning, organization, personnel policy, management and control, on family farms engaged in entrepreneurship. The research is comprised of an analysis of family entrepreneurship in the muncipality of Bosanski Petrovac. It was conducted with the aim of answering the way in which family farms operate, who they employees are, what advantages they have compared to other forms of organization, what are the challenges and limitations that family enterneurship faces, how ownership is transfered, and which decision-making process is important for the development of a familiy farms. The research was conducted on a sample of 20 registered agricultural entrepreneurs or craftsmens engaged in entrepreneurship and registered in the Registry of Entrepreneurs/Craftsmen. The research covered the same agricultural producers in the period of five years before registration, and five years after registration. The conducted research indicates that the registration of farms had positive effects, primarily, an increase in income and business volume by 85% on the surveyed farms. Furthermore, the registration of farms enabled an improvement in the quality of life on the farms by 65%, followed by an increase of physical capital by 90% and an increase of the number of employees by 75%.

Key words: family entrepreneurship, legislation, case study

P3_09

Determination of the production price of brandy made from goji berry

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Abstract

Goji berry is relatively a new agricultural plant introduced in the Republic of North Macedonia. It's prevalent on limited small plantations, where there are controlled breeding conditions. It provides a yield after only 4 months from planting, which allows fast placement on the market. This and the adaptability to minimal growing conditions causes great interest in further expansion of its production. The goal of this paper was to make a calculation on the production price for making a brandy from this product, from collected data from the oldest and most experienced producer of goji berry in our country. Several groups of costs were taken into consideration: starting with the planting costs, then fruit production costs, transport costs, brandy production costs and at the end costs for packaging of the final product. The average yield of goji berry per year is 5t/ha and the production price is 1.9 EUR/kg. Approximately 550 l of brandy with 40 vol. % can be produced, and the production price per bottle of 0.5 l of brandy made from goji berry with 40 vol. % is 14.90 EUR. The purpose of these results is to indicate the importance of calculating the production prices for the agricultural and processed products, especially when it comes to the introduction of new ones that will help producers to improve their farm management. Furthermore, this kind of estimations can be adjusted and replicable for other agricultural and processed products on farm and national policy level.

Key words: production price, brandy, goji berry

P3_10

The state of organic buckwheat production in the Republic of Serbia

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Abstract

Areas under organic plant production in Serbia have been permanently increasing. In 2019, of the total area under this type of production (21265.4 ha), the greatest share was under orchards (5324.4 ha), and cereals (4788.8 ha). In recent years, buckwheat has become popular due to its many health benefits. Despite that, the reduction of areas under this crop is noticeable. Considering that fact, the aim of this study was to show the range of areas under buckwheat in Serbia and to show the regional distribution for the period 2011-2019. Data were obtained from the Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia. The following methods were used in the study: desk research, content analysis, comparative analyses and analyses of base and chain indices. The largest production of buckwheat was recorded in the region of Šumadija and western Serbia and Vojvodina. Considering that Serbia has exceptionally favourable natural conditions for buckwheat production, it is evident that natural potentials are not used enough, although needs for healthy, organic buckwheat in the world market are unlimited.

Key words: organic production, cereals, buckwheat, areas

P3_11

Evaluation of criteria when selecting agricultural machinery suppliers

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Abstract

The aim of this paper is to apply a modern decision-making method to select the given criteria that would help in selecting the most favourable supplier of sowing equipment. For that purpose, DEMATEL (*Decision making trial and evaluation laboratory*) is a suggested method for multi-criteria decision-making, i.e. its *fuzzy* logic. The reason for this is the use of professional judgment of experts in a given field of analysis where the *fuzzy* logic of decisions tried to approach human thinking. The paper focus is the equipment for sowing of an agricultural farm in the municipality of Bijeljina, and the obtained results show the influence of certain criteria that are crucial in the selection of suppliers. Also, the benefit of the research stems from the observation of shortcomings, i.e. improving the quality of the subject of work according to certain processed criteria.

Key words: multicriteria decision making, DEMATEL method, fuzzy logic, agricultural mechanization

P3_12

The agricultural insurance system in the Republic of Serbia as a response measure to climate change

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Abstract

Agriculture in the Republic of Serbia has suffered significant losses due to adverse weather conditions caused by climate change. According to climate change scenarios, we can expect more frequent occurrences of extreme weather conditions, drought and then reduction of the amount of summer precipitation, in particular, the increased number of dry days and days with extreme temperatures in the individual sub-periods of vegetation (high spring and summer temperatures), warmer winters with a lower number of frostless days. Subsidies and state support to national agricultural insurance programs are important measures for adapting to climate change. The Republic of Serbia uses premium aid agricultural insurance programmes. The Ministry of Agriculture, Forestry and Water Management established several subsidy rates for agricultural insurance. The standard rate is 40 percent, while a higher rate of 45 percent is available to farmers residing in the areas with difficult working conditions in agriculture, and a special rate of 70 percent is available to farmers in 5 regions: Šumadijski, Moravički, Zlatiborski, Podunavski and Kolubarski, where agricultural production is more exposed to natural disasters. The subsidy for agricultural insurance aims to encourage farmers to regularly buy insurance and thus protect their production from natural disasters. In the last five years, the number of farmers who insure their production is increasing year to year, from 22.116 subsidy recipients in 2017 to 29.897 in 2021. A similar increase was observed for the subsidy sum provided: RSD 602,225,476.50 in 2017 versus RSD 1,505,105,349.89 in 2021 (MAFWM, 2022). The data is collected and analyzed yearly in accordance to the crop type, municipality and the subsidy paid. Performance results of insurance industry indicate that the

agriculture insurance has negative results in previous years and without government subsidy wouldn't be sustainable.

Key words: climate change, adaptation, agriculture, insurance, subsidies

P3_13

The natural and organic cosmetics market as a promising bioeconomy sector

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Abstract

The bioeconomy covers all sectors and related services that produce, process or use different forms of biological resources. Bioeconomy is of strategic importance for the development of rural areas, because it develops on the basis of plant, animal and microorganisms resources as well as inanimate nature resources, which are mainly found in the countryside. One of the sectors of bioeconomy is the production of natural and organic cosmetics (also known as biocosmetics). The aim of the research was to compare the characteristics of conventional cosmetics and biocosmetics and to present the situation on the natural and organic cosmetics market (value, share in the total cosmetics market, main consumer trends, development prospects). The research is based on secondary sources such as public statistics data, industry reports and specialist literature resources. Biocosmetics are based on natural ingredients found in nature and/or by the addition of biocomponents - the main recognition of which is related to the biofuel industry, but more and more often they are also used in the production of cosmetics. The offer related to bio-cosmetics is developing dynamically, which is a response to consumer trends, in which for buyers an important place is: naturalness, care for health and beauty, sustainable development or a style of consumption based on environmentally friendly products. In Europe, the value of the natural cosmetics market in 2018 was 3.64 billion EUR (4.6% of the total cosmetics market). It is estimated that the value of the global cosmetics market in 2019 was 500 billion USD, including 36 billion USD of the value of the natural and organic cosmetics market. The obtained results confirm the growing importance of the biocosmetics market and the possibility of its development in the future.

Key words: bioeconomy, biocosmetics, biocomponents, natural and organic cosmetics market

Session 3: AGRICULTURAL ECONOMICS AND RURAL DEVELOPMENT

Oral Presentations

O3_01

European Green Agenda and implications for Agriculture and Rural Development Policy of Bosnia and Herzegovina

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Abstract

The decision-makers of the Western Balkans and the European Union have agreed to the list of commitments that would contribute to the achievement of the objective of the European Green Agenda. The paper investigates the implications of these commitments on the strategic and legal framework for agriculture and rural development in Bosnia and Herzegovina, and tries to assess Bosnia and Herzegovina 's readiness to implement the Green Agenda.
The paper uses the desk research method, and data sources refer to official data of institutions responsible for agriculture and rural development in BiH, as relevant international and domestic, scientific and professional organizations that analyze the development of agriculture and rural areas. The paper analyzes the instruments for improving social, environmental and economic sustainability in food production, covered by the EU Farm to fork strategy, as well as the Biodiversity Strategy, such as: legislation and regulations, financial support, education and research and innovation.
The results of the research confirm the low level of application of instruments for the implementation of the Green Agenda in the field of agriculture and rural development in Bosnia and Herzegovina.

Key words: green agenda, agriculture, rural development, Bosnia and Herzegovina

O3_02

Impact of the COVID-19 pandemic on agriculture and food supply – evidence from the Republic of Srpska

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Abstract

The COVID-19 virus had such a spread and consequences that was declared a worldwide pandemic. The pandemic evolved in the Republic of Srpska (one of two entities in Bosnia and Herzegovina) through four characteristic waves during two year period. The research question is - did and to what extent the pandemic affect agriculture and food supply in the Republic of Srpska? The research was based on collecting data from secondary sources and comparing data from the period 2021-2022 mostly with the last pre-pandemic year (2019), followed by own analytical observations and conclusions. The results showed that primary food production has increased, mainly due to fears of possible food shortages and famine. While plant production grew, animal production stagnated. The food processing industry operated at below pre-pandemic capacity. Food retail has largely met volatile demand, and food prices have started to rise significantly since mid-2021 (they have risen by about 10% in two years). Food prices of products of plant origin grew faster than these of animal origin. Inputs for agriculture, especially fuel and fertiliser, also had a rise in prices. Sales of food in green markets have declined in favour of other direct sale methods. Foreign trade in food decreased in 2020, and increased in 2021 (compared to 2019). The deficit in food trade balance has increased due to the stagnation of export and increased import in 2020. The conclusion is that the COVID-19 pandemic had a certain impact on agricultural production, trade and food supply, particularly at the beginning of the pandemic, but it did not cause significant disruptions in food supply and demand. The recommendation is that the Republic of Srpska should increase its food production and food reserves to reduce dependence on food import in order to increase its resilience to market disturbances in extreme conditions such as a pandemic.

Key words: COVID-19 deasease, food production, food prices, food foreign trade

O3_03

Food for Future - Consumer Perspective

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Abstract

Food for future is one of the approaches towards eating habits change with focus in innovation. In this paper two kinds of food were observed, insect based food products and laboratory grown meat. Both are available in Asian markets, but also has its interested consumers in Europe. Main goal in this paper was to research consumer attitudes towards this kind of food from personal and collective perspective, more accurately form personal health benefit and climate change reduction perspective. For this research was used quantitative analysis based in data collected trough google form questionnaire that was open from June 16th until 17th 2021. Number of participants was 80 of what 66.3% were female, 31.3% male and 2.4% those who prefer not to say or other. Most of participants identify themselves as omnivores (71.3%), vegetarians (8.8%) and pescatarians (7.5%) with age range of 20-69. Respondents were from B&H, Italy, Serbia, Germany, Togo, Kenya, Croatia, Brasil, USA, Cambodia, Sweden, Ethiopia, Azerbaijan, Slovenia, Russia, Montenegro, Romania and North Macedonia. Besides this general, respondents answered to seven questions. Five questions were about insect based food products and laboratory grown meat, one about microgreens and one about future of the world in terms of food. Results of the research showed that respondents are more willing to consume occasionally or regularly this type of food when have in mind collective perspective. Also, they found laboratory grown meat comparing to insect based food products more attractive which is especially visible in personal perspective. Also, 71.3% respondents marked insect based food products consumer as omnivore. Interestingly, 23.8% claimed to feel guilty if consume plant sprouts. However, according to this research, world future will mostly depend on radically changed eating habits (36.7%) and organic agriculture (32.9%).

Key words: consumption, consumers, future, insect based food, lab grown meat

O3_04

Interest of Polish farmers in water and drainage investments - selected results of the INOMEL project

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Abstract

One of the challenges of modern agriculture is the proper management of water and limiting the effects of climate change, including warming and periods of drought and excessive rainfall occurring alternately. This means that it is necessary to look for solutions that will allow for sustainable water management on agricultural land and the achievement of appropriate production and financial results, thanks to the proper management of the available water resources. The research and implementation project INOMEL is carried out in Poland and concerns water and melioration issues and is to prepare proposals for innovative technical and organizational solutions that can improve water management on agricultural land. The aim of the study is to present the assumptions and selected results of the INOMEL project, including in particular the results of farmers' opinion surveys on determining the directions of potential interest in water and drainage investments in farms. Primary sources were used for the research. Data was collected using the survey method. The selection of respondents was deliberate and included farmers managing farms in Poland. Responses from 784 people were used for a detailed analysis. The respondents were most often interested in the modernization of the existing drainage facilities (53% of indications) and modern technical devices for regulating the water level on agricultural land (46% of indications). About 30% of people would like to build wells for irrigation, 21% of people - installations and devices for rainwater irrigation, and almost 14% - installations for drip irrigation. Quite a large group showed interest in computer software (15.5%) and smartphone applications (18.9%), which can help in remote monitoring and regulation of water and drainage devices.

Key words: water management, drainage, farmers, agricultural investments, farmer's opinion, innovation

O3_05

Export competitiveness of milk and dairy products of Republic of Srpska on the international market

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Abstract

The aim of this research is an analysis of competitiveness of milk and dairy sector of the Republic of Srpska on the international market. Indicators analyzed in the paper are: net trade index (NTI) and index of contribution to the trade balance (CTBI). Additionally, the paper investigated the type of external competitiveness of the milk and dairy products according to four criteria based on a comparison of unit prices of export and import. All indicators are calculated based on statistical data on foreign trade milk and of dairy products and referred to the period 2015 - 2021. In the structure of total export of agri-food sector, milk and dairy products have significant participation of 10.40% of total export. CEFTA and EU countries as the major market destinations for milk and dairy products recorded the participation of 20.30% and 4.81% in the total agri-food export of the Republic of Srpska. Unlike EU countries, the analysis of the NTI showed the existence of competitiveness in the trade of milk and dairy products between the Republic of Srpska and the world as well as CEFTA countries. The calculated values of CTBI indicated that milk and dairy products made a positive contribution to the trade balance between the Republic of Srpska and CEFTA countries as well as to the total trade balance. In trade with EU milk and dairy products showed comparative disadvantages. The results of the analysis based on the comparison of a unit of export and import prices indicated market segmentation of milk and dairy products into three parts: dominated price competitiveness on the world market, price and quality competitiveness on CEFTA market and predominantly price non – competitiveness on EU market. The conclusion includes recommendations for the improvement of the export competitiveness of the dairy sector of the Republic of Srpska, especially in trade with EU countries.

Key words: milk and dairy products, export competitiveness, Republic of Srpska, foreign trade

O3_06

Analysis and forecasting of fruit prices in Serbia

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Abstract

The paper presents the analysis and forecasting prices for three important fruit in Serbia: apple, plum and raspberry. The absolute fruit prices were analyzed for the period 2002-2020, staring thus from the year the euro was introduced. Conversion of the prices into euro was carried out according to the average annual exchange rate of euro, based on the data of the National Bank of Serbia. The analysis of the relative prices, which are price parities of certain fruit in relation to wheat, was conducted for the period 1994-2020.

The aim of this analysis was to formulate the relative changes of the economic position of certain fruit in relation to wheat. Forecasting of the prices for certain fruit was made for a five-year period 2021-2025.

ARIMA models were used for the forecast of price parity. Change rates were used to forecast absolute prices in euro.

The average price parities of the fruits for the period 1994-2017 will have next forecast for year 2025: apple price parity will improve from 3.13 to 3.15; plum from 2.31 to 2.88, and raspberry from 6.76 to 11.28.Absolute prices of raspberry and plum will increase significantly in 2025, comparing with average prices in 2002-2020. period: raspberry from 1.166 to 1910EUR/t and plum from 294 to 532 EUR/t. Price of apple has insignificant negative change rate, but in 2025, price will be higher (441 EUR/t) than average (372 EUR/t).

Key words: fruits, price, forecast, Serbia

O3_07

Fish market analysis with particular emphasis on the Recirculating Aquaculture System (RAS)

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Abstract

The fish market is an important part of the food sector. One of the divisions of this market concerns marine fish and fish produced in fish ponds. Fish farming in commercial ponds is confronted with problems of climatic, health, environmental and social causes like the perception of fish farming by the society and changing eating habits. RAS (Recirculating Aquaculture System) is currently the most widespread and popular form of keeping fish. Its absolute advantage is the possibility of continuous observation of the health condition of the fish and immediate reaction to any inappropriate behavior. In RAS, the farmers can create ideal conditions for the proper growth and development of each species. The unquestionable advantage of RAS is water - it can be reused, which solves the problem of water shortage. RAS is a part of the "Blue economy" principles. The aim of the paper is to present the situation on the fish market and to show the economic opportunities related to RAS. The analysis of the fish market covered the years 2010-2021. The following sources of information were used during the research: industry reports from EUMOFA, data from the Polish Central Statistical Office, and other branch reports and development strategies. Main conclusion is that fish production in RAS can contribute to the economic effect and increase the production of fish and seafood, what is important not only from economic point of view but also from the global food security.

Key words: Recirculating Aquaculture System, fish market, food security, fish ponds

O3_08

External price parities of wheat and maize in the Republic of Srpska

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Abstract

The aim of this research was to examine the changes in external price parities for wheat and maize, i.e. the relation between the prices of inputs (seeds, mineral fertilizers and fuel) and purchase prices of observed crops. The research was based on secondary data published by the Institute of Statistics of Republic Srpska for the period from 2010 to 2020. Considering the source of data, the desk research method was applied. The external price parities for wheat and maize are calculated, and additionally determined the basic indicators of descriptive statistics. The average price of wheat was 0.34 BAM/kg with a coefficient of variation of 13.09%, while the average price of maize was 0.33 BAM/kg and with a coefficient of variation of 14.65%. The research results showed that the purchase prices of wheat and corn had a slower growth compared to the prices of selected inputs. Compared to other inputs, the prices of mineral fertilizers had more pronounced variations, especially UREA (16.38%). In the analyzed period, maize price had a negative compound annual growth rate as well as euro diesel price. The external parities showed an imbalance of wheat and maize prices in relation to variable inputs prices which indicate an unfavorable economic position of agricultural producers in the Republic of Srpska.

Key words: wheat, maize, prices, external parities, Republic of Srpska

O3_09

The economic significance of biostimulants on the example of orchard production

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Abstract

Fruit growers are able to use modern anti-stress agents called biostimulants, also known as phytostimulants. In the event of unfavorable weather conditions these products when applied to a given plant help it return to its physiological balance faster. That way such a plant regenerates faster. At the same time, if stress factors do not occur on the plantation, biostimulants strengthen trees, make them grow faster and contribute to the development of stronger and deeper root system. Biostimulants have a multidirectional effect, they increase the amount of set fruit. The growing popularity of biostimulants in agriculture may result from the fact that their use goes in line with both the principles of integrated production and the importance of economic aspects. Among the preparations available on the Polish market there are Asahi SL, Shigeki, Kaishi, Tytanite, but also preparations based on seaweed filtrates such as Goemar BM 86, Algex or Agrocean. The available studies related to the use of biostimulants in apple production show positive production results (e.g. the use of Asashi SL increased the yield by 11.1 tons per ha). The aim of the study is to determine the importance of biostimulants and to present the calculation of profitability of their using in apple production. To collect the data a documentary analysis has been used. For the research findings a descriptive method has been used along with a method of financial calculations. The performed calculations show that the use of biostimulants in orchard production is profitable and helps to increase production value.

Key words: biostymulant, orchard production, agribusiness calculation, profitability

O3_10

Climate change adaptation measures in agriculture: the perspective of different experts groups

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Abstract

Climate change has a significant impact on agriculture and there are many measures proposed for its mitigation and adaptation. The selection of the most suitable measures for given local conditions is crucial for proper planning, implementation, and sustainability. In this paper, we present the results of the evaluation and prioritization of 24 measures done by 10 experts in a three-step multi-criteria procedure. First, experts individually assessed seven criteria for evaluating the measures: level of responsibility, category, implementation timeframe, multi-functionality, technical skills, cost-benefit ratio, and mitigation effectiveness. Assessment of criteria and calculation of their priorities is performed by using the analytic hierarch process (AHP), well known multi-criteria method. Second, experts are grouped into three clusters according to their backgrounds, and their priorities within each cluster are aggregated into group priorities of criteria. Finally, criteria priorities of each cluster are used to rank proposed measures as alternatives by the TOPSIS method. Results obtained for three groups of experts show differences in prioritization of criteria, as well as in the ranking of adaptation and mitigation measures. The applied methodology proved that planning of adaptation/mitigation measures requires the inclusion of different experts in the assessment and evaluation process, but also careful joint analysis of the results since wrong decisions can influence financial feasibility and applicability of measures in the practice.

Key words: climate change, agriculture, adaptation measures, planning, multi-criteria analysis, AHP, TOPSIS

Session 4: ANIMAL SCIENCES

Poster Presentations

P4_01

Physiological and ethological aspects of horse feeding

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Abstract

The paper aimed to define the optimal daily number of rations of a "modern" horse, regarding the physiological and ethological aspects, and to determine the number of ratios in horses in boarding and private accommodation in Croatia. From an evolutionary and physiological point, the horse was built for constant feeding. The rations have to provide an adequate supply of energy and nutrients and largely affects the horses' ethology. The management of feeding and quality of ration affects the horses' health and welfare. Today horses are far less physically active than before. The frequency of rations affects the physiological parameters of digestion and the aetiology of the horse. How to balance the appropriate ration frequency considering the physiological and ethological aspects, and the usage of the horse itself depends primarily on the daily amount and quality of feed required for the horse to remain fit. Usually, adult horses have two rations a day with a 10-hour daily interval and 14-hours nightly interval between rations. The frequency of a horses' ration varies depending on the way of keeping, category, physiological condition and usage. The effect of feeding on the health and welfare of horses is mainly focused on the appropriate intake of energy and nutrients and on the consideration of the aetiology of feeding, limiting concentrates to specific needs, availability of water and hygienic correctness of feed and water. Knowledge of the specific feeding needs of horses in physiology and aetiology should be considered an essential part of preserving the horses' welfare.

Key words: feeding, horse, feeding frequency

P4_02

An analysis of Simmental breed production results in the municipality of Loznica before and during the COVID19 pandemic

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Abstract

The COVID19 pandemic exerted a strong impact on various sectors of the economy, including agriculture. This paper aimed to show whether the pandemic had also affected the situation in animal husbandry in the municipality of Loznica and to what extent. According to the official data, there were 886,000 cattle heads in our country in 2020, which is the historical minimum in livestock production. The long-term negative trend in the number of Simmental cattle heads in the municipality of Loznica has affected the total milk production, as well as the average milk production per cow. The COVID19 pandemic made a great impact on the agricultural production of this area. Exports and imports of goods were also impeded, which affected the cattle breeding process. At the beginning and in the course of the pandemic, the general interest in cultivating the land declined. The presented results show that the trend in decreasing the number of monitors was followed by the trend of decreasing the amount of produced milk, year in and year out. Also, the analysis of the results indicates that the value of milk fat content ranged from 3.85% to 4.16%. The highest value of milkfat content was in 2021, and the lowest value was recorded in 2018. The protein content had the lowest value in 2021 (2.90%,), and the highest value was measured in 2018 (3.06 %). The results are characterized by small variability between the years, because the research was conducted in the same area, on cows of the same breed composition and a similar diet. This trend of livestock production in the municipality of Loznica is a consequence of inadequate and non-standardized cattle nutrition due to the limited activities of agricultural producers following the COVID19 pandemic.

Key words: milk, production, milkfat, proteins, pandemic

P4_03

Free traffic in robotic milking of cows through ethological and welfare approach

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Abstract

The cow welfare it is subject to various influences, in both negative and positive ways, such as: social interactions with other cows, human-animal interactions, management systems, nutrient supply, barn design, climate, etc. Two basic behaviours that are important in ethology of animals are eating and resting. The milking was incorporated between those two needs in robotic milking, or it was given to the free will of the animal itself. Robotic milking has gained widespread acceptance, as a way to reduce labour on dairy farms, increase milk production and simultaneously improve dairy cow welfare by allowing cows to choose when to be milked. The free cow traffic is one of the variations of cow traffic strategies, where cows can access feeding and resting areas of the barn with no restriction. The basic concept for such traffic is increase the comfort of cows, and compliance with the five freedoms of animal welfare.

Key words: dairy cows, free traffic, robotic milking, ethology, welfare

P4_04

Hoof trimming as factor affecting milk production in high-producing dairy cows

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Abstract

The milking cow uses a number of factors. The most important are breed, age of the cattle head, period of lactation, climatic conditions, microclimatic conditions in the facilities, dietary conditions and maintenance of healthy conditions of the animal. One of the most important factors used in the production results of dairy cows is the negative hoof status. The aim of this study was to examine the production results of two groups of dairy cows aged 3 years (second lactation) whose processing and care of hoofs affected the level of productivity. The total number of analyzed animals, in the free breeding system, was 100 dairy cows in the second lactation at the cattle farm "Lazar" in Blace. The first group (1) consisted of 50 dairy cows of the Simmental breed with which the hooves were circumcised twice during the year, at the age of 3 years. The second group consisted of 50 (2) heads of dairy cows of the Simmental breed with uncircumcised hooves, aged 3 years. The analysis included the total amount of milk produced during lactation, during which a weekly control of milk, proteins and milk fats was performed and in that way their quantitative and qualitative production results were monitored. For data analisys, the statistical method ANOVA was used, which examined the effect of several independent variables on a single variable. The correlation between the observed parameters and the Pearson correlation coefficient were also determined. Statistical processing of data and review of stable lists of production heads showed that the first group of animals showed a higher level of production of milk, milk fat and milk proteins compared to the second group of cows. It was proved that there are differences between the groups and that this difference is statistically significant at the level of $P<0.001$. All correlations are statistically significant at the $p<0.001$ level.

Key words: hoof trimming, care, dairy cows, milk.

P4_05

Yield and abatement of Trappist cheese "Marija Zvijezda"

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Abstract

In this paper the results of research for the cheese yield of the Trappist cheese will be presented. The cheese has been produced for more than 140 years by the monks of the Marija Zvijezda Monastery in Banja Luka. In 2008 the cheese production has been restored on the location where the first Trappist dairy plant was established and the cheese has been presented to the market in cooperation with Agricultural Cooperative "Livač" based in Aleksandrovac in Laktaši. Characteristic of the Trappist cheese is that it is made in the form of a wheel weight 1.6-2.0 kg and it has a natural rind which is yellowish, thin and smooth. Conditions and a way in which it ripens are specific and give a special flavor to the cheese. The duration of the ripening is a minimum of 90 days and it is happening under specific conditions of humidity and temperature. The cheese ripens on wooden boards and it is rotated and cleaned manually. The cheese consistency is soft, elastic, mild and easily cut. The cut is smooth without or with very little holes and it is paled colored. It is characterized by a clean scent of milk, slightly salty and easily soluble. The cheese yield calculated of the Trappist cheese is 12.81%. The actual cheese yield obtained after ninety days of cheese ripening is 10.74 %. By monitoring the production process, the cheese abatement is changing with ripening time and at the end of the production cycle, which lasts ninety days, is 0.322 kg or 15.85%. The amount of whole milk needed for one kilo of the final cheese product is about 9.35 kg.

Key words: cheese abatement, cheese yield, monastery of Marija Zvijezda, Trappist cheese

P4_06

Incubation results of heavy line hybrid breeding eggs with cracked shell and membrane

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Abstract

The aim of study was to examine the possibility of using breeding eggs with cracked shell and membranes for incubation after repairing the damage with surgical tape. A total of 525 eggs from the Cobb 500 parent flock were used as experimental material. The collected eggs were divided into 5 groups with 105 eggs per group. The control group were eggs with intact shell and membranes. The first experimental group were unrepaired eggs with cracked shell and membranes, the second experimental group eggs with unrepaired cracked shell, the third experimental group eggs with repaired cracked shell, and the fourth experimental group were eggs with repaired cracked shell and membranes. The study was conducted in an incubation station where the egg weight was measured immediately before their placement in the pre-hatchery and the day 18 of incubation, the number and quality of chickens and the inspection of the hatchery residue on the day of hatching. The following parameters were determined: egg fertilization (%), hatchability of all and fertilized eggs (%), early, medium and late embryonic mortality (%) and contamination of eggs (%). Statistical data processing was performed using the methods of descriptive analysis and analysis of variance in the software Statistica 12, and the significance of differences in the meanings was examined by post hoc Tukey test. Repairing of shell and membrane cracks with surgical tape had an impact on the hatchability of all and fertilized eggs, as well as on the percentage of contaminated eggs. The group of eggs with unrepaired shell and membrane cracks had the lowest values of hatchability of all and fertilized eggs, and the highest percentage of contaminated eggs.

Key words: breeding eggs, shell and membrane cracks, repairing, incubation results

P4_07

State of biosecurity on cooperative broiler farms

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Abstract

The aim of study was to examine the state of biosecurity on cooperative broiler farms, and the level of farmers' knowledge about biosafety. In order to assess the state of biosecurity, the survey was conducted on 30 broiler cooperative farms in Prnjavor region. The questionnaire consisted of 63 questions divided into 11 units. Questions were about biosecurity practices related to the following production phases: procurement of one-day-old chickens, housing of chickens, feed and water supply, removal of manure and dead birds, visitors and workers, bedding, infrastructure, location, cleaning and disinfection, diseases, and use of equipment. The answers were offered according to the principle of the Likert scale, and the methods of descriptive statistics were used to analyse collected data. The study confirmed that there is a positive relation between biosecurity practices on cooperative broiler farms and achieved production results. That means that higher level of application of recommended biosecurity measures led to the better production results. The consequences of non-compliance with preventive biosecurity measures can be detrimental for both production and financial results on the farm. Research has also shown a high degree of ignorance of farmers about the importance of biosecurity measures, and the low awareness of the consequences they can cause by not respecting them. The main production organizer should organize the additional education for the farmers, and to provide financial support for the implementation of biosecurity measures on their farms.

Key words: broilers, biosecurity, production, education

P4_08

Effects of high water temperature on embryonic development and different times of initial nutrition on survival and growth of juvenile rainbow trout (*Oncorhynchus mykiss*)

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Abstract

The aim of this study was to determine the duration of individual stages of embryonic development at high water temperatures, the effect of initial feeding time on survival of rainbow trout to three months of age and growth characteristics of three-month-old rainbow trout. The research was carried out in laboratory conditions for 144 days, and consisted of three parts; I - effects of high water temperature (15.16±0.79ºC) on the duration of embryonic development, II - effects of initial feeding time on survival of rainbow trout to three months of age and III - effects of initial feeding time on growth of three-month-old rainbow trout. Embryonic development in stages lasted; 14 days (221 degree day) until the appearance of the eyes, 18 days (280 degree day) until the beginning of the hatch, 24 days (368 degree day) the hatch was completed and 33 days (500 degree day) all the fish swam. In the second part, after swimming, two groups of 300 fish were formed. The initial diet with commercial feed in the G_{12} group started 12 (528 degree day) and in the G_{16} group 16 days (580 degree day) after the outbreak. Mortality during the second period (G_{12} = 5.33% and G_{16} = 3.33%) was not statistically significant ($p > 0.05$). In the third part, it has been determined a statistically significant difference in mean weight, total length and fork length ($p < 0.05$) was found, as a result of different time initial diet. In the second week, a significant difference ($p < 0.05$) was found only for the fork length, and no significant differences were found until the end. No significant difference was found between the observed groups in the condition factor (CF), the feed conversion ratio (FCR), the specific growth rate (SGR) and the thermal unit growth coefficient (TGC).

Key words: embryonic development, survival, initial diet, growth, rainbow trout

P4_09

Investigation of morphometric specification of crayfish (*Austropotamobius torrentium* Schrank, 1803) in Subotica river, Bosnia and Herzegovina

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Abstract

Stone crayfish (*Austropotamobius torrentium*) is one of the four native European crayfish species inhabiting Bosnia and Herzegovina. In Bosnia and Herzegovina, stone crayfish can be found in the Sava river basin (rivers Bosna, Una, Vrbas). The aim of this study was to investigate the variability of selected morphometric characteristics of male and female crayfish of the species *A. torrentium* from the Subotica river (Bronzani Majdan). The crayfish were sampled in September and October of 2021 and then 20 individuals (14 males and 6 females) were caught. Crayfish were analyzed fresh in the field and in the laboratory. Dimensions of 22 morphometric characteristics were analyzed, in males and females, while condition indices were also calculated. The mean body length ± SD was 75.8 ± 13.06 mm in males and 78.44 ± 7.60 mm in females. The mean recorded body weight ± SD was 21.44 ± 10.56 g in males and 16.51 ± 3.51 g in females. Using the linear regression method, a positive correlation was found between body length and weight (♂ R2 = 0.8563; ♀ R2 = 0.8439), body weight and claws length (♂ R2 = 0.9824; ♀ R2 = 0.8494), as well as carapace width and body length (♂ R2 = 0.874; ♀ R2 = 0.6726). Using the Mann-Whitney U test, a statistically significant difference of the analyzed morphometric parameters was found between the sexes in length of the claw palm ($p = 0.03$) and abdomen width ($p = 0.005$), which is explained by the pronounced sexual dimorphism of this type of Stone crayfish. The values of condition index (Fulton´s Conditions Factor and Crayfish Constant) point to favorable conditions in Subotica river for the existence of the species *A. torrentium*.

Key words: Stone crayfish, males, females, morphometric characteristic

P4_10

Analysis of the frequency distribution of metabolic parameters in a pooled sample in early lactating cows

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Abstract

The use of a pooled blood sample can be of great importance in assessing the metabolic status of cows. Pulling of samples allows a single sample to be obtained from a large number of individual samples. The aim of this paper was to examine the frequency distribution characteristics of a large number of pooled samples. The experiment included 60 pooled samples consisting of 10 individual samples. Samples were selected by random selection, and originated from 100 cows in early lactation (0-60 days of lactation) from which blood was taken and 30 individual samples were made from each cow. Laboratory analysis includes determination of beta-hydroxybutyrate, non-esterified fatty acids, cholesterol, triglycerides, glucose, albumin, total protein, urea, Ca, P, total bilirubin and aspartate aminotransferase. The mean values and standard deviations are similar to the reference values of cow metabolites. There is a significant correlation between the values of the pooled sample and the calculated mean values of the individual samples participating in the pool. By visual analysis of frequency distributions (histogram and QQ-plot) we conclude that there is a distribution that corresponds to the normal frequency distribution. The KS-test confirmed the normality of the frequency distribution for all metabolites from the pooled samples except for BHB, TGC and AST. The normality of the distribution of pooled samples and their mean value and variability similar to the reference values indicate that there are good preconditions for the use of pool samples in the assessment of the metabolic status of the herd in early lactation.

Key words: cow, early lactation, pooled sample, metabolic profile.

P4_11

The influence of the saeason on milk urea content in dairy goat farms

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Abstracts

Milk urea content is a useful indicator of protein and energy balanced diet and it is used in systematic control of cows' milk, while in sheep and goat milk it is not determined or controlled. The aim of this study was to determine the urea level in goat milk and examine the influence of season.

The observation was made on 10680 samples of milk control records of goats in the period of three years, from year 2019 to 2021. The goats on the three observed farms were reared in a closed system with a balanced diet throughout the whole year. Analyses of raw milk samples were carried out on the FOSS instruments MilcoScan in Laboratory for Milk Quality Control, at the Faculty of Agriculture, Department of Animal Science. According to the season of sampling, milk samples were divided into four groups: group I winter (December – February), group II spring (March – May), group III summer (June – August) and group IV autumn (September – November). Statistical analysis were done using program Statistica 14.0. The average MU content was 39.69 mg/dl (10.40 – 95.40 mg/dl). The study shows statistically highly significant differences in MU content ($P<0.01$) between seasons and also between all observed milk parameters (milk fat, protein, lactose and daily milk yield). The lowest urea content was in spring (37.83 mg/dl), and the highest was in autumn (41.94 mg/dl).

Key words: milk urea, goat milk, milk parameters

P4_12

Relationship between the characteristics of estral mucus and the results of artificial insemination of cows

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Abstract

The aim of the study was to examine the relationship between the time since estrus detection, the quality of estrous mucus of cows (quantity, density, purity) and the degree of crystallization on the one hand, and the success of artificial insemination, expressed through the percentage of pregnant cows, on the other. Samples of estrous mucus (n = 51, originating from 14 heifers, one first-calving cows and 36 cows of higher parity) were taken by a trained inseminator, during artificial insemination, by transferring drops of mucus from insemination catether to the microscopic slide, on which a smear was then made. Estrous mucus smears were air dried and observed under a microscope to establish a crystallization model. The degree of crystallization was assessed according to the classification given by Bishnoi et al. (1982) and Tsiligianni et al. (2000). The collected data were grouped in relation to the time since estrus detection, mucus quality and degree of crystallization from one, and the percentage of pregnant cows on the other side. The results of this research indicate that during the period from the detection of estrus to insemination, there are changes in the quality of estrous mucus, as well as in the degree of its crystallization, which can significantly affect the results of artificial insemination.

Key words: cows, estrous mucus, insemination, pregnancy

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P4_13

Influence of parity and farrowing season on reproductive characteristics of sows

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Abstract

The most complex challenge of modern pig farms is to maintain the level of production and achieve financial business plans. Farms achieve results based on reproductive efficiency and genetic improvement of desirable productive and reproductive traits of animals. In addition, the production conditions themselves play a very important role. For the purposes of this research, data were collected from a commercial pig farm in the territory of Eastern Serbia, for a period of three years, observing all four time seasons. The impact analysis was performed on the following parameters: weaning-estrus interval, number of farrowed sows, number of stillbirths per litter, number of live births per litter, death of piglets up to day 3 (%), number of weaned piglets, body weight of piglets at weaning, duration of lactation-days, duration of pregnancy-days. Data processing was performed using the software package SPSS 17.0. Using descriptive statistics with arithmetic mean, standard deviation, multiple linear regression methods and the method of one-factor analysis of variance - ANOVA, it can be concluded that season and farrowing parity have an impact on the observed reproductive parameters.

Key words: sows, farrowing parity, farrowing season, reproductive performances

P4_14

Review of hemorrhagic fever with renal syndrome (HFRS) and leptospirosis in the Republic of Srpska, 2014-2018

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Abstract

Hemorrhagic fever with renal syndrome (HFRS) is a viral zoonosis, primarily a disease of forest rodents known as natural-focal disease. Leptospirosis is a contagious disease of humans, domestic and wild animals, caused by bacteria of the genus Leptospira. This paper presents the number of patients, the incidence rate, the percentage representation and the geographical distribution of HFRS and leptospirosis in the period 2014-2018, in the Republika of Srpska. The data used were obtained at the Clinic for Infectious Diseases of the University clinical centre of the Republic of Srpska in the period from January 1, 2014 to June 30, 2018, and the Institute of Public Health of the Republic of Srpska. In the observed period, the highest number of patients with leptospirosis was registered in 2014 (27.45%; incidence rate of 3.0‰), and the lowest in 2018 (4.0%; incidence rate of 0.3‰). Regarding the geographical distribution, most patients are from the Banja Luka Region (76.34%), followed by the Prijedor Region (18.28%) and the Doboj Region (5.38%). The HFRS incidence rate was the highest in 2017 at 8.1‰, and 49.22% of the share in the total incidence of anthropozoonosis, and the lowest in 2018 at 6.67% and the incidence rate of 0.4‰. The percentage of HFRS by region was the highest in Banja Luka Region 57.94%, and the lowest in Bijeljina Region 0.94%. The risk of these diseases is always present in natural foci and it is not possible to estimate what the trend will be, compared to previous years. During epidemic years, when the risk is somewhat higher, it is necessary to adhere to the prescribed personal protection measures as well as to conduct continuous systemic deratization in order to reduce the level of mouse-like rodents to a biological minimum.

Key words: hemorrhagic fever with renal syndrome, leptospirosis, natural-focal disease

P4_15

Application of sensory analysis in the assessment of the quality of meat products with different sodium chloride content

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Abstract

The aim of this paper was to evaluate sensory quality of commercial boiled chicken sausages and boiled pork sausages with different salt content. Descriptive sensory analysis was used. The basic physico-chemical parameters of samples were also determined. The results showed that the chicken sausage sample with 3.42% salt and the pork sausage sample with 3.03% salt had better sensory quality compared to the samples with 2.43 and 3.30% salt, respectively. Chicken sausage with lower salt content had a less pronounced odor, aroma and taste and softer consistency with significant differences ($P < 0.05$) comparing to sample with higher salt content. The difference in salt content between pork sausages was smaller than between chicken sausages, but also significant ($P \leq 0.05$).

Key words: boiled sausages, NaCl, sensory quality

P4_16

The occurrence of heavy metals (Pb and Cd) in the kidneys of wild boar (*Sus scrofa*), mangulica and fattening pigs

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Abstract

The heavy metals as lead (Pb) and cadmium (Cd) are possible contaminants of food and feed. For the purpose of this work the samples of kidneys of fatteners, Mangulica pigs and wild boar were analyzed. Fattening pigs live in control conditions up to six months, while Mangulica pigs and wild boar live longer and in uncontrolled conditions. In total 20 samples of kidneys were analyzed (2 wild boars, 6 Mangulica and 12 fattening pigs). In all samples the concentration of lead and cadmium was above the limit of detection. For cadmium the limit of detection (LOD) was 2.32 µg/kg, while limit of quantification was 7.04 µg/kg. For lead LOD was 4.26 µg/kg and LOQ was 12.9 µg/kg The concentration of lead and cadmium in samples of kidneys of fattening pigs was in the allowed range while for the Mangalica pigs and wild boar the concentration of lead in some samples exceeded the permitted levels. The maximum concentration of lead and cadmium was found in samples of kidneys of Mangulica and were 1069 µg/kg and 484 µg/kg respectively. The average concentrations of lead for the Mangulica, wild boar and fattening pigs were 759, 731 and 243 µg/kg respectively. In all samples the concentration of cadmium was in the allowed range, with the average concentration from 337 µg/kg. There is a need for the further research.

Key words: heavy metals, kidneys, Mangulica, wild boar

P4_17

A review of pheasant hatching production results at the Ristovača pheasant farm in the period between 2019 and 2021

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Abstract

The paper presents the results used from the registry records in the pheasant farm "Ristovača" for the period from 2019 to 2021. They show data on the number of incubated eggs, the number of hatched pheasants and the mortality of pheasants that were achieved by stages of production in the observed period. Today, in the hunting grounds of Serbia, there are a large number of production and technical facilities that are used for artificial breeding of pheasant chickens. Growing pheasants in controlled conditions is a necessity and a need to increase the insufficient natural production of pheasants. The health condition of the parent flock, the general condition of the individuals and the condition of the parent pairs affect the quality of the obtained eggs, ie a larger number of fertilized and a smaller number of scrapped eggs. Based on previous research, it can be concluded that egg hatching of 75% represents the limit of profitability in controlled pheasant breeding conditions. In our research, the average egg hatching was 80.38% and ranged from 77.45% to 81.94%. This effect was the result of high egg fertilization by an average of 87.58%. Poor production results and a high degree of scrapped eggs were observed in the period of bad weather conditions and extreme temperatures (13.48%). The success of growing pheasant chickens largely depends on climatic conditions, so it is recommended to grow pheasants in controlled conditions where it is possible to achieve better production results.

Key words: pheasant, breeding, hunting ground, fertilization, feasibility.

P4_18

Impact of fat levels in a meal on pheasant chicks´ growth under controlled brooding conditions

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Abstract

The paper presents research results relating to the growth of pheasant chicks in the initial phase of brooding, in the period between the first and forty-second day, affected by the level of fat in the mixtures used to feed pheasant chicks. The research objective was to establish the extent to which the level of fat affects pheasant chicks´ body mass, the number of dead chicks, the feathering of chicks, and the uniformity of a flock. The body mass of little pheasant chicks at the moment of release into the hunting ground is very important for the degree of survival in the period of adaptation to natural conditions. The research was conducted at the pheasant farm of the Niš Hunting Association under controlled conditions and in accordance with hunting ethical principles. The research included 200 pheasant chicks divided into four groups of 50 heads, one control group, and three experimental groups. Each group of pheasant chicks was fed with a standard mixture technologically recommended for that age group, and enriched with different % of lard, 0,5% (I), 1,5% (II), and 2,5% (III). When one considers the current data in relevant reference literature one can conclude that brooding pheasant chicks under controlled intensive conditions requires a well-balanced meal and high-fat levels in the third and fourth weeks of life (day 20-30), immediately before their intensive growth and accelerated feathering. Increased weight gain of 13.94 g in the period between the first and third measurement indicates that the share of added lard with 1.5% in the mixture is considered rational and has a positive effect on chicks´ body mass, weight gain, flock feathering, reduced mortality and flock uniformity.

Key words: pheasant, chicks, feeding, fat

P4_19

Analysis of the quality of Roe deer nutrition in winter and spring period in the hunting ground

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Abstract

The aim of this study is to compare the specifics of winter and spring diet of the roe deer on the basis of the results of the analyzed samples of rumen content. Chemical analysis was performed on a total of 13 samples of roe deer rumen content, where 7 samples make up the rumen contents with the remnants of the winter diet, and 6 samples are rumen contents from the spring feeding period. The parameters examined in this study were the level of crude protein and the content of fiber (NDF, ADF and ADL). The obtained data was processed by descriptive statistics, after which a comparison was made between the groups using F-test. Based on the analysis, it was found that there is a statistically significant difference in the level of NDF in the content of rumen in winter and spring, as well as a statistically very significant difference in the amount of crude protein in rumen contents between groups. Content of NDF in samples from the winter period was higher in relation to the rumen content from spring period, while the amount of crude protein was significantly higher in the samples from the spring period of feeding.

Key words: Roe deer, rumen content, fiber content, crude protein

P4_20

Age structure and real growth rate of brown hare (*Lepus europaeus* P.) at the Serbian hunting grounds in 2021

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Abstract

The paper presents the results of the analysis of the age structure and real growth of harvested brown hare, as one of the most economically important species of small game in Serbia. The analysis included ten hunting grounds with a total of 548 collected brown hare samples, in accordance with the Law on Game and Hunting (2010). In order to determine the age structure of the brown hare population, we used the method of measuring the eye lenses. The participation of brown hare aged three months in the age structure of harvested hares individuals has not been determined. Since the brown hare was hunted in the last week of October and in November, this indicates that the participation of kittens from the July-August litter was not present. The share of brown hare aged 3-6 months in the total harvesting was 17.34%, which indicates that the May-July litter in 2021 did not have a decisive impact on the size of the population. The share of brown brown hare s aged 6 months to 1 year was 32.66%. This situation in the observed hunting year can be interpreted in the way that the first brown hare litters have a significant share in the autumn population. The real brown hare growth in 2021 was 50.00%, which can be characterized as "weak growth" observed for all ten hunting grounds. However, depending on the hunting ground, the real increase varied from 30.74% to 64.10%. In the surveyed hunting grounds during 2021, the number of autumn brown hare populations was most affected by brown hare litters born until May. The variability of the participation of age groups is influenced by a large number of exogenous factors, especially climatic factors, as well as the presence of vegetation in the hunting ground.

Key words: Lepus europaeus Pallas, age, growth rate, management

P4_21

Possibility of applying higher drying temperature of eye lenses in order to determine the age of brown hare (*Lepus europaeus* Pallas)

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Abstract

The aim of this study was to examine the possibility of shortening the duration of the reference method for determining the age of brown hare (*Lepus europaeus* Pallas) based on ocular lenses by increasing the drying temperature. Samples (eye lenses) that were processed and analyzed were from hunting grounds "Cer" and "Barajevo", and total number of the samples was 64. The methodology was based on increasing the drying temperature of eye lenses from 37°C to 48°C, and the final results were compared with the results obtained by the reference method. The analysis of the eye lenses mass dried by the reference method (at 37°C for 72h) and lenses dried at 48°C for 48h didn't showed statistically significantly difference ($p>0,05$). The standard method can give the final results in six days, and since the hunt is done once a week, depending on the time of delivery of samples to the laboratory, the final results can be obtained immediately before the next hunt. In that way, the user of the hunting ground cannot determine the structure (the dynamics of the population), and thus the shooting plan, which lead to the one week delay in hunting. On the other hand, by increasing the drying temperature, the drying time can be reduced by one day, which means that the final results can be obtained the day before. Thus, the user of the hunting ground has enough time to analyze the data, which enables the realization of the next hunt without delay. In order for the obtained results, and thus the method, to be taken into account and used in further work, it is necessary to perform research on a larger number of samples, i.e. to determine the possibility of applying this method within all age categories.

Key words: brown hare, age determination, eye lenses, population dynamics

Session 4: ANIMAL SCIENCES

Oral Presentations

O4_01

Sustainable development of livestock production in the light of climate change

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Abstract

The agriculture area is limited worldwide. Sustainable land management is necessary, not only against the background of climate change, in order to do justice to the various interests in the area. Existing functions on the land, for example the production of food or animal husbandry. Livestock is an important branch in the economies of the Western Balkan countries. The question for the future is: What is sustainable livestock production? It is considered to be the Integrated system of animal production practice that will meet human needs for food, protein and fiber while improving the quality of the environment through the most efficient use of non-renewable resources. At the same time, it will ensure economic sustainability, improve the quality of life, protect the health and welfare of all farmed species. Risks of climate change are an increase in temperature and / or drought (lack of water) before the time of germination, siding, screwing or grain filling phase, which can lead to a drop in yield or loss of quality. On the other hand, excess water before harvest can also lead to serious quality losses. Higher temperatures, increased rainfall, and less snow cover encourage traditional animal husbandry (livestock) systems. Such situations, which occur more and more often from year to year, will have a negative impact on the preparation of food for domestic animals and thus on their yields. With regard to all models of climate change assessment, livestock will find itself in a situation to look for new models of domestic animal breeding, with a focus not only on breeding animals that will be less sensitive to heat stress with optimal production, but also on breeding crops that will also be resistant to high temperatures. This is certainly a challenge for current and future generations of researchers.

Key words: sustainable agriculture, livestock production, climate change

O4_02

Overview of research and education activities in precision livestock farming

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Abstract

Precision Livestock Framing (PLF) is one of fundamental pillars for the future of animal production. PLF can be defined as the management of livestock farming by continuous automated real-time monitoring/controlling of production/reproduction, health and welfare of livestock and environmental impact, applying engineering principles and process control in livestock management. In this presentation, the following aspects related to PLF will be addressed: - International organizations that carry out PLF related activities - Approach to some PLF projects and case studies for extensive and intensive livestock production systems with emphasis on the AWARTECH (Animal Welfare Adjusted Real Time Environmental Conditions of Housing) project - Framework of teaching PLF in different universities around the world. The role of the newly created PLF Education group within the CIGR (World Organization of Agricultural Engineering).

Key words: Precision Livestock Farming, Research, education, globalisation

O4_03

The precision technologies in livestock production

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Abstract

The forecasts indicate that the global human population by the year 2050 will be over 9 billion resulting in the consumption of 50–60% more food compared to the present consumption. Furthermore, the global population is becoming wealthier indicating that will tend to prefer animal products (meat, milk and eggs). In order to prevent global food insecurity, it is essential to enable sustainable intensification of animal production under the following conditions: increased demand for animal products, reduced resources required for production (agricultural land, water), and availability of various tools and production methods. In these conditions, intensification of animal production implies the increase of animal density and decrease of the stock-person per animal ratio. In the case of increasing herd size and decreasing workforce availability, precision livestock farming imposes as an optimal solution. Precision livestock farming implies the usage of various sensors and big data analysis in order to provide a simple score concerning animal health, productivity, fertility, and welfare. By gathering and analyzing a large quantity of data precision livestock farming can provide farmers with information regarding the production, reproduction and welfare at the animal and herd level. That information enables a farmer to optimize the management of the farm and consequently realize an efficient and sustainable animal production system. The benefits of the application of precision livestock farming are reflected through improved animal health and welfare, increased efficiency, decreased production costs, improved quality of products, decreased negative environmental effects and increased sustainability of the farm. Currently, there are a large number of different precision livestock farming technologies on the market. The decision of what system should be applied (single/multiple sensors) on a particular farm depends entirely on the farmer.

Key words: livestock production, precision technologies, sensors, big data

O4_04

The impact of breeding region and lactation on milk yield traits in the of Simmental cattle population of the Republic of Serbia

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Abstract

The objective of this research was to study phenotypic expression and factors that can affect milk yield traits in the population of Simmental cattle breed in the Republic of Serbia. The research was conducted on a set of data that included records on the production and origin of Simmental breed cows displayed both in regional and municipal exhibitions in the territory of the Republic of Serbia in the period from 2004 to 2017. A final data set included records on production and origin of 1176 Simmental breed cows. The animals were raised in the area covering 9 regions of the Republic of Serbia. The research included most important milk yield traits in standard lactation: milk yield, milk fat content, milk fat yield, yield of 4% fat-corrected milk (4%FCM). An average milk yield in studied population accounted for 5.520±919 kg, milk fat content 3.94±0.11%, milk fat yield 218±38 kg, while the yield of 4% fat-corrected milk accounted for 5.474±933 kg. It was determined that region, age and lactation had a very high statistically significant effect on studied traits while the age of cows had no statistical effect.

Key words: milk traits, Simmental breed, breeding region

O4_05

Harm to the well-being of the udder at the level of dairy farms of Sidi Mhamed Benali Wilaya of Relizane (Algeria)

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Abstract

Background: Among the dairy cattle production problems in Algeria, mastitis rank first in terms of socio-economic impact. Our aim is to identify the state of well-being of the udder in order to manage and control mastitis related problems. Methods: The pH analysis of 177 cow milk samples was performed at two farms located in the Sidi Mhamed Benali region in northwest Algeria associated with an assessment (of the udder's cleanliness degree, the udder's position, the teat's hyperkeratosis lesion and the ITH) out over a period of one year (2020-2021). Result: Analysis of mean (of cleanliness, udder position and ITH) between cold and warm season were significantly different at a value of [(4.11; 2.75); (5.19; 4.11); (56.96; 73.76)] respectively. The paper test revealed that the health of the udder is influenced by any variation in cleanliness and the ITH whose correlation coefficient is equal to 0.72 leading to the appearance of subclinical mastitis during the cold season. While during the hot season the bad milking procedure is incriminated in the appearance of hyperkeratosis lesion at a mean value equal to 1 (smooth ring stage) inducing the appearance of clinical mastitis with $p<0.05$, moreover the cows in first lactation are the most influenced by these elicited factors. In conclusion, monitoring and evaluating the well-being of the udder around the parturition is a tool that allows better prevention of mastitis.

Key words: animal welfare, audit, dairy cattle, mastitis

O4_06

Phenotypic description of the Lipicane horses' population from Bosnia and Herzegovina and Serbia

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Abstract

Lipicane horses play an important role in horse breeding in Bosnia-Herzegovina and Serbia, particularly through the studs Vučijak, Karađorđevo and Kelebija. The breeding goals at these stud farms are different, and have results in differences in the phenotype of the horses. The aim of this study was to present the means and differences in body traits of Lipicane horses between three stud farms. Out of a total of 225 horses (88 stallions and 137 mares) following body measurement were recorder: height at withers, circumference of chest and circumference of cannon bone forelimb. All horses were at least 4 years or older at the time of measuring. Based on morphological measures, chest girth and boniness index were calculated. The results showed that Lipicane horse from these three stud farm are significantly different ($p<0,01$). The biggest horses were in Kelebija, middle in Karađorđevo and the smallest were in Vučijak stud farm. We can conclude that the Lipizzan population at the Vučijak and Karađorđevo stud farms is on average lower than recommendations of LIF, while the horses at the Kelebija stud farm are at the lower limit. Observed by sex, we see that stallions from the stud farm Karađorđevo and Kelebija as well as mares from the stud farm Kelebija are in accordance with by international standards, while mares and stallions from the Vučijak stud farm as well as mares from the Karađorđevo stud farm are below this standard.

Key words: stud farm, Lipicane horse, body measurement, difference

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