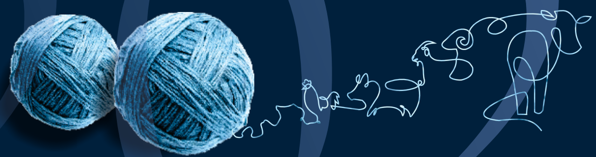
14th INTERNATIONAL SYMPOSIUM

MODERN TRENDS IN LIVESTOCK PRODUCTION

2023



PROCEEDINGS

4 - 6 October 2023, Belgrade, Serbia

Institute for Animal Husbandry
Belgrade - Zemun, SERBIA

14th
INTERNATIONAL
SYMPOSIUM

MODERN TRENDS IN LIVESTOCK PRODUCTION

2023

PROCEEDINGS

4 - 6 October 2023, Belgrade, Serbia

PATRONS

Ministry of Science, Technological Development
and Innovation of the Republic of Serbia
Ministry of Agriculture, Forestry and Water Management
of the Republic of Serbia

ORGANIZER

Institute for Animal Husbandry
Autoput 16, P. Box. 23,
11080, Belgrade-Zemun, Serbia
Tel: +381 11 2691 611; +381 11 2670 121; +381 11 2670 541;
Fax: + 381 11 2670 164;

PUBLISHER
Institute for Animal Husbandry, Belgrade-Zemun, Serbia

Editor
Zdenka Škrbić, PhD, Principal Research Fellow
Institute for Animal Husbandry, Belgrade-Zemun

The Proceedings is printed by the Institute for Animal Husbandry,
Belgrade, 2023

biotechnology.izs@gmail.com
www.istocar.bg.ac.rs
Circulation 100 copies.

ISBN 978-86-82431-80-0

INTERNATIONAL SCIENTIFIC COMMITTEE

INTERNATIONAL SCIENTIFIC COMMITTEE

INTERNATIONAL SCIENTIFIC COMMITTEE

Dr. **Sam Millet,**
ILVO, Flanders Research Institute for Agriculture, Fisheries and Food, Belgium
Prof. Dr. **Antonella Dalle Zotte,**
Departmernt of Animal Medicine, University of Padova, Italy
Prof. Dr. **Snežana Trivunović,**
University of Novi Sad, Faculty of Agriculture, Serbia
Prof. Dr. **Predrag Perišić,**
University of Belgrade, Faculty of Agriculture, Serbia
Prof. Dr. **Martin Škrlep,**
Agricultural Institute of Slovenia, Slovenia
Dr. **Violeta Caro Petrović,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Dr. **Nevena Maksimović,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Prof. Dr. **Vesna Gantner,**
Josip Juraj Strossmayer University of Osijek,
Faculty of Agrobiotechnical Sciences, Osijek, Croatia
Dr. **Maria Munoz,**
Departamento Mejora Genética Animal,
INIA, Spain
Dr. **Violeta Mandić,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Prof. Dr. **Pero Mijić,**
Josip Juraj Strossmayer University of Osijek,
Faculty of Agrobiotechnical Sciences, Osijek, Croatia
Prof. Dr. **Zoran Luković,**
University of Zagreb, Faculty of Agriculture,
Department of Animal Science and Technology, Croatia
Prof. Dr. **Dubravko Škorput,**
University of Zagreb, Faculty of Agriculture,
Department of Animal Science and Technology, Croatia
Prof. Dr. **Aleksandar Simić,**
University of Belgrade, Faculty of Agriculture, Serbia
Prof. Dr. **Simeon Rakonjac,**
University of Kragujevac, Faculty of Agronomy, Serbia

INTERNATIONAL SCIENTIFIC COMMITTEE

Dr. **Jasna Prodanov-Radulović,**
Scientific Veterinary Institute "Novi Sad", Serbia
Prof. Dr. **Rosa Nieto,**
Departament of Physiology and Biochemistry of Animal Nutrition Estacion Experimental del Zaidín, CSIC Armilla, Granada, Spain
Dr. **Jordan Marković,**
Institute for Forage Crops, Kruševac, Serbia
Dr. **Juan M. García Casco,**
Departamento Mejora Genética Animal, INIA, Madrid, Spain
Dr. **Slavica Stanković,**
Maize Research Institute „Zemun Polje", Belgrade, Serbia
Dr. **Vesna S. Krnjaja,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia

ORGANIZING COMMITTEE

CHAIRMAN

Dr. **Nikola Delić,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia

SECRETARY

Dr. **Maja Petričević,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia

MEMBERS

Dr. **Marina Lazarević,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Dr. **Marija Gogić,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Dr. **Vladimir Živković,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Dr. **Nenad Mićić,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Dr. **Vesna Dragičević,**
Maize Research Institute „Zemun Polje", Belgrade, Serbia
Prof. Dr. **Tanja Vasić,**
Faculty of Agriculture, University of Niš, Serbia
Prof. Dr. **Tanja Petrović,**
Faculty of Agriculture, University of Belgrade, Serbia
Dr. **Nataša Tolimir,**
Institute for Science Application in Agriculture, Serbia

SYMPOSIUM SECRETARIAT

CHAIRMAN

Dr. **Maja Petričević,**
Institute for Animal Husbandry, Belgrade-Zemun, Serbia

MEMBERS

Slavko Maletić, grad. econ.
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Olga Devečerski, grad. prof.
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Bogdan Cekić, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Miloš Marinković, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Nenad Stojiljković, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Ivan Ćosić, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Tamara Stamenić, MPharmSc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Tanja Keškić, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Danijel Milenković, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Nemanja Lečić, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia
Aleksandra Petrović, Msc,
Institute for Animal Husbandry, Belgrade-Zemun, Serbia

Address:

Institute for Animal Husbandry,
Autoput 16, P. Box 23,
11080, Belgrade-Zemun, Serbia

Tel:
+381 11 2691 611
+381 11 2670 121
+381 11 2670 541
Fax:
+381 11 2670 164

E-mail: biotechnology.izs@gmail.com
www.istocar.bg.ac.rs

CONTENT

Martin Wähner
THE SCIENTIFIC CONFERENCES OF THE ZEMUN INSTITUTE - A REVIEW AND OUTLOOK (Germany)………………………………….. 1-7

Vesna Gantner, Maja Gregić, Čedomir Radović
SUSTAINABILITY OF A PLANT-BASED DIET(Croatia, Serbia)…. 8-23

Federica Sportelli, Benedetta Delfini, Costanza Delsante, Carla Giuditta Vecchiato, Carlo Pinna, Giacomo Biagi
THE INFLUENCE OF NUTRITION ON CANINE BEHAVIOR AND THE ROLE OF THE GUT-BRAIN AXIS: A COMPREHENSIVE REVIEW (Italy)………………………………………………………. 24-39

Giuseppe Bee, Steve Jacot, George Guex, Claudine Biolley
EFFECT OF THE FATTY ACID COMPOSITION OF THE MATERNAL DIETS OF SWISS LARGE WHITE SOWS ON THE FATTY ACID COMPOSITION OF THE BACKFAT OF THE PROGENY (Switzerland).. 40-60

Sam Millet, Sophie Goethals
BALANCING AMINO ACID LEVELS IN PIGLET DIETS (Belgium) 61-72

Zaira Pardo, Ignacio Fernández-Fígares, Manuel Lachica, Isabel Seiquer, Luis Lara, Consolación García-Contreras, Fernando Sánchez-Esquiliche, Rosa Nieto
HEAT STRESS EFFECTS ON IBERIAN PIG GROWTH AND PRODUCTIVITY (Spain).. 73-82

Vladimir Živković, Wladyslav Migdal, Lukasz Migdal, Marija Gogić, Nenad Stojiljković, Aleksandra Petrović, Čedomir Radović
ENHANCING PIGLET GROWTH WITH LIVE YEAST: A NUTRITIONAL SUPPLEMENT STUDY (Serbia, Poland).................... 83-92

Bojana Savić, Martin Škrlep, Klavdija Poklukar, Nina Batorek Lukač, Marjeta Čandek-Potokar
VARIATION IN CARCASS, MEAT AND FAT QUALITY OF AUTOCHTHONOUS BREED IN CONVENTIONAL AND ORGANIC PRODUCTION SYSTEM (Slovenia)………………………………… 93-103

Galia Zamaratskaia, Ayaz Mammadov, Javid Ojaghi, Simon Tobias Höxter, Oksana Kravchenko, Nataliia Hryshchenko, Mykhailo Matvieiev, Elina Åsbjer, Birgitta Staaf Larsson, Svitlana Usenko, Anders H. Karlsson, Hallvard Wie, Iveta Kocina, Liene Ansone, Vytautas Ribikauskas, David Richard Arney, Ragnar Leming, Francesca Carnovale, Andriy Getya
ATTITUDES OF CONSUMERS TOWARDS ANIMAL WELFARE IN UKRAINE AND AZERBAIJAN (Sweden, Ukraine, Azerbaijan, Latvia, Lithuania, Estonia)………………………………………………… 104-113

Ljiljana Samolovac, Dragan Nikšić, Dušica Ostojić Andrić, Vladimir Živković, Dragan Stanojević, Vlada Pantelić, Nenad Mićić
ORGANIZATION OF CATTLE PRODUCTION IN CONDITIONS OF CLIMATE CHANGE (Serbia)... 114-128

Nevena Maksimović, Dragana Ružić-Muslić, Violeta Caro Petrović, Bogdan Cekić, Ivan Ćosić, Nemanja Lečić, Nikola Stanišić
GOATS AND CLIMATE RESILIENCE (Serbia).................................... 129-143

*Fatmagül Tolun, Ergün Demi*r
CARBON CAPTURE TECHNOLOGIES FOR LIVESTOCK FARMS (Türkiye)…………………………………………………………….. 144-156

Slavča Hristov, Marko Cincović, Branislav Stanković, Radojica Đoković, Dušica Ostojić Andrić, Ljiljana Samolovac, Dimitar Nakov
DETERMINATION OF NEW WELFARE AND STRESS INDICATORS OF THE ANIMALS ON CATTLE AND PIG FARMS BASED ON DIFFERENT PUBLICATIONS (Serbia, North Macedonia) 157-167

Branislav Stanković, Slavča Hristov, Marko Cincović, Radojica Đoković, Dušica Ostojić Andrić, Ivana Milošević-Stanković, Dimitar Nakov
DETERMINATION OF NEW BIOSECURITY INDICATORS ON CATTLE AND PIG FARMS BASED ON DIFFERENT PUBLICATIONS (Serbia, North Macedonia)…………………………. 168-181

Simeon Rakonjac, Snežana Bogosavljević-Bošković, Zdenka Škrbić, Miloš Lukić, Vladimir Dosković, Veselin Petričević, Milun D. Petrović
ORGANIC POULTRY PRODUCTION: GENOTYPE CHOICE AND WELFARE (Serbia)………………………………………………….. 182-192

Marko Pajić, Slobodan Knežević, Jelena Maletić, Sava Spiridonović, Biljana Đurđević, Dalibor Todorović, Dušica Ostojić Andrić
ASSESSMENT OF THE CURRENT STATE OF BIOSECURITY MEASURES ON BROILER CHICKEN FARMS WITH DIFFERENT CAPACITIES IN VOJVODINA (Serbia)……………………………… 193-205

María Muñoz, Ángel M. Martínez-Móntes, Almudena Fernández, Josep María Folch, Ana I. Fernández
EXPLORING PORCINE GROWTH AND FATNESS THROUGH LIVER TRANSCRIPTOME ANALYSES IN DIFFERENT IBERIAN GENETIC BACKGROUNDS (Spain)………………………………… 206-213

Martin Škrlep Nina Batorek Lukač
ADVANTAGES AND DRAWBACKS OF REARING OF ENTIRE MALE AND IMMUNOCASTRATED PIGS (Slovenia)……………… 214-231

Dubravko Škorput, Danijel Karolyi, Ana Kaić, Zoran Luković
OPTIMUM CONTRIBUTION SELECTION: PRACTICAL IMPLEMENTATION IN BLACK SLAVONIAN AND BANIJA SPOTTED PIG (Croatia)……………………………………………….. 232-240

Fernando Sánchez-Esquiliche, Patricia Palma-Granados, Luisa Ramírez Hidalgo, Alberto Márquez, María Muñoz, Juan M. García Casco
IMPROVING THE REPRODUCTIVE CHARACTERISTICS OF THE PUREBRED IBERIAN PIG: A CHALLENGING ENDEAVOR (Spain) 241-250

*Aleksandar Stanojković, Nikola Stanišić, Nikola Delić, Ivan Bošnjak, Violeta Mandić, Aleksandra Stanojković-Sebić, Jakov Nišavi*ć
STREPTOCOCCUS SUIS, TWO-FACED GAME CHANGER (Serbia) 251-266

Jasna Prodanov-Radulović, Jelena Petrović, Siniša Grubač, Milijana Nešković, Slavča Hristov, Jovan Bojkovski
RELEVANT BIOSECURITY MEASURES TO PREVENT THE SPREAD OF AFRICAN SWINE FEVER IN THE DOMESTIC PIG PRODUCTION SECTOR IN SERBIA (Serbia)……………………… 267-275

Igor M. Stojanov, Doroteja A. Maričić, Radomir D. Ratajac, Jasna Z. Prodanov Radulović, Stevan G. Rodić, Jelena B. Apić, Ivan M. Pušić
SIGNIFICANCE OF *LISTERIA* ISOLATES IN ABORTED MATERIALS FROM COWS (Serbia)……………………………….. 276-285

Ivan Pavlović, Stanko Minić, Violeta Caro Petrović, Milan P.Petrović, Ivan Dobrosavljević, Nemanja Zdravković, Jovan Bojkovski, Ana Vasić, Marija Pavlović, Aleksandra Tasić
COENUROSIS OF SHEEP IN SERBIA - CASE REPORT (Serbia)….. 286-296

Yunus Emre Ata, Kemal Çelik
INVESTIGATION OF THE USE OF PROPOLIS IN BROILER FEEDS AND ITS EFFECTS ON HEALTH AND PERFORMANCE PARAMETERS (Türkiye)…………………………………………… 297-310

Muhittin Zengin, Ergün Demir, Abdulkadir Keskin
CURRENT APPROACHES TO THE RELATIONSHIP OF ZEARALENONE AND FERTILITY IN LIVESTOCK (Türkiye)…… 311-324

Jack Bergsma
THE USE OF STARCH IN THE MEAT PROCESSING INDUSTRY (The Netherlands)……………………………………………………… 325-334

Nikola Stanišić, Nikola Delić, Slaviša Stajić, Maja Petričević, Slobodan Lilić, Tamara Stamenić, Aleksandar Stanojković
EFFECT OF FAT LEVEL ON QUALITY CHARACTERISTICS OF TRADITIONAL SUCUK SAUSAGES. PART 1: PHYSICO-CHEMICAL CHANGES DURING PRODUCTION (Serbia)……….. 335-345

Nikola Delić, Nikola Stanišić, Aleksandar Stanojković, Maja Petričević, Tamara Stamenić, Nevena Maksimović, Tanja Keškić
EFFECT OF FAT LEVEL ON QUALITY CHARACTERISTICS OF TRADITIONAL SUCUK SAUSAGES. PART 2: TEXTURE, COLOUR AND SENSORY QUALITY (Serbia)…………………………………. 346-354

Władysław Migdał, Čedomir Radović, Vladimir Živković, Maria Walczycka, Anna Migdał, Łukasz Migdał
MEAT OF NATIVE PIGS BREEDS AS A RAW MATERIAL FOR TRADITIONAL PRODUCTS OBTAINED IN SERBIA AND POLAND (Poland, Serbia)……………………………………………………… 355-374

Ana Kaić, Dubravko Škorput, Danijel Karolyi, Zoran Luković
ASSESSMENT OF WATER-HOLDING CAPACITY IN DIFFERENT MEATS USING EZ-DRIPLOSS METHOD: A REVIEW OF KEY METHODOLOGICAL FACTORS (Croatia)…………………………… 375-383

Yalcin Bozkurt, Mevlüt Türk, Sabahattin Albayrak
PATH COEFFICIENT ANALYSIS BETWEEN BODY WEIGHT AND SOME REAL-TIME BODY MEASUREMENTS OF GRAZING CATTLE ON DIFFERENT ARTIFICIAL PASTURES (Türkiye)…… 384-395

Jordan Marković, Vladimir Zornić, Ratibor Štrbanović
EFFECT OF CONDENSED TANNINS CONCENTRATIONS ON PROTEIN DEGRADABILITY OF RED CLOVER, ITALIAN RYEGRASS AND THEIR MIXTURES (Serbia)……………………… 396-407

Marina Lazarević, Vlada Pantelić, Dragan Stanojević, Dragan Nikšić, Nevena Maksimović, Miloš Marinković, Ljiljana Samolovac
TREND OF MILK YIELD TRAITS OF BULL MOTHERS OF THE HOLSTEIN-FRIESIAN BREED (Serbia)………………………………. 408-417

Tina Bobić, Pero Mijić, Vesna Gantner, Mirjana Baban, Maja Gregić
FARMER EXPERIENCE IN TRANSITION FROM CONVENTIONAL TO ROBOTIC MILKING (Croatia)………………………………….. 418-424

Savaş Atasever
BROMOTYMOL BLUE TEST SCORES FOR DETECTING RAW MILK QUALITY OF BUCKET MILK OF JERSEY COWS (Türkiye) 425-431

Amila Milišić, Zlatan Sarić, Lejla Biber, Amila Oras, Munevera Begić, Tarik Dizdarević, Miroljub Barać, Svijetlana Sakić-Dizdarević
PRODUCTION AND QUALITY ASPECTS OF PROBIOTIC FERMENTED MILK WITH ADDITION OF HONEY (Bosnia and Herzegovina, Serbia)………………………………………………….. 432-440

POSTER SECTION

Milun D. Petrović, Vladan Bogdanović, Snežana Bogosavljević-Bošković, Simeon Rakonjac, Radojica Đoković, Radica Đedović, Miloš Ži. Petrović
EFFECT OF SYSTEMATIC FACTORS ON MILK PRODUCTION PER MILKING, PRODUCTIVE AND LIFETIME DAY IN SIMMENTAL COWS (Serbia)………………………………………… 441-449

Vesna Gantner, Ivana Jožef, Vera Popović, Maja Gregić, Dragan Solić, Klemen Potočnik
THE EFFECT OF MASTITIS PREVALENCE RISK ON THE DAILY PRODUCTION OF DAIRY COWS CONCERNING THE MILK RECORDING YEAR (Croatia, Slovenia)…………………………… 450-459

Dušica Ostojić Andrić, Slavča Hristov, Branislav Stanković, Violeta Caro Petrović, Marko Pajić, Dragan Nikšić, Ljiljana Samolovac, Miloš Marinković
MEDICINAL AND AROMATIC PLANTS IN LIVESTOCK FARMING: A PROMISING APPROACH FOR BOOSTING HEALTH AND PERFORMANCE (Serbia).. 460-475

Dragan Dokić, Vera Popović, Maja Gregić, Vesna Gantner
IMPROVING THE DEVELOPMENT OF THE COMPETITIVENESS OF PIG AND CATTLE PRODUCTION IN THE REPUBLIC OF CROATIA BY APPLYING GENERIC STRATEGIES (Croatia)…….. 476-483

Maja Gregić, Tina Bobić, Dragan Dokić, Vesna Gantner
THERMOREGULATION OF SPORTS HORSES (Croatia)………… 484-492

Ivan Vlahek, Nevena Maksimović, Aneta Piplica, Maja Maurić Maljković, Nikola Delić, Marina Lazarević, Velimir Sušić
POPULATION TRENDS OF GOATS IN SERBIA AND CROATIA FROM 2012 TO 2021 (Croatia, Serbia)………………………………. 493-507

Alkan Çağli, Hasan Coğan, Murat Yilmaz
COMPARİSON OF BODY WEİGHT, FAMACHA © BCS AND HAİR SCORES İN SAANEN GOATS DURİNG PREGNANCY AND BİRTH PERİOD (Türkiye)…………………………………………………….. 508-518

Bogdan Cekić, Dragana Ružić Muslić, Nevena Maksimović, Violeta Caro Petrović, Ivan Ćosić, Nemanja Lečić, Zsolt Becskei
NEW ASPECTS IN RISK STATUS EVALUATION OF SMALL RUMINANT LOCAL BREEDS IN SERBIA (Serbia)....................... 519-530

Maria Babetsa, Evangelia D. Apostolidi, Loukia V. Ekateriniadou, Evridiki Boukouvala
PRNP GENE POLYMORPHISMS IN HEALTHY GREEK SHEEP FROM 2017 TO 2022 - NATIONAL DATABASE FROM RESISTANT RAMS (Greece)……………………………………………………. 531-539

Nikola Metodiev
THE EFFECT OF THE APPLICATION OF MELATONIN IMPLANTS IN THE SPRING ON THE MANIFESTATION OF ESTRUS AND FERTILITY IN ILE DE FRANCE SHEEP (Bulgaria)………………… 540-546

Klavdija Poklukar, Marjeta Čandek-Potokar, Nina Batorek Lukač, Marie-José Mercat, David Picard Druet, Martin Škrlep
GENE POLYMORPHISMS FREQUENCIES IN KRŠKOPOLJE PIG BREED (Slovenia, France)…………………………………………… 547-555

Klavdija Poklukar, Marjeta Čandek-Potokar, Nina Batorek Lukač, Marie-José Mercat, David Picard Druet, Martin Škrlep
THE EFFECT OF PRKAG3 AND RYR1 GENE ON MEAT QUALITY TRAITS IN THE LOCAL KRŠKOPOLJE PIG BREED (Slovenia, France)……………………………………………………………. 556-565

Vesna Krnjaja, Violeta Mandić, Slavica Stanković, Ana Obradović, Tanja Petrović, Tanja Vasić, Marina Lazarević
FUSARIUM AND DEOXYNIVALENOL CONTAMINATION OF WINTER WHEAT DEPENDING ON GROWING SEASON AND CULTIVAR (Serbia)………………………………………………… 566-576

Proceedings of the 14th International Symposium
Modern Trends in Livestock Production
October 4 – 6, 2023, Belgrade, Serbia

FUSARIUM AND DEOXYNIVALENOL CONTAMINATION OF WINTER WHEAT DEPENDING ON GROWING SEASON AND CULTIVAR

Vesna Krnjaja[1], Violeta Mandić[1], Slavica Stanković[2], Ana Obradović[2], Tanja Petrović[3], Tanja Vasić[4], Marina Lazarević[1]

[1]Institute for Animal Husbandry, Autoput 16, 11080 Belgrade, Serbia
[2]Maize Research Institute „Zemun Polje", Slobodana Bajića 1, 11185 Belgrade, Serbia
[3]Faculty of Agriculture, University of Belgrade, Nemanjina 6, 11080 Belgrade, Serbia
[4]Faculty of Agriculture, University of Niš, Kosančićeva 4, 37000 Kruševac, Serbia
Corresponding author: Vesna Krnjaja, vkrnjaja@istočar.bg.ac.rs; vesnakrnjaja.izs@gmail.com

Abstract: Wheat is the most important staple food in the world and the main source of carbohydrates, fibre, proteins, vitamins, minerals and phytochemicals for human consumption. The nutrients from wheat kernels can also be used as livestock feed. Fusarium head blight (FHB), caused by fungal species of the *Fusarium* genus, is one of the most important wheat diseases worldwide. The lack of FHB management strategies results in significant economic losses in yield and quality of wheat kernels. In this study, the influence of growing season and wheat cultivar on some FHB and yield component traits, as well as on the trichothecene mycotoxin deoxynivalenol (DON) levels during the harvest period in 2014 and 2015, was investigated. Significant influence of growing season (year) and wheat cultivar on disease (FHB index – FHBI, incidence of *Fusarium*-damaged kernels – FDK and levels of DON) and yield parameters (spike weight – SW, kernel weight per spike – KWS, and 100-kernel weight) was found. FHBI, FDK, and DON were higher in 2014, while SW, KWS, and 100-kernel weight were lower in 2014 than in 2015. The mid-early wheat cultivar Simonida had lower FHBI, FDK, and levels of DON and significantly higher SW, KWS, and 100-kernel weight than the mid-late cultivar NS 40S. There was a significant effect of year × cultivar interaction on FHBI, FDK and 100-kernel weight.

Key words: Fusarium head blight, *Fusarium* and deoxynivalenol contamination, yield component traits, winter wheat

Introduction

Wheat (*Triticum aestivum* L.) is one of the most important cereal crops in the world. In Serbia, wheat is grown on about 600,000 ha, with a total production of 3.4 million tonnes and an average yield of 5.7 t ha^{-1} in 2021 *(Statistical Yearbook of the Republic of Serbia, 2022)*. It is used in the food industry to produce bread, pasta, cakes, crackers, cookies, pastries, starch, alcohol, flour, etc. The nutrient composition of wheat kernels varies depending on genotypic characteristics, yields, climate and soil. Wheat grown in dry climates is usually a durum type with a protein content of 11-15% and a strong structure of protein gluten (elastic protein). The durum type provides the most suitable flour for bread making. Wheat from humid areas is softer, with a protein content of about 8-10% and a weak gluten structure, ideal for cakes, cookies, pastries, etc. *(Lafiandra et al., 2022)*. Due to the high proteins (on average 10-12%), carbohydrates (75%) and fibre (13.4%) contents, wheat is also used for animal feed, in feeding ruminants, pigs and poultry, especially in developed countries *(Grote et al., 2021; Tóth et al., 2022; Kartseva et al., 2023)*. Fusarium head blight (FHB) is a devastating fungal disease in wheat crops that causes yield loss with destructive effects on grains, shrivelled and discoloured kernels, and the formation of the trichothecene mycotoxin deoxynivalenol (DON) *(Jones, 2000; Wegulo et al., 2011)*. *Fusarium graminearum* sensu lato (teleomorph: *Gibberella zeae* (Schwein.) Petch.), also called *F. graminearum* species complex (FGSC), is the major causal agent of FHB. The FGSC includes more than 16 phylogenetically distinct species *(Sarver et al., 2011)*, of which *F. graminearum* sensu stricto (s.s.) is the most widespread. In Serbia, in addition to *F. graminearum* s.s., *F. vorosii* was recently identified as a member of the FGSC *(Obradović et al., 2022)*. Several *Fusarium* species, *F. graminearum*, *F. culmorum*, *F. avenaceum*, and *F. poae*, are considered the predominant species causing FHB. Among them, *F. graminearum* and *F. culmorum* are the most aggressive to winter wheat and the most important DON-producing fungal species *(Bottalico and Perrone, 2002; Tan et al., 2021; Balducci et al., 2022)*.

Wheat straws and chaffs are used in pig and turkey production and can be contaminated with secondary metabolites of fungi (mycotoxins) as forage of wheat kernels for cattle feed. Mycotoxins have toxic effects on animal and human health, causing acute and chronic diseases (mycotoxicoses). Animal toxicoses occur through mycotoxin-contaminated feed and bedding *(Cowger and Arellano, 2013)*. Intoxication of animals through DON-contaminated feed can cause anorexia, emesis, and feed refusal. DON has also neurotoxicity and immunotoxicity effects *(Haidukowski et al., 2005)*.

FHB and DON contamination are influenced by many factors such as climatic, agroecological and environmental conditions, especially during flowering stages, which is the most sensitive host stage for *Fusarium* infection, and by agrotechnical measures. Agricultural practices such as tillage, crop rotation, crop residue management, irrigation management, resistant cultivars, chemical and biological control, and disease forecasting are preharvest strategies against FHB and to reduce DON accumulation in wheat kernels *(Yuen and Schoneweis, 2007; Blandino et al., 2012; Wegulo et al., 2015)*. Since of the economic importance of FHB in wheat crops, the main objective of this study was to evaluate the effect of the growing season (year) and wheat cultivar on *Fusarium* and DON contamination during harvest in 2014 and 2015 in Serbia, taking into account the infection with *Fusarium* spp. under natural conditions.

Material and Methods

Field trials. A field trial was conducted at the Institute of Animal Husbandry, Belgrade-Zemun, Serbia (44°84' N, 20°40' E; 88 m a.s.l.) under dry farming conditions in response to natural precipitation. During the two harvest seasons, 2014 and 2015, FHB and yield traits and DON levels of two Serbian wheat cultivars, Simonida and NS 40S, were evaluated. These cultivars were selected due to widespread cultivation around the experimental area in Serbia. The sowing dates were in the third decade of October, with seven days between the sowing of mid-early and mid-late cultivars. The soil type was carbonate chernozem. The previous crop was maize. The field trials were arranged as split-plot randomized block designs with four replications. The size of the subplot was 5 m^2. Fertilization with ammonium nitrate was applied at the end of February at the rate of 250 kg ha^{-1} (33.4% N). At the tillering wheat stage, weeds, fungal leaf diseases and insects were controlled by adequate chemical treatments. Wheat kernels were harvested in the first decade of July in both investigated years.

Disease and wheat yield component traits. FHB severity of naturally infected plants was estimated on 20 randomly selected wheat spikes within each subplot (80 wheat spikes per treatment tested) at the end of the flowering stage (GS 69). The evaluation was based on the scale of *Blandino et al. (2012)* with seven evaluation classes (1 = 0 to 5%, 2 = 5 to 15%, 3 = 15 to 30%, 4 = 30 to 50%, 5 = 50 to 75%, 6 = 75 to 90%, 7 = 90 to 100% spike area infected). Following the methods of *Wegulo et al. (2011)*, the FHB index (FHBI) was calculated using the formula = (incidence (%) × severity (%))/100, where FHB incidence was the percentage of infected spikes and FHB severity was the percentage of infected spikelets, while the incidence of *Fusarium*-damaged kernels (FDK) was visually evaluated in wheat-harvested subsamples of 10 grams.

Wheat kernel subsamples were ground by an analytical mill (IKA A11, Germany) and analysed by competitive direct enzyme-linked immunosorbent assay (ELISA) for the detection of deoxynivalenol (DON). According to the instructions of the manufacturer of the Celer DON ELISA kits (Tecna, Italy), the assay procedure was performed. The absorbance values of the samples were measured optically at a wavelength of 450 nm using an ELISA reader (Biotek EL x 800TM, USA). The detection limit for DON in wheat was 0.04 mg kg^{-1}.

Spike weight (SW), kernel weight per spike (KWS) and 100-kernel weight as yield components were also determined.

Meteorological data. Weather data for the Surčin area (Belgrade) were provided by the Republic Hydrometeorological Service of Serbia (Table 1).

Table 1. Meteorological data (mean monthly temperature, total precipitation and mean monthly relative humidity (RH)) in two growing seasons (October 2013 – July 2014) and (October 2014 – July 2015) in the Surčin area (Belgrade)

Growing season	Month	Temperature (ºC)	Precipitation (mm)	RH (%)
2013–2014	October	14.6	45.8	72
	November	9.4	28.7	80
	December	2.1	6.7	85
	January	4.6	24.6	80
	February	7.0	12.9	72
	March	9.9	44.5	69
	April	13.1	86.9	73
	May	16.8	233.4	72
	June	20.8	85.6	68
	July	22.4	181.0	71
	Seasonal mean temperature	12.07		
	Total season precipitation		750.1	
	Seasonal mean RH			74.2

Table 1. (continue)

Growing season	Month	Temperature (ºC)	Precipitation (mm)	RH (%)
	October	13.6	57.1	76
	November	9.2	9.9	78
	December	3.8	61.4	82
	January	2.9	48.3	78
2014–2015	February	3.2	50.0	77
	March	7.0	102.0	73
	April	11.8	30.9	62
	May	17.7	58.9	70
	June	20.6	84.2	70
	July	25.1	1.7	58
	Seasonal mean temperature	11.49		
	Total season precipitation		504.4	
	Seasonal mean RH			72.4

Data analyses. The effects of two growing seasons on FHB variables (FHBI and FDK), DON levels and yield component traits (SW, KWS, and 100-kernel weight) in two wheat cultivars were analysed using a general linear model (Multivariate Analysis of Variance) with SPSS software (IBM SPSS Statistic 20). Tukey's test was used to compare treatment means at P≤0.05 and P≤0.01 significance levels. Linear relationships between tested variables were calculated using Pearson's correlations.

Results

FHB traits and deoxynivalenol levels. *F* values of the year and cultivar and their interaction are shown in Table 2. The year and cultivar had a highly significant (P≤0.01) effect on FHBI, FDK, and DON levels. FHBI, FDK and DON were higher in 2014 than in 2015. The mid-late cultivar NS 40S had a statistically significantly higher (P≤0.01) FHBI, FDK and DON than the mid-early cultivar Simonida. High significance (P≤0.01) showed by year × cultivar interaction for FHB variables, FHBI and FDK (Table 2).

Yield component traits. The influence of year and cultivar treatments was significant (P≤0.05) for SW and KWS and highly significant (P≤0.01) for 100-kernel weight. The *F* values of the year × cultivar interaction were highly significant (P≤0.01) for 100-kernel weight. SW, KWS and 100-kernel weight were statistically significantly lower in 2014 and in the mid-late cultivar NS 40S compared to 2015 and the mid-early cultivar Simonida (Table 3).

Table 2. Year and cultivar effects on FHB index (FHBI), the incidence of *Fusarium*-damaged kernels (FDK), and deoxynivalenol (DON) levels in wheat kernels

Factor	FHBI (%)	FDK (%)	DON (mg kg^{-1})
Year effects (Y)			
2014	27.67^{a}	17.46^{a}	3.238^{a}
2015	17.08^{b}	7.28^{b}	1.916^{b}
F-test	**	**	**
Cultivar effects (C)			
Simonida	20.47^{b}	5.94^{b}	1.640^{b}
NS 40S	24.28^{a}	18.80^{a}	3.514^{a}
F-test	**	**	**
Interactions (F-test)			
Y × C	**	**	ns
Means	22.38	12.37	2.58

Y, Year; C, Cultivar;
Means followed by the same letter within a column are not significantly different by *Tukey's test* at P ≤ 0.05 level. ns, not statistically significant; **significant at the 0.01 level of probability.

Table 3. Year and cultivar effects on wheat yield component traits, spike weight (SW), kernel weight per spike (KWS) and 100-kernel weight

Factor	SW (g)	KWS (g)	100-kernel weight (g)
Year effects (Y)			
2014	1.79^{b}	1.42^{b}	3.63^{b}
2015	2.09^{a}	1.72^{a}	4.37^{a}
F-test	*	*	**
Cultivar effects (C)			
Simonida	2.10^{a}	1.70^{a}	4.43^{a}
NS 40S	1.78^{b}	1.45^{b}	3.57^{b}
F-test	*	*	**
Interactions (F-test)			
Y × C	ns	ns	**
Means	1.94	1.57	4.00

Y, Year; C, Cultivar;
Means followed by the same letter within a column are not significantly different by *Tukey's test* at P ≤ 0.05 level. ns, not statistically significant; **significant at the 0.01 level of probability.

Correlations between tested variables. In correlation analyses, there were highly significant (P≤0.01) positive correlations between FHBI with FDK (r = 0.84) and DON levels (r = 0.80), SW with KWS (r = 0.99) and 100-kernel weight (r = 0.65), and KWS with 100-kernel weight (0.70). FDK had a highly significant

(P≤0.01) positive correlation with DON levels (r = 0.90). Significant negative correlation coefficients were also obtained for the relationships between disease variables (FHBI, FDK, and DON level) and yield component traits (SW, KWS, and 100-kernel weight) (Table 4).

Table 4. The correlation coefficients (r) between tested variables

	FHBI	FDK	DON	SW	KWS
FDK	0.84**				
DON	0.80**	0.90**			
SW	-0.61**	-0.51**	-0.68*		
KWS	-0.69**	-0.57**	-0.72*	0.99**	
100-kernel weight	-0.85**	-0.95**	-0.92**	0.65**	0.70**

FHBI, FHB index; FDK, the incidence of *Fusarium*-damaged kernels; DON, deoxynivalenol; SW, spike weight; KWS, kernel weight per spike. *significant at the 0.05 level of probability; **significant at the 0.01 level of probability

Discussion

This study evaluated year and cultivar effects on wheat kernel quality and yield. During the observation period, the 2013-14 growing season was wetter, with total precipitation of 750.1 mm compared to 2014-15 (504.4 mm). Mean temperatures and RH were similar in both investigated growing seasons, October 2013 – July 2014 (12.07 °C and 74.2%) and October 2014 – July 2015 (11.49 °C and 72.4%) (Table 1). During the most susceptible stage for *Fusarium* infection (flowering), in May, total precipitation was higher in 2014 (233.4 mm) than in 2015 (58.9 mm), with mean monthly temperatures of 16.8 °C and 17.7 °C, respectively. In June, at the milk and maturity wheat stages, total precipitation and mean temperatures were similar in both years (2014 – 85.6 mm and 20.8°C, and 2015 – 84.2 mm and 20.6°C). In May and June 2014, the mean relative humidity (RH) was 72 and 68%, respectively, and in May and June 2015, they were similar (70%).

Considering the meteorological data during flowering in both investigated growing seasons, the weather conditions for FHB development on wheat spikes were more favourable in 2014 than in 2015. FHBI, FDK, and DON were significantly higher by 1.6, 2.4, and 1.7 times, respectively, in 2014, while SW, KWS, and 100-kernel weight were significantly lower by 1.2, 3.2, and 2.1 times, respectively, in 2014 than in 2015 (Tables 2 and 3). In similar studies in Serbia, *Jevtić et al. (2021, 2022)* reported higher FHBI, FDK, and yield losses in 2014 than in 2015, emphasizing to some extent the influence of climatic factors during wheat anthesis in May. According to the results of *Cowger et al. (2009)*, prolonged fog in the post-flowering period affected FHB severity, FDK, and DON in winter wheat. *Kriss et al. (2010)* also found that year-to-year variation in FHB intensity was related to environmental conditions (moisture and wetness), especially two months before wheat maturity and indicated a strong influence of wheat cultivar resistance, fungicide control, and agronomic practices such as crop rotation and tillage type on FHB epidemics, yield loss, and DON contamination. In this study, levels of DON were higher in treatments with higher FHBI and FDK, which is in agreement with reports by *Jones and Mirocha (1999)*, *Jones (2000)*, *Wegulo et al. (2011)*, and *Mesterházy et al. (2003, 2011, 2015)*. In treatments of years and cultivars, DON levels exceeded the maximum level (MPL) prescribed by the European Commission (1881/2006/ EC) for unprocessed cereals, except for durum wheat, oats, and maize (1,250 mg kg^{-1}) (Table 2), consistent with previous reports by *Krnjaja et al. (2015)*.

Although resistant cultivars are critical for reducing FHB and DON contamination of wheat, most commercial cultivars are susceptible to FHB in practice. In this study, the mid-late cultivar NS 40S showed higher susceptibility to *Fusarium* and DON contamination than the mid-early cultivar Simonida. *Jevtić et al. (2021)* identified sets of moderately resistant cultivars with FHBI of 25% or less and moderately susceptible or susceptible cultivars with FHBI of 26 to 54% based on cultivar response to FHB in 2014. Since FHBI was 20.47% (Simonida) and 24.28% (NS 40S), both wheat cultivars studied could be classified as moderately resistant.

In correlations between disease variables (FHBI, FDK, DON), FHBI and FDK, FHBI and DON, and FDK and DON were significantly positively correlated (Table 4). According to the reports of *Paul et al. (2005)* and *Wegulo et al. (2011)*, the correlation coefficient between FDK and DON and FHBI and DON was above 0.50, while in this study, it was between FHBI and FDK, FHBI and DON, and FDK and DON. *Jevtić et al. (2021)* found a higher correlation coefficient between FHBI and FDK in moderately resistant wheat cultivars (r = 0.732) than in susceptible/moderately susceptible wheat cultivars (r = 0.362). *Mesterházy et al. (2015)* reported that FHB levels had a lower effect on DON contamination than FDK in 40 winter wheat cultivars from Hungary (20) and Austria (20). There were also significant negative correlations between yield component traits (SW, KWS, 100-kernel weight) with FHB variables (FHBI and FDK) and DON values (Table 4). These results were in line with those of *Wegulo et al. (2011)*. In addition, using statistical analysis with multiple stepwise regression, *Jevtić et al. (2022)* found a more significant influence of FDK than FHBI on thousand kernel weight (TKW) in moderately resistant cultivars, while both FHBI traits, FHBI and FDK, influenced TKW in moderately susceptible and susceptible cultivars.

Conclusion

It can be concluded that in this study, growing season and cultivar had a significant effect on both disease and yield variables in winter wheat. Contamination of wheat kernels with *Fusarium* and deoxynivalenol was higher in the wetter year of 2014 than in 2015, while yield component traits (SW, KWS and 100-kernel weight) were lower in 2014 than in 2015. The mid-early wheat cultivar Simonida showed lower susceptibility to FHB and DON than the mid-late cultivar NS 40S.

These results indicate the need to improve breeding programs by creating wheat cultivars from an earlier maturing group. Since environmental conditions in Serbia are very convenient for FHB development and DON accumulation in wheat crops, cultivar selection should be recommended as a primary agricultural measure to achieve high and healthy wheat yields.

Acknowledgements
This research was funded by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia, based on the Agreement on the realization and financing of scientific research work of SRO No. 451-03-47/2023-01/200022, No. 451-03-47/2023-01/200040, No. 451-03-47/2023-01/200116 and 451-03-47/2023-01/200383.

References

BALDUCCI E., TINI F., BECCARI G., RICCI G., CERON-BUSTAMANTE M., ORFEI M., GUIDUCCI M., COVARELLI L. (2022): A two-year field experiment for the integrated management of bread and durum wheat fungal diseases and of deoxynivalenol accumulation in the grain in Central Italy. Agronomy, 12, 840.
BLANDINO M., HAIDUKOWSKI M., PASCALE M., PLIZZARI L., SCUDELLARI D., REYNERI A. (2012): Integrated strategies for the control of Fusarium head blight and deoxynivalenol contamination in winter wheat. Field Crops Research, 133, 139-149.
BOTTALICO A., PERRONE G. (2002): Toxigenic Fusarium species and mycotoxins associated with head blight in small-grain cereals in Europe. European Journal of Plant Pathology, 108, 611-624.
COWGER C., ARELLANO C. (2013): *Fusarium graminearum* infection and deoxynivalenol concentrations during development of wheat spikes. Phytopathology, 103, 460-471.

COWGER C., PATTON-ÖZKURT J., BROWN-GUEDIRA G., PERUGINI L. (2009): Post-anthesis moisture increased Fusarium head blight and deoxynivalenol levels in North Carolina winter wheat. Phytopathology, 99, 320-327.

GROTE U., FASSE A., NGUYEN T.T., ERENSTEIN O. (2021): Food security and the dynamics of wheat and maize value chains in Africa and Asia. Frontiers in Sustainable Food Systems, 4, 617009.

HAIDUKOWSKI M., PASCALE M., PERRONE G., PANCALDI D., CAMPAGNA C., VISCONTI A. (2005): Effect of fungicides on the development of Fusarium head blight, yield and deoxynivalenol accumulation in wheat inoculated under field conditions with *Fusarium graminearum* and *Fusarium culmorum*. Journal of the Science of Food and Agriculture, 85, 191-198.

JEVTIĆ R., SKENDEROVIĆ N., ŽUPUNSKI V., LALOŠEVIĆ M., ORBOVIĆ B., MAŠIREVIĆ S., BAGI, F. (2021): Association between yield loss and Fusarium head blight traits in resistant and susceptible winter wheat cultivars. Journal of Plant Diseases and Protection, 128, 3.

JEVTIĆ R., SKENDEROVIĆ N., ŽUPUNSKI V., LALOŠEVIĆ M., ORBOVIĆ B., MAŠIREVIĆ S. (2022): The relationship between *Fusarium* head blight traits, thousand-kernel weight, and yield in winter wheat. Scientia Agricola. 79, 3, e20200046.

JONES R.K. (2000): Assessments of Fusarium head blight of wheat and barley in response to fungicide treatment. Plant Disease, 84, 1021-1030.

JONES R.K., MIROCHA C.J. (1999): Quality parameters in small grains from Minnesota affected by Fusarium head blight. Plant Disease, 83, 506-511.

KARTSEVA T., ALQUDAH A.M., ALEKSANDROV V., ALOMARI D.Z., DONEVA D., ARIF M.A.R., BÖRNER A., MISHEVA S. (2023): Nutritional genomic approach for improving grain protein content in wheat. Foods, 12, 7, 1399.

KRISS A.B., PAUL P.A., MADDEN L.V. (2010): Relationship between yearly fluctuations in Fusarium head blight intensity and environmental variables: A window-pane analysis. Phytopathology, 100, 784-797.

KRNJAJA V., MANDIĆ V., BIJELIĆ Z., STANKOVIĆ S., PETROVIĆ T., VASIĆ T., OBRADOVIĆ A. (2015): Influence of N-fertilization on Fusarium head blight and mycotoxin levels in winter wheat. Crop Protection, 67, 251-256.

LAFIANDRA D., SESTILI F., SISSONS M., KISZONAS A., CRAIG F.M. (2022): Increasing the versatility of durum wheat through modifications of protein and starch composition and grain hardness. Foods, 11, 11, 1532.

MESTERHÁZY Á., BARTÓK T., LAMPER C. (2003): Influence of wheat cultivar, species of *Fusarium*, and isolate aggressiveness on the efficacy of fungicides for control of Fusarium head blight. Plant Disease, 87, 1107-1115.

MESTERHÁZY Á., TÓTH B., VARGA M., BARTÓK T., SZABÓ-HEVÉR Á., FARÁDY L., LEHOCZKI-KRSJAK S. (2011): Role of fungicides, application of nozzle types, and the resistance level of wheat varieties in the control of Fusarium head blight and deoxynivalenol. Toxins, 3, 1453-1483.

MESTERHÁZY A., LEHOCZKI-KRSJAK S., VARGA M., SZABÓ-HEVÉR Á., TÓTH B., LEMMENS M. (2015): Breeding for FHB resistance via Fusarium damaged kernels and deoxynivalenol accumulation as well as inoculation methods in winter wheat. Agricultural Sciences, 6, 970-1002.

OBRADOVIĆ A., STEPANOVIĆ J., KRNJAJA V., BULAJIĆ A., STANKOVIĆ G., STEVANOVIĆ M., STANKOVIĆ S. (2022): First report of head blight of wheat caused by *Fusarium vorosii* in Serbia. Plant Disease, 106, 758-758.

PAUL P.A., LIPPS P.E., MADDEN L.V. (2005): Relationship between visual estimates of Fusarium head blight intensity and deoxynivalenol accumulation in harvested wheat grain: A meta-analysis. Phytopathology, 95, 1225-1236.

SARVER B.A.J., WARD T.J., GALE L.R., BROZ K., KISTLER H.C., AOKI T., NICHOLSON P., CARTER J., O'DONNELL K. (2011): Novel Fusarium head blight pathogens from Nepal and Louisiana revealed by multilocus genealogical concordance. Fungal Genetics and Biology, 48, 1096-1107.

STATISTICAL YEARBOOK OF THE REPUBLIC OF SERBIA (2022): Statistical Office of the Republic of Serbia. Belgrade, Serbia. https://publikacije.stat.gov.rs/G2022/Pdf/G20222055.pdf

TAN J., DE ZUTTER N., DE SAEGER S., DE BOEVRE M., TRAN T.M., VAN DER LEE T., WAALWIJK C., WILLEMS A., VANDAMME P., AMEYE M., AUDENAERT K. (2021): Presence of the weakly pathogenic *Fusarium poae* in the Fusarium head blight disease complex hampers biocontrol and chemical control of the virulent *Fusarium graminearum* pathogen. Frontiers in Plant Sciences, 12, 641890.

TÓTH V., LÁNG L., VIDA G., MIKÓ P., RAKSZEGI M. (2022): Characterization of the protein and carbohydrate related quality traits of a large set of spelt wheat genotypes. Foods, 11, 14, 2061.

WEGULO S.N., BAENZIGER P.S., NOPSA J.H., BOCKUS W.W., HALLEN-ADAMS H. (2015): Management of Fusarium head blight of wheat and barley. Crop Protection, 73, 100-107.

WEGULO S.N., BOCKUS W.W., HERNANDEZ NOPSA J., DE WOLF E.D., ESKRIDGE K.M., PEIRIS K.H.S., DOWELL F.E. (2011): Effects of integrating cultivar resistance and fungicide application on Fusarium head blight and deoxynivalenol in winter wheat. Plant Disease, 95, 554-560.

YUEN G.Y., SCHONEWEIS S.D. (2007): Strategies for managing Fusarium head blight and deoxynivalenol accumulation in wheat. International Journal of Food Microbiology, 119, 126-130.

==============================

CIP - Каталогизација у публикацији Народна библиотека Србије,
Београд

636/638(082)(0.034.2)
631/635(082)(0.034.2)

**INTERNATIONAL Symposium Modern Trends in Livestock Production (14
; 2023 ; Beograd)**
Proceedings [Elektronski izvor] / 14th International Symposium Modern Trends
in Livestock Production, 4-6 October 2023, Belgrade, Serbia ; [organizer] Institute
for Animal Husbandry, Belgrade - Zemun ; [editor Zdenka Škrbić]. - Belgrade :
Institute for Animal Husbandry, 2023 (Belgrade : Institute for Animal Husbandry).
- 1 USB fleš memorija ; 1 x 3 x 6 cm

Sistemski zahtevi: Nisu navedeni. - Nasl. sa naslovne strane dokumenta. - Tiraž 100.
- Bibliografija uz svaki rad.

ISBN 978-86-82431-80-0

a) Сточарство -- Зборници b) Пољопривреда -- Зборници

COBISS.SR-ID 125636361

==============================

14th INTERNATIONAL SYMPOSIUM
MODERN TRENDS IN LIVESTOCK PRODUCTION
4 - 6 October 2023 - Belgrade, Serbia

P R O C E E D I N G S

INSTITUTE FOR ANIMAL HUSBANDRY
Autoput 16, P. Box 23, 11080, Belgrade - Zemun, Serbia
www.istocar.bg.ac.rs
ISBN 978-86-82431-80-0

2023

9 788682 431800